PROJECT IMPLEMENTATION UNIT
EDUCATION CITY PROJECT
INVESTMENT DEPARTMENT

NOTIFICATION

NO: PD/E.City/1-2/2009: In pursuance of Rule 31 of SPPRA Rule 2010 a Complaint Redressal Committee is hereby constituted comprising of following officers for for procurement of Goods, Works and Services for the project of Education City Project:

The committee shall comprise of following members;

1. Secretary Investment Department, GoS, — Chairman
2. Representative of Accountant General Sindh — Member
3. Chief Executive Officer, SEDF, GoS — Member

The Complaint Redressal Committee shall announce its decision within seven days and intimate the same to the bidder and authority within three working days

NO: PD/E.City/1-2/2009/1934
Date: 20-9-20

(NAJAM AHMED SHAH)
SECRETARY INVESTMENT

A Copy is forwarded for information and necessary action to:-

1. CEO SEDF, GoS
2. Director (Admin), Investment Department, GoS
3. Office copy

PROJECT DIRECTOR
EDUCATION CITY PROJECT

First Floor, Block B, Finance & Trade Centre, Shahra-e-Faisal, Karachi
Tel: 021-99207512-14, Fax: 021-99207515

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PROJECT IMPLEMENTATION UNIT
EDUCATION CITY PROJECT
INVESTMENT DEPARTMENT

NOTIFICATION

NO: PD/E.City/1-2/2009: In pursuance of Rule 7 of SPP Rules 2010 a Procurement Committee is hereby re-constituted comprising of following officers for procurements of Goods, Works and Service for the Project Implementation Unit of Education City project. The earlier notification of even numb dated 20th August, 2020 is hereby withdrawn:

The committee shall comprise of following members;

1. Project Director, Education City, GoS — Chairman
2. Project Coordinator, Investment Department, GoS — Member
3. Representative of Works & Services. Department, GoS — Member
   (Not below the rank of BPS-17)

Terms of Reference of the committee are as follows:

Term of Reference

- Preparation of bidding documents.
- Carrying out technical as well as financial evaluation of the bids.
- Preparing evaluation report as provided in Rule 45 of SPP Rules.
- Making recommendations for the award of contract to the competent authority, and
- Perform any other function ancillary and incidental to the above.

NO: PD/E.City/1-2/2009/1938
Date: 9-9-2020

(NAJAM AHMED SHAH)
SECRETARY INVESTMENT

A Copy is forwarded for information and necessary action to:-

1. Secretary to Government of Sindh, Works & Services Department.
2. Office copy

PROJECT DIRECTOR
EDUCATION CITY PROJECT

First Floor, Block B, Finance & Trade Centre, Shahra-e-Faisal, Karachi
Tel: 021-99207512-14, Fax: 021-99207515

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ANNUAL PROCUREMENT PLAN

(WORKS, GOODS & SERVICES)

Financial year 2026-27

PIU (Education City).

Sr. No:	Description of Procurement	Quantity (where applicable)	Estimated unit cost (where applicable)	Estimated total cost	Funds allocated	Source of funds (ADP/Non ADP)	Proposed procurement method	Timing of procurements				Remarks
								1st Qtr	2nd Qtr	3rd Qtr	4th Qtr	
1	Commercial Kitchen & furniture Addl/Encl	220M	220M	220M	NON	Two Envlp						
2	Site Road & Infra Structure Civil K.	1075M	1075M	1075M	NON-ADP	Two Envlp.						

Approved and signed by the Head of Procuring Agency

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PROJECT IMPLEMENTATION UNIT, EDUCATION CITY
GOVERNMENT OF SINDH

NOTICE INVITING TENDER

Tender # NIT/PIU/2026/0612

1. The Employer invites sealed bids from eligible Firms/Contractors for the project titled **"Special Technology Zone (STZ) Package-1 Road and Infrastructure Works, Education City, Karachi"** under the **Single Stage – Two Envelope Bidding Procedure"**. Interested bidders shall possess a valid **Pakistan Engineering Council (PEC)** license for the year **2025–2026** in **Category C-1** with specialization codes **CE-01(i), CE-02(ix), CE-09(i & ii), CE-10(i), and CE-11(i & vii)**. Furthermore, the bidding firm/company must be duly registered with the **Federal Board of Revenue (FBR)** and the **Sindh Revenue Board (SRB)**. Only those firms/contractors fulfilling the above eligibility requirements shall be considered for participation in the bidding process.

Start Date of Issue	Submission Date/Time	Opening Date/Time	Tender Fee	Bid Security
17th June 2026	6th July 2026	6th July 2026	**10,000/-** (Non-Refundable)	**2%** of Bid Price

2. Tender documents containing detailed Bill of Quantity (BoQ), evaluation criteria and scope of services can be downloaded from SPPRA website https://portalsindh.eprocure.gov.pk through **EPAD** (E-Procurement) System and Education City website www.educationcity.gos.pk. Interested bidders are required to submit a Pay Order / Demand Draft of **Rs. 10,000/-** (non-refundable) in favor of **Education City Project** as the cost of tender documents.

3. **EPADs portal** at https://portalsindh.eprocure.gos.pk. Financial proposals must be accompanied by a bid security of **2%** of the total bid amount (refundable) in the form of a Pay Order / Bank Draft / Bank Guarantee issued by a scheduled bank of Pakistan. The bid security should remain Valid for at least **90 days** beyond the bid validity date. One hard copy of both technical and financial proposals (in separate sealed envelopes), identical to the documents uploaded on **SPPRA EPADs**, must be submitted along with the required original bid security at the address given below.

4. The procuring agency reserves the right to reject any or all bids as per the relevant provisions of SPPRA Rules 2010, specifically Rule 25(1). Further, any false or misleading information submitted by a firm/company/agency will result in immediate disqualification at any stage of the process.

PROJECT IMPLEMENTATION UNIT (EDUCATION CITY)
GOVERNMENT OF SINDH
1st Floor, Block A, FTC Building, Shahrah-e-Faisal Karachi

EDUCATION CITY

INFRASTRUCTURE DEVELOPMENT OF EDUCATION CITY,KARACHI

Special Technology Zone Package 1
Road and Infrastructure works

VOLUME - I

CONDITIONS OF CONTRACT

GOVERNMENT OF SINDH

CGD CONSULTING

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3. BIDDING DATA
4. FORM OF BID AND APPENDICES TO BID
5. FORMS
   - BID SECURITY
   - FORM OF PERFORMANCE SECURITY
   - FORM OF CONTRACT AGREEMENT
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Volume-II

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Volume-III

11. TENDER DRAWINGS

No. _____ Dated: _____

INVITATION TO BIDDERS

SUBJECT: Special Technology Zone (STZ) Package 1 Road and Infrastructure works Education City, Karachi.

1. The Employer invites sealed bids under Single Stage-Two Envelope bidding procedure from eligible firms licensed by the Pakistan Engineering Council valid for the year 2025-2026 in Category C-1 with specialization codes CE-01(i), CE-02(ix), CE-09 (i & ii), CE-10(i), CE-11 (i) & vii). The company must be registered with FBR and SRB.

2. Tender documents containing detailed Bill of Quantity (BoQ), evaluation criteria and scope of services can be downloaded from SPPRA website https://portalsindh.eprocure.gov.pk through EPAD (E Procurement) System and Education City website www.educationcity.gos.pk from _____, 2025 till _____, 2025 on or before _____ hrs. Interested bidders are required to submit a Pay Order / Demand Draft of Rs. 10,000/- (non-refundable) in favor of "Project Implementation Unit, Education City Project" as the cost of tender documents.

3. All interested bidders must upload their Bids (Technical and Financial) via the SPPRA EPADs portal at https://portalsindh.eprocure.gos.pk. Financial proposals must be accompanied by a bid security of **2%** of the total bid amount (refundable) in the form of a Pay Order / Bank Draft / Bank Guarantee issued by a scheduled bank of Pakistan. The bid security should remain Valid for at least 90 days beyond the bid validity date and be made in favor of "Education City Project". Note: One hard copy of both technical and financial proposals (in separate sealed envelopes), identical to the documents uploaded on SPPRA EPADs, must be submitted along with the required bid security at the address (Project Implementation Unit, 1st Floor, Block A, FTC Building, Shahrah-e-Faisal Karachi) of the procuring agency is mandatory.

4. Bids must be uploaded via the SPPRA E-Procurement Portal on or before _____ hrs. on _____,2025 and same will be opened on same date at _____hrs. through SPPRA's E-pad portal. All designated committee members and interested bidders are required to be online during the opening and evaluation, Bidders who fail to appear online during the opening session will be marked as absent, and their bids will be rejected.

5. The procuring agency reserves the right to reject any or all bids as per the relevant provisions of SPPRA Rules 2010, specifically Rule 25(1). Further, any false or misleading information submitted by a firm/company/agency will result in immediate disqualification at any stage of the process.

6. Date of opening of Financial Bids of Technically qualified bidders shall be notified at later date after Evaluation of the Technical Bids.

7. The blue ink shall be used to fill all the form/ BOQ.

8. Join Venture will not be allowed.

9. Any work executed under for mode shall not be considered as an experience.

10. Performance shall be given to than bidders who are ISO certify.

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INSTRUCTIONS TO BIDDERS

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

A. GENERAL

IB.1 Scope of Bid Source of Funds

1.1 Procuring agency as defined in the bidding data hereinafter called "the procuring agency" wishes to receive bids for the construction and completion of works as described in these bidding documents, and summarized in the bidding data hereinafter referred to as the "Works".

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

IB.2 Source of Funds

2.1 Procuring agency has received/allocated/] applied for loan/grant/ Federal/ Provincial/Local Government funds from the source(s) indicated in the bidding data in various currencies towards the cost of the project /scheme specified in the bidding data, and it is intended that part of the proceeds of this loan/grant/funds will be applied to eligible payments under the contract for which these bidding documents are issued.

IB.3 Eligible Bidders

3.1 This Invitation for Bids is open to all interested bidders who are eligible under provisions of Sindh Public Procurement Rules as mentioned below and the criteria given in the Notice Inviting Tender (NIT)/ Bidding Document.

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

(a) Bidders may be excluded if;

(i) as a matter of law or official regulations, commercial relations are prohibited with the bidder's country by the federal government in case of ICB, or

(ii) a firm is blacklisted/ debarred by the procuring agency and the matter has been reported to the Authority, subject to Rule 30 of Sindh Public Procurement Rules 2010.

(b) Government-owned enterprises or institutions may participate only if they can establish that they are;

(i) legally and financially autonomous, and

(ii) operate under commercial law

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

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

(c) Bidders are:-

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

(ii) registered with Pakistan Engineering Council in particular category and discipline

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

IB.4 One Bid per Bidder

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

IB.5 Cost of Bidding

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

IB.6 Site Visit

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

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

B. BIDDING DOCUMENTS

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

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

1. Instructions to Bidders
2. Bidding Data
3. General Conditions of Contract, Part-I (GCC)
4. Special Conditions of Contract, Part-II (SCC)
5. Specifications
6. Form of Bid and Appendices to Bid
7. Bill of Quantities (Appendix-D to Bid)
8. Form of Bid Security

9. Form of Contract Agreement
10. Forms of Performance Security, Mobilization Advance Guarantee, Integrity Pact and Indenture bond for secured advance
11. Drawings

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

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

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

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

IB.9 Amendment/ Modification of Bidding Documents

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

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

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

C. PREPARATION OF BIDS

IB.10 Language of Bid

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

IB.11 Documents Accompanying the Bid

11.1 Each bidder shall:

(a) submit a written authorization on the letterhead of the bidding firm, authorizing the signatory of the bid to act for and on behalf of the bidder;

(b) update the information indicated and listed in the bidding data and previously submitted with the application for prequalification, and continue to meet the minimum criteria set out in the prequalification documents, which as a minimum, would include the following;

(i) Evidence of access to financial resources along with average annual construction turnover;

(ii) Financial predictions for the current year and the following two years, including the effect of known commitments;

(iii) Work commitments since prequalification;

(iv) Current litigation information; and

(v) Availability of critical equipment.

And

(c) furnish a technical proposal taking into account the various Appendices to Bid specially the following:

Appendix-E to Bid	Proposed Construction Schedule
Appendix-F to Bid	Method of Performing the Work
Appendix-G to Bid	List of Major Equipment
Appendix-K to Bid	Organization Chart for Supervisory Staff and other pertinent information such as mobilization programme etc;

11.2 Bids submitted by a joint venture of two (2) or more firms shall comply with the following requirements:

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

(b) the bid, and in case of a successful bid, the Form of Contract Agreement shall be signed by the authorized partner so as to be legally binding on all partners;

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

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

(e) a copy of the agreement entered into by the joint venture partners shall be submitted with the bid stating the conditions under which it will function, its period of duration, the persons authorized to represent and obligate it and which persons will be directly responsible for due performance of the contract and can give valid receipts on behalf of the joint venture, the proportionate participation of the several firms forming the joint venture, and any other information necessary to permit a full appraisal of its functioning. No amendments / modifications whatsoever in the joint venture agreement shall be agreed to between the joint venture partners without prior written consent of the procuring agency;

(f) submission of an alternative Letter of Intent to execute a Joint Venture Agreement shall be mandatory.

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

IB.12 Bid Price

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

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

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

Additional / reduced duties, taxes and levies due to subsequent additions or changes in legislation shall be reimbursed / deducted as per Sub-Clause 13.7 of the General Conditions of Contract Part-I.

12.4 The rates and prices quoted by the bidders are subject to adjustment during the performance of the contract in accordance with the provisions of Clause 13.7of GCC. The bidders shall furnish the prescribed information for the price adjustment formulae in Appendix-C to Bid, and shall submit with their bids such other supporting information as required under the said Clause. Adjustment in prices quoted by bidders shall be allowed as per Sub-Para 4(ii) of Section C of Instructions to bidders and bidding data.

IB.13 Currencies of Bid and Payment

13.1 The unit rates and the prices shall be quoted by the bidder entirely in Pak rupees. A bidder expecting to incur expenditures in other currencies for inputs to the works supplied from outside the procuring agency‟s country (referred to as the “Foreign Currency Requirements”) shall indicate the same in Appendix-B to Bid. The proportion of the bid price (excluding Provisional Sums) needed by him for the payment of such Foreign Currency Requirements either (i) entirely in the currency of the bidder‟s home country or, (ii) at the bidder‟s option, entirely in Pak rupees provided always that a bidder expecting to incur expenditures in a currency or currencies other than those stated in (i) and (ii) above for a portion of the foreign currency requirements, and wishing to be paid accordingly, shall indicate the respective portions in the bid.

13.2 The rates of exchange to be used by the bidder for currency conversion shall be the selling rates published and authorized by the State Bank of Pakistan prevailing on the date, 07 (seven) days prior to the deadline for submission of bids. For the purpose of payments, the exchange rates used in bid preparation shall apply for the duration of the contract.

IB.14 Bid Validity

14.1 Bids shall remain valid for the period stipulated in the bidding data from the date of opening of bid specified in clause IB.23.

14.2 In exceptional circumstances, prior to expiry of the original, the procuring agency may request the bidders to extend the period of validity for a specified additional period, which shall not be for more than one third of the original period of bid validity. The request and the responses thereto, shall be made in writing. A bidder may refuse the request without the forfeiture of the bid security. In case, a bidder agreed to the request, shall not be required or permitted to modify the bid, but will be required to extend the validity of the bid security for the period of the extension, and in compliance with Clause IB.15 in all respects.

IB.15 Bid Security

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

15.2 The bid security shall be at the option of the bidder, in the form of deposit at call, Pay order or a bank guarantee issued by a Scheduled Bank in Pakistan or from a foreign bank duly counter guaranteed by a Scheduled Bank in Pakistan in favour of the procuring agency, which should commensurate with the bid validity period. The bank guarantee for bid security shall be acceptable in the manner as provided at Annexure BS-1.

15.3 Any bid not accompanied by an acceptable bid security shall be rejected by the procuring agency as non-responsive.

15.4 Bid security shall be released to the unsuccessful bidders once the contract has been signed with the successful bidder or the validity period has expired.

15.5 The bid security of the successful bidder shall be returned when the bidder has furnished the required Performance Security and signed the Contract Agreement.

15.6 The Bid Security may be forfeited:

(a) if the bidder withdraws his bid except as provided in sub- clause IB 22.1

(b) if the bidder does not accept the correction of his bid price pursuant to sub- clause IB 27.2 hereof; or

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

(i) furnish the required Performance Security; or

(ii) sign the Contract Agreement.

IB.16 Alternate Proposals/Bids

16.1 Each bidder shall submit only one bid either by himself, or as a member of a joint venture, until and unless they have been requested or permitted for alternative bid, then he has to purchase separate bidding documents and alternate bid shall be treated as separate bid.

16.2 Alternate proposals are allowed only for procurement of works where technical complexity is involved and more than one designs or technical solutions are being offered. Two stage

two envelope bidding procedure will be appropriate when alternate proposal is required.

16.3 Alternate bid(s) shall contain (a) relevant design calculations; (b) technical specifications; (c) proposed construction methodology; and (d) any other relevant details / conditions, provided that the total sum entered on the Form of Bid shall be that which represents complete compliance with the bidding documents.

IB.17 Pre-Bid Meeting

17.1 Procuring agency may, on his own motion or at the request of any bidder, hold a pre- bid meeting to clarify issues and to answer any questions on matters related to the bidding documents. The date, time and venue of pre-bid meeting, if convened, shall be communicated to all bidders. All bidders or their authorized representatives shall be invited to attend such a pre-bid meeting at their own expense.

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

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

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

IB.18 Format and Signing of Bid

18.1 Bidders are particularly directed that the amount entered on the Form of Bid shall be for performing the contract strictly in accordance with the bidding documents.

18.2 All appendices to bid are to be properly completed and signed.

18.3 Alteration is not to be made neither in the form of bid nor in the Appendices thereto except in filling up the blanks as directed. If any such alterations be made or if these instructions be not fully complied with, the bid may be rejected.

18.4 Each bidder shall prepare by filling out the forms without alterations and shall provide an original copy along with photocopies as per the requirement of the procuring agency specified in the bidding data. The original as well as copies of the document shall be clearly marked as “ORIGINAL” and „COPY”, as the case may be. If there is any discrepancy between original and copy (ies) then the original shall prevail.

18.5 The original and all copies of the bid shall be typed or written in indelible ink (in the case of copies, Photostats are also acceptable) and shall be signed by a person(s) duly authorized to sign on behalf of the bidder pursuant to sub- clause IB 11.1(a) hereof. All pages of the bid shall be initialed and stamped by the person(s) signing the bid.

18.6 The bid shall contain no alterations, omissions or additions, except to comply with instructions issued by the procuring agency, or as are necessary to correct errors made by the bidder. Such corrections shall be initialed by the person(s) signing the bid.

18.7 Bidders shall indicate in the space provided in the Form of Bid their full and proper postal addresses at which notices may be legally served on them and to which all correspondence in connection with their bids and the contract is to be sent.

18.8 Bidders should retain a copy of the bidding documents as their file copy.

D. SUBMISSION OF BID

IB.19 Sealing and Marking of Bids

19.1 Each bidder shall submit his bid as under:

(a) ORIGINAL and COPIES of the bid shall be separately sealed and put in separate envelopes and marked as such.

(b) The envelopes containing the ORIGINAL and COPIES shall be put in one sealed envelope and addressed as given in sub - clause IB 19.2 hereof.

19.2 The inner and outer envelopes shall:

(a) be addressed to the procuring agency at the address provided in the bidding data;

(b) bear the name and identification number of the contract as defined in the bidding data; and

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

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

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

IB.20 Deadline for Submission of Bids

20.1 (a) Bids must be received by the procuring agency at the address specified not later than the time and date stipulated in the bidding data;

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

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

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

20.2 The Procuring Agency may, at its discretion, extend the deadline for submission of bids by issuing an amendment in accordance with IB 09. In such case, all rights and obligations of the procuring agency and the bidders shall remain the same as mentioned in the original deadline.

IB.21 Late Bids

(a) any bid received by the procuring agency after the deadline for submission of bids prescribed in to clause IB 20 shall be returned unopened to such bidder

(b) delays in the mail, person in transit, or delivery of a bid to the wrong office shall not be accepted as an excuse for failure to deliver a bid at the proper place and time. It shall be the bidder's responsibility to submit the bid in time

IB.22 Modification, Substitution and Withdrawal of Bids

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

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

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

22.4 Withdrawal of a bid during the interval between the deadlines for submission of bids and the expiration of the period of bid validity specified in the Form of Bid may result in forfeiture of the bid security in pursuance to clause IB 15

E. BID OPENING AND EVALUATION

IB.23 Bid Opening

23.1 Procuring agency will open the bids, including withdrawals, substitution and modifications made pursuant to Clause IB.22, in the presence of bidders" representatives who choose to attend, at the time, date and location stipulated in the bidding data. The bidders or their representatives who are in attendance shall sign an attendance sheet.

23.2 Envelopes marked "MODIFICATION", "SUBSTITUTION" or "WITHDRAWAL" shall be opened and read out first. Bids for which an acceptable notice of withdrawal has been submitted pursuant to clause IB.22 shall not be opened.

23.3 Procuring agency shall read aloud the name of the bidder, total bid price and price of any Alternate Proposal(s), if any, discounts, bid modifications**,** substitution and withdrawals, the presence or absence of bid security, and such other details as the procuring agency may consider appropriate, and total amount of each bid, and of any alternative bids if they have been requested or permitted, shall be read aloud and recorded when opened.

23.4 Procuring Agency shall prepare minutes of the bid opening, including the information disclosed to those present in accordance with the sub-clause IB.23.3.

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

24.1 Information relating to the examination, clarification, evaluation and comparison of bid and recommendations for the award of a contract shall not be disclosed to bidders or any other person not officially concerned with such process before the announcement of bid evaluation report in accordance with the requirements of Rule 45, which states that Procuring agencies shall announce the results of bid evaluation in the form of a report giving reasons for acceptance or rejection of bids. The report shall be hoisted on website

of authority and that of procuring agency if it website exists and intimated to all bidders at least seven (7) days prior to the award of contract The announcement to all bidders will include table(s) comprising read out prices, discounted prices, price adjustments made, final evaluated prices and recommendations against all the bids evaluated. Any effort by a bidder to influence the procuring agency's processing of bids or award decisions may result in the rejection of such bidder's bid. Whereas, any bidder feeling aggrieved, may lodge awritten complaint as per Rule 31; however mere fact of lodging a complaint shall not warrant suspension of the procurement process.

IB.25 Clarification to Bid (SPP Rule 43)

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

IB.26 Examination of Bids and Determination of Responsiveness

26.1 Prior to the detailed evaluation of bids, the procuring agency will determine whether the bidder fulfills all codal requirements of eligibility criteria given in the tender notice such as registration with tax authorities, registration with PEC (where applicable), turnover statement, experience statement, and any other condition mentioned in the NIT and bidding document. If the bidder does not fulfill any of these conditions, it shall not be evaluated further.

26.2 Once found to be fulfilling the eligibility criteria, as mentioned in sub- clause 26.1, the bids of eligible bidders will be evaluated for technical responsiveness as per specification and criteria given in the bidding documents. Technical and financial evaluations may be carried out in accordance with single stage-single one envelope, single stage-two envelopes, two stage or two stage-two envelopes bidding procedures depending on the selection procedure adopted by the procuring agency.

26.3 A bid will be considered technically responsive if it (i) has been properly signed; (ii) is accompanied by the required bid security; and (iii) conforms to all the terms, conditions and specifications of the bidding documents, without material deviation or reservation. A material deviation or reservation is one (i) which affect in any substantial way the scope, quality or performance of the works; (ii) which limits in any substantial way, inconsistent with the bidding documents, the procuring agency's rights or the bidder's obligations under the contract; or (iii) adoption/rectification whereof would affect unfairly the competitive position of other bidders presenting substantially responsive bids.

26.4 If a bid has major deviations to the commercial requirements and technical specifications will be considered technically non responsive. As a general rule, major deviations are those that if accepted, would not fulfill the purposes for which the bid is requested, or would prevent a fair comparison or affect the ranking of the bids that are compliant with the bidding documents.

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

(i) has been not properly signed;
(ii) is not accompanied by the bid security of required amount and manner;

(iii) stipulating price adjustment when fixed price bids were called for;
(iv) failing to respond to specifications;
(v) failing to comply with Mile-stones/Critical dates provided in Bidding Documents;
(vi) sub-contracting contrary to the Conditions of Contract specified in Bidding Documents;
(vii) refusing to bear important responsibilities and liabilities allocated in the Bidding Documents, such as performance guarantees and insurance coverage;
(viii) taking exception to critical provisions such as applicable law, taxes and duties and dispute resolution procedures;
(ix) a material deviation or reservation is one:

(a) which affect in any substantial way the scope, quality or performance of the works

(b) adoption/rectification whereof would affect unfairly the competitive position of other bidders presenting substantially responsive bids

(B) Minor Deviations

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

IB.27 Correction of Errors before Financial Evaluation

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

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

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

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

IB.28 Financial Evaluation and Comparison of Bids

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

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

(a) making any correction for errors pursuant to clause IB 27;

(b) excluding provisional sums (if any), for contingencies in the Summary Bill of Quantities, but including competitively priced Day work; and
(c) making an appropriate adjustment for any other acceptable variation or deviation

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

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

28.5 Bidders may be excluded if involved in **"Corrupt and Fraudulent Practices"** means either one or any combination of the practices given below SPP Rule2(q)

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

(ii) "**Collusive Practice**" means any arrangement between two or more parties to the procurement process or contract execution, designed to achieve with or without the knowledge of the procuring agency to establish prices at artificial, noncompetitive levels for any wrongful gain

(iii) **"Corrupt Practice"** means the offering, giving, receiving or soliciting, directly or indirectly, of anything of value to influence the acts of another party for wrongful gain

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

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

28.6 Evaluation Report (SPP Rule 45)

After the completion of evaluation process, as described in clauses IB 27 and IB 28, the procuring agency shall announce the results of bid evaluation in the form of report (available on the website of the authority) giving reasons for acceptance and rejection of bid. The report shall be hoisted on website of the authority and that of procuring agencies

if its website exists and intimated to all bidders at least seven (7) days prior to the award of contract.

F. AWARD OF CONTRACT

IB.29 Award (SPP Rule 49)

29.1 Subject to clauses IB 30 and IB 34 and provision of the rule: The procuring agency shall award the contract to the bidder whose bid has been determined to be substantially responsive to the bidding documents, and who has offered the lowest evaluated bid**,** but not necessarily the lowest submitted price, within the original or extended period of bid validity. Provided that such bidder has been determined to be eligible in accordance with the provisions of clause IB 03 and qualify pursuant to sub- clause IB 29.2.

29.2 Procuring agency, at any stage of the bid evaluation, having credible reasons for or having *prima facie* evidence of any deficiency(ies) in contractor's capacities, may require the contractor to provide information concerning their professional, technical, financial, legal or managerial competence whether already pre-qualified or not for the said project.

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

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

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

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

31.1 Prior to expiry of the period of bid validity, including extension, prescribed by the procuring agency, the procuring agency shall notify the successful bidder in writing ("Letter of Acceptance") that his bid has been accepted. This letter shall mention the sum which the procuring agency will pay to the contractor in consideration of the execution and completion of the works by the contractor as prescribed by the contract (hereinafter and in the conditions of contract called the "Contract Price").

31.2 No negotiation with the bidder having evaluated as lowest responsive or any other bidder shall be permitted, however, procuring agency may hold meetings to clarify any item in the bid evaluation report

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

31.4 Upon furnishing by the successful bidder of a Performance Security and signing of the contract, the procuring agency will promptly notify the name of the successful bidder to all bidders and return their bid securities accordingly

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

(1) Evaluation Report;
(2) Form of Contract and letter of Award;
(3) Bill of Quantities or Schedule of Requirement

31.6 Debriefing (SPP Rule 51)

(a) A bidder may ask the procuring agency for reasons for non acceptance of his bid and may request for a debriefing meeting and procuring agency shall give him the reasons for such non acceptance, either in writing or by holding a debriefing meeting with such a bidder.

(b) The requesting bidder shall bear all the costs of attending such a debriefing

IB.32 Performance Security (SPP Rule 39)

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

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

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

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

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

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

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

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

33.4 Stamp Duty

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

IB.34 Stamp Duty

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

IB.35 Integrity Pact (SPP Rule 89)

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

IB.36 Instruction not part of Contract

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

IB.37 Arbitration (SPP Rule 34)

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

BIDDING DATA SHEET

The following specific data for the Works to be bidded shall complement, amend, or supplement the provisions in the Instructions to Bidders. Wherever there is a conflict, the provisions herein shall prevail over those in the Instructions to Bidders.

Instructions to Bidders
Clause Reference

1.1. Name and address of the Procuring Agency

Project Implementation Unit,
Education City Project
1st Floor, Block-A. Finance & Trade Centre
Shahra-e-Faisal, Karachi

1.2. Name of the Project & Summary of the Works:

Name of the Project :-

Special Technology Zone (STZ) Package 1 Road and Infrastructure works Education City, Karachi.

Summary of The Project-:

Construction of Roads, Stormwater Drainage, Culvert in the Contract.

2.1. Name of the Borrower/Source of Financing/Funding Agency

The Employer has arranged funds from its own sources.

2.1 Amount and type of financing

Not used

3 Eligible Bidders (and Qualification Criteria)

For consideration of the bids following are the key requirements for qualification;

3.1 ELIGIBILITY CRITERIA (MANDATORY REQUIREMENT)

The bidder who meets the following eligibility criteria/ mandatory requirements would be declared responsive for further evaluation. Verification documentary proof for all following requirements is a mandatory, noncompliance of any below requirement will lead to disqualification. The bids disqualified/ non-responsive to the Mandatory Eligibility Evaluation Criteria provided shall not be eligible for further evaluation.

SR. NO.	QUALIFICATION CRITERIA (MANDATORY REQUIREMENT)
1	Bidders should have Valid licence for 2025-2026 from Pakistan Engineering Council, in Category C-B with specialization codes CE-01(i), CE-02(ix), CE-09 (i & ii), CE-10(i), CE-11 (i) & vii), EE-04,EE05, EE-06, EE-11(vi).
2	Active Registration with Income Tax. Must attach last 03-year FBR tax return.
3	Active Registration with Sindh Revenue Board (SRB). Must attach last 03-month SRB return.
4	The Participating firm(s) must be registered with K-Electric as a contractor with valid vendor ID.

SR. NO.	QUALIFICATION CRITERIA (MANDATORY REQUIREMENT)
5	Valid Electrical License issued from Inspectorate of Electrical License Sindh of the similar region with respect to works shown above.
6	Five years of Experience in the similar type of Composite Civil works (Roads, SWD, Sewerage, Water Supply) & Composite Electrical Works (Streel Lighting, MV, LV Distribution and FPB) with Government Govt. Societies/ Housing Development Schemes project cost 1000 Million or above. *(Work Completion Certificates / Work order as documentary evidence)*
7	The participating firm(s) must have at least (01) similar nature of work in hand (i.e Government Society / Housing Scheme Development project) worth Rs.800M or above. *(Work order to be attached for verification)*
8	Annual Tax Returns of last 05 years
9	Bank Statement for last 06 months
10	Audit Reports for last 05 years
11	The participating firm(s) must have average annual turnover of Rs.500M or above during last 03-years and must be reflected in FBR/Audit report.
12	Undertaking on Stamp Paper of Rs.500/- containing that: - a) Affidavit to the effect that firm has not been black listed previously by any executing agency. b) List of litigation (if any) their nature and status / outcomes. c) Affidavits to the effect that all documents / particulars / information furnished are true and correct.
13	Bid Security **Rs. 20 Million in Pak Rupees** in shape of Call Deposit / Pay Order/ Demand Draft from any scheduled Bank of Pakistan in favor of the Employer.
14	Tender fee Rs. 10,000/- in shape of Pay Order
15	Each page of bidding document should be signed & stamped by the bidder, conditional bid will not be considered.

The bidder failing in Mandatory Requirement will be disqualified technically.

3.2 ELIGIBILITY CRITERIA FOR TECHNICAL PROPOSALS BASED ON PASS OR FAIL BY MARKS/ SCORE

The Eligible/ Technically Qualified Bidders will be considered for further evaluation. Bids with required documents attached shall be evaluated on the score obtained and firms obtaining 70 marks shall be considered technically qualified. Technical Bids will be evaluated on the basis of following criteria and Financial Bids of only those bidders will be opened who have qualified technically. Aggregate qualifying score is 70% but it is mandatory to obtain at least 50% to declare as PASS in each of the following sections.

DETAILED TECHNICAL EVALUATION CRITERIA:

Sr. No.	Category	Weightage/ Marks/ Points	
		Maximum	Minimum
A.	Company Profile & Relevant Experience	5	2.5
B.	Experience of The Firm Company	40	20
C.	Personnel Capabilities Required for This Project	25	12.5
D.	Equipment Capability	10	5
E.	Financial Soundness	20	10
	Total	**100**	**50**

A. Company Profile — 05 Marks

(a)	Period since Firm/ Constructor is in Construction Business Between 6-10 years Above 10 years Attach your first/old PEC license for reference, as well as your most recent valid PEC license.	**2.5 Marks** 1.0 Marks 2.5 Marks
(b)	Office Facilities If office in Karachi If outside Karachi (attached documents evidence)	**2.5 Marks** 2.5 Marks 1.0 Marks

B. Experience of The Firm Company — 40 Marks

(a)	Project of Similar Nature i.e Composite Civil works (Roads, SWD, Sewerage, Water Supply) & Composite Electrical Works (Streel Lighting, MV, LV Distribution and FPB), Rs 800 Million or above (each) completed in any Government sector all over in Pakistan during last 5 years. 10-Marks will be given for each Project.	**20 Marks**
(b)	Similar nature of Infrastructure Development Project (Roads, SWD, Sewerage, Water Supply) & Composite Electrical Works (Streel Lighting, MV, LV Distribution and FPB) of Rs.1000 Million or above (each) in hand in any Government sector all over in Pakistan during last 05-years. 10-Marks will be given for each Project	**20 Marks**

C. Personnel Capabilities Required for This Project — 25 Marks

Employed Engineers must have valid registration with Pakistan Engineering Council (PEC) and active Tax Payer also reflected in firms PEC license.

The key technical personnel required at site and factors for marking are as follows:

Sr.	Description / Position with Minimum Qualification & Experience	Marks Assigned	Remarks
1	**Project Manager (01 No.)** BE/ME (Civil) registered with Pakistan Engineer council (PEC) having experience of 20 years or above.	05	**01 Marks** BE qualification upto 20 Years. **01 Marks** ME with 10 years of experience after Masters. **01 Marks** Registered as a Professional Engineer with PEC. **02 Marks** Completion of similar nature 02 project.
2	**Construction Engineer (01 No.)** B.E. (Civil) registered with Pakistan Engineering Council (PEC) having experience of 15 years or above.	02	**01 Marks** Experience between 10-15 years. **01 Marks** Completion of similar nature 02 project.

Sr.	Description / Position with Minimum Qualification & Experience	Marks Assigned	Remarks
3	**Contract Engineer (01 No.)** B.E. (Civil) registered with Pakistan Engineering Council (PEC) having experience of 15 years or above.	02	**01 Marks** Experience between 10-15 years. **01 Marks** Completion of similar nature 02 project
4	**Site Supervisor (MEP) Engineer (01 No.)** B.E.(Elect./Elect/Telecomm/IT) registered with Pakistan Engineering Council (PEC) Min. experience 10 years	02	**01 Marks** Experience upto 10 years. **01 Additional Marks** Experience above 10 years.
5	**Quantity Surveyor - DAE in Civil (01 No.)** DAE in Civil having relevant experience of Min. 10 years .	02	**01 Marks** Experience upto 10 years. **01 Additional Marks** Experience More than 10 years.
6	**Site Supervisor in Civil (01 No.)** **DAE** in Civil having minimum 15 years of relevant experience .	02	**01 Marks** Experience upto 15 years. **01 Additional Marks** Experience above 15 years.
7	**Site Supervisor Elect / IT (01.)** DAE in Civil having relevant experience of 10 years or above.	02	.**01 Marks** Experience upto 10 years **01 Additional Marks** Experience above 10 years.
9	**Site Chief Surveyor (Civil) 01 No** DAE in Civil having relevant experience of 20 years or above.	01	**01 Marks** Experience upto 20 years
10	**CAD Operator (Civil) 01** DAE in Civil having relevant experience of 10 years or above.	01	**01 Marks** Experience upto 10 years
11	**Lab Technician / Material Engineer** Bachelors in Material Engineering / Geology having relevant experience of 15 years or above.	01	**01 Marks** Experience upto 15 year
12	**Site Architect** Bachelor of Architect having relevant experience of 20 Years.	02	**01 Marks** Experience upto 20 years **01 Additional Marks** Experience of 03 similar projects.
13	**Infrastructure Engineer** Bachelor of Urban Infrastructure Planning / Town Planning having relevant experience of 15 Years.	02	**01 Marks** Experience upto 15 years **01 Additional Marks** Experience of 03 similar projects.
14	**Safety Officer** Bachelors / DAE / Short Courses in NEBOSH / IOSH having relevant experience of 05 Years	01	**01 Marks** Experience upto 05 years

D. Equipment Capability **10 Marks**

(a) Critical equipment and number required for the Project shall be specified by the Procuring Agency.
(b) High value equipment should be an option to own, lease or hire.
(c) Total equipment available with the applicant is to be listed along with its current mobilization and on- going projects.

Details are to be provided as per the below form with documentary proof of ownership / rental/Leased failure to do so can result in rejection of tender).

Sr.	Description	Qty	Unit	Marks
1	Excavator (Showel / Back Hoe)	3	No.	01
2	Earth Moving Machinery (Grader, Bulldozer, Loader)	3	No.	0.5
3	Bobcat Loader (Mini Loader)	2	No.	0.5
4	Dumper Truck	15	Nos.	01
5	Transit Mixer	6	Nos.	1.5
6	Concrete Pump for Ready Mix	2	No.	0.5
7	Tractor with Trolley	3	No.	0.5
8	Vibratory Roller 1 Ton	3	Nos.	0.5
9	Plate Compactor & Frog Compactor	3	Nos.	0.25
10	Vibrator (Large Shaft! Small Shaft)	4	Nos.	0.25
11	Air Compressor (15 HP Cap,)	1	Nos.	0.25
12	Generator 100 KVA	2	Nos.	0.25
13	Concrete Batching Plant	1	Nos.	0.5
14	Steel cutting & Bending Machine	4	Set.	0.5
15	Formwork & PC Girder Molds 50,000 Sft	1	Set	0.5
16	Scaffolding Pipe 50,000 Rft	1	Set	0.5
17	Total Station with Staff etc	3	Set	0.25
18	Dewatering Pumps	1	Sets	0.25
19	Allied Construction Tools & Plants	2	Sets	0.25
20	Suzuki Van	4	Nos.	0.25
	Total Marks			**10**

Note: The following formula is applicable to evaluation criteria based on marks/score only.

a) If the available quantity of equipment is less than specified limit, give weight age as under: T = M x (A/Required Quantity).

b) If the available quantity of equipment is more than the minimum equipment requirement full marks will be given.
A = Available quantity of each equipment of each Item.
T = Marks obtained M = Marks assigned.

E. Financial Soundness 20 marks

For Financial Status assessment, the Applicants have to submit Income tax returns for the last FIVE years and SRB monthly return. Further, the bidder will provide evidence from bank for verifying financial soundness of the bidder.

Average Credit Limit **10 Marks**

Bank Letter showing credit limit/worth of the firm

i. upto 300 Million 05 Marks
ii. Above 300 Million 10 Marks

Turnover for last 05 Years **10 Marks**

Turnover for last 05 Years (Income Tax return / Audited financial report)

i. Less than 15% of Estimated Cost of this Work 02 Marks
ii. 16 - 25% of Estimated Cost of this Work 04 Marks
iii. 26 - 40% of Estimated Cost of this Work 08 Marks
iv. More than 40% of Estimated Cost of this Work 10 Marks

3.3 COMMERCIAL EVALUATION

It will be examined in detail whether the Bids comply with the commercial/ contractual conditions of the Bid Documents. It is expected that no major deviation/ stipulation shall be taken by the Bidders.

3.4 EVALUATED BID PRICE

In evaluating the Bids, the Employer will determine for each Bid in addition to the Bid Price, the following factors (adjustments) in the manner and to the extent indicated below to determine the Evaluated Bid Price:

(i) Making any correction for errors pursuant to Sub-Clause 27.2 hereof.

(ii) Excluding Provisional Sums, if any, but including priced Day work (if applicable)

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

4.1 One Bid per Bidder

Out of a parent organization and / or sister organization, only one entity shall submit a Bid. If more than one Bid is submitted by the entities belonging to same parent organization and / or being sister organizations, all such Bids shall be rejected to avoid Conflict of Interest.

8.1. Time limit for clarification

07 Days prior to the deadline for submission of bids.

10.1. Bid language

The same language in which the bid documents are written i.e. English language.

11.1 (A) In continuation with the document mentioned in Clause IB 3.1 hereabove, the Bidder shall also submit with its Technical Bid (Envelope - A) the following documents:

a). Letter of Technical Bid
b). Bid Security (IB.15)
c). Written confirmation authorizing the signatory of the Bid to commit the Bidder (IB.18.5)
d). Pending litigation information
e). Special Stipulations (as filled by the Employer) (Appendix - A)
f). Proposed Construction Schedule (Appendix - E)
g). Method of Performing the Work (Appendix - F)
h). Availability of Critical Equipment (Appendix - G)
i). Construction Camp and Housing Facilities (Appendix - H)
j). List of Sub-contractors (Appendix - I)
k). Organization Chart for Supervisory Staff (Separately for Construction & O & M Period) (Appendix - K)
l). Integrity Pact (Appendix - L)
m). Financial Competence and Access to financial Resources (appendix - M)
n). Past Performance, Current Commitment, Qualification and Experience (Documentary Evidences) (Appendix - N)
o). In separate envelope, the documents in support of Technical Bid as stipulated in Clause IB28.5 of Bidding Data

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

a). Letter of Price Bid
b). Price Adjustment under Clause 70 (Appendix - C)
c). Bill of Quantities (Appendix - D)
d). Proposed Payment Yard Stick (Appendix - J)

11.4 Documents Accompanying the Bid

After issuance of Letter of Acceptance by the Procuring Agency to the successful bidder and prior to signing of Contract, the successful bidder shall provide licensed copy of the General Condition of Contract, duly signed and stamped. The cost of procuring and providing the said General Condition of Contract shall be the bidder's account. The said GCC shall be made part of the contract.

13.1 Currencies of Bid and Payment

The unit rates and prices shall be quoted by the bidder entirely in Pak Rupees and will be paid in Pak Rupees only.

14.1 Period of Bid Validity

Bid shall remain valid and open for acceptance for a period of ninety (90) calendar days after the latest dead line for submission of bid.

15.1 Amount of Bid Security

Each Bidder shall furnish, as part of his bid, a Bid Security in the amount of not less than ***Rs. 60 million*** *in* ***PKR in the form of Pay Order in favour of Employer or Bank Guarantee from a Schedule Bank of Pakistan . or from a Foreign Bank duly counter guaranteed by a Scheduled Bank in Pakistan in favour of the Employer.***

The Bid Security shall be, at the option of the bidder, in the Form of Deposit at Call or a Bank Guarantee issued by a Scheduled Bank in Pakistan or from a Foreign Bank duly counter guaranteed by a Scheduled Bank in Pakistan in favour of the Employer.

16 Alternate Proposals by Bidders

Not Allowed

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

Venue : Project Implementation Unit, Education City, 1st Floor, Block-A. Finance & Trade Centre, Shahra-e-Faisal, Karachi

Time : _____
Date : Will Be Intimated if required

Bidders have to submit their queries in writing for determination of the Pre Bid Meeting.

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

One original and one copy

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

Name and address of the Employer is:
Project Implementation Unit,
Education City Project,
1st Floor, Block-A. Finance & Trade Centre
Shahra-e-Faisal, Karachi

19.2 (b) Name and Identification Number of the Contract

Special Technology Zone (STZ) Package 1 Road and Infrastructure works Education City, Karachi.

BID Reference No. CGDC/PIU/ECP/2025/STZ/PKG1/R&IW

20.1 (a) Deadline for submission of bids

As per NIT

22.5 Modification, Substitution and Withdrawal of Bids

No alterations or additions shall be made by the Contractor in the Bill of Quantities and rates must be filled in hand written in ink, both in figures and words clearly and legibly in the columns provided in the schedule of quantities. All corrections must be initiated by the contractors. Any Bid which does not comply with this condition will be liable to be summarily rejected and not taken into account when preparing comparative statement.

23.1 Venue, time, and date of Bid opening

Opening of Technical Proposals:
Venue : Project Implementation Unit, Education City, 1st Floor, Block-A. Finance & Trade Centre, Shahra-e-Faisal, Karachi

Time : _____ ***Hours***
Date : _____ ***2026***

Opening of Financial Proposals:

Venue : Project Implementation Unit, Education City, 1st Floor, Block-A. Finance & Trade Centre, Shahra-e-Faisal, Karachi

Time : To be announced after Evaluation of Technical Bids
Date : To be announced after Evaluation of Technical Bids

32 Standard form and amount of Performance Security acceptable to the Employer

Amount of Performance Security shall be per Clause 10.1 of Part II-Conditions of Particulars Application.

33 Signing of Contract Agreement

The agreement would be made on stamp paper of value to be determined at the rate of 0.35 percent of the contract value or as determined by the Inspectorate of Stamp Duty. Cost of stamp duty would be borne by the Contractor before mobilization on site.

FORM OF BID

(LETTER OF OFFER)

Bid Reference No. _____

SUBJECT: SPECIAL TECHNOLOGY ZONE (STZ) PACKAGE 1 ROAD AND INFRASTRUCTURE WORKS, EDUCATION CITY, KARACHI.

To:

_____
_____
_____

1. Having examined the bidding documents including Instructions to Bidders, Bidding Data, and Conditions of Contract, Specifications, Drawings and Bill of Quantities and Addenda Nos.__ for the execution of the above-named work, we/I, the undersigned, offer to execute and complete the work and remedy any defects therein in conformity with the Conditions of Contract, Specifications, Drawings, Bill of Quantities and Addenda for the sum of Rs. _____ (Rupees _____) or such other sum as may be ascertained in accordance with the said conditions

2. We/I understand that all the Appendices attached hereto form part of this bid.

3. As security for due performance of the undertakings and obligations of this bid, we/I submit herewith a bid security in the amount of Rs. _____ (Rupees _____) drawn in your favour or made payable to procuring agency and valid for a period of _____ days beginning from the date, bid is opened

4. We/I undertake, if our bid is accepted, to commence the works and to complete the whole of the works comprised in the contract within the time stated in Appendix-A to Bid.

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

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

7. We do hereby declare that the bid is made without any collusion, comparison of figures or arrangement with any other bidder for the works.

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

9. We undertake, if our/my bid is accepted, to execute the Performance Security referred to in Clause 10 of Conditions of Contract for the due performance of the Contract.

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

in the capacity of_____duly authorized to sign Bids for and on behalf of

Dated this _____ day of _____, 2025

Signature _____

in the capacity of _____duly authorized to sign bid for and on behalf of _____
(Name of Bidder in Block Capitals)
(Seal)

Address
_____

_____

_____

Witness:

(Signature)_____

Name:_____

Address:

_____

_____
____

BA-1
APPENDIX - A TO BID

SPECIAL STIPULATIONS

		Clause No.	
	Engineer's Authority to issue Variation in emergency	3.1	2% of the Contract Price stated in the Letter of Acceptance.
	Amount of Performance Security	4.2	5% of Contract Price.
	Time for Furnishing Program	8.3	Within 14 days from the date of receipt of Letter of Acceptance.
	Minimum amount of Third Party Liability Insurance	18.3	Rs. 1,000,000/- for property damage & Rs. 500,000/- for personnel injury/death per occurrence with number of occurrences unlimited.
	Time for Commencement	8.1	Within 07 days from the date of receipt of Engineer's Notice to Commence, which shall be issued within Seven (7) days after signing of Contract Agreement.
	Time for Completion	8.2	24 Calendar Months from the date of receipt of Engineer's Notice to Commence.
	Amount of Liquidated Damages/ Delay Damages/ Penalties (LD)	8.7	0.01% Damages per day but total amount will not be more than10% of Contract Price.
	Defects Liability Period	11.1	12 Calendar Months from the effective date of Substantial Completion/Taking Over of Project.
	Percentage of Retention Money	14.2	10 % of the amount of Interim/Running Payment Certificate.
	Limit of Retention Money	14.2	5 % of Contract Price stated in the Letter of Acceptance.
	Minimum amount of Interim / Running Payment Certificates	14.2	5% of Contract Price, however it's the Engineer's discretion to approve any amount considering the project & site conditions.
	Time of Payment from delivery of Engineer's Interim/Running Payment Certificate to the procuring agency.	14.7	28 working days for issuance date of Interim Payment Certificate (IPC) certified by the Engineer. The Engineer shall certify the IPC within 14 working days of its receipt.
	Mobilization Advance (Interest Free)	*14.2	10% of Contract Price stated in the Letter of Acceptance against Bank Guarantee.

*** Note:** For complete text please Refer related clause in Conditions of Contract

Initials of Signatory of Bid _____

BB-1
APPENDIX-B TO BID

FOREIGN CURRENCY REQUIREMENTS

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

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

Not Used

3. Table of Exchange Rates

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

BC-1
Appendix-C to Bid

PRICE ADJUSTMENT UNDER CLAUSE 13.8 OF CONDITIONS OF CONTRACT

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

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

(*To be filled by the procuring agency)*

Cost Element	Description	Weight ages	Applicable index
1	2	3	4
(i)	Fixed Portion	0.350	
(ii)	Local Labor		Government of Pakistan (GoP) Federal Bureau of Statistics (FBS) Monthly Statistical Bulletin.
(iii)	Cement – in bags		" " "
(iv)	Reinforcing Steel		" " "
(v)	High Speed Diesel (HSD)		" " "
(vi)	Bricks		" " "
(vii)	Bitumen		" " "
(viii)			
	Total	1.000	

Notes:

1) Indices for "(ii)" to "(vii)" are taken from the Government of Pakistan Federal Bureau of Statistics, Monthly Statistical Bulletin. The base cost indices or prices shall be those applying 15 days prior to the latest day for submission of bids. Current indices or prices shall be those applying 28 days prior to the last day of the billing period.

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

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

BD-1
Appendix-D to Bid

BILL OF QUANTITIES

A. Preamble

1. The Bill of Quantities shall be read in conjunction with the Conditions of Contract, Specifications and Drawings.

2. The quantities given in the Bill of Quantities are estimated and provisional, and are given to provide a common basis for bidding. The basis of payment will be the actual quantities of work executed and measured by the Contractor and verified by the Engineer and valued at the rates and prices entered in the priced Bill of Quantities, where applicable, and otherwise at such rates and prices as the Engineer may fix as per the Contract (in case of item not mentioned in Bill of Quantities).

3. The rates and prices entered in the priced Bill of Quantities shall, except insofar as it is otherwise provided under the contract include all costs of contractor's plant, labour, supervision, materials, execution, insurance, profit, taxes and duties, together with all general risks, liabilities and obligations set out or implied in the contract. Furthermore all duties, taxes and other levies payable by the contractor under the contract, or for any other cause, as on the date 14 days prior to deadline for submission of Bids in case of ICB/NCB respectively, shall be included in the rates and prices and the total bid price submitted by the bidder.

4. A rate or price shall be entered against each item in the priced Bill of Quantities, whether quantities are stated or not. The cost of items against which the contractor will have failed to enter a rate or price shall be deemed to be covered by other rates and prices entered in the Bill of Quantities and shall not be paid separately.

5. The whole cost of complying with the provisions of the Contract shall be included in the items provided in the priced Bill of Quantities, and where no items are provided, the cost shall be deemed to be distributed among the rates and prices entered for the related items of the works.

6. General directions and description of work and materials are not necessarily repeated nor summarised in the Bill of Quantities. References to the relevant sections of the bidding documents shall be made before entering prices against each item in the priced Bill of Quantities.

7. Provisional sums included and so designated in the Bill of Quantities shall be expended in whole or in part at the direction and discretion of the Engineer in accordance with sub-clause 13.5 of Part I, General Conditions of Contract.

BE-1
Appendix-E to Bid

PROPOSED CONSTRUCTION SCHEDULE

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

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

BF-1
Appendix-F to Bid

METHOD OF PERFORMING THE WORK

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

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

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

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

BG-1
Appendix-G to Bid

LIST OF MAJOR EQUIPMENT – RELATED ITEMS

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

BG-2
Appendix-G to Bid

LIST OF MAJOR EQUIPMENT (SAMPLE)

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

BH-1
Appendix-H to Bid

CONSTRUCTION CAMP AND HOUSING FACILITIES

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

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

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

1. Site Preparation (clearing, land preparation, etc.).

2. Provision of Services.

    a) Power (expected power load, etc.).
    b) Water (required amount and system proposed).
    c) Sanitation (sewage disposal system, etc.).

3. Construction of Facilities

    a) Contractor's Office. Workshop and Work Areas (areas required and proposed layout, type of construction of buildings, etc.).
    b) Warehouses and Storage Areas (area required, type of construction and layout).
    c) Housing and Staff Facilities (Plans for housing for proposed staff, layout, type of construction, etc.).

4. Construction Equipment Assembly and Preparation (detailed plans for carrying out this activity).

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

6. Detail of testing Lab with testing equipment etc.

BI-1
Appendix-I to Bid

LIST OF SUBCONTRACTORS

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

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

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

BJ-1
Appendix-J to Bid

ESTIMATED PROGRESS PAYMENTS

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

Month	**Amounts (1,000 Rs.)**
1	**2**
1st Quarter	
2nd Quarter	
3rd Quarter	
4th Quarter	

Bid Price	

BK-1
Appendix-K to Bid

ORGANIZATION CHART FOR THE SUPERVISORY STAFF AND LABOUR

(To be filled in by the bidder)

BL-1
Appendix-L to Bid

(INTEGRITY PACT)

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

(FOR CONTRACTS WORTH RS. 10.00 MILLION OR MORE)

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

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

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

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

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

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

……
[Procuring Agency] [Contractor]

BS-1

BID SECURITY

Security Executed on _____
(Date)
Name of Surety (Bank) with Address: _____
(Scheduled Bank in Pakistan)
Name of Principal (Bidder) with Address _____
_____
Penal Sum of Security Rupees _____ (Rs._____)
Bid Reference No. _____

KNOW ALL MEN BY THESE PRESENTS, that in pursuance of the terms of the bid and at the request of the said Principal (Bidder) we, the Surety above named, are held and firmly bound unto _____ (hereinafter called the 'Procuring Agency') in the sum stated above for the payment of which sum well and truly to be made, we bind ourselves, our heirs, executors, administrators and successors, jointly and severally, firmly by these presents.

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

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

(1) that the bid security shall remain in force up to and including the date 28 days after the deadline for validity of bids as stated in the Instructions to bidders or as it may be extended by the procuring agency, notice of which extension(s) to the Surety is hereby waived;

(2) that the bid security of unsuccessful bidders will be returned by the procuring agency after expiry of its validity or upon signing of the Contract Agreement; and

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

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

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

BS-2

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

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

SURETY (BANK)

WITNESS:

Signature _____

1. _____

Name _____

_____

Title _____

Corporate Secretary (Seal)

Corporate Guarantor (Seal)

2. _____

_____
Name, Title & Address

PS-1

FORM OF PERFORMANCE SECURITY

Guarantee No._____
Executed on _____
Expiry date _____

[Letter by the Guarantor to the Procuring Agency]

Name of Guarantor (Bank) with address:_____
(Scheduled Bank in Pakistan)
Name of Principal (Contractor) with address: _____
Penal Sum of Security (express in words and figures) _____
_____
Letter of Acceptance No. _____ Dated _____

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

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

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

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

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

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

PS-2

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

_____
Guarantor (Bank)

Witness:

1. _____ Signature _____

_____ Name _____
Corporate Secretary (Seal)

Title _____

2. _____

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

CA-1

FORM OF CONTRACT AGREEMENT

THIS CONTRACT AGREEMENT (hereinafter called the "Agreement") made on the _____ day of_____(month) 2025 between _____ (hereafter called the "Procuring Agency") of the one part and _____ (hereafter called the "Contractor") of the other part.

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

NOW this Agreement witnesseth as follows:

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

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

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

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

4. Procuring agency hereby covenants to pay the contractor, in consideration of the execution and completion of the works as per provisions of the contract, the contract Price or such other sum as may become payable under the provisions of the contract at the times and in the manner prescribed by the contract.

CA-2

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

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

Signed, Sealed and Delivered in the presence of:

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

MG-1

MOBILIZATION ADVANCE GUARANTEE

Guarantee No._____ Date _____

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

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

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

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

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

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

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

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

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

GUARANTOR

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

WITNESS

1. _____
   _____
   Corporate Secretary (Seal)

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

INDENTURE FOR SECURED ADVANCES

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

This INDENTURE made the …….. day of ..... 2025 BETWEEN (hereinafter called "the Contractor" which expression shall where the context so admits or implied be deemed to include his heirs, executors, administrators and assigns) of the one part and _____ (hereinafter called "the Government" of the other part).

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

(Here enter (the description of the works).

AND WHEREAS the contractor has applied to the ……..……..for an advance to him of Rupees ……..…… (Rs. .....) on the security of materials absolutely belonging to him and brought by him to the site of the said works the subject of the said agreement for use in the construction of such of the said works as he has undertaken to execute at rates fixed for the finished work (inclusive of the cost of materials and labour and other charge) AND WHEREAS the Government has agreed to advance to the Contractor the sum of Rupees, (Rs. .....) on the security of materials the quantities and other particulars of which are detailed in Part II of Running Account Bill (B). the said works signed by the contractor
Fin R.Form.l7.A

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

Notes on the Conditions of Contract

The Conditions of Contract comprise two parts:

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

Over the years, a number of "model" General Conditions of Contract have evolved. The one used in these Standard Bidding Documents was prepared by the International Federation of Consulting Engineers (Federation International des Ingenieurs-Conseils, or FIDIC), and is commonly known as the FIDIC Conditions of Contract. (The used version is the harmonized Edition March 2006).

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

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

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

The FIDIC Conditions of Contract are copyrighted and may not be copied, faxed, or reproduced. Without taking any responsibility of its being accurate, Pakistan Engineering Council with prior consent of FIDIC Secretariat, has reproduced herein the FIDIC General Conditions of Contract for reference purpose only which cannot be used by the users for preparing their bidding documents. The bidding document may include a purchased copy, the cost of which can be retrieved as part of the selling price of the bidding document. Alternatively, the FIDIC Conditions of Contract can be referred to in the bidding documents, and the bidders are advised to obtain copies directly from FIDIC.*

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* Add the following text if the bidding documents, as issued, do not include a copy:

"Copies of the FIDIC Conditions of Contract can be obtained from: To request such permission please contact:
FIDIC CASE POSTALE, CH-1215 Switzerland; Tel. +41 22 799 49 00;
Fax; +41 22 799 49 01
E-mail: fidic@fidic.org.

After issuance of Letter of Acceptance by the Procuring Agency to the successful bidder and prior to signing of Contract, the successful bidder shall provide licensed copy of the following General Condition of Contract, duly signed and stamped (as per Clause IB 11.4 Bidding Data). The cost of procuring and providing the said General Condition of Contract shall be the bidder's account. The said GCC shall be made part of the contract.

Conditions of Contract for CONSTRUCTION

FOR BUILDING AND ENGINEERING WORKS DESIGNED BY THE EMPLOYER

Multilateral Development Bank Harmonized Edition
March 2006

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

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General Provisions

1.1 Definitions

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

1.1.1 The Contract

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

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

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

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

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

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

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

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

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

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

1.1.2 Parties and Persons

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

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

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

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

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

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

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

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

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

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

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

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

1.1.3 Dates, Tests, Periods and Completion

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

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

1.1.3.3 “Time for Completion” means the time for completing the Works or a Section (as the case may be) under Sub-Clause 8.2 [Time for Completion], as stated in the Contract Data (with any extension under Sub-Clause 8.4 [Extension of Time for Completion]), calculated from the Commencement Date.

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

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

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

1.1.3.7 “Defects Notification Period” means the period for notifying defects in the Works or a Section (as the case may be) under Sub-Clause 11.1 [Completion of Outstanding

Work and Remedying Defects], which extends over twelve months except if otherwise stated in the Contract Data (with any extension under Sub-Clause 11.3 [Extension of Defects Notification Period]), calculated from the date on which the Works or Section is completed as certified under Sub-Clause 10.1 [Taking Over of the Works and Sections].

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

1.1.3.9 "day" means a calendar day and "year" means 365 days.

1.1.4 Money and Payments

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

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

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

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

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

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

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

1.1.4.8 "Local Currency" means the currency of the Country.

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

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

1.1.4.11 "Retention Money" means the accumulated retention moneys which the Employer retains under Sub-Clause 14.3 [Application for Interim Payment Certificates] and pays under Sub-Clause14.9 [Payment of Retention Money].

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

1.1.5 Works and Goods

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

1.1.5.2 "Goods" means Contractor's Equipment, Materials, Plant and Temporary Works, or any of them as appropriate.

1.1.5.3 "Materials" means things of all kinds (other than Plant) intended to form or forming

part of the Permanent Works, including the supply-only materials (if any) to be supplied by the Contractor under the Contract.

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

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

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

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

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

1.1.6 Other Definitions

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

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

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

1.1.6.4 "Force Majeure" is defined in Clause 19 [Force Majeure].

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

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

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

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

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

1.2 Interpretation

In the Contract, except where the context requires otherwise:

(a) words indicating one gender include all genders;

(b) words indicating the singular also include the plural and words indicating the plural also include the singular;

(c) provisions including the word "agree", "agreed" or "agreement" require the agreement to be record in writing;

(d) "written" or "in writing" means hand-written, type-written, printed or electronically made, and resulting in a permanent record; and

(e) the word "tender" is synonymous with "bid", and "tenderer" with "bidder" and the

words “tender documents” with “bidding documents".

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

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

1.3 Communications

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

(a) in writing and delivered by hand (against receipt), sent by mail or courier, or transmitted using any of the agreed systems of electronic transmission as stated in the Contract Data; and

(b) delivered, sent or transmitted to the address for the recipient’s communications as stated in the Contract Data. However:

(i) if the recipient gives notice of another address, communications shall thereafter be delivered accordingly; and

(ii) if the recipient has not stated otherwise when requesting an approval or consent, it may be sent to the address from which the request was issued.

1.4 Law and Language

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

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

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

1.5 Priority of Documents

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

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

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

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PART II - SPECIAL /PARTICULAR CONDITIONS OF CONTRACT

1.1 Definitions

1.1.1.4 "Form of Bid" is synonymous with "Letter of Tender".

1.1.1.5 "Bid" is synonymous with "Tender".

1.1.1.10 "Bidding" is synonymous with "contract".

The following paragraph is added:

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

1.1.2.4 The Engineer is **CGD Consulting Pvt Ltd**, or any other competent person appointed by the Employer, and notified to the Contractor, to act in replacement of the Engineer. Provided always that except in cases of professional misconduct, the outgoing Engineer to formulate his certifications / recommendations in relation to all outstanding matter, disputes and claims relating to the execution of the Works during his tenure.

1.12.2 "Employer" is synonymous with "Procuring Agency"

1.1.2.9 "DB" is synonymous with "Committee".

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

1.1.3.7 "Defects notification Period" is synonymous with "Defects liability Period".

1.15 Inspections and Audit by the Procuring Agency

The Contractor shall give access to Procuring Agency or its representative to its record and audit to verify the funds of the project has been used for the purposes intended in the Tender documents.

1.4 Law and Language(s)

(a) The Contract Documents shall be drawn up in the English language.
(b) The Contract shall be subject to the Laws of Islamic Republic of Pakistan.

1.5 Priority of Contract Documents

Add following paragraph at the end of Sub-clause:

In case of discrepancies between drawings, those of larger scale shall govern unless they are superseded by a drawing of later date regardless of scale. All Drawings and Specifications shall be interpreted in conformity with the Contract and these Conditions. Addendum, if any, shall be deemed to have been incorporated at the appropriate places in the documents forming the Contract.

3.1 Engineer's Duties and Authority

The following paragraph is added after duties:

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

The Engineer shall obtain the specific approval of the Procuring Agency before carrying out his duties in accordance with the following Clauses:

(i) Consenting to the sub-letting of any part of the Works under Sub Clause 4.4 “Subcontracting”.

(ii) Certifying additional cost determined under Sub-Clause 4.12 “Not Foreseeable Physical Obstructions or Conditions”.

(iii) Any action under Sub-Clause 4.2 “Performance Security” and Clause 18 “Insurance” of sorts.

(iv) Any action under Clause 16 “Suspension”.

(v) Any action under Clause 8.4 “Extension of Time for Completion”.

(vi) Any action under Clause 8.7 “Delay Damages” or Payment of Bonus for Early Completion of Works.

(vii) Issuance of “Taking-Over Certificate” under Clause 10.

(viii) Issuing a Variation Order under Clause 13,except:

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

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

(ix) Fixing rates or prices under Clause 13.3.

(x) Extra payment as a result of Contractor’s claims under Clause 20.

(xi) Release of Retention Money to the Contractor under Sub-Clause 14.9 “Payment of Retention Money”.

(xii) Issuance of “Final Payment Certificate” under Sub-Clause 14.11 & 14.13.

(xiii) Issuance of “Defect Liability Certificate” under Sub-Clause 11.

* (The Contractor shall notify the Engineer at the earliest opportunity of specific likely future events or circumstances that may adversely affect the work, and if in the opinion of the Engineer an emergency occurs (whether notified by the Contractor or not) affecting the safety of life or of the Works or of adjoining property, the Engineer may, without relieving the Contractor of any of his duties and responsibilities under the Contract, instruct the Contractor to execute all such work or to do all such things as may, in the opinion of the Engineer, be necessary to abate or reduce the risk. The Contractor shall forthwith comply with any such instruction of the Engineer. The Engineer shall determine an addition to the Contract Price, in respect of such instruction, in accordance with Clause 13 and shall notify the Contractor accordingly, with a copy to the Procuring Agency.)

The following sub-clause 3.6 is added in (GCC):

3.6 Engineer Not Liable

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

4.2 Performance Security

Delete and replace **'28' days** with **'14' days** wherever found in the sub-clause.

Add the following text at the end;

The Performance Security shall be binding irrespective of changes in the quantities or variations in the Works or Extensions in Time for Completion of the Works which are granted or agreed upon under the provisions of the Contract.

4.3 Contractor's Representative

The following text is to be added after last line:

The contractor's authorized representative or Project Manager must be a graduate civil engineer i.e. BE or B.Sc. (Civil) registered with the Pakistan Engineering Council as Professional Engineer having at least 20 years' experience in the relevant field and should not be more than 50 years old. The Project Manager should be authorized to take instruction from the Engineer and direct contractor's team to complete the works in accordance with the specifications. In case the Contractor fails to appoint his representative / PM and other staff, as stated above & as indicated in Appendix-K to bid, the Engineer may order to stop complete or appropriate portion of work at site until Contractor fulfills the requirement of staff employment.

Following are added after sub clause 4.24;

4.25 Vesting of Contractor's Plant, Equipment Temporary Works and Materials:

(a) **Definitions**

For the purpose of Sub-Clause 4.17.

(i) The expression "Construction Plant" shall be deemed to exclude vehicles engaged in transporting any labour equipment or materials to or from the site.

(ii) The expression "Essential Hired Plant" shall mean all Constructional Plant, Equipment Temporary Works and materials of Temporary Work the withdrawal of which in the event of termination under Sub-Clause 15.2 hereof might (having regard to the methods of construction employed prior to the termination) endanger the safety or stability of or result in serious disturbance to the execution of any part of the Works and which are held by the Contractor under any agreement for hire thereof.

(iii) The expression "Hired Plant" shall mean any Constructional Plant, Equipment, Temporary Works (other than essential hired plant) held by the Contractor under any agreement for hire thereof.

(iv) The expression "Agreement for Hire" shall be deemed not to include an agreement for hire purchase with an option to purchase or for conditional sale either of which is herein referred to as an "agreement for the purchase".

(v) The expression "Hire Purchase Plant" shall mean any Constructional Plant, Equipment, Temporary Works held by the Contractor under an agreement for hire purchase thereof.

(vi) The expression "owner" means the owner of the plant and equipment of any Hire Purchase Plant.

(b) **Vesting of Certain Plant**

All Constructional Plant, Equipment, Temporary Works and material owned by the Contractor or by any company in which the Contractor has a controlling interest shall when brought on to the site (or in the case of hire purchase plant upon becoming the property of the Contractor) and shall be deemed to become the property of the Procuring Agency.

(c) **Conditions of Hire of Certain Plant**

With a view to securing in the event of termination Sub-Clause 15.2 hereof the continued availability for the purpose of executing the Works of any essential hired plant and equipment the Contractor shall not bring on to the Site any essential hired plant unless the agreement for hire thereof contains a provision that the owner will on request in writing made by the Procuring Agency within 7 days after the date on which any such termination has become effective and on the Procuring Agency undertaking to pay all hire charges in respect thereof on the same terms in all respects as the same was hired to the contractor save that the Procuring Agency shall be entitled to permit the use thereof by any other contractor employed by it for the purposes of completing the works under the terms of Sub-Clause 15.2 hereof.

(d) **Costs for purpose of Approval of Materials not implied**

In the event of the Procuring Agency entering into any agreement for hire of essential hired plant pursuant to the contract provisions, all sums properly paid by the Procuring Agency under the provisions of any such agreement and all expenses incurred by it (including stamp duties) in entering into such agreement shall be deemed for the purpose of Sub-Clause 15.2 hereof to be part of the cost of completing the Works.

(e) **Contractor's Certificate as to Hiring Provisions**

The Contractor shall upon request made by the Engineer at any time in relation to any item of essential hired plant forthwith notify to the Engineer in writing the name and address of the owner and shall certify that the agreement for the hire thereof contains a provision in accordance with the requirements of Approval of Materials not Implied. The Contractor shall also upon request as aforesaid give a like notification (but without certificate) in regard to any hire purchase plant.

(f) **Hire Purchase Payment by the Procuring Agency**

The Procuring Agency shall in order to avoid seizure by the owner of any hire purchase plant be entitled to pay to such owner the amount of any overdue installment or other sum payable optionally or otherwise under any Agreement of hire purchase and in the event of his doing so any amount so paid by him shall be debt due from the Contractor to the Procuring Agency and may be deducted by the Procuring Agency from any moneys due or that may become due to the Contractor under the Contract or may be recovered by the Procuring Agency from the Contractor at law.

(g) **Irrevocability of Certain Plant etc.**

No Constructional Plant, Equipment Temporary Works or materials or any part thereof shall be removed from the site without the written consent of the Engineer which consent shall not be unreasonably withheld where the same is no longer immediately required for the purposes of completion of the Works but the Procuring Agency will permit the Contractor the exclusive use of all such Constructional Plant, Equipment, Temporary Works and materials in and for the completion of the Works until the occurrence of any event which gives the

Procuring Agency the right to expel the Contractor from the site and proceed with the completion of the Works.

(h) **Re-vesting and Removal of Plant**

Upon the removal with the consent of the Engineer of any such Constructional Plant Equipment, Temporary Works or materials as have been deemed to have become the property of the Procuring Agency, the property therein shall be deemed to re-vest in the Contractor and, upon completion of the Works the property in the remainder of such Constructional Plant, Equipment, Temporary Works and materials as aforesaid shall subject to the provisions of Sub-Clause 15.2 be deemed to re-vest in the Contractor who shall remove the same together with any essential hired plant or hire purchase plant. If the Contractor shall fail to remove any Constructional Plant, Equipment, Temporary Works or materials as aforesaid or any essential hire plant or hire purchase plant within such reasonable time after completion of the Works as may be allowed by the Engineer then the Procuring Agency may:

i) sell any such Constructional Plant, Equipment, Temporary Works and materials as aforesaid, and

ii) return at the Contractor's expenses to the person firm or company from whom any Essential Hired Plant or any Hire Purchase Plant was held by the Contractor such essential hired plant or hire purchase plant, and after deducting from any proceeds of sale, the costs, charges and expenses of and in connection with such sale and return as aforesaid shall pay the balance (if any) to the Contractor but to the extent that the proceeds of any sale are insufficient to meet all such cost, charges and expenses the excess shall be a debt due from the Contractor to the Procuring Agency and shall be deductible or recoverable by the Procuring Agency accordingly as aforesaid.

(j) **Liability for loss or injury to plant**

The Procuring Agency shall not at any time be liable for the loss of or injury to any of the Constructional plant, Temporary Works or materials which have been deemed to become the property of the Procuring Agency, hereof save as mentioned in Sub-Clause 20 hereof.

(k) **Incorporation of Sub-Clause in Sub-Contracts**

The Contractor shall when entering into any sub-contract for the execution of any part of the Works incorporate in such sub-contract (by reference or otherwise) the provisions of this Sub-Clause in relation to Constructional Plant, Temporary Works and materials. Essential Hired Plant and Hire Purchase Plant to be brought on the Site by the subcontractor.

(l) **Approval of Materials etc., not implied**

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

6.9 Engineer at Liberty to Object

The following is added at the end of sub clause in General Conditions of Contract: If the Procuring Agency asks the Engineer to direct Contractor to remove a person who is a member of his staff or workforce stating the reasons the Contractor shall ensure that the person leaves the site immediately and has no further connection with the work in the Contract.

6.10 Records of Contractor's Personnel and Equipment

The following paragraph is added:

The Contractor shall, upon request by the Engineer at any time in relation to any item of hired Contractor's Equipment, forthwith notify the Engineer in writing the name and address of the Owner of the equipment and shall certify that the agreement for the hire thereof contains a provision in accordance with the requirements set forth above.

Add the following sub-clause at the end of 6.22 in (GCC)

6.23 Compliance by Subcontractors

The Contractor shall be responsible for compliance by his Subcontractors of the provisions of this Clause. The following sub-clause 7.9 is added in (GCC)

The following sub-clause 7.9 is added in (GCC):

7.9 Use of Pakistani Materials and Services

The contractor shall, so far as may be consistent with the contract, make the maximum use of materials, supplies, plant and equipment indigenous to or produced or fabricated in Pakistan and services, available in Pakistan provided such materials, supplies, plant, equipment and services shall be of required standard.

8.1 Commencement of Works

The last para is deleted and substituted with the following:

The contractor shall commence the works on site within the period named in Appendix-A to Bid from the date of receipt by him from the Engineer of a written Notice to Commence. Thereafter, the contractor shall proceed with the works with due expedition and without delay.

8.3 Programme

The following paragraphs are added:

The program/schedule shall be submitted in the form of Critical Path Method (CPM) identifying the critical path/activities, in hard form as well as in soft form in latest version of MS Project or as agreed with the Engineer.

a) The Contractor shall submit to the Engineer detailed programme for the following:
   (1) Execution of Works;
   (2) Key Deliverables and submittals
   (3) Labour Resources;
   (4) Local Material Procurement;
   (5) Material Imports, if any; and
   (6) Other details as required by the Engineer.

b) If Contractor fails to submit updated work schedule within the time instructed by the Engineer/Project Manager, the Engineer/Project Manager may withhold an amount at his discretion from next due amount and continue to withhold this amount until the next payment after the date on which the overdue program has been submitted.

c) During the period of the Contract, the Contractor shall submit to the Engineer no later than the 8th day of the following month, 04 copies each of Monthly Progress Reports covering:

(1) Progress update of the project program/schedule indicating the monthly progress in percentages with actual start and finish dates;

(2) Description of all work carried out since the last report;

(3) Description of the work planned for the next 56 days sufficiently detailed to enable the Engineer to determine his programme of inspection and testing;

(4) Monthly summary of daily job record; and

(5) Information about problems and difficulties encountered, if any, and proposals to overcome the same.

d) During the period of the Contract, the Contractor shall keep a daily record of the work progress, which shall be made available to the Engineer as and when requested. The daily record shall include particulars of weather conditions, number of men working, deliveries of materials, quantity, location and assignment of Contractor's equipment.

e) The detailed Cash Flow Estimate shall be submitted within 21 days from the date of receipt of Letter of Acceptance.

8.11 Prolonged Suspension

Replace 84 days by 120 days.

13.1 Right to vary

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

13.3 Variation procedure

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

13.8 Adjustment for changes in cost

Sub-Clause 13.8 is deleted in its entirety, and substituted with the following:

The amounts payable to the Contractor, pursuant to Sub-Clause 14.6, shall be adjusted in respect of the rise or fall in the cost of labor, materials, and other inputs to the Works, by applying to such amount the formula prescribed in this Sub-Clause.

(a) Other Changes in Cost

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

(b) Formula for Price Adjustment

1. The formula mentioned below is in its generalized form. The Employer/ user shall determine the proportions of A, b, c, d, by appropriate rate analysis following the procedure enumerated herein below:

$$Pn = A + b\frac{Ln}{Lo} + c\frac{Mn}{Mo} + d\frac{En}{Eo} + \text{.....}$$

where,

"Pn" 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.

"**Lo, Mo, Eo**....." are the Base Date Prices/ Indices for the specified (adjustable) elements.

"**Ln, Mn, En**....." are the Current Date Prices/ Indices of the specified (adjustable) elements for the period "n".

If "**P**" is the amount payable (prior to adjustment) at the rates entered in the Price Schedule of the work carried out in period "n" then, Adjusted amount payable to the Contractor for the work carried out in the period "n" shall be equal to **Pn×P**.

For the purpose of calculating **Pn**, the coefficient for each eligible element shall be used irrespective of the actual constituents of the work performed during the billing period.

2. Base Date Prices and Current Date Prices

The Base Date Prices and Current Date Prices of the specified elements shall be obtained from the sources specified in the Amendment to the contract.

3. Elements for Price Adjustment

The Specific Elements for highway and bridge construction would typically be:
(i) POL (HSD);
(ii) Labour;
(iii) Cement;
(iv) Steel;
(v) Bitumen;
(vi) Aggregate ; and
(vii) Other major elements depending on the nature of the project.

Similarly, the specified elements for building construction would typically be:
(i) POL (HSD);
(ii) Labour ;
(iii) Cement;
(iv) Steel;
(v) Bricks;
(vi) Tiles;

(vii) Cables;
(viii) Conduits (all types);
(ix) Pipes (all types);
(x) Steel Sheet (all types);
(xi) Steel Sections (all types);
(xii) Aluminum Sections (all types);
(xiii) Electric Switch Gears; and
(xiv) Other major elements depending upon the nature of the project.

Similarly, major specified elements for other types of projects can be specified in the Amendment to the Contract in addition to or instead of the specified elements as enumerated above.

4. Coefficients or Weightages

The coefficient for each specified adjustable element shall be determined by the user proportionate to its ratio in the Contract Price, in accordance with the procedure D-1 given under Part-1. The sum of these coefficients shall form the adjustable portion of the Contract, which shall not exceed 0.70.

5. Adjustable Portion of the Contract

The adjustable portion of the Contract shall be computed as provided in foregoing Procedures.

6. Sources of Prices

Sources of Base Date Prices and Current Date Prices shall be as stipulated at item D-4 under Part-1. The sources shall be clearly stated in the Amendment to the Contract.

.

14.1 The Contract Price

Sub-para (d) is deleted.

14.2 Advance Payment

The Text is deleted and replaced with following:

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

Mobilization Advance/Advance Payment

(i) Mobilization advance up to 10% of the Contract Price may be paid by the procuring agency to the Contractor on the works costing Rs2.5 million or above on following conditions:

a. on submission by the Contractor of a mobilization advance guarantee for the full amount of the advance in the specified form, from a Scheduled Bank in Pakistan, acceptable to the procuring agency;

b. contractor shall pay interest on the mobilization advance at the rate of 10% per annum on the advance; and

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

14.3 Application for Interim Payment Certificate

Following para is added at the end of sub-clause 14.3:

The Contractor shall submit a certificate signed and stamped by the contractor, certifying that the Contractor has paid all dues of the materials, suppliers, workmen and subcontractors for the works whose payment is claimed in this Application of Interim Payment.

14.5 Plants and Materials intended for Works

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

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

i) The materials are in accordance with the specifications for the permanent works;

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

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

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

v) Ownership of such materials shall be deemed to vest in the procuring agency and these materials shall not be removed from the site or otherwise disposed of without written permission of the procuring agency;

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

vii) Secured Advance shall not be allowed unless and until the previous advance, if any, is fully recovered;

viii) Detailed account of advances must be kept in part II of running account bill or a separate statement; and

ix) Secured Advance may be permitted only against materials/quantities anticipated to be consumed / utilized on the work within a period of 3 months from the date of issue of secured advance and in no case for full quantities of materials for the entire work/contract.

(II) Recovery of Secured Advance:

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

14.7 Payment

For Payment of Interim Payment Certificates, delete and replace 56 days with 42 days, out of which 14 days shall be maximum time for Engineer's review and verification from the date it is submitted in complete with all supporting documents as per agreed format and 28 days' time for the payment to contractor by Procuring agency.

14.8 Delayed Payment

Second Para is replaced with following text:

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

15.2 Termination by Employer

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

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

15.6 Corrupt and fraudulent Practices

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

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

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

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

(b) terminate the Contract; and

(c) recover from the Contractor any loss or damage to the procuring agency as a result of such termination or of any other corrupt business practices of the Contractor or any of his Subcontractors, agents or servants.

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

16.4 Payment on Termination

Sub-paragraph (c) is deleted.

17.3 Employer's/ Procuring Agency's Risks

Sub-Clause 17.3 (h) is deleted.

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

18.1 General Requirements for Insurance

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

The Contractor shall insure with any one of the insurance companies approved for this purpose by the Procuring Agency. The insurance policies shall be in the joint names of the Procuring Agency, and the Contractor against all losses or damages as stated in the General Conditions of Contract Part I and as stated herein. Notwithstanding the responsibilities of the Contractor for indemnities and insurances as described in General Conditions of Contract Part I, the Contractor before commencing work on Site, must discuss fully with the Engineer and the Procuring Agency the insurance coverage provided under any general policies which are to be applied to this Contract to ensure that there are no contingencies left uncovered and to reduce, as far as practicable, duplication of coverage. Should any areas of omission be discovered that are not covered by definition of responsibilities set out in these conditions, the addition or reduction in premiums required to give such insurance coverage will be paid by the Contractor. Such policies shall be obtained by the Contractor with consent of the Engineer/Procuring Agency.

The Contractor shall be responsible for deductibles and losses/damages not covered by insurances other than the excepted risks.

The insurance losses shall not affect the Procuring Agency's or the Contractor's rights and obligations under the Contract. The Contractor shall be responsible for compliance by his sub-contractors of insurances specified in these Sub-Clauses. Before each sub-contractor starts work, the Contractor shall provide the Procuring Agency proof that the sub-contractor(s) are covered by insurances specified herein for the Contractor.

All policies shall state that:

i) The Procuring Agency shall receive at least 30 days written notice of intended Cancellation or change affecting coverage.

ii) The Contractor is fully protected so as to provide full indemnity to Procuring Agency in respect of liability against losses or damages assumed by the Contractor under the Contract.

iii) The inclusion of more than one insured shall not affect the rights of any other insured.

iv) If a loss occurs the Contractor and the Procuring Agency shall be paid in relation of their share of the loss.

v) The Insurer has no subrogation rights against any person, corporation, or organization including directors, officers, employees, servants' agents thereof which:

- is an insured under the policy or
- is Controlled by, Owned by, or associated with an insured, or
- is a sub-contractor on the works, or has, before or a loss occurs, been released from liability by an insured.

Hold harmless provisions: The Procuring Agency, the Engineer and the Contractor shall be indemnified against all losses.

Procuring Agency use or occupancy: If the Procuring Agency uses or occupies all or part of the works during the life of the insurance policy, the Contractor shall ensure that the policy continues in full force and the Procuring Agency shall pay any resulting extra cost of insurance.

Loss Procedure: If a loss occurs the Contractor shall, on behalf of the Procuring Agency and himself negotiate the value of the loss with the insurer. Unless directed otherwise by the Engineer, when agreement is reached the Contractor shall repair all damages and the Procuring Agency shall pay him in accordance with the Engineer's Certificates for that part of the repairs which is the Procuring Agency's responsibility.

If directed by the Engineer, instead of carrying out repairs, the Contractor shall pay to the party suffering the loss that part of the agreed value of the loss which is the Contractor's responsibility.

The provisions of this Sub-Clause shall be applicable to other insurance covered by Clauses 18 of General Conditions of Contract Part-I.

Automobile Liability Insurance: The Contractor shall also provide automobile liability insurance of all licensed vehicles owned, hired and operated by the Contractor at the Site and the risk insured shall be bodily injury, death of person and property damage or loss.

There shall be no obligation for the insurances to include loss or damage caused by the risks listed under Procuring Agency's risk.

19.6 Optional Termination, Payment and release by the Employer

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

20.6 Arbitration

Text will be replaced as under;

Any dispute in respect of which:

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

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

The place of arbitration shall be Karachi in Sindh Province.

Following Sub-Clause 21.1 is added;

22.1 Notice to Contractor

The following paragraph is added:

For the purposes of this Sub-Clause, the Contractor shall, immediately after receipt of Letter of Acceptance, intimate in writing to the Procuring Agency and the Engineer by registered post, the address of his principal place of business or any change in such address during the period of the Contract.

2.2 Notice to Procuring Agency and Engineer

For the purposes of this Sub-Clause, the respective addresses are:

a) The Procuring Agency:

Project Implementation Unit,
Education City Project
1st Floor, Block-A. Finance & Trade Centre
Shahra-e-Faisal, Karachi

b) The Engineer:

CGD Consulting Pvt Ltd
7-C, 5th Zulfiqar Commercial Street,
Phase VIII-A, Dha Karachi.

The following Sub-Clauses 23.1 is added:

23.1 Payment of Taxes including GST

The Contractor, Subcontractors and their employees shall be responsible for payment of all their Income Tax, GST and other Taxes on income arising out of the Contract and the rates and prices stated in the Contract shall be deemed to cover all such taxes. As per Government of Pakistan (GoP) regulations, the income tax of the contractor will be deducted at source i.e. Procuring Agency.

The Contractor firm is required to provide details & all relevant documentation/evidence of its registration with relevant registration authorities like FBR &/or Sindh Revenue Board.

Annex PROCEDURAL RULES

Procuring Agency retains SPPRA rules without changes, in case of contracts under Project, Bank and donor's program.

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SPECIFICATIONS - SPECIAL PROVISIONS

1. DESCRIPTION OF PROJECT

1.1. General

The Employer intends to the Extension of Approach Road at Special Technology Zone (STZ), Education City, Karachi.

2. THE SITE

2.1. Site of Works

The Site of the Works is the area for construction lying within the right-of-way lines, boundaries and limits shown on the Drawings and any such additional areas adjacent thereto as may be designated by the Engineer subject to approval of Employer from time to time for the construction to be performed under the Contract, and all such areas and additional areas shall be comprised in the Site as defined in Clause 1 of the Conditions of Contract.

The Employer will give to the Contractor possession of the area designated and defined as the Site and shown on the drawing as may be required to implement as much of the Works, when the Engineer's Notice to Commence the Works is given.

3. THE WORKS UNDER THE CONTRACT

3.1. General Description

The Contract comprises to construct the work in all respect with the provision of plant/equipment, labor and material required for execution, completion, the execution and completion of the Works, remedying of any defects therein, maintenance of utility services and everything whether of a temporary or permanent nature required in and for such execution, completion, remedying and maintenance so far as the necessity for providing the same is specified or can reasonably be inferred from the Contract.

The following description of the Works to be performed under this Contract is general in nature and is not intended to describe all of the facilities to be provided under this Contract.

4. GENERAL RULES OF SPECIFICATIONS

a) Specification or as Specified

Specification" or "as specified" refers to the specifications outlined in these Documents and where no specifications are available for any work or where the same are found not applicable then the relevant applicable ASTM or BSS specifications or equivalent standards shall apply in the same order.

Any item for which no specifications are outlined but which are identified on drawings, shall be completed according to the standards as per ASTM / BSS, these include items that may be added in the future. The Employer / Employer's Representative may supplement such specifications during the progress of work. All materials and processes used for these items shall be subjected to standard testing and, if found below the pertinent ASTM / BSS standards, shall be removed from the site immediately at Contractor's expense.

b) Standards and Codes

Wherever reference is made in the specifications to the respective standards and codes in accordance to which goods and materials are to be furnished, and work is to be performed or tested, the provisions of the latest current edition or revision of the relevant standards and codes in effect shall apply, unless otherwise expressly set forth in the Contract.

c) Materials and Processes

All goods and materials to be incorporated in the Works shall be new, unused, of the most recent or current models and incorporate all recent improvements in design and materials unless provided otherwise in the Contract.

d) Equivalent Materials, Processes, etc.

Where specific materials, processes, etc. are specified and the same are not available other alternative materials and processes which ensure an equal or higher quality than those specified will be accepted subject to the Employer / Employer's Representative's prior review and written approval. Differences between those specified and the proposed alternatives must be fully described in writing by the Contractor and submitted to the Employer / Employer's Representative at least 30 days prior to the date when the Contractor desires the Employer / Employer's Representative's approval who may give such approval after determining that the alternative proposed ensures equal or higher quality.

e) Approved, Directed, Instructed

Approved, directed, instructed means the approval, etc. of the Employer / Employer's Representative unless otherwise stated.

f) Alternatives

Where alternative materials, processes etc., are specified the selection will depend on local conditions and discretion rests with the Employer / Employer's Representative whose decision shall be final and binding.

g) Catalogues / Standards / Manufacturer's Instructions, etc.

Wherever the manufacturer's/supplier's instructions, manuals, guarantees and ASTM/BSS Standards are referred to in the specifications and details of Bills of Quantities; all such literature shall be submitted by the Contractor to the Employer / Employer's Representative for due checking, approval and record.

h) Applicability

Unless stated or specified else-where to the contrary these General Rules shall apply to all sections of work irrespective of their sequence, location and description.

5. DRAWINGS

5.1. Bid Drawings

Bid Drawings issued with the Bid Documents, called the Tender Drawings, show scope of the work to be performed by the Contractor. The Drawings are generally in sufficient detail so as to be used as a basis for construction, fabrication and for placing orders for materials subject to corrections based on the future issue of supplementary Drawings as provided under Sub-Clause 5.2 hereof.

5.2. Construction Drawings, Supplementary Drawings

After award of Contract, the Contractor shall carry out “Joint Survey” at Site of Works in pursuance to Sub-Clause 6.4, Specifications - Special Provisions. The Contractor shall submit to the Engineer “Joint Survey”, duly signed, dated and stamped by the representatives of the Employer, Consultant and Contractor.

Simultaneously, the Contractor shall submit to the Engineer detailed “Work Programme” in terms of Sub-Clause 14.1 Conditions of Contract.

After receipt of “Joint Survey” and “Work Programme” from the Contractor, the Engineer will start issuing Construction Drawings to the Contractor. The Engineer shall have authority to issue to the Contractor, from time to time, such Supplementary Drawings and instructions as shall be necessary for the purpose of the proper and adequate execution and completion of the Works and the remedying of any defects therein. The Contractor shall follow these Drawings.

The Contractor shall give notice to the Engineer regarding the part of the Drawings which in his opinion contain discrepancies or are not clear. The Engineer shall issue necessary clarifications or Supplementary Drawings in greater details as required to execute the Works. These Supplementary Drawings showing changes from the Bid Drawings, in the opinion of the Contractor, shall be reviewed by the Engineer for his determination of adjustment of the Contract Price under Clause 51 and 52 of the Conditions of Contract.

5.3. Definition of Term Drawings

The term Drawings as used in the Specifications means the Drawings referred in Clauses 5.1 and 5.2 hereof.

5.4. Checking of Drawings

The Contractor shall check all Drawings carefully as soon as practicable after receipt thereof, and shall promptly notify the Engineer of any errors discovered.

5.5. Copies of Drawings

Drawings will be issued to the Contractor and the Employer as described below.

5.5.1. Bid Drawings

One (1) set each of the Bid Drawings will be issued to the Contractor and Employer along with Bid Documents. Additional sets will be provided at cost of reproduction upon written request of the Contractor.

5.5.2. Construction Drawings / Supplementary Drawings

One (1) print of each Construction Drawings / Supplementary Drawing will be issued to the Contractor and Employer free of charge. Additional sets will be provided at cost of reproduction upon written request of the Contractor.

5.6. Drawings to be furnished by the Contractor / As-Built Drawings

The Contractor shall submit to the Engineer for review of such drawings as required under the Contract, sufficiently in advance of the work intended to be executed.

The Contractor shall, at all times, keep on Site a separate set of prints on which all significant changes between the work shown on the Drawings and that which is actually constructed, shall be noted neatly, accurately and promptly as the work progresses. The

Subcontractor(s) for plumbing, mechanical and electrical shall, at all times, keep on Site, a separate set of prints of the drawings (showing their parts of the Works) on which all significant changes between the work shown on the Drawings and that which is actually constructed, shall be noted neatly, accurately and promptly as the work progresses. Such drawings shall show the exact physical location and configuration of the works as actually installed.

The Contractor shall, within fourteen (14) days of issuance Taking-Over Certificate for whole of the Works, furnish to the Engineer for his approval two (2) copies of such marked up drawings. One (1) copy of each of the marked up drawings approved by the Engineer shall be returned to the Contractor by the Engineer and these shall be used for the preparation of the As - Built Drawings.

The Contractor shall furnish to the Engineer six (6) complete sets of all As -Built Drawings as well as AutoCAD soft copy within thirty (30) days of receipt of drawings stated above, from the Engineer.

5.7 Shop Drawings & Design

The Contractor to prepare and provide detailed shop drawings & design, for all the required items as per the instructions and approval of the Employer/ Engineer and as mentioned in Bidding documents and drawings including but not limited to Architectural, Structural, Road works, Hard & Soft Landscaping, Electrical, Water Supply, Drainage, ICT or any related electro-mechanical works apart from Bar-bending schedule, etc. All drawings should be prepared based on the rules, regulation and requirements of the concerned departments and should be prepared electronically on latest venison of AutoCAD, hard copies along with soft copies on CD’s shall be submitted for the approval of Engineer as per the Nos. required in Scope of Work.

Any item which is neither shown on the drawing not mentioned in the Bill of Quantities or Specification but is a pre-requisite to carryout, the contractor is required to prepare shop drawing of the missing/ required items, distributed among the rates and prices entered for the related items of works and shall be considered to be included in the contract price. The decision of the Engineer shall be final and binding on the Contractor unless before the deadline for submission of Bids, such discrepancies are to be clarified. The clarifications in either case would be sent to all bidders as an Addendum.

6. SETTING OUT OF WORK AND SURVEY

6.1. Reference Points, Lines

The Contractor shall establish bench marks and / or reference line at the Site in accordance with the instructions of the Engineer. The Contractor shall set out its work from these bench marks and / or lines.

6.2. Verification

The Engineer and the Employer may make checks as the work progress to verify lines and grades established by the Contractor and to determine the conformance of the work as it progresses with the requirements of the Drawings and Specifications. Such checking by the Engineer shall not relieve the Contractor of his responsibility to perform all work in accordance with the Drawings and Specifications and the lines and grades given therein.

6.3. Survey Instruments

The Contractor shall maintain at the Site the requisite surveying instruments in perfect working conditions for the use of the Engineer’s Representative to check levels and lines

of the work at all times. These instruments shall include (but not limited to) One Total Station, Adequate nos. of Levels, theodolites, Tapes, etc.

6.4. No work without Joint Survey

The Contractor shall not start the excavation and / or embankment works until the Joint Survey has been done to establish the existing/ original ground levels (i.e. National Surface Level or NSL).

7. APPROVAL OF MATERIALS AND PLANT

7.1. Quality of Materials

All materials, fixtures, fittings, supplies and plant furnished under the Contract shall be new and unused, standard first grade quality and of the best workmanship and design. No inferior or low-grade materials, supplies or articles will be either approved or accepted, and all work of assembly and construction shall be done in a first-class and workmanlike manner. In asking for prices for materials intended for delivery to the Site and incorporation in the Works under any portion of these Specifications, the Contractor shall provide the manufacturer or supplier with complete information as may be necessary to secure compliance to this Clause and, in every case, he shall quote this Clause in full to each such manufacturer or supplier.

The Employer will select the manufacturer of his choice and approval will be conveyed to the Engineer and Contractor.

7.2. Submission of Samples and Data

As soon as practicable after award of Contract, the Contractor shall submit for the approval of the Engineer drawings, catalogues, diagrams and other descriptive data for all mechanical, electrical, architectural and such other materials and plant designated by the Engineer subject to approval of Employer, which the Contractor proposes for use under this Contract. For certain materials and plant, data may be required to be submitted in accordance with a detail form furnished by the Engineer. Samples of materials (1 set) each shall be submitted by the Contractor to the Engineer and the Employer at Contractor's cost for approval sufficiently in advance of the materials intended to be incorporated in the Works.

7.3. Testing

Testing, except as otherwise specified herein, shall be performed by a testing agency as proposed by the Contractor and approved by the Engineer, at no extra cost to the Employer. The Engineer/ Employer may require all testing to be carried out under their supervision only.

The quality control testing shall be performed by the Contractor's competent personnel in accordance with a site testing as approved by the Engineer/ Employer.

The Contractor shall keep a complete record of all quality tests programme performed on Site.

7.4. Testing Laboratory Certificates

The Engineer may accept a certificate from a commercial testing laboratory, satisfactory to him, certifying that the product has been tested within a period acceptable to the Engineer and that it conforms to the requirements of these Specifications. The Employer may carryout testing from independent laboratory at the cost of the Contractor.

7.5. Inspection

All material and Plant furnished and all work performed under this Contract will be subject to inspection by the Engineer/ Employer or Employer's Representative at all times and in all states of completion both off-Site and on-Site. The Contractor shall furnish promptly without additional charge, all facilities, labour and materials reasonably needed for performing such inspection and testing as may be required by the Engineer/ the Employer or Employer's Representative.

7.6. Approved Sample at Site

The Contractor shall, at all times, keep on the Site approved samples. All such samples shall be made available to the Engineer/ Employer as and when required.

7.7. Site Laboratory

The Contractor shall establish a site laboratory for the purpose of necessary testing. The cost of equipment and salaries of the manpower required will be borne by the Contractor.

8. CONSTRUCTION SCHEDULE

8.1. Submittal Date

The programme of Works submitted by the Contractor in accordance with Clause 14" Programme to be Submitted", of the Conditions of Contract shall be submitted in the form of a CPM schedule based on Primavera Project Planner or Microsoft Project covering all construction activities indicating critical activities with critical path, total and free float, interdependencies between the construction activities and resource scheduling for Contractor's Equipment, material and labour, within the period stated in the Appendix A to Tender. All milestones shall be clearly identified.

If the Contractor fails to submit the construction schedule indicating all the details as listed above within 30 days of Notice of Commencement a penalty of Rs 30,000/- per week will be charged on the Contractor.

8.2. Requirements

The detailed submittal shall consist of schedules, network analysis tabulations and narrative descriptions of the proposed construction programme.

Each summary or detailed schedule shall consist of a bar chart and a time -scaled network. The scheduled start and finish times for all activities on the bar chart shall agree with those on the network. All inter-relationships and inter-dependencies between structures shall be clearly indicated on the schedules.

The network shall show the order and interdependence of activities planned by the Contractor, and shall be time-scaled according to calendar dates.

8.3. Monthly Reports

Each month, the Contractor shall submit a report consisting of:

- Copies of the bar charts for the current phase with both actual progress and scheduled progress shown.

- Network analysis tabulations as in Sub-Clause 8.3 above, reflecting actual start and finish dates where applicable.

- A narrative report discussing any significant deviations from the schedule and, if necessary, explaining the steps proposed to be taken to maintain the approved schedule.

9. Not used

10. SITE OFFICE AND TEMPORARY FACILITIES PROVIDED BY THE CONTRACTOR

10.1. Contractor's Office, Facilities etc.

The Contractor shall establish and maintain a Site office. The Contractor shall provide all facilities in connection with the execution, completion, of the Works, remedying defects therein and maintenance of the utilities services. The facilities shall, not be limited to, the Contractor's Site Office, labour camps, workyard and storage areas, temporary water supply, waste water disposal, temporary electricity, medical unit, temporary roads, fire protection and fire fighting equipment etc. The Contractor shall be solely responsible for arranging the facilities.

The Contractor shall arrange his labour camp, work yard, storage area, site office within the area available at the Site.

10.2. Notice Board

The Contractor shall erect and maintain at the Site in a location to be approved by the Engineer, 3 Sign Boards 4.45 M height and 2 M wide for writing the name of Work, name of Employer, name of Consultants, name of Contractor and Project Cost. The notice board shall comprise of the following;

- Frame of 3" dia GI Pipe properly painted as per the direction of the Consultants/ Engineer and as per drawing.

- 2 Nos. Posts of 3" dia GI Pipe 4.45M above ground and 1M below ground embedded in 1:2:4 CC 2'x2'x4' with proper arrangements of anchorage and brasses. Pipes painted with anti-rust as directed by the Engineer.

- 4 Nos. Steel Sheets 0.6M high and 2M wide fixed on both sides with 50mm gap between each. The background of plates is of white color whereas the writing would be black or red color (as approved by the Engineer)

- White imported 3M sheet used as background. The color of monogram would be, green, red or black etc. (as approved by the Engineer)

- Alphabets of appropriate size as approved by the Engineer in 3M reflective sheet in blue/ black color.

The Contractor shall maintain the display of the notice boards at his own cost throughout the length of the project.

11. FACILITIES FOR ENGINEER'S PERSONNEL PROVIDED BY THE CONTRACTOR

11.1 Engineer Facilities

The Contractor shall provide, operate and maintain the following facilities within 14 days of the Engineer's Order to Commence the Works for the Engineer:

a). Contractor shall establish a container office accommodation complex (Approx. 1000 sft) as per provided drawing. One office container of 40 feet with partition fully Air-Conditioned and maintain the same facility for Engineer, till the completion of the project (including) DLP, including all costs of washroom, electricity, telephone, water supply,

sewerage, janitorial services, provision of stationery / consumable / supplies (as per the requirement of the Engineer).

b). Contractor shall provide 01 No office boy, 02 Nos. Security Guards etc. Contractor shall be responsible for all salaries, benefits etc. of the appointed people. Cost of all the above works are deemed to be included in the contract price and no additional payment shall be made by the Employer to the Contractor under any circumstances.

c). Contractor shall provide all tea items for use in Engineer office.

d). 02 Nos. **Desktop** - Core i7 10th Gen or Higher, 32/64 GB Ram, Latest Intel Motherboard as required by the processor & GPU, Nvidia GPU RTX 3000 Series or Higher, 1TB HDD + 256 SSD, Keyboard, Mouse, DVD Writer, 21" LED, Licensed Windows 10/11, Ms Office latest version, USB 3.0 64 GB, Latest UPS for backup.

e). Contractor shall provide and maintain with cartridge etc., 02 Nos. **HP Color Printer** with Scanner (All in one) latest model throughout the contract period including DLC period.

f). Contractor shall provide two nos. of vehicles detailed as under, to be used by the Engineer at site. The Contractor shall pay the POL maintenance and driver charges and no additional payment shall be made by the Engineer to the Contractor under any circumstances. The vehicle shall be returned to the Contractor after completion of the project on as is where is basis. Details of the vehicles are as under:

(i) 01 Nos. Toyota Corolla Altis 1600 Cc (full options with Driver)
(ii) 01 Nos. Toyota Yaris / Honda City / Suzuki Swift 1300 Cc (full options with Driver)

g). Contractor should also provide all protective gear like Helmet, goggles, safety boots to the Engineer staff at site.

h). Providing all stationery and consumable items like pen, pencils, papers, binder cards, plastics, staples, etc. as per requirement.

i). The Contractor shall provide an average cost of Rupees Twenty -Five Thousand only (Rs. 25,000/-) per month pertaining to mobile & telephone use.

The above equipment shall be in use of the Engineer and shall become property of the Employer and as-such will be handed-over to the Engineer in good working condition on completion of the project.

In case of non-provision of facilities mentioned above, the same shall be arranged by the Employer / Engineer and be deducted from any monies due / becoming due to the Contractor by the Employer along with 10% overheads till these facilities are provided satisfactorily to the Engineer.

Cost of all above facilities are deemed to be included in the contract price and no additional payment shall be made by the Engineer to the Contractor under any circumstances.

The vehicle should be brand new and latest model. The vehicles are for the exclusive use of the Engineer / Engineer’s supervision team to meet their transportation needs. The use of such transportation facilities shall be exclusively under the control of the Engineer and the contractor shall be wholly responsible for furnishing at all times above said facilities. The said facility shall be provided within 14 days of Engineer’s issue of commencement letter and shall continue un-interrupted till the completion of works. The said vehicles shall be handed-over back to the Contractor on completion of work.

a). The Contractor shall furnish, supply and provide, without specific direction of the Engineer all lubricants, tyres, other supplies, regular service and maintenance at all times for the above vehicles till the issue of the Completion Certificate of the contract.

b). The Contractor shall provide an amount equivalent to, 1 x 600 liters for Toyota Corolla Altis, 1x 600 liters for Toyota Yaris / Honda City, Petrol / diesel per month to the Engineer & Employer by 5th of each month in advance for complete duration of work including any extended period.

In case of non-provision of facilities mentioned above, the same shall be arranged by the Employer / Engineer and be deducted from any monies due / becoming due to the Contractor by the Employer alongwith 10% overheads till these facilities are provided satisfactorily to the Engineer.

Cost of all above facilities are deemed to be included in the contract price and no additional payment shall be made by the Engineer to the Contractor under any circumstances.

12. SAFETY

12.1. Accident Prevention, Protective Equipment

The Contractor shall comply and enforce compliance by all his Subcontractors with the highest standards of safety and accident prevention in compliance with all applicable laws, ordinance and statutory provisions.

Where overhead work is being carried out, warning signs shall be installed at ground level clearly warning of the overhead work.

All warning signs shall be in two languages, English and Urdu, and shall at all times be maintained in a clean and legible condition, to the satisfaction of the Engineer.

Trash shall be removed at frequent intervals to the satisfaction of the Engineer.

If, safety precautions/ warning signs are not installed by the Contractor, employer will charge an amount of Rs. 10,000/- per site per day for the period.

13. PAYMENT FOR WORK REQUIRED BY SPECIAL PROVISIONS

Unless otherwise specifically stated in the Contract, the price of all work required by the Special Provisions shall be considered to be included in the Contract Price.

14. The Bided Rates shall be inclusive of all lead and lift

15. No alterations or additions shall be made by the Contractor in the Bill of Quantities and rates must be filled in ink or typed out both in figures and words clearly and legibly in the columns provided in the schedule of quantities. All corrections must be initialed by the contractors. Any Tender which does not comply with this condition will be liable to be summarily rejected and not taken into account when preparing comparative statement.

16. Materials obtained from excavations will be the property of the Employer. Serviceable materials are to be stacked in places pointed out by Engineer-in-charge. The Contractor undertakes to have the site clean and free from rubbish to the satisfaction of the Engineer. All surplus materials, rubbish, etc., will be removed to places to be fixed by the Engineer and nothing extra will be paid for this.

17. On completion of the work or earlier as directed by the Engineer, the Contractor shall remove all temporary structure (Godowns, site offices, etc.), erected by him at the site of work. He shall fill tanks dug out by him at site, remove all debris and other materials like

surplus sand, stone ballast, rubbish, etc.; and in short, shall leave the site in a neat and tidy condition.

18. The contractors in the course of their works should understand that all material (e.g., stone and other materials) obtained in the work or dismantling, excavation, etc., will be considered as Employer's property and issued to the contractors (if they require the same for their own use) at rates approved by the Engineer. If the materials are not required by them they will be disposed off in the interest of Employer.

19. The contractor shall inspect the site of works and acquaint himself with the nature and requirements of the work, facilities of access for materials, removal of rubbish, cost of carriage, nature of strata, etc., before submitting his Bid.

20. The contractor shall have to make temporary approach roads, etc., at his own cost to facilitate movement of materials, such approach roads shall be aligned in a manner approved by the Engineer.

21. The contractor shall have to make proper arrangements for road crossing barriers during working hours in the day time as well as in the night when danger lights will have to be provided on either ends at his own cost and no extra cost will be paid. Sufficient barricades and red lights will be provided by the Contractor where required to avoid the chances of accidents. In case an accident occurs for failure on the part of the contractor, he shall be entirely responsible for the consequences.

22. The Contractor shall have to make arrangements for diversions for traffic wherever necessary and shall have to provide diversion and caution boards as per directions of the Engineer at his own cost for which no extra cost will be paid. The diversion shall be watered and consolidated as per directions of the Engineer.

23. No material shall be removed from the site without the written permission of the Engineer.

24. Dewatering including shoring wherever so required for any foundation area, pumping, bailing out water, drainage of water within plot areas if any shall be deemed to have been included in the rates quoted by the bidders and no extra payment will be made. The rates shall be deemed inclusive of such incidental charges.

25. The Contractors shall execute all works at their own cost for diversion of water away from the plot as per site requirements to have full satisfaction of Engineer and no additional payment will be made on this account.

26. The Engineer, subject to approval of the Employer, reserves the right to select all materials and the type, grade, heating capacity and quantity of proportion of any or all materials as required for a particular work. The decision of Employer in this respect shall be final and binding on the Contractor. The rejects on materials must be carted at his own cost. If the rejected materials are not re moved within one month of its rejection the materials will become the property of the Employer or will be removed at Contractors cost.

27. ATTENDANCE OF MEETINGS

The Contractor shall attend and shall cause his Sub-Contractors to attend any or all meetings when called by the Employer or the Engineer or his Representative to discuss progress of the work and other matters related to the work and the Contract, without any compensation from the Employer.

27.1. The Contractor shall bear all expenses of the Employer and his agents and representatives and the Engineer, his agents and representatives if requested by the Contractor for any meetings, instructions and approvals away from the Site.

27.2. The proceedings of the meetings shall be recorded by the Engineer which shall be circulated to all the participants including those of the Contractor. All decisions taken in the meetings shall be binding on the Contractor and shall form part of the Contract.

28. DOCUMENTS NOT TO BE ALTERED OR MUTILATED

No alteration or mutilation (other than filling in all the blanks intended to be filled in) shall be made in the form of Bid or in any of the documents attached to it. Any comments which it is desired to make shall not be placed on any of the documents attached hereto, but shall take the form of a separate statement which shall be as brief as possible and referenced to items, clauses and pages of the annexed documents.

Such statements shall not qualify the acceptance of the Bid based upon a proposed change or changes in the annexed documents, nor shall be binding upon the Employer in any way in making the award. Alterations of already written prices must be signed in the place of alteration by the Bidder or his legally authorized representative.

29. PERSONAL LIABILITY OF PUBLIC OFFICIALS OR ENGINEER

In carrying out any of the provisions of these specifications, or in exercising any power of authority granted to them by or within the scope of the Contract, there shall be no liability upon the Employer or his authorized representatives or the Engineer or his authorized representatives their personally or in their official capacity, it being understood that in all matters they act solely as agents and representatives of the Employer.

30. ACCESS AND EXISTING ROADS

If the Contractor finds it necessary or elects to use existing roads, the Contractor shall make all necessary arrangements and obtain all permits from the relevant departments for travel over and use of such roads. The Contractor shall observe all rules regulations of the concerned department regarding the use of said roads. The cost of maintaining all necessary safety measures and temporary structures and making any necessary repairs, replacements or similar operations and all or any other costs required by reason of his use of such roads shall be borne by the Contractor and the Contractor shall save harmless and indemnify the Employer in respect of all claims, demands proceedings, damages, costs, charges and expenses whatsoever arising out of or in relation to any such operation or interference.

31. FIRST AID FACILITIES

The Contractor shall provide and maintain adequate First Aid Facilities at all times, convenient to the Site to the approval of the Employer.

32. FINAL HAND-OVER

At the end of the Defect Liability Period stipulated in the contract, the Employer and the Engineer on application of the Contractor, shall decide the members of the final hand over committee and announce the same to the Contractor. The committee, after inspection of Work, if satisfied that there are no deficiencies or defects due to work of the Contractor

shall certify the final hand-over, and the Employer will then issue a final Certificate of Completion of Work within thirty (30) calendar days thereafter.

Once completion has been formalized and endorsed both by the contractor as well as controlling officer, the work will be regarded as completed for all purpose as per contract agreement although the accounts may not have been settled, no further new works will be authorized against the sanctioned project and not further supplementary estimates or claims may be accepted.

33. EMPLOYER AND ENGINEER NOT PERSONALLY LIABLE

No member or officer of the Government or the Employer or the Employer's Representative or the Engineer or his representatives or any one of their respective staffs or their employees shall be in anyway personally bound or liable for the acts or obligations of the contractor under the contract or answerable for any default or omission in the observance or performance of any of the acts, matters or things which are herein, contained.

34. PROGRESS PHOTOGRAPHS

The contractor shall furnish to the Employer and to the Engineer every two weeks at least six photographs to clearly show the progress of construction. The photographs shall be submitted in glossy prints 20 cm x 20 cm. Each print shall be marked on the back with the date and serial number. There shall be no writing, lettering or marking on the face of the photographs. The set of photographs of the Engineer should accompany respective negatives.

35. SITE ORDER BOOK

The Contractor shall maintain site order book {of triplicate leaves} at the Site, for taking down instructions of the Engineer and/ or the Employers, with out any obligation and charges to the Employer / Engineer.

36. REPORT ON PROGRESS OF WORK AND PHOTOGRAPHS

The Contractor shall, during the execution of the work, submit to the Employer (3 copies) and Engineer (2 copies) so as to reach them in the first week of every calendar month, a report on the actual progress of the works attained by him during the preceding month fully supported with colour photographs of (5” x 7”) size, at least 15, depicting the complete stages of the works. Each photograph should be properly pasted on A-4 size paper, indicating the location and other relevant information of the area photographed. The report will be submitted on the standard format to be supplied later on. In case the Supervision Engineer are different from the Design Engineer, one copy each of photographs should be sent to both the Engineer.

The set of photographs for the Design Engineer should be submitted with respective negatives.

CIVIL & ARCHITECTURE VENDOR'S LIST

S.No.	Description	Manufacturer as Per Design Specifications	Local Representative / Vendor
1	Cement	M/s. DG Cement	Mr. Ammar (0323-3212322)
		M/s. Attock Cement	
		M/s. Power Cement	Mr. Taha (0333-3036434)
		M/s. Lucky Cement	Mr. Umair Khan (0321-2821837)
		Or other equivalent approved by the Consultant / Engineer	
2	Steel Reinforcement	M/s. Amreli Steels	Mr. Naveed Ansari (0324-5979184)
		M/s. Agha Steels	
		M/s. Union Steel	Mr. Zain (0331-8753823)
		M/s. Faizan Steel	Mr. Khurram (0333-4934931)
		Or other equivalent approved by the Consultant / Engineer	
3	Porcelain & Ceramic Tiles (Flooring & Dado)	M/s. Master Tiles	Mr. Hammad (0330-6277222)
		M/s. Shabbir Tiles	Mr. Hassan (0301-8262553)
		M/s. White Horse	Mr. Waqas (0332-2498637)
		M/s. City Tiles	Mr. Yasir Taqi (0324-2043171)
		M/s. Granitto Tiles	Mr. Hassan (0321-9222863)
		M/s. Benitoz Homes	Mr. Abdul Qadir (0300-8211840)
		M/s. H & H Ceramics	Mr. Danish (0321-2491656)
		Or other equivalent approved by the Consultant / Engineer	
4	Marble / Granite / Stone (Flooring, Wall Cladding, Kitchen & Vanity Countertop etc.) - type and sourcing of marble / granite / stone as per finishing schedule	M/s. Inexterior	Mr. Fahad (0340-1118887)
		M/s. Marble World	Mr. Hasham Farooq (0340-7866381)
		M/s. Stone City	Mr. Muneeb Haque (0340-1118886)
		Or other equivalent approved by the Consultant / Engineer	
5	Carpet Tiles & Wooden Flooring	M/s. Pak Carpet Industries	Mr. Imran (0333-3802017)
		M/s. Seenqaaf Industrial Co.	
		Or other equivalent approved by the Consultant / Engineer	
6	FibreGlass Chairs	M/s. Techno FRP Services	Mr. Shahid Hussain (0321-9252436)
		M/s. Hasan Trading Co.	Mr. Hassan (0336-2707272)
		Or other equivalent approved by the Consultant / Engineer	
7	UPVC & Aluminum Doors, Windows, Ventilators etc.	M/s. Explore Interior	Mr. Navaid Farooqui (0300-2284822)
		M/s. Maptech	Mr. Khalid Hussain (0333-6699955)
		M/s. Hitech Engineering Services	Mr. Adil Kushtiwala (0300-8200506)
		M/.s JAGW AlucoGlass System	Mr. Nadeem (0335-1371047)
		Or other equivalent approved by the Consultant / Engineer	
8	ACP Cladding	M/s. Hitech Engineering Services	Mr. Adil Kushtiwala (0300-8200506)
		M/.s JAGW AlucoGlass System	Mr. Nadeem (0335-1371047)
		Or other equivalent approved by the Consultant / Engineer	
9	Termite Proofing	Mirage	Mr. Badar Jamal (0336-6822155)
		Agenda 25 EC	Mr. Arif Akhtar (0300-8939992)
		Termicure 25 EC	Mr. Arif Akhtar (0300-8939992)
		Or other equivalent approved by the Consultant / Engineer	
10	Solid & Hollow Blocks	M/s. BES Block	Mr. Shahid (0300-2307353)
		M/s. Megnacrete	Mr. Abdullah Shahid (0300-2019122)
		M/s.Envicrete	Mr. Rasheed (0331-2356101)
		M/s. Banu Mukhtar	Mr. Kamran Tola (0300-8270087)
		M/s. Caracrete Industries	Mr. Adeel (0321-2696795)
		Or other equivalent approved by the Consultant / Engineer	
11	Bricks, Brick Tiles and Brick Jali	M/s. Tasneem Bricks	Mr. Shakil (0307-2824771)
		M/s. Al-Nasir Bricks	Mr. Liaquat Malik (0303-7733567)
		Or other equivalent approved by the Consultant / Engineer	
12	Water Proofing (Bitumen, Torch Applied Membrane, Crystalline, Cementatious, Floor Hardner, Waterstopper)	M/s. Fospak	Mr. Faheem (0300-8250632)
		M/s. Sika	Mr. Mansoor Raza (0300-8430092)
		M/s. Aqaufin	Ms. Kashmala (0301-8283272)
		M/s. Mitchell Construction Chemicals	Mr. Usman (0342-2839291)
		M/s. Ressichem	Mr. Hussain Zulfiqar (0309-7772464)



CIVIL & ARCHITECTURE VENDOR'S LIST

S.No.	Description	Manufacturer as Per Design Specifications	Local Representative / Vendor
		M/s. Pak Hy-Oils Limited	Mr. Samad (0332-2900799)
		M/s. Mega Sealers	Ms. Mantasha Khan (0318-3880161)
		M/s. Professional Sealers	Mr.Fahad A. Khan (0321-1110475
		Or other equivalent approved by the Consultant / Engineer	
13	Geotextile and Geomembranes (Typer Geotextile, PVC Geomembrane, Needle Punched Geotextile etc.)	M/s. Matrixx	Mr. Babar Farid (0300-2038112)
		M/s. Fospak	Mr. Faheem (0300-8250632)
		M/s. Sika	Mr. Mansoor Raza (0300-8430092)
		M/s. Mega Sealers	Ms. Mantasha Khan (0318-3880161)
		Or other equivalent approved by the Consultant / Engineer	
14	Polypropylene Fibre	M/s. Matrixx	Mr. Babar Farid (0300-2038112)
		M/s. Fospak	Mr. Faheem (0300-8250632)
		M/s. Sika	Mr. Mansoor Raza (0300-8430092)
		M/s. Mega Sealers	Ms. Mantasha Khan (0318-3880161)
		Or other equivalent approved by the Consultant / Engineer	
15	Acrylic Base / Weather Shield / Reflective Paint (Local)	M/s. Akzo Nobel	Mr. Raza Aziz (0300-0606867)
		M/.s Nippon	
		M/s. Jotun	Mr. Usama Amir (0345-8475791)
		M/s. Berger	
		M/s. Gobis	
16	Gypsum / MR Boards	M/s. United Gypsum	Mr. Ayaz Saleem (0300-0566855)
		M/s. Lodhia Gypsum Industries Pvt. Ltd.	Mr. Kamran Sheikh (0301-8734684)
		M/s. Thermec Engineering Company	Mr. Saad (0300-8238934)
		Or other equivalent approved by the Consultant / Engineer	
17	Glass Partition (Plain & Tempered)	M/s. Ghani Glass	Mr. Kashif (0300-8251049) Mr. Ahmed (0302-9257887)
		M/s. Tariq Float Glass	
		Or other equivalent approved by the Consultant / Engineer	
18	Fibre Reinforce Polymer Sheet (Corrugated Double Sided Finish)	M/s. Master Composite	Mr. Waqas Ahmed (0345-2030093)
		Or other equivalent approved by the Consultant / Engineer	
19	GRC (Glass Fibre Reinforced Concrete) Mesh	M/s. Cara Tiles	Mr. Ataullah (0309-3338673)
		Or other equivalent approved by the Consultant / Engineer	
20	C.C. Tiles, Pavers, Kerbstone, Terracota Tiles, Kaprail & C.C Coping etc.	M/s. Envicrete	Mr. Rasheed (0331-2356101)
		M/s. Magnacrete	Mr. Abdullah Shahid (0300-2019122)
		M/s. Cara Tiles	Mr. Ataullah (0309-3338673)
		M/s. Caracrete Industries	Mr. Adeel (0321-2696795)
		M/s. Matrixx	Mr. Irfanuddin (0300-2038114)
		M/s. Banu Mukhtar	Mr. Kamran Tola (0300-8270087)
		M/s. First Floor	Mr. Usman Elahi Faruqi (0300-8293156)
		M/s. Rockerete	Ms.Laiba Sajid (0330-2241281)
		M/s. Pak Tiles	Mr. Shahzad (0300-4617715)
		Or other equivalent approved by the Consultant / Engineer	
21	Keystone	M/s. Envicrete	Mr. Rasheed (0331-2356101)
		M/s. Caracrete Industries	Mr. Adeel (0321-2696795)
		Or other equivalent approved by the Consultant / Engineer	
22	Ready Mix Concrete	M/s. Allied Materials (Private Limited)	Mr. Humayun Shamsi (0346-2425828)
		M/s. King Enterprises	Mr. Arif (0333-2288537)
		Or other equivalent approved by the Consultant / Engineer	
23	Gazebo's & Wood Works	M/s. Sindh Wood Works Enterprises Pvt. Ltd.	Mr. Irfan Khan (0334-3237281)
		Or other equivalent approved by the Consultant / Engineer	
24	Prefabricated Security Cabin	M/s. Porta Cabin	Mr. Riaz (0300-4577603)
		Or other equivalent approved by the Consultant / Engineer	
25	Fabrication Works (MS, S.S, C.I, G.I etc)	M/s. Fancy Iron Grill Works	Mr. Rasheed (0333-2644422)
		M/s. Junaid Casting Iron Works	Mr. Zahid Khilji (0300-8299756)
		M/s. The Protectors	Mr. Zafar Rehmatullah (0300-8284740)
		Or other equivalent approved by the Consultant / Engineer	

CGD CONSULTING (PVT) LIMITED
CGDC

CIVIL & ARCHITECTURE VENDOR'S LIST

S.No.	Description	Manufacturer as Per Design Specifications	Local Representative / Vendor
26	Tensile Fabric Canopy	M/s. Urban Objects	Mr. Sohail Raees (0333-2158844)
		M/s. The Protectors	Mr. Zafar Rehmatullah (0300-8284740)
		Or other equivalent approved by the Consultant / Engineer	
27	Asphalt Batching Plant	M/s. King Enterprises	Mr. Saleem (0300-8217994)
		M/s. Bakhri Ahmed Khan	Mr. Haji Abdul Majeed (0300-2019513)
		Or other equivalent approved by the Consultant / Engineer	
28	Concrete Admixture	M/s.Sika	Mr. Mansoor Raza (0300-8430092)
		M/s. Fospak	Mr. Faheem (0300-8250632)
		M/s. Ressichem	Mr. Hussain Zulfiqar (0309-7772464)
		M/s. Mega Sealers	Ms. Mantasha Khan (0318-3880161)
		M/s. Aquafin	Ms. Kashmala (0301-8283272)
		Or other equivalent approved by the Consultant / Engineer	
29	Horticulture Works (Sweet Earth, Cow Dung, Ground Covers, Trees, Shurubs, Plants, Flowers, Grass, Planters etc.)	M/s. Greenland Services	Mr. Munir Nauroz (0332-2149962)
		M/s. Rohan and Co.	Mr. Amjad (0300-2366102)
		M/s. Green Concepts	Mr. Khalid Zubari (0321-8292580)
		Or other equivalent approved by the Consultant / Engineer	
30	Road Signs, Lane Markings, Studs, Cateyes, Speed Breakers etc.	M/s. S.K Associate	Mr. Sahir Khan (0312-2818168)
		M/s. NH Enterprises	Mr. Nadeem (0333-3516881)
		Or other equivalent approved by the Consultant / Engineer	
31	Bridges & Buildings Expansion Joints (Local / Imported)	M/s. Pioneer Techniques	Mr. Sheraz Ahmed Siddiqui (0300-9279057)
		M/s. HRM Associates (Arfen Tukey)	Ms. Fahmina (0309-3331738)
		Or other equivalent approved by the Consultant / Engineer	
32	Bearing Pads	M/s. Pioneer Techniques	Mr. Sheraz Ahmed Siddiqui (0300-9279057)
		M/s. HRM Associates (Arfen Tukey)	Ms. Fahmina (0309-3331738)
		Or other equivalent approved by the Consultant / Engineer	
33	FRP Gratings & Manhole Cover (Local / Imported)	M/s. HRM Associates (Kompozit Kimya)	Ms. Fahmina (0309-3331738)
		M/s. Mentor Building Materials	Mr. Shahid Ali Khan (0321-2595775)
		M/s. Fibre Craft Industries	Mr. Nadeem Asghar (0300-8403969)
		Or other equivalent approved by the Consultant / Engineer	



EDUCATION CITY

INFRASTRUCTURE DEVELOPMENT OF EDUCATION CITY,KARACHI

Special Technology Zone Package 1
Road and Infrastructure works

VOLUME - II

TECHNICAL SPECIFICATIONS

GOVERNMENT OF SINDH

CGD CONSULTING

Technical Specifications:

1. Civil Works

2. Road, Bridges and Infrastructure Works

3. Wet Utility Services

Technical Specifications:

Civil Works

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1. DESCRIPTION

The works covered by this section of the Specifications, consist of furnishing all plant, labour, equipment, protection method s, appliances and materials, and in performing all operations in connection with earthworks and protection of existing works done by others and/or executed by the Contractor, in accordance with this section of the Specifications and the applicable drawings, subject to the terms and conditions of the Contract.

2. GENERAL

i The Contractor shall acquaint himself with the nature of the ground, existing structures, conditions of all excavation and related works performed by others/contractor for foundations and sub-soil conditions which may be encountered during excavation or other earthworks.

ii The Subsoil Investigation Report is available with the Engineer for reference. However, the Employer does not guarantee or warrant in any way that the material to be found in the excavation will be similar in nature to that of any samples which may have been exhibited or indicated in the Report, Drawings or in any other Contract Documents or to material obtained from boring or trial holes. The Contractor shall be deemed to have made local and independent inquiries as to, and shall take the whole risk of the nature of the ground, sub- soil or material to be excavated or penetrated and the Contractor shall not be entitled to receive any extra or additional payment nor be relieved from any of his obligations by reasons of the nature of such ground subsoil or material.

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

iv. Arrange for inspection by Local Authority to verify and approve the discharge of surface water and to verify the location of the sewer connection.

3. DUST CONTROL

i Control dust on and near the work and near off-site borrow areas if such dust is caused by the Contractor's operations during performance of the work or if resulting from the condition in which the Contractor leaves the Site.

ii Thoroughly moisten surfaces as required to prevent dust being a nuisance to the public, neighbours, and concurrent performance of other work on the Site.

4. ANTIQUITIES

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

5. SITE PREPARATION

i The Contractor shall set out the works including protection of the existing excavated earth work performed by others if any and shall be responsible for true and perfect setting out of the same and for correctness of the positions, levels, dimensions and alignments of all parts thereof. If, at any time, any error in this respect should appear during the progress of the works, the Contractor shall at his own expense rectify such an error to the satisfaction of the Engineer.

ii The Contractor shall construct and maintain accurate bench marks, so that, the lines and levels can be easily checked by the Engineer.

iii The Contractor shall construct and maintain such ditches, in addition to those shown on the plans, as will adequately drain areas under construction, at no extra cost to the Employer.

iv Clearing shall consist of filling and cutting up, or the trimming of trees and the satisfactory disposal of the trees and other vegetation designated for removal, together with downed timber, snags, bushes and rubbish occurring within the areas to be cleared. Tees, other vegetation, stumps, roots, and bushes in areas to be cleared shall be cut off flush with or below the original ground surface except such individual trees, group of trees, and vegetation as may be indicated on the drawings or designated by the Engineer to be left standing. Individual trees, group of trees, and other vegetation, to be left standing shall be thoroughly protected from damage incident to construction operations, by the erection of the barriers or by such other means as the circumstances require, as approved by the Engineer. Clearing operations shall be conducted, so as to prevent damage by falling trees to trees left standing, to existing structures and installations, and to those under construction, and to provide for the safety of workers, so as to provide for the safety of employees and others.

v Grubbing shall consist of the removal and disposal of all stumps, roots, larger than 1-1/2" (38 mm) in diameter, matted roots in the designated grubbing areas. Stumps,

roots, logs or other timber larger than 1-1/2" (38 mm) in diameter, matted roots & other debris shall be excavated and moved to a depth not less than 18" (450mm) below any subgrade, shoulder or slope. In areas, where the cut is over 3ft (1.0m), grubbing shall not be necessary. In areas to be paved, or in areas indicated on the drawings as future paved areas, where, excess excavation from grading operations is placed, or in areas designated by the Engineer as future paved areas, where excess excavation from grading operations is placed, grubbing will be necessary.

vi Timber and other refuse to be disposed off by burning, shall be burned at locations specified by the Engineer in a manner that will avoid all hazards such as damage to the existing structures, construction in progress, trees and vegetation. The Contractor shall be responsible for compliances with all pertinent laws and regulations. Disposal by burning shall be kept under constant attention until the fires have been burned out or have been extinguished. No materials will bepermitted to be pushed or placed on adjacent private property without prior writtenapproval of the Engineer.

Existing Utilities

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

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

Do not interrupt existing utilities servicing facilities occupied and used by the Employer or others, except when permitted in writing by the Engineer and then only after acceptable temporary utility services have been provided.
Demolish and completely remove from the site existing underground utilities indicated to be removed. Coordinate with local utility companies for shut-off of services if lines are active.

Use of Explosives

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

Protection of Person and Property.

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

6. EXCAVATION

i Excavation shall include the removal of all material including material left over by others of every name and nature.

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

iii For all or any excavation performed by contractor or others, the Contractor shall submit for prior approval of the Engineer, full details and drawings showing the proposed method or procedure of supporting and strutting, de-watering and maintenance of adjacent structures. The design, provision, construction, maintenance and removal of such temporary works shall be the responsibility of the Contractor, and all costs in this respect shall be included in the billed rates for the permanent works.

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

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

vi Excavation shall extend to sufficient distance from walls and footing to allow for placing and removal of forms, installations of services, and for inspection, except where it is required to deposit concrete for walls and footings directly against excavated surface.

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

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

ix If excavation for footings are carried below the required level, as shown in the Drawings or as directed by the Engineer, the surplus depth shall be filled with concrete having f'c = 1.5 ksi at the sole cost of the Contractor.

x All excavation shall be performed in the dry. The placing of blinding concrete, placing of reinforcement and casting of the permanent works in the excavation shall be carried out in the dry and the Contractor shall have sufficient equipment for this purpose. Adequate precautions shall be taken to prevent any erosion due to undercutting from underneath the previously constructed adjoining foundations. Any dewatering required for this purpose shall be deemed to be included in Contractor's rates for this excavation.

xi Shoring, including sheet piling, where required during excavation, shall be installed to protect workmen and the banks, adjacent paving, structures and utilities. The term shoring shall also be deemed to cover whatever methods the Contractor elects to adopt, with prior approval of Engineer, for upholding the sides of excavation and also for planking and strutting the excavation against the side of public roadways and adjoining properties in existing 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.

xii Excavations, for deep retaining walls, shall be protected from drying out by covering with tarpaulins or other means, if excavation is to stand open more than 24 hours. This is a precaution to prevent excessive surcharge loads acting on the wall, from the drying out and subsequent swelling of the clay soils when saturated either by rain or capillarity of ground water.

xiii If rock is encountered, it shall be removed carefully and without excessive noise and vibration. Blasting, if required shall be done by persons skilled in such work and as directed by the Engineer. Necessary permission for blasting should be obtained from respective Government Authorities by the Contractor. All necessary precautions shall be taken to see that the general public and the properties in the vicinity shall not receive any damage by such blasting. Rock, to receive footings shall be stepped and leveled.

xiv Existing utility lines that are shown on the drawings or the locations of which are made known to the Contractor prior to excavation, which are to be retained, as well as those utility lines constructed during excavation operations, shall be protected from damage during excavation and 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 at his own cost. When, utility lines which are to be removed, are encountered within the area of operations, the Contractor shall notify the Engineer in ample time for the necessary measures to be taken to prevent interruption of the service.

xv Excavated material suitable for use as filling material shall be deposited as directed by the Engineer. Surplus or material unsuitable for use as filling shall be disposed off by the Contractor to areas approved by relevant authorities for this purpose.

7. FILLING

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

ii Filling shall be approved selected material from excavation or other predominantly granular material and free from slurry, mud, organic or other unsuitable matter and capable of compaction by ordinary means.

iii Filling in trenches and foundations shall be placed in 6" (150 mm) layers and compacted to optimum moisture content by mechanical means, where possible.

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

v Material for bulk filling shall be as approved by the Engineer and shall be placed in layers of 6" (150 mm) and saturated with sufficient water or otherwise compacted to produce not less than 95% in-situ density with respect to the maximum density, at optimum moisture content, as per ASTM D- 1557 method C. In place determination of dry density of soil shall be by ASTM D-1556-64.

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

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

viii All structures retaining the earth shall have a filling of granular material for drainage through the weep holes or rubble drain as shown on the drawings or as additionally directed by the Engineer. This granular material shall consist of following gradation requirements.

SIEVE % PASSING BY WEIGHT

1-½" …….. 100
¾" …….. 80-90
#4 …….. 60-70
#10 …… 45-55
#40 …… 15-25
#100 …….. 5-15
#200 ..... less than 5

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

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

8. EMBANKMENT

i No embankment shall be commenced until the foundations have been approved by the Engineer. When approved as suitable by the Engineer, material arising from the excavations may be used for filling as required. Mud, slurry, organic matter, peat and any other unsuitable material shall not be used for filling for any purpose on the Site. Where suitable materials from the excavations are insufficient for filling, the requirements shall be made up of other granular material which the Contractor shall obtain from sources approved by the Engineer.

ii The location of sources of supply of this filling material will be left to the Contractor, but the quality of the filling material brought from outside will be subject to the approval of the Engineer. The Engineer shall require the Contractor to carry out various tests of the filling material. All such tests, shall be made at an approved laboratory at the cost of the Contractor.

Once, a material from a specific source has been approved, the material of the same quality and from the same source shall be used. Any filling material from borrow pits, which has not been approved or the quality of which differs from the approved material shall be rejected outright without recourse. The Engineer reserves the right to order the removal of any such materials brought to the Site of the works, at Contractor's expense. In order to ensure satisfactory compaction, it will be necessary to carry out, depending upon the type of material, particle size distribution tests, determination of organic content tests, maximum and minimum density tests and determination of optimum moisture content for the filling material.

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

iv Having established the method of compaction to be used, no departure from this approved method shall be permitted without the prior approval of the Engineer. The adequate control of the filling and compacting operations shall be ensured by in-situ density tests and in order to obtain significant results, not less than two measurements shall be carried out per one thousand square feet (100 square meter) of area compacted. The frequency of tests shall be determined on Site and may be varied at the discretion of the Engineer as the work proceeds. Tests shall be carried out in accordance with ASTM D - 1557 method C or such other standards as approved by the Engineer. The standard of acceptance of the compaction be not less than 95% in-situ density with respect to the maximum density, at optimum moisture content, achieved in accordance with ASTM D - 1557 method C.

v The exact thickness of layers and the method of placing and compacting the filling shall be determined by the field tests, as stated above, but not withstanding the

results of these trials, filling shall not be placed in layers exceeding 6" (150 mm) in thickness. The full width of the embankment shall be placed in one operation. In order to maintain control of the thickness of layers, timber profiles shall be used. The Contractor shall provide adequate supply of water and sufficient capacity of mechanical water carriers to ensure uniform and uninterrupted operation of compaction. The Engineer may forbid the Contractor to proceed with pacing and/or compaction of filling and/or removal and re-compaction of such filling if he finds that the Contractor has insufficient or defective equipment or that the work is improper.

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

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

9. MEASUREMENT AND PAYMENT

i Unless otherwise specifically stated in the Bill of Quantities, or herein, all items shall be deemed to be inclusive of, but not limited to the following:

a Labour and all cost in connection therewith.

b Materials, goods, equipment and all costs in connection therewith (e.g. conveyance; delivery; unloading; storing; returning, packing; dewatering; handling; hoisting; lowering; shoring and protection of all existing and new excavation; formworks; etc.)

c Setting out of works.

d Cost of all laboratory and field tests stipulated in these Specifications.

e Use of Plant.

f Waste of Materials.

g Establishment charges, overhead charges & profit.

h All other expenses, royalities, charges and taxes specified in Conditions of Contract.

ii Quantities of excavation, filling, embankments, etc. shall be calculated from level taken by the Contractor and agreed by the Engineer before commencement of the work.

iii Excavation

a) The quantities given for excavating and subsequent disposal, shall be deemed to be the bulk before excavating and no allowance shall be made for any subsequent variation in bulk or for any extra space required to accommodate planking and strutting.

b) The unit price for excavation shall be deemed to include the following also:

- Excavating below water-level and excavating in rock

- Getting out excavated materials by any means necessary and subsequent disposal of excavated material to any lift and lead.

- Keeping excavations free from water, from any source whatsoever, and providing pumps and other equipment, power attendance for pumping and standing time.

- Shoring, which shall mean providing everything requisite to uphold the sides of existing and any other excavation by whatever means are necessary.

- Placing and compacting of backfilling in the excavations to the required degree and elevations as stipulated in the Drawings and as directed by the Engineer.

c) Excavation and its measurements for foundation/ trenches shall be to the exact dimensions shown on the drawings multiplied by vertical depth of excavation.

d) The area, shall be that of the lean concrete layer under all footings and shall not include any extra excavation required for shoring, formwork etc. No payment shall be made for any excavation beyond that defined above, or for any unauthorized width and depth.

iv Embankment

a) Quantities for embankment shall be deemed to be the net volume of the embankment after being placed and compacted to the required degree and elevation as stipulated in the Drawings and as additionally directed by the Engineer.

b) Treating the surface of the embankment, filling (e.g. leveling, grading to falls, grading to cambers) shall be deemed to be included in the unit price of embankment.

c) Trimming the sides of embankment to slope shall be deemed to be included in the unit price of embankment.

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8. SAMPLES & TESTS....3
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1. DESCRIPTION

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

2. MATERIALS

i ‘Agenda 25EC’ by Jaffar Brothers / “Miraj” by IBS or equivalent product approved by the Engineer, mixed in clean water for application in earth or fill as recommended by the Manufacturer.

ii ‘Wood Protek’ (England) or equivalent product approved by the Engineer, on exposed wooden surfaces.

iii ‘Solignum’ or equivalent product approved by the Engineer, on concealed/covered wooden surfaces.

3. METHOD OF APPLICATION

Spray, Shower or flood the water mixed ‘Agenda 25EC’ / “Miraj” solution @ 5 liters per sq. meter to all applications to, on or in earth or fill. ‘Wood protek’ can be applied to wood with brush or spray. Wooden elements intended to be treated must be bark free, dry and not painted, varnished, polished or stained. After application of ‘Wood Protek’ let the surface dry-out for at least 12 hours. Spraying to wood shall be done by hand compressionwith an approximate pressure of 20 psi (1.4 kg/sq.cm).

4. WORKMANSHIP

The treatment operation shall be carried out as follows:-

i After excavation and soil compaction for foundation trenches and pits is complete in each and every respect, and passed for concreting work, but before laying of concrete or stone soling, Pesticides shall be penetrated to a depth of 1 ins (25 mm) minimum in porous earth or fill material at bottom and 2 ins (50 mm) to 3 ins (75 mm) at sides of excavations.

ii Stock piled excavated materials or materials brought from outside the site and to be used as backfill are to be treated as above. After backfilling to required grade the area is again to be sprayed.

iii After grading, compaction and leveling of earth or sand fill and before laying of any soling or lean concrete, all such areas are to be sprayed with 'Agenda 25EC' / "Miraj" or equivalent product approved by the Engineer penetrating a minimum of 1 ins (25 mm) into the earth or fill.

iv Pesticide solution shall be applied inside the building lines and for a distance of 10 feet (3m) outside all building with specified pressure.

v All rough wood work for the entire project is to be pesticide treated. All to be concealed/covered wooden elements such as internal frames, cores etc. shall be anti-termite treated with 'Solignum' or approved equivalent (not colorless) whereasall exposed wooden surfaces such as wooden ply shutters/frames, handrails etc. shall be treated with 'wood protek' (England) or approved equivalent colorless termite control chemical. The aforesaid pesticides shall be applied in accordance with the manufacturer's instructions. Pesticide shall be sprayed on all surfaces of all the wooden work viz, door frames blocking, furring, planks, boards etc., before installation. Spraying is to be done at the Site, after delivery and before installation. No spraying shall be necessary after field sawing, planning, joining or installation of such material. All spraying will be done within one week of working of the materials.

5. LOCATION AND SCHEDULING

i Saturation of earth or fill material is to be done by adequate personnel and in such a manner as to in no way disrupt the progress of the work.

ii Care shall be exercised to ensure that no mark or damage occurs to the finished building as a result of the work under this section, and Contractor shall verify and ensure that no material used herein will impede the growth of grass or plants in areas where spraying is done.

6. STANDARDS

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

7. GUARANTEE

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

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

8. SAMPLES AND TESTS

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

9. MEASUREMENT AND PAYMENT

i Unless otherwise specifically stated in the Bill of Quantities or herein, all the works involved within the scope of this section of Specifications shall be deemed to be inclusive of but not limited to the following:

a) CONTRACTORS establishment charges, overhead charges, profit, interest.

b) All other expenses, charges, taxes specified in the Conditions of CONTRACT.

c) Labor and all costs in connection therewith.

d) Use of plant, equipment and machinery and all costs in connection therewith, e.g. mobilization, demobilization, transporting, fuel, energy charges, grease, oil, installing, operating, storing, watching, returning, replacing, handling, maintaining, idle stand parking, removing, damaged, destroyed, salvaged.

ii Material and goods, e.g. marketing, selecting, conveyance, loading, unloading, storing, watching, returning, handling, hoisting, lowering, cutting, joining, fixing, wastage, destroyed, damaged, salvaged.

a) The cost of all the works involved within the scope of this section of Specifications as per all the relevant Drawings are covered within the quoted unit rate of the item of the Bill of Quantities. **The scope of work**

includes treatment to all horizontal and vertical surfaces below grade and under floors. However, the measurement shall be made on the basis of excavated footprint of the building at Ground floor only and the unit rate shall cover all surfaces to be treated (horizontal and vertical).

b) No separate payment will be made for Termite Control treatment on wood work covered under this section of Specifications, and all cost in connection therewith shall be deemed to have been included in the unit rates of the relevant items.

ARTICLE INDEX

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3. CONSTRUCTION 1
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1. SCOPE

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

2. STONE

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

3. CONSTRUCTION

Preparation of sub-grade:

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

Compaction shall be done by approved methods compatible with the soil /material to be compacted.

4. STONE BALLAST/ SOLING

i The stone ballast shall be well graded and broken hard stone of 2" (50mm) in maximum size obtained from an approved quarry.

ii The well compacted soling stone shall be approximately 6" (150mm) in size from an approved quarry.

Laying:

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

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

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

5. MEASUREMENT AND PAYMENT

i Unless otherwise specifically stated in the Bill of Quantities or herein, all the workinvolved within the scope of this section of Specifications shall be deemed to be inclusive of but not limited to the following:

a Contractor's establishment charges, overhead charges, profit, interest.b All other expenses, charges, taxes specified in conditions of Contract.c Labour and all costs in connection therewith.

d) Use of plant, equipment and machinery and all costs in connection therewith e.g. mobilization, demobilization transporting, fuel, energy charges, grease, oil, installing, operating, storing, watching, returning, replacing, handling, maintaining, idle stand, parking, removing, damaged,destroyed, salvage.

e) Material and goods e.g. marketing, selecting, conveyance, loading, unloading, storing, watching, returning, handling, hoisting, lowering, cutting, joining, fixing, wastage, destroyed, damaged, salvaged.

ii The cost of all the works involved within the scope of this Specifications as per allthe drawings and conditions of Contract are covered only within the quoted rate ofitems of the B.O.Q.

iii Unless due to change of Technical Specifications or change in the Drawings, no payment for separate items shall be made.

iv The measurement for payment of stone soling as specified in the Specifications and B.O.Q will be made on the basis of Cft (CM) of compacted stone soling conforming to the drawings or as directed by the Engineer.

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1. SCOPE

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

2. GENERAL

a. Full co-operation shall be given to other trades to install embedded items.

b. Suitable templates or instructions, or both will be provided for setting items not placed in the forms. Embedded items shall have been inspected, and tests for concrete and other material or for mechanical operations shall have been completed and approved, before concrete is placed.

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

d. CONTRACTOR shall also prepare BAR BENDING SCHEDULE, and get the same approved by the ENGINEER, prior to commencement of work.

e Approximate equivalent conversion of F.P.S. and S.I. units are indicated in the text. Engineers decision on any specific conversion shall be final and binding on all parties.

3. RELATED SPECIFICATIONS

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

a. British Standards:

B.S. 12-78	Portland Cement, Ordinary and Rapid Hardening (in lieu of C-150).
B.S. 410	Test Sieves.
B.S. 693	General Requirements for Oxyacetylene Welding of Mild Steel

B.S. 822-1201	Concrete aggregates from Natural Sources.
B.S. 1141	Cold Worked Steel Bars for the reinforcement of Concrete. General Requirements for the Metal - Arc Welding of MildSteel.
B.S. 1881	Methods of Testing Concrete.
B.S. 3148	Tests for Water for Making Concrete.
B.S. 4027	Sulfate-Resisting Portland Cement.
B.S. 4449	Hot Rolled Steel Bars for the Reinforcement of Concrete.
B.S. 4461	Cold Worked Steel Bars for the Reinforcement of Concrete.
B.S. 4466	Bending Dimensions and Scheduling of Bars for the Reinforcement of Concrete.

b. ASTM Standards:

A 615	Deformed Billet-Steel Bars for Concrete Reinforcement.
C 33-78	Standard Specification for Concrete Aggregates.
C 39-72	Compressive Strength of Cylindrical concrete Specimens.
C 42-77	Standard Methods of Obtaining and Testing Drilled Cores and Sawed Beams of Concrete.
C 94-78	Standard Specification for Ready Mixed Concrete.
C 138-7I T	Tentative Method of Test, for Weight per Cubic Foot, Yield, and Air Content (Gravimetric) of Concrete.
C143-78	Standard Method of Test for Slump of Portland Cement Concrete.
C 150-72	Standard Specification for Portland Cement.
C 171-69	Standard Specification for Sheet Materials for Curing Concrete.
C 172-71	Standard Method of Sampling fresh Concrete.
C 173-71	Standard Method of Test for Air Content of freshly Mixed Concrete by the Volumetric Method.

C 208-72	Standard Specification for Insulating Board (Cellulosic Fiber) Structural and Decorative.
C 231-72T	Tentative Method of Test for Air Content of Freshly Mixed Concrete by the Pressure Method.
C 260-77	Standard Specifications for Air Entraining Admixtures
C309	Standard Specification for Liquid Membrane-Forming Compounds for curing Concrete.
C 494-71	Standard Specification for Chemical Admixtures for Concrete.
E 329-70	Recommended practice for Inspection & Testing Agencies for Concrete & Steel as Used in Construction.

c **ACI Standards:**

ACI 318	Building Code Requirements for Reinforced Concrete

e In addition, the latest editions of other Pakistan and British Standards, American Concrete Institute Standards, American Society for Testing and Materials Standards and other Standards as may be specified by the ENGINEER for special Materials and Construction are also relevant.

4. MATERIALS

4.1 Aggregates (Except for light-weight concrete):

a. The sources of supply of all fine and coarse aggregates shall be subject to the approval of ENGINEER.

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

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

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

TOTAL PASSING		**PERCENT BY WEIGHT**
2" B.S	Sieve (50.00 mm)	100
1-1/2"	Sieve (38.00 mm)	95 - 100
3/4"	Sieve (19.00 mm)	35 - 70
3/8"	Sieve (9.50 mm)	10 - 30
No. 4	Sieve (4.75 mm)	0 - 5

Coarse aggregate for all cast-in-place concrete other than mass concrete and thick fair faced cast-in-place concrete shall be graded with the following limits:-

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

Coarse aggregate for thin fair faced cast-in-place concrete shall be graded as follows:-

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

e. The nominal maximum size of aggregate for precast fair faced concrete shall be smallest of the following:

i One-fifth of the narrowest dimensions between sides of forms.

ii One-third of the depth of slabs.

iii. Three-fourth of the minimum clear distance between reinforcing bars or between bars and form.

iv. 1/2" (12 mm).

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

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

g. The aggregate shall be stockpiled for a period before use so as to drain nearly to constant moisture content (as long as SITE and other conditions permit, preferably for at least a day). The grading of the coarse and fine aggregate shallbe tested at least once for every 50 tons (or 750 C. ft) supplied to ensure that the

grading is uniform and the same as that of the samples used in the preliminary tests.

4.2
Cement:

a. Cement shall conform to ASTM C - 150.

b. Only one brand of each type of cement shall be used for concrete in any individual member of the structure.

c. Cement shall be used in the sequence of receipt of shipment, unless otherwise directed. There shall be sufficient cement at SITE to ensure that each section of WORK is

completed without interruption. If the cement is supplied by THE OWNER, the CONTRACTOR shall inform ENGINEER of his requirement much before its use in construction.

d. Cement reclaimed from cleaning of bags or from leaky containers shall not be used.

e. CONTRACTOR shall provide and erect, at his own cost, in a suitable place, dry, well ventilated, and water proof shed of sufficient capacity to store the cement.

f. The cement shall be used as soon as possible after delivery, and cement which ENGINEER considers has become stale or unsuitable through absorption of moisture from the atmosphere or otherwise shall be rejected and removed immediately from the SITE at CONTRACTOR's expense. Any cement in containers, damaged so as to allow the contents to spill or access of the atmosphere to the cement prior to opening at the time of concrete mixing shall berejected and removed immediately from the SITE at CONTRACTOR's expense.

g. The mixing together of different types of cement shall not be permitted.

4.3
Water:

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

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

Oil -------- 0.00 ppm.
Chlorides ---------- 1000 ppm.
Sulfates ----------1000 ppm.
Turbidity ---------- 2000 ppm.

Acids---------- 10,000 ppm.

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

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

4.4
Reinforcement:

a. Reinforcement for concrete shall conform to the respective British, ASTM or other standards as specified in the Drawings and CONTRACT Documents or as may be specified by ENGINEER.

b. Unless otherwise specified, all deformed reinforcing bars shall comply with the requirements of ASTM A615 for deformed steel bars and shall have minimum characteristic stress of 60 ksi, (414 N/mm2). with minimum elongation of 12%.

c. Reinforcement shall be obtained only from the manufacturer approved by the ENGINEER. If and when required CONTRACTOR shall provide all necessary facilities to ENGINEER for the selection of test pieces and shall cause these to be prepared and submitted where directed for tests at CONTRACTOR's cost.

d. If the reinforcement is to be supplied by the OWNER, the CONTRACTOR shall inform ENGINEER of his requirements much before its use in construction.

e. CONTRACTOR shall report immediately on receipt of any consignment, having any deviation in the standard weights of the reinforcing bars beyond those allowed in respective standards mentioned in clause (4.4.b) and (4.4.c) herein before.

5.
CONCRETE MIX PROPORTIONS

5.1
General:

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

b. The proportions of ingredients shall be selected in accordance with Section 5.6 to produce the proper placeability, durability, strength and other required properties.

5.2
Strength:

The Specified compressive strength of the concrete cylinder, shall be 3000 psi, (21 N/mm sq) except where otherwise noted on Drawings. The equivalent cube strength shall be at least 25% higher than the specified cylinder strength. Strength requirements shall be based on the sampling and testing methods of ASTM C 39-72 (and BS 1881 for cube).

5.3
Durability:

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

Type of Structure	**Structure** continuously wet or frequently freezing and thawing[1]	**Structure** exposed to sea or sulfates
i. Thin sections & sections with less than 1" (25mm) cover over steel	0.45	0.40[2]
ii. All other Structures	0.50	0.45[2]

5.4
Slump:

[1]Concrete should also be air-entrained.
[2]If S. R. Cement is used, permissible water-cement ratio may be increased by 0.05.

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

5.5
Admixtures:

If required or permitted, admixtures used shall be in accordance with the manufacturer's instructions except as otherwise specified herein.

5.6
Methods of Obtaining Mix Design:

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

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

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

6.
PLANT AND WORKMANSHIP

6.1
Formwork:

a. Forms shall be used, wherever necessary, to confine the concrete and shape it to the required dimensions. Forms shall have sufficient strength to with-stand the pressure resulting from placement and vibration of the concrete and shall have sufficient rigidity to maintain specified tolerances.

Structurally adequate, form work shall also conform to the requirements of the special architectural finishes of the in-situ Plain and Reinforced Concrete specified/or shown on the Drawings. Shop drawings of such form shall be subject to the approval of the ENGINEER prior to its use. ENGINEER shall refuse concreting of any part which in his opinion may not yield specified finishes.

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

c. Mud centering shall not be permitted without the prior approval of the ENGINEER.

d. Formwork shall be made of either timber, steel, plywood, proprietary building boards and such special material, as may be shown on the drawings or approved by the ENGINEER which gives the required finish to the surface of concrete. Wooden frame work shall be free from loose knots and shall be well seasoned. For the external concrete finishes 1/16" (1.5 mm) thick mild steel sheet forms shall be used. CONTRACTOR shall furnish shop drawings of such formwork prepared on the basis of architectural concept for the approval of the ENGINEER.

e. 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 concrete, and shall be sufficiently tight to prevent loss of cement slurry. The design and engineering of the formwork, as well as its construction, shall be the responsibility of 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.

CONTRACTOR shall establish and maintain in an undisturbed condition, and until final completion and acceptance of the WORK, sufficient control points andbench marks to be used for reference purpose to check tolerances.

f. Requirements for facing materials are given in clause 8 "Finishing of formed Concrete". The maximum deflection of facing materials reflected in concrete surfaces exposed to view shall be 1/240 of the span between structural members.

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

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

i. 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 within the, joints so that patches of tie holes will not fall within the panel areas.

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

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

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

m. Where concreting of narrow 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 the concrete. Small temporary openings shall be provided at the bottom of the formwork to columns, walls and deep beams to permit the cleaningout of debris and observations immediately before concrete is deposite.

n. 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 twice the diameter or twice the minimum dimension of the tie from the formed faces of concrete to be permanently exposed to view except that in no case shall this distance be less than 3/4" (19 mm) when the formed face of the concrete is not to be permanently exposed to view, form tie may be cut off flush with the formed surfaces. Through bolts shall 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.

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

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

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

r. Board forms having joints opened by shrinkage of the wood shall be swelled until closed by wetting before concrete is placed. Plywood and other woodsurface not subject to shrinkage shall be sealed against absorption of moisture from the concrete either by (1) a field applied, approved form oil or sealer, or (2) a factory applied non- absorptive liner. When forms are coated to prevent bond with concrete, it shall be done prior to placing of the reinforcing steel. Care shall be taken that such approved coating is kept out of contact with the reinforcement. Whereas cast finishes are required, materials, which will impart a stain to the concrete shall not be applied to the form surfaces. Where the finished surface is required to be painted, the material applied to form surface shall be compatible with the type of paint to be used.

s. In normal circumstances generally where temperatures are above 68°F (20°C) 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 directed by the ENGINEER.
-	Slabs (Shores or props left under, removal and refixing of props not permitted).	10 days
-	Beams soffits (Shores or props left under, removal and refixing of props not permitted).	12 days
-	Removal of shores or props to slabs:	
	1. Spanning upto 14 ft. (4 meters)	10 days
	2. Spanning over 14 ft. (4 meters)	21 days
-	Removal of shores or props of beams:	
	1. Spanning upto 20 ft. (6 meters)	18 days
	2. Spanning over 20 ft. (6 meters)	25 days

For rapid hardening cement 1/2 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.

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

u. 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.

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

w. All formwork shall be removed without such shock or vibration as would damage the reinforced concrete.

x. 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 duringreshoring shall concrete in beams, slab, columns or any other structural member be subject to combined dead and construction loads in excess of the load permitted by ENGINEER for the developed concrete strength at the time of reshoring. Reshores shall be placed simultaneously with stripping operations are but in no case later than the end of working day on which stripping occurs.

Reshores shall be tightened to carry their required loads without over stressing the concrete. Reshores shall remain in place at least until representative tests of the concrete being supported have reached the strength/time specified in 6.1.s.

y. 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 have a capacity equal to at least one half of capacity of theshoring system above. The reshores shall be located directly under a shore position above unless other locations are permitted.

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

No loads, other than those permitted by the ENGINEER in connection with the actual work in hand, shall be allowed on suspended floors until 28 days after concreting where ordinary Portland cement is used and 14 days when rapid hardening Portland cement is used.

z. It is required to give forms for reinforced concrete an upward camber to ensure that the beams or slabs including cantilever slabs do not have a sag when they have taken up their deflection. Camber, unless indicated otherwise on drawings, should be about l/240 for supported beams and slabs and l/180 for cantilevers.

6.2
Reinforcement:

a. All metal for reinforcement shall be free from loose mill scale, loose rust, mud, oil, grease, or other harmful matter immediately before the concrete is placed.

b. Reinforcement is to be accurately placed as shown in the Drawings, and secured against displacement by using 18-20 gauge black annealed wire ties or suitable slips at intersections and supported from the formwork by using concrete, metal or plastic chairs and spacers or hangers of an approved pattern. Where concrete blocks are used for ensuring the cover they shall be made of mortar not leaner than 1 part of cement to 2 parts of sand. Where the concrete surface will be exposed to the weather in the finished structure the portions of all accessories in contact with the formwork shall be galvanized or shall be made of plastic.

c. Bars used for concrete reinforcement shall be fabricated in accordance with the dimensions shown in the Bending Schedule.

d. The cutting tolerance for all bars shall be +/-1" (+/- 25 mm).

e. 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

DIMENSIONS OF BENT BARS				**TOLERANCE**			
Over		Upto and Including		Plus		Minus	
Inches	(mm)	Inches	(mm)	Inches	(mm)	Inches	(mm)
--	--	36	900	1/8	3	1/4	6.0
36	900	72	1800	1/4	6.0	1/2	12.0
72	1800	--	--	1/2	12.0	1	25.0

f. Bars shall be placed to the following tolerances:

i. Concrete cover to formed surface:
+/- 1/4" (6.0 mm)

ii. Minimum spacing between bars:
+/- 1/4" (6.0 mm)

iii. Top bars in slabs and beams:

* Members 8" (200 mm) deep or less:
+/- 1/4" (6.0 mm)

* Members more than 8" (200 mm) but not over 24" (600 mm) deep:
+/- 1/2" (12.0 mm)

* Members more than 24" (600 mm) deep:
+/- 1" (25 mm)

iv. Crosswise of member:
spaced evenly
within 1" (25 mm)

v. Lengthwise of members:
+/- 2" (50 mm)

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

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

i. Reinforcement shall not be bent or straightened in a manner that will injure the material. No bars shall be bent twice in the same place, nor shall they be straightened after bending.

Unless permitted by the ENGINEER, reinforcement shall not be bent after being partially embedded in hardened concrete. Bars which depend for their strength on cold working shall not be heated for any reason (except for welding) Reinforcement larger than 1-1/2" (38.0 mm) in dia may be bent by the use of heat at (not exceeding 1550 °F). Bars bent shall not be cooled by quenching.

j. No splice of reinforcement shall be made except as shown on the working Drawings.

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

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

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

6.3
Batching:

a. All cement, including cement supplied in bulk, shall be batched by weight. A bag of cement, unless marked otherwise, may be taken as 112 lbs (50 kg) or as directed by the ENGINEER

b. Aggregate shall be batched by weight, due allowance being made for water content. Aggregate may be batched by volume only with the prior permission of ENGINEER. The apparatus for weight batching may be an integral part of the mixer or a separate unit of a type approved by ENGINEER.. It shall be accurate within 2% and shall be checked for accuracy at least once a week.

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

d. Where volumetric batching of aggregate is permitted gauge boxes shall be provided for measuring the coarse and the fine aggregate. These shall be **deep and narrow rather than shallow and wide.** Tests for the bulking of sand shall be made at intervals and the necessary quantity of sand added.

e. Each batch shall be so charged into the mixer that some water will enter in advance of the cement and aggregates. Water shall continue to flow for a period which may extend to the end of the first 25 percent of the specified mixing time.

6.4
Mixing:

a. The concrete shall be mixed in an approved batch mixer conforming to the requirement of B.S 1305. It shall be fitted with the manufacturer's plate stating the rated capacity and the recommended number of revolutions per minute and

shall be operated in accordance therewith. It shall be equipped with a suitable charging mechanism and an accurate water measuring device.

b. Mixing shall continue for the period recommended by the mixer manufacturer or until apparently the mix is uniform in color, whichever period is longer. If it is desired to use a mixing period less than 1-1/2 minute ENGINEER's approval shall be obtained in writing.

c. Controls shall be provided to ensure that the batch cannot be discharged until the required mixing time has elapsed. At least three quarters of the required mixing time shall take place after the last of the mixing water has been added.

d. The interior of the mixer shall be free of accumulations that will interfere with mixing action. Mixing blades shall be replaced when they have lost 10% of their original height.

e. Concrete shall be mixed only in quantities for immediate use. Concrete which has set shall not be retempered, but shall be discarded.

6.5
Transport:

a. The concrete shall be transported from the place of mixing to the place of final deposit as rapidly as practicable by means which will prevent segregation or loss or addition to ingredients. It shall be deposite as nearly as practicable in its final position so as to avoid rehandling or flowing. All skips vehicles, or containers used for transporting the concrete shall be thoroughly cleaned.

b. During hot or cold weather, concrete shall be transported in deep containers to minimize the loss of water/heat.

6.6
Placing:

a. Before placing of concrete, formwork shall have been completed, water shallhave been removed, reinforcement shall have been secured in place, expansion joint material, anchors, and other embedded items shall have been kept in position, and the entire preparation shall have been approved.

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

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

d. The concrete shall be placed after it has been mixed as soon as is practicable. Once the concrete has left the mixer no more water shall be added, although the concrete may be mixed or agitated to help maintain workability. The concrete shall not be used if, through any cause, the workability of the mix at the time of placing is too low for it to be compacted fully and to an acceptable finish by whatever means are available.

The time between mixing and placing should be reduced if the mix is richer or the initial workability of the mix is lower than normal, if a rapid hardening cement or an accelerator is used, or if the work is carried out at a high temperature or exposed to a drying atmosphere. CONTRACTOR shall ensurethat the delay between mixing and placing does not exceed 30 minutes under any circumstances. Any concrete which does not satisfy this requirement shall not be used.

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

f. The free fall of concrete shall not be allowed to exceed eight feet and where it is necessary for the concrete to be lowered more than this amount, it is not to be dropped into its final position, but it is to be placed through pipe, the lower end of which shall be kept in, or close to the freshly deposite concrete. The dia. of the pipe shall be not less than 4 times the maximum size of aggregate.

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

h. The workmen carrying concrete to the SITE, and all other workmen moving about before the concrete is placed shall move only along runways or planks placed over the forms.

i. Prior to the laying of concrete on load bearing masonry walls, bearing plates and at other points, as may be directed by ENGINEER, the surface will be brought to a true, hard smooth, level using a cement sand mortar in the ratio of 1 volume of cement to 3 volumes of sand. Two layers of building paper weighing 1.3 oz/sq. ft (400 g/m) will then be laid flat to separate the concrete from the surface on which it is to be laid.

6.7
Construction Joints:

a. Concreting shall be carried out continuously upto construction joints, the position and arrangement of which shall be pre-determined with the approval of the ENGINEER.

b. Joints not shown on the Drawings shall be so made and located as to least impair the strength of the structure and shall need prior approval of ENGINEER. In general, they shall be located near the middle of the spans of slabs and beams unless a secondary beam intersects a main beam at this point, in which case the joint in the main beam shall be offset to a distance equal to twice the width of the secondary beam. Joints in walls and columns shall be at the underside of floors

slab or beams, and at the top of footings. Beams, brackets, columns, capitals, haunches, and drop panels shall be placed at the same time as slabs. Joints shall be perpendicular to the main reinforcement.

c. All reinforcing steel shall be continued across joints. Key and inclined dowels shall be provided as directed by ENGINEER. Longitudinal keys at least 1- 1/2" (40 mm.) deep shall be provided in all joints in walls and between walls and slab or footings.

d. When the work is to be resumed on a surface which has hardened, such surface shall be roughened in an approved manner which will expose the aggregate uniformly and will not leave laitance, loosened particles of aggregate or damaged concrete at the surface.

e. The hardened concrete of construction joints and of joints between footings and walls or columns, between walls or columns and beams or floors they support,

joints in un-exposed walls and all others not mentioned below shall be dampened (but not saturated) immediately prior to placing of fresh concrete.

f. The hardened concrete of joints in exposed work, joints in the middle of beams, and slabs and joints in work designed to contain liquids shall be dampened (but not saturated) and

then thoroughly covered with a coat of cement grout of similar proportions to the mortar in the concrete. The grout shall be as thick as possible on vertical surface and at least 1/2" (12.0 mm) thick on horizontal surface. The fresh concrete shall be placed before the grout has attained its initial set.

g. Where the concrete has not fully hardened, all laitance shall be removed by scrubbing the wet surface with wire or bristle brush. Care being taken to avoid dislodging of particles of aggregate. The surface shall then be coated with neat cement grout. The first layer of concrete to be placed on this surface shall not exceed 6" (150 mm) in thickness, and shall be well rammed against old work, particular attention being paid to corners and close spots.

h. Stop ends for movement joints or construction joints shall be made by splitting them along the lines of reinforcement or the concrete. Stop ends made of expanded metal or similar material may only be left permanently in the concrete with prior written approval of ENGINEER. Where such stop ends are used, no metal may be left permanently in the concrete closer to the surface of the concrete than the specified cover to the reinforcement. Wood strips inserted for architectural treatment shall be kerfed to permit swelling without pressure on the concrete.

6.8
Embedded Items:

a. The material, design and location of waterstops in joints shall be as indicated in the Drawings. Each piece of premolded water stop shall be of maximum practicable length in order that the number of end joints will be held to a minimum.

Joints at intersections and at end of pieces shall be made in the manner most appropriates to the material being used. Joints shall develop effective

watertightness fully equal to that of the continuous water-stop material, and shall permanently develop not less than 50% of the mechanical strength of the parent section, and shall permanently retain their flexibility.

b. Electric conduits and other pipes which are planned to be embedded shall not, with their fittings, displace more than four percent of the area of the cross sectionof a column on which stress is calculated or which is required for fire protection. Sleeves, conduits, or other pipes passing through floors, walls, or beams shall be of such size or in such location so as not to impair unduly the strength of the construction. Such sleeves, conduits in compression in the displaced concrete, provided that they are not exposed to rusting or other deterioration, are of uncoated or galvanized iron or steel not thinner than standard steel pipe, have a nominal inside diameter not over 2" (50 mm) and are spaced at centers not less than thrice their diameter. Except when plans of conduits and pipes are approved by ENGINEER embedded pipes or conduits other than those merely passing through, shall not be larger in outside diameter than one-third the thickness of theslab, walls, or beam in which they are embedded nor shall be spaced closer than three diameters on center, nor so located as to impair unduly the strength of the construction. Sleeve pipes, or conduits with-in the limitations of this section may be embedded in concrete with the approval of ENGINEER, provided they are not considered to replace the displaced concrete.

c. All sleeves, inserts, anchors, and embedded items required for adjoining work or for its support shall be placed prior to concreting.

All Contractors whose work is related to the concrete or must be supported by it shall be given ample notice and opportunity to introduce and/or furnish embedded items before the concrete is placed.

d. Expansion joint material, waterstops and other embedded items shall be positioned accurately and supported against displacement. Voids in sleeves, inserts, and anchor slots shall be filled temporarily with readily removable material to prevent the entry of concrete into the voids.

6.9
Consolidation:

a. All concrete shall be consolidated by vibration, so that the concrete is thoroughly worked around the reinforcement, around embedded items, and into corners of form, eliminating all air or stone pockets which may cause honeycombing, pitting, or planes of weakness. Internal vibrators shall have a minimum frequencyof 800 vibrations per minute and sufficient amplitude to consolidate the concrete effectively.

Vibrators shall be inserted and withdrawn at points approximately 18" apart (450 mm). At each insertion, the duration shall be sufficient to cause consolidation, generally from 5 to 15 sec. A spare vibrator shall be kept on the SITE during all concreting operations. Where the concrete is to have an as-cast finish, a full surface of mortar shall be brought against the form by the vibration process supplemented if necessary by spading to work the coarse aggregate back from theformed surface.

b. If there is any tendency for the mix to segregate during consolidation, particularly if this produces excessive laitance, the mix proportions shall bemodified to affect an improvement in the quality of the concrete to the satisfaction of ENGINEER and in conformity with the provisions of Clause 5.

c. Vibrators shall not be allowed to contact the formwork for exposed concrete surface.

d. Mechanical vibrators shall be of a type suited in the opinion of ENGINEER to the particular conditions.

e. Over-vibration or vibration of very wet mix is harmful and should be avoided.

6.10
Curing and Protection:

a. Beginning immediately after placement, concrete shall be protected from premature drying, excessively hot or cold temperatures, and mechanical injury, and shall be maintained with minimal moisture loss at a relative constant temperature for the period necessary for hydration of the cement and hardeningof the concrete. The materials and methods of curing shall be subject to approval of ENGINEER.

b. For concrete surfaces not in contact with forms, one of the following procedures shall be applied immediately after completion and finishing:

- Ponding or continuous sprinkling.
- Application of absorptive mats or fabric kept continuously wet.
- Application of water proof sheet materials approved by ENGINEER.
- Application of other moisture retaining covering as approved.
- Application of curing compound conforming to ASTM C 309. The compound shall be applied in accordance with the recommendations of the

manufacturer immediately after any sheen which develops after finishing has disappeared from the concrete surface. It shall not be used on any surface against which additional concrete or other materials to be bonded unless it is proved that the curing compound will not prevent bond, or unless positive measures are taken to remove it completely fromarea to receive bonded applications.

c. Moisture loss from surface placed against wooden forms or metal forms exposed to heating by the sun shall be minimized by keeping forms wet until they can be safely removed. After form removal, the concrete shall be cured until the end of the limit prescribed in Clause 6.10.d by one of the methods of Clause 6.10.b.

d. Curing in accordance with clause 6.10.a & 6.10.b shall be continued for at least 14 days in the case of all concrete except concrete with Rapid hardening Portland cement for which the period shall be at least 7 days.

Alternatively, if tests are made of cylinders/cubes kept adjacent to the structure and cured by the same methods, moisture retention measures, unless stated otherwise on drawings, may be terminated when the average compressive strength has reached 70 percent of the minimum specified works strength. If one of the first four curing procedures of clause 6.10.b is used initially, it may be replaced by one of the other procedures of that Clause any time provided the concrete is not permitted to become surface dry during the transition.

e. When the mean daily outdoor temperature is less than 41-degree F (5 C) then temperature of the concrete shall be maintained between 50-68°F (10°C-20°C) for the required curing period of Clause 6.10.d. When necessary arrangements for heating, covering, insulation or housing the concrete work shall be made in advance of placement and shall be adequate to maintain the required temperature without injury to concentration of heat. Combustion heaters shall not be used during the first 24 hours unless approved precautions are taken to prevent exposure of the concrete to exhaust gases which contain carbon dioxide.

f. When necessary, provision for windbreak, shading for spraying, sprinkling, ponding or wet covering with a light-colored material shall be made in advance of placement, and such protective measures shall be taken as quickly as concrete hardening and finishing operations will allow.

g. Changes in temperature of the air immediately adjacent to the concrete during and immediately following the curing period shall be kept as uniform as possible and shall not exceed 5°F (3°C) in any one hour or 50°F (28°C) in any 24-hour period.

h. During the curing period, the concrete shall be protected from damaging mechanical disturbances, such as load stresses, heavy shock and excessive vibration. All finished concrete surfaces shall be protected from damage by construction equipment, materials or methods by application of curing procedures, and by rain or running water, self-supporting structures shall not be loaded in such a way as to over stress the concrete.

6.11
Works in Extreme Weather:

a. Unless adequate protection is provided and approval is obtained concrete shallnot be placed during rain. Rain water shall not be allowed to increase the mixing water nor to damage the surface finish.

b. When the temperature of the surrounding air is expected to be below 40 degrees F (4.4 C) during placing or within 24 hours thereafter, the temperature of the plastic concrete, as placed shall be no lower than 55 degrees F (13 - C) for sections less than 12" (300 mm) in any dimension nor 50°F (10°C) for any othersections.

When necessary, concrete materials should be heated before mixing and carefully protected after placing; in general, heating of mixing water alone to about 140°F (60°C) may be sufficient for this purpose. Dependence should not be placed on salt or other chemicals for the prevention of freezing. No frozen material or materials, containing ice shall be used. All concrete damaged by frost shall be removed. It is recommended that concrete exposed to the action of freezing weather should have entrained air and the water content of the mix should not exceed 5.5 gallons (25 liters) per bag of cement. If water or aggregate is heated above 100°F (38°C) the water shall be combined with the aggregate in the mixer before cement is added. Cement shall not be mixed with water or with mixtures of water and aggregate having a temperature greater than 100°F (38°C).

c. During hot weather, the temperature of the concrete as placed shall not be so high as to cause difficulty from loss of slump, flash set, or cold joints and should not exceed 90°F (32.°C). For massive concrete this temperature should not exceed 70°F (21.°C). When the temperature of the concrete exceeds 90°F (32°C), precautionary measures approved by ENGINEER shall be put into effect.When the temperature of the steel is greater than 122°F (50°C) steel forms and reinforcement shall be sprayed with water just prior to placing the concrete. The ingredients shall be cooled before mixing, or flake ice or well-crushed ice of a size that will melt completely during mixing may be substituted for all or part of the mixing water if, due to high temperature, low slump, flash set or cold joints are encountered.

Other precautions recommended by ACI standard 305R-91 shall also be adopted.

7.
TEST FOR CONCRETE QUALITY

7.1
General:

CONTRACTOR shall provide samples of concrete for testing at ENGINEER's direction. Proper facilities shall be provided for making and curing the test specimens in accordance with the specifications. A competent person shall be employed by CONTRACTORwhose first duty shall be to supervise all stages in the preparation and placing of the

concrete. All test specimens shall be made and SITE tests carried out under his direct supervision and at CONTRACTOR's cost.

7.2
Samples:

Conduct strength tests on at least one test sample per 50 cubic yards of concrete (38 cu meters) with a minimum of one sample per concrete pour. Each test sample shall consist of no less than

three concrete test cylinders/cubes made from a single sample of concrete from a randomly selected batch of concrete, taken at point of discharge from mixer or truck, cured under standard conditions. One cylinder/cube from each sample shall be tested at age 3 days and two at age 28 days unless otherwise directed by the ENGINEER.

7.3
Adequacy of Mix:

In case of Concrete mix, the appropriate strength requirement shall be considered to be satisfied if none of the strengths of the specimen is below the specified strength or if the average strength of the three specimens is not less than the specified strength and the difference between the greatest and least strengths is not more than 20% of that average.

When the results of tests show that the strength of any concrete is below the minimum specified, ENGINEER may give instructions for the whole or part of the work concerned to be removed and be replaced at the expense of CONTRACTOR. CONTRACTOR shall

bear the cost of any other part of his, or any other CONTRACTOR’s work, which has to be removed and replaced as a result of the defective concrete. If any concrete is held to have failed, ENGINEER may order the proportions of that class of concrete to bechanged in order to provide the specified strength.

8.
FINISHING OF FORMED CONCRETE

8.1
General:

a. After removal of forms the surfaces of concrete shall be given one or more of the finishes specified below in locations designated by the Drawing or as specified in Clause 8.5.

b. When finishing is required to match a small sample furnished to CONTRACTOR, the sample finish shall be reproduced on an area at least 100 square feet in an inconspicuous location designated by ENGINEER before proceeding with the finish in the specified location.

8.2
As-Cast Finishes:

a. Rough Form Finish:

No selected form facing materials shall be specified for rough form finish surfaces. Tie holes and defects shall be patched, Unless if required to be retained if so directed by ENGINEER. Fins exceeding 1/4" (6 mm) in height shall be chipped off or rubbed off. Otherwise, surfaces shall be left with the texture imparted by the forms.

b. Smooth Form Finish:

The form facing material shall produce a smooth hard uniform texture on the concrete.

It may be plywood, tempered concrete-form grade hardboard, metal, plasticpaper, or other approved material capable of producing the desired finish. The arrangement of the facing material shall be orderly and symmetrical, with the number of seams kept to the practical minimum. It shall be supported by studs or other backing capable of preventing excessive deflection. Material with raised grain, torn surfaces, worn edge, patches, dents, or other defects which will impair the texture of the concrete surface shall not be used. Tie holes and defects shall be patched. All fins shall be completely removed.

8.3
Architectural Finishes:

a. Textured Finishes:

Textured form liners may be of formed plastic sheet, wood, sheet metal, or other material designated in Drawings. Liner panels shall be secured in forms by cementing or stapling, but not by methods which will permit impressions of nail heads, screw heads washers, or the like to be imparted to the surface of the concrete, unless shown otherwise on the Drawings. Edges of textured panels shall be sealed to each other or to dividing strips, if specified or shown, to prevent bleeding of grout. The sealant used shall be non-staining to the surface.

b. Applied Finishes:

When finishes of plaster or similar trowelled materials are to be applied, the surface of the concrete shall be prepared to ensure permanent adhesion of the finish. If the concrete is less than 24 hours old, it can be roughened with a heavy wire brush or scouring tool. If the concrete is older the surface may be roughenedmechanically or by etching with dilute hydrochloric acid. After roughening, the surface shall be washed free of all dust, acid, chemical retarder, and other foreignmaterial before the final finish is applied.

8.4
Rubbed Finishes:

The following finishes shall be produced on concrete with a smooth form finish. Where smooth rubbed finish is to be applied, the forms shall have been removed and necessary patching completed as soon after the placement of the concrete as possible without compromising any structural requirements.

a. Smooth Rubbed Finish:

Smooth rubbed finish shall be produced on newly hardened concrete not later than a day following form removal.

Surfaces shall be wetted and rubbed with carborundum brick or other abrasive until uniform color and texture are produced. No cement grout shall be used otherthan the cement paste drawn from the concrete itself by the rubbing process.

b. Grout Cleaned Finish:

No cleaning operations shall be undertaken until all contiguous surfaces to be cleaned are completed and accessible. Cleaning as the work progresses shall not be permitted.

Mix 1 part Portland Cement and 1-1/2 part fine sand with sufficient water to produce a grout having the consistency of thick paint. White Portland Cement shall be substituted for a part of the grey Portland Cement in order to produce a color matching the color of the surrounding concrete, as determined by a trial patch. Wet the surface of the concrete sufficiently to prevent absorption of water from the grout and apply the grout uniformly with a brush or a spray gun. Immediately after applying the grout, scrub surface vigorously with a cork float or stone and fill all air bubbles and holes. While the grout is still plastic, remove all excess grout by working the surface with a rubber float, sack or other means. After the surface whitens from drying (about thirty minutes at normal temperature) rub vigorously with clean burlap. The finish shall be kept damp for at least 36 hours after final rubbing.

c. Cork Floated Finish:

1. Remove forms at an early stage, within 2 to 3 days of placement where

possible.

2. Remove ties, and all burrs and fins.

3. Mix 1 part Portland cement and 1 part fine sand with sufficient water to produce a stiff mortar.

4. Dampen surface.

5. Apply mortar with firm rubber float or with trowel, filling all surface voids.

6. Apply a small amount of water with a fog spray to prevent too rapid drying of compressed mortar.

7. Apply a small amount of water with a fog sprayer.

8. Produce the final texture with a cork float using a swirling motion.

8.5

Unspecified Finishes:

If the finish is not designated in the Drawings, the following finishes shall be used as applicable:

a. Rough Form Finish:

For all concrete surface not exposed to public view and / or are specified to have subsequent finishing.

b. Smooth Form Finish:

For all concrete surfaces exposed to public view and or are not required to have subsequent finishing.

8.6
Related Unformed Surfaces:

Tops of walls or buttresses, horizontal offsets, and similar unformed surfaces occurring adjacent to formed surfaces shall be struck smooth after concrete is placed and shall be floated to a texture reasonably consistent with that of the formed surfaces. Final treatment on form surfaces shall continue uniformly across the unformed surfaces.

9.
REPAIR OF SURFACE DEFECTS:

9.1

General:

a. Any concrete failing to meet the specified strength or not formed as shown on Drawings, concrete with surface beyond tolerances or with defective surfaces which cannot be properly repaired or patched in the opinion of ENGINEER shall be removed and replaced at CONTRACTORS's expenses. ENGINEER may reject any defective concrete and order it to be cut out in part or in whole and replaced at the CONTRACTOR's expense. Only in case of minor surface defects, ENGINEER may approve a surface treatment in accordance with the Clause. 9.2

b. All ties and bolt holes and all repairable defective areas shall be patched immediately after the removal of forms.

9.2
Repair of Defective Areas:

a. All honeycombed and other defective concrete shall be removed down to sound concrete. The area to be patched and area at least 6" (150 mm) wide surrounding

it shall be dampened to prevent absorption of water from the patching mortar. A bonding grout shall be prepared using a mix of approximately 1 part cement to 1 part fine sand or an approved bonding agent shall then be well brushed/ applied into the surface.

b. The patching mixture shall be made of the same material and of approximately the same proportions as used for the concrete, except that the coarse aggregate shall be omitted and the mortar shall consist of not more than 1 part cement to 2- 1/2 parts sand by damp loose volume. White Portland cement shall be substitutedfor a part of the grey Portland cement on exposed concrete in order to produce a color matching the color of the surrounding concrete, as determined by a trial patch.

c. The quantity of mixing water shall be not more than necessary for handling and placing. The patching mortar shall be mixed in advance and allowed to stand with frequent manipulation with a trowel, without addition of water, until it has reached the stiffest consistency that will permit placing.

d. After surface water has evaporated from the area to be patched, the bond coat shall be well brushed into the surface. When the bond coat begins to loose the water sheen, the

premixed patching mortar shall be applied. The mortar shall be thoroughly consolidated into place and struck off so as to leave the parch slightly higher than the surrounding surface to permit initial shrinkage; it shall be left undisturbed for at least one hour before being finally finished. The patched area shall be covered by approved curing compound, except as specified in Clause 9.2 g. Metal tools shall not be used in finishing a patch in a formed wall which will be exposed.

e. Where as-cast finishes are specified, the quantity of patched area shall be strictly limited. The combined total of patched areas in as-cast concrete surfaces shall not exceed 2 square ft. in each 1000 square feet (2 sq. m in each 1000 sq.m) of as-cast surface. This is in addition to form tie patches, if the project design permits to fall within as-cast areas.

f. Any patches in as-cast architectural concrete shall be indistinguishable from surrounding surfaces. The mix formula for patching mortar shall be determinedby trial to obtain a good color match with the concrete when both patch and concrete are cured and dry. After initial set, surface of patches shall be dressed manually to obtain the same texture as surrounding surfaces.

g Patches in architectural concrete surfaces shall be cured for 7 days. Patches shall be protected from premature drying to the same extent as the body of the concrete.

9.3
Tie and Bolt Holes:

After being cleaned and thoroughly dampened, the tie and bolt holes shall be filled solid with patching mortar.

9.4
Proprietary Materials:

If permitted or required by ENGINEER proprietary compounds for adhesion or as patching ingredients may be used in lieu of or in addition to the foregoing patching procedures. Such compounds shall be used in accordance with the manufacturer's recommendation with prior approval of ENGINEER.

10.
CONCRETE CONSTRUCTION TOLERANCE

Where tolerances are not stated in the Specifications or Drawing for any individual structure or feature, maximum permissible deviations from established lines, grades and dimensions shall conform to the following. The CONTRACTOR is expected to set and maintain concrete forms so as to ensure completed work within the tolerance limits. These allowable tolerances shall not relieve CONTRACTOR of his responsibility for correct fitting of indicated materials. These tolerances are not cumulative.

10.1
Variation from the plumb
(or as specified for sloped walls).

a. In the lines and surfaces of columns, piers and walls.

*	In any 10 ft (3 m) of length or height:	1/4" (6 mm)
*	In any storey or 20 feet (6 meters) Max:	3/8" (10 mm)
*	Maximum for the entire length or height:	3/4" (20 mm)

b. For exposed corner columns, control joint grooves and other conspicuous lines.

* In any bay or 20 feet (6 meters) maximum: 1/4" (6 mm)

* Maximum for the entire length or height: 1/2"(12.0 mm)

10.2
Variation from the levels or the grades indicated on Drawings:

a. In floors, ceilings, beam soffits, and in arrises.

* In any 10 feet (3 meters) of length: 1/4" (6 mm)

* In any bay or 20 feet (6 meters) feet maximum: 3/8" (10 mm)

* Maximum for the entire length: 3/4"(20 mm)

b. For exposed lintels, sills, parapets, horizontal grooves, and other conspicuous lines:

* In any bay or 20 feet(6m) maximum: 1/4" (6 mm)

* Maximum for the entire length: 1/2"(12.0 mm)

10.3
Variation of the entire building lines from established position in plan and related position of columns, walls and partitions.

a. In any bay or 20 feet (6 m) maximum: 1/2" (12.0 mm)

* Maximum for the entire length: 1" (25 mm)

10.4
Variation of the size and locations of sleeves, floors openings and wall openings:
1/4" (6 m)

10.5
Variation in cross-sectional dimensions of columns and beams and in the thickness of slabs and walls.

Minus: 1/4" (6 mm)
Plus: 1/2" (12.0 mm)

10.6 Footings:

a. Variations in dimensions in plan.

* Minus: 1/2"(12.0 mm)

* Plus (plus variation applied to concrete only, not to bars dowels): 2" (50 mm)

b. Misplacement or eccentricity of concrete.

* 2 percent of the footing width in the direction of misplacement but not more than 2"(50 mm)

c. Reduction in thickness

* Minus 5 percent of specified thickness.

10.7 Variation in Steps

a. Rise: 1/8" (3 mm)

Tread: 1/4" (6 mm)

b. In consecutive steps

Rise: 1/16" (1.0 mm)

Tread: 1/ 8" (3 mm)

10.8 Tolerance for Precast Concrete:

Forms must be true to size and dimensions of concrete members shown on the plans and be so constructed that the dimensions of the finished product will be within the following limits at the time of placement of these units in the structure, unless otherwise noted on ENGINEER's Drawings.

a. Overall dimensions of members per 10 ft (3 mm): +/- 1/16" (1.0 mm)

b. Cross-sectional dimensions Section less than 3"(75 mm): +/- 1/16" (1.0 mm)

Section over 3" (75 mm) less

than 18" (450 mm): +/- 1/ 8" (3 mm)

Section over 18" (450 mm): +/- 1/ 4" (6 mm)

c. Deviations from straight lines in long sections. Not more than 1/8 inch per10 ft (3mm / 3 m).

d. Deviation from specified camber +/- 1/16" (1.5 mm) per 10 ft (3m) of span. Maximum differential between adjacent units in erected position 1/4 inch (6 mm).

10.9
Tolerance for Pavements:

a. Ramps

* Departure from established alignment +/- 1/2 inch (12.0 mm).

* Departure from established longitudinal +/- 1/4" (6 mm) grade on any line.

* Departure from transverse template contour except at transverse joints +/- 1/8 inch (+/- 3 mm).

* Departure from transverse template control at transverse joints +/- 1/4"(+/-6 mm) in width of one traffic lane.

10.10
Pavements for Parking Areas:

Twice values listed for ramp pavements.

11.
ACCEPTANCE OF STRUCTURE

11.1
General:

a. Completed concrete work which meets all applicable requirements will be accepted subject to the other terms of the CONTRACT Documents.

b. Completed concrete work which fails to meet one or more requirements and which has been repaired to bring it into compliance will be accepted subject tothe other terms of the CONTRACT Documents.

c. Completed concrete work which fails to meet one or more requirements and which cannot be brought into compliance may be accepted or rejected as provided in these Specifications or in the CONTRACT Documents. In this event, modifications complies with the requirements.

11.2
Dimensional Tolerances:

a. Formed surfaces resulting in concrete outlines smaller than permitted by the tolerances of Section 10 considered potentially deficient in strength and subject to the provisions of Section 11.4.

b. Formed surfaces resulting in concrete outlines larger than permitted by the tolerances of Section 10 may be rejected and the excess material shall be subject to removal. If removal of the excess material is permitted, it shall be accomplished in such a manner as to maintain the strength of the section and to meet all other applicable requirements of function and appearance. Permission is required if excess material is to be removed in accordance with this Section.

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11.3
Appearance:

a. Architectural concrete with surface defects exceeding the specified limitations shall be removed in accordance with this Section.

b. Concrete members cast in the wrong location may be rejected if the strength, appearance or function of the structure is adversely effected or misplaced items interfere with other construction.

c. Inaccurately formed concrete surfaces exceeding the limits of Section 6 & of Section 10 and which are exposed to view, may be rejected and shall be repaired or removed and replaced if required.

d. Other concrete exposed to view with defects which adversely affect the appearance of the specified finish may be repaired only by approved methods.

e. Concrete not exposed to view, but of defective appearance, may be accepted at the discretion of the ENGINEER.

11.4
Strength of Structure:

a. The strength of structure in place will be considered potentially deficient if it fails to comply with any requirements which control the strength of the structure, including but not necessarily limited to the following conditions:

- Concrete strength requirements not considered to be satisfied in accordance with Section 7.

- Reinforcing steel size, quantity, strength, position or arrangement at variance with the requirements of Section 4.4 & 6.2 of the CONTRACT Documents.

- Concrete which differs from the required dimensions or location in such a manner as to reduce the strength.

- Curing less than that specified.

- Inadequate protection of concrete from extreme temperature during the early stages of hardening and strength development.

- Mechanical injury, construction fires, accidents or premature removal of formwork likely to result in deficient strength.

- Poor workmanship likely to result insufficient strength.

b. Structural analysis and/or additional testing may be required when the strength of the structure is considered potentially deficient.

c. Core tests may be required when the strength of the structure is considered potentially deficient.

d. If core tests are inconclusive or impractical to obtain or if structural analysis does not confirm the safety of the structure, load tests may be required and their results evaluated in accordance with ACI Standard 318.

e. Concrete work judged inadequate by structural analysis or by results of a load test shall be reinforced with additional construction, if so directed byENGINEER or shall be replaced, at the CONTRACTOR's expense.

f. The CONTRACTOR shall pay all costs incurred in providing the additional testing and/or analysis required by this Section.

g. THE OWNER will pay all costs of additional testing and/or analysis which is made at his request and which is not required by specifications, or the CONTRACT Documents.

12.
METHODS OF MEASUREMENT OF CONCRETE WORKS

12.1
General:

a. Unless otherwise specifically stated in the Bill of Quantities, or herein, all items shall be deemed to be inclusive of, but not limited to, the following:

i. Labor/plant and all costs in connection therewith.

ii. Materials, goods and all costs in connection therewith, e.g. conveyance, delivery, unloading, storing, returning, packing, handling, hoisting, lowering.

iii. All fixtures and all costs in connection therewith for precast works.

iv. Fitting and fixing materials and goods in position.

v. Waste of materials, and Square cutting.

vi. Mixing, transporting, hoisting, placing in from at any level, compacting through vibration & curing etc. complete including the cost of formwork & its removal (but excluding cost of reinforcement).

vii. Establishment charges, overhead charges and profit.

viii. All other expenses, charges and taxes specified in Conditions of CONTRACT.

b. Works shall be measured net as fixed in position as per drawings and instructions of ENGINEER. Each measurement shall be taken to the nearest 1/2" (12.0 mm). This rule shall not apply to any dimensions stated in the descriptions.

12.2
Concrete:

a. Concrete shall be measured as executed but no deduction shall be made for the following:

- Volume of any steel embedded in the concrete.

- Volume occupied by water pipes, conduits etc., not exceeding 4 square inch (2500 sq. mm) each in cross-sectional area.

- Voids not exceeding 1 square foot in work given in square feet and 0.1 sq M in work given in Sq Meters. If any void exceeds above limit total void shall be deducted.

- Voids not exceeding 1 cubic foot in work given in cubic feet, 0.03 cubic meter in work given in cubic meter. If any void exceeds above limits, unit total void shall be deducted.

b. Voids, which are not to be deducted as per Section 12.2.a 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 size.

c. Junctions between straight and curved works shall in all cases be deemed to be included with the work in which they occur.

d. Concrete work shall be classified and measured separately as follows unless otherwise described elsewhere:-

- Buildings, foundation beams, foundation slabs, footings, bases of columns, machine foundations, mass concrete etc., in cubic feet (Cu Meter).
- Floor slabs on ground with floor beams in cubic feet (Cubic Meter).
- Walls in foundations, plinth and superstructure in cubic feet (Cubic Meter) stating thickness.
- Columns, piers, pilasters, pillars etc., in cubic feet (Cubic meter).
- Lintels, beams and brackets in cubic feet (Cubic Meter).
- Suspended floors, roofs and stair landings in square feet (sq. Meter) stating thickness.
- Stairs (excluding landing) in cubic feet (Cubic Meter).
- Railings in cubic feet (Cubic Meter), square feet (Sq. Meter), or linear feet (Meter) stating description.
- Parapets, purdees and the like in cubic feet (Cubic Meter) stating thickness.
- Jali, blocks in square feet (Sq. Meter) stating thickness & description.
- Precast concrete items shall each be enumerated except if otherwiseshown in the Bill of Quantities, separately stating the description.

e. Measurement of walls shall be taken between attached columns, piers or pilasters. The thickness of attached columns, piers or pilasters shall be taken as the combined thickness of the wall and the columns, piers or pilasters. Attached or isolated columns, piers, pilasters and the like (except where caused by openings) having a length on plan not exceeding four times the thickness shall beclassified as columns. Those having a length over four times the thickness and caused by openings in walls shall be classified as walls.

Columns shall be measured from the top of footings/beams or floor surfaces to the under side of beams or slabs as the case may be. Where the width of the beams is less than the width of columns, the extra width at the junction shall be included in the beam.

The depth of the beams shall be measured 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 below or above the slab.

12.3
Formwork:

a. Formwork (if separate and extra payment is specifically stated in the Bill of Quantities) shall be measured in square feet (Sq. M) as the actual surface of the finished structure which required to be supported during the deposition of the concrete, including the upper surfaces to the work sloping more than 15 degree from the horizontal. No allowance shall be made for overlaps and passing at angles and no deduction shall be made for the following:-

- Voids not exceeding ten square feet (1 Sq. m).
- Intersections of main beams with walls or columns.
- Intersections of secondary beams with main beams.

b. Formwork shall be deemed to be inclusive of, but not limited to items detailed in section 12.1 and the following:-

- Batten, struts, reversed cut strings, bolting, oiling, wedging, easing, striking, removing and making good exposed faces of concrete after removal of formwork. Also yokes, wales sheathing, jack rods, jacks, working platforms and finishers, scaffolds, etc.

c. Forming chamfers not exceeding 2" (50mm) wide and forming splayed internal angles not exceeding 1/2" (12.0 mm) wide shall not be paid for extra.

d. Temporary stop ends for constructed joints shall not be measured and paid for.

e. Classification of formwork (if separate and extra payment is specifically stated in the Bill of Quantities) shall be as follows:-

- To horizontal or sloping soffits of suspended slabs, floors, roofs, staircases, landings and the like.
- To sloping upper surfaces of suspended slabs, floors, roofs and the like where more than 15 degree from horizontal.
- To vertical or battering sides of foundations, foundation beams and slabs, ground beams, machine foundations and the like.
- To vertical or battering sides of walls, solid balustrades and the like.
- To vertical or battering sides.
- To vertical or battering sides of stanchion casings, columns, piers, plasters and the like.

- To sides and soffits of openings in walls, recesses in walls, projecting panels on walls and the like.

- To sides and soffits of horizontal or sloping beam casings, beams, brackets, lintels, staircase, strings and the like.

- To sloping upper surfaces of beam casings, beams, brackets, lintels, staircase-strings and the like where more than 15 degrees from horizontal.

- To edges of beds, roads, footpaths, paving and the like.

- To edges of suspended slabs, floors, roofs, landing and the like.

- To risers of steps and staircases.

- To sides of kerbs, upstands and the like.

f. Formwork to throats, grooves, chases, rebates, chamfers over 2" wide (50 mm) splayed internal angles over 1/2" wide (12.5 mm) moldings and the like shall each be measured separately in linear feet stating the size.

12.4
Rate for Reinforcement:

a. The rate tendered for any type of reinforcement by the CONTRACTOR shall also be inclusive of the cost of binding wire wastages, and the cost of concrete, metal or plastic chairs and spacers or hangers, etc.

b. All reinforcement shall be provided in length shown in Drawings and as per Specifications.

Should the CONTRACTOR provide lengths of reinforcement which are greater than shown on the Drawings no payment of extra length shall be made. Overlaps, unless clearly shown in working Drawings, shall not be allowed and measured.

c. The CONTRACTOR shall be paid for reinforcement by weight computed from Table-2 and from linear measurements of reinforcements actually used at SITE as per the Drawings, Specifications and instructions of ENGINEER. No payment shall be made for steel chairs or wastage. CONTRACTOR shall not claim for the difference in the actual weights of bars and their standard weights given in Table -2.

TABLE-2:

Nominal Bar Diameter (Inches)[3]	Bar Number	Weight lbs/ft
1/4"	-	0.167
3/8"	# 3	0.376
1/2"	# 4	0.668
5/8"	# 5	1.043
3/4" .	# 6	1.502
7/8"	# 7	2.044
1"	# 8	2.670
1-1/8"	# 9	3.400
1-1/4"	#10	4.303
1-3/8"	#11	5.313
1-3/4"	#14	7.650
2-1/4"	#18	13.600

(mm)	(kg/m)
8	0.395
10	0.616
12	0.887
16	1.576
20	2.463
22	2.980
25	3.849
28	4.828
32	6.306
36	7.981

[3]To the nearest 1/8

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1. GENERAL

1.1 DESCRIPTION

1. Work included:

   Supply and install masonry accessory materials not specifically described in other Sections of these specifications but required for the construction of masonry unit walls indicated on the Drawings.

2. Items:

   Steel dowels indicated as being steel bars similar to plain or deformed types, normally used for the reinforcement of concrete.

1.2. SUBMITTALS

1. Within 120 days after award of Contract, and before any material is delivered to theJob Site, submit to the Engineer complete samples of masonry constituent/ accessories proposed to be furnished and installed.

1.3. PRODUCT HANDLING

1. Protection:

   Protect these materials before, during, and after installation and protect the installed work and materials of other trades.

2. PRODUCTS

1. Replacements:

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

2.1. MATERIALS

1. Where masonry accessories are required, and no material or thickness is indicated on the Drawings, furnish and install the highest quality.

2. Masonry accessories:

a) Control joint filler: Preformed rubber, neoprene or polyvinyl chloride materials of size and shape indicated on Drawings. Refer to Section 7900 Joint Sealants.

b) Steel dowels for tying masonry shall be 3/8 in. dia. (9mm) deformed reinforcing bar, coated with liquid galvanizing, in accordance with Section 3300 Cast-in-Place Concrete.

c) Wall ties: mild steel wire 1/2 in. by 1/2 in. (12mm x 12mm) mesh 3 ins (75mm) wide, galvanized to B.S. 729 after fabrication or galvanized butterfly type.

d) Rope made of jute for weep-hole vents.

e) Wall base Flashing: See Division 7.

f) Anchors:

i) Plate type: minimum 1/8 in. (3mm) galvanized steel, of shapes and sizes to suit purpose.

ii) Wire type: 1/4 in. (6mm) galvanized wire of shapes and sizes shown.

iii) Anchor bolts: including nuts, washers, studs, ferrules, and related items, of galvanized steel or brass, as detailed.

2.2.
OTHER MATERIALS

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

3.
EXECUTION
3.1.
INSTALLATION

1. Build-in anchors, plugs, lintels, ties, frames, inserts and other equipment or materials to be embedded in masonry work, as indicated on Drawing or specifications in section 4200.

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1. GENERAL

1.1 DESCRIPTION

1. Work included:

   Unit masonry required for this Work is indicated on the Drawings and includes the provision and installation of Concrete blocks, Clay bricks, brick work, coping units and related material both inside and outside the building.

1.2. QUALITY ASSURANCE

1. Qualifications of workmen:

   a) For the actual cutting and placing of masonry units, use only skilled masons who are thoroughly experienced with the materials and methods specified and thoroughly familiar with the design requirements.

   b) In acceptance or rejection of installed masonry units, no allowance will be made for lack of skill on the part of workmen.

   c) Provide one skilled mason who shall be present at all times during execution of the work of this Section and who shall personally direct the execution of this portion of the Work.

1.3. SUBMITTALS

1. Samples and Mock-ups:

   a) Within 120 days after award of Contract, and before any masonry materials are delivered to the Job Site, submit six samples of the proposed masonry units and colour samples of mortar to the Engineer for his approval in accordance with these Specifications.

   b) At Engineer's or Consultant's direction, construct mock-ups required as part of this Contract:

      i) Construct built-in lighting niches of various types for review of maintenance, appearance and light dispersal.

      ii) Construct other special light fixtures in block or brick forms for review.

iii) Construct external and internal facade/facing of building with all edges, details niches etc. as shown on drawings and instructed by Engineer.

1.4. PRODUCT HANDLING

1. Protection and Storage:

   a) Protect masonry materials before, during, and after installation and protect installed work and materials of other trades.

   b) Masonry units and packaged material shall be placed on planks raised from the ground, covered with a waterproof tarpaulin and kept well ventilated until time of use. No material shall be allowed to become wet. Use only quantities of blocks/bricks required for immediate use. Do not stock pile units on the structure. Sand or loose material shall be stored so that it will not be contaminated from dirt or other extraneous material from the ground.

2. Replacements:

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

2. PRODUCTS

2.1. CONCRETE BLOCKS

1. Block sizes shall be 16 ins. by 8 ins by 4 ins, 6 ins and 8 ins. (400x200 mm by 100, 150, and 200 mm) thickness including a 3/8 in. (10mm) allowance for jointing. Physical requirements of blocks shall comply with B.S. 6073.

2. Solid concrete blocks have a minimum crushing strength of 1,200 psi. per average of 3 units tested, or 1,000 psi. per individual unit tested, based on gross area.

3. Hollow concrete block units wherever specified shall have cores with cross sectional area atleast equal to the percent of gross area of block given below:

   8 ins (200 mm) 38 percent

   6 ins (150 mm) 30 percent

   4 in. (100 mm) 30 percent

4. Minimum shell wall thickness 1-1/4 in. (31 mm)

5. Permissible tolerance in size of block shall be 1/8 in. (3 mm) each way.

6. Block Making:

a) Blocks shall be machine moulded.

b) Blocks shall be continuously water cured for a minimum of 10 days and covered between sprinkling operations with a 4 mm. thick polyethylene sheet or hessian cloth. After the curing period blocks shall be air dried. Blocks shall not be installed until completely dry.

c) Cured concrete blocks shall be stored off the ground so as to allow air circulation.

d) Blocks cast on different days shall be stacked separately and shall be labelled showing the date on which they were cast.

e) Properties of blocks not specified here shall conform to BS 6073.

7.

a) The Contractor shall provide test certificates proving the average minimum crushing strength of the blocks prior to the commencement of the construction. Further test certificates shall be provided as required by the Engineer to ensure that all batches of blocks have the minimum crushed strength specified. The Block strengths are to be determined in accordance with BS 2028.

b) The test shall be carried out by a laboratory approved by the Engineer. Evidence shall be produced that the block manufacturer has an efficient method of quality control. The Engineer will require to periodically test samples of blocks, & the Contractor shall make any necessary arrangements. The method of sampling for all tests shall be in accordance with BS 2028.

c) All properties of specifications of blocks not explained in these specifications or BS 2028, shall comply with the requirements of P.S. 419, as directed by the Engineer.

8. ABSORPTION RATE

The Contractor shall at his own cost, satisfy the Engineer that the absorption rate of the block when determined in accordance with BS 3921 does not exceed 20g/mm^2/min. or that the Contractor is able to adjust it so that it does not exceed this value on site.

9. SOLUBLE SALT CONTENT

For exposed Blockwork, the contents, by weight percent of soluble sulphate, calcium, magnesium potassium and sodium radicals, shall not exceed respectively 0.30, 0.10, 0.03, and 0.03, percent when ascertained in accordance with BS 3921 at the cost of the Contractor.

2.2.
FACE BRICKS

1. a) Clay bricks to be of first quality, and comply with pertinent data of B.S. 3921.

   b) Brick sizes shall be generally 9 ins by 4-1/2 ins by 3 ins. (225 x 113 x 75mm). A small size of 9 ins by 2-1/4 ins by 1-1/2 ins (225 x 56 x 38mm) shall be used where shown on Drawings. Non Standard sizes and shapes shall be as shown on Drawings. Dimensions include a 3/8 in. (9 mm) allowance for jointing.

   i) Bricks shall be sound, hard and well burnt with uniform size, shape and colour, homogeneous in texture and free from flaws and cracks.

   ii) A fracture surface should show a uniform compact structure free form holes, lumps or grit.

   iii) Arises should be square, straight and sharply defined.

   iv) Brick dimensions shall not vary more than 1/8 in. (3 mm) from standard size.

   v) Bricks shall give a metallic ring when struck with a small hammer or another brick.

   vi) Surface should be hard enough to prevent scratching by a finger nail.

   vii) Bricks should not break when struck against another brick or dropped flat form a height of 3 to 4 ft. (900mm to 1200mm) on a sold surface.

   viii) Bricks shall not absorb water more than 1/16th of their own weight when dry.

   ix) Non-standard shapes shall be of same texture, colour etc. as described for standard units.

2.3.
MASONRY BRICKS

1. All bricks shall be of first class quality made form good brick earth, free from saline deposits and shall be sand moulded. They shall be thoroughly burnt with outbeing vitrified shall be regular, uniform in shape and size with sharp and square edges parallel faces and of deep red or copper colour. First class bricks shall be homogenous in texture and emit a clear ringing sound when struck, and shall be free form flaws, cracks, chips, stones and modules of lime. First class brick is an oven dried condition shall not absorb more than 1.5 of its weight of water when immersed one hour in water of 21 to 27 degrees centigrade and shall show no signs of efflorescence on subsequent drying. The average compressive strength of five representative first class brick shall be not less than 8.5 N/mm^2 (1200 psi) for an individual brick.

2. All bricks shall be manufactured by the Trench Kiln Method or other standard methods approved by the Engineer. The earth used in manufacturing bricks shall be carefully selected and shall be free from objectionable quantities of lime, gravel coarse sand, roots, or other organic matter. Salts shall not exceed 0.3 percent and calcium carbonate shall not exceed 2.0 percent.

3. The mould used in the manufacture of bricks shall be thoroughly sanded before each use and shall be sufficiently large than the size of the bricks being manufactured to allow for shrinkage in drying and burning. Over-size irregular and worn moulds shall be destroyed. Each finished brick for brick masonry shall be 225mm by 114mm by 75mm in size and weight between 3.2 to 4.2 kilograms. All bricks shall have a "frog" 5mm deep on one face.

2.4. GLASS BLOCKS

1. Glass blocks used for decorative purposes are described under section 4270 of the specifications.

2.5. MORTAR

1. Mortar for unit masonry shall achieve a compressive strength of 1500 psi in 28 days, and consist of:

   a) Portland Cement to BS 12-78.

   b) Aggregate: damp loose sand to BS 1200, Table 10 graded 3/16 in. down.

   c) Water: clean and clear water which does not have sweet, saline or brackish taste to be used for mixing and curing of concrete. Conform to B.S. 3148 is essential.

   d) Mortar colorings: finely ground, first quality, sun-proof, lime-proof, high purity mineral pigment with a specific gravity similar to cement, conforming to B.S. 1014.

   e) Additives where used, shall be proprietary products used in the proportions and manner recommended by the manufacturer. The additives, shall in no way adversely affect the mortar strength or contain chemicals which may be harmful to other buildings materials. To add gypsum to cement is strictly forbidden.

2.6. REINFORCEMENT STEEL

1. Reinforcement steel required for masonry units shall be as described in Section 4050 Basic Masonry Materials and Methods.

GROUT

1. Grout shall consist of Portland cement, sand, pea gravel and adequate water to produce a concrete of approximately 10 inches (250 mm) slump, and shall have anultimate compressive strength of 1500 psi in 28 days.

2.8. CONCRETE

1. Concrete for infill between top of masonry walls and underside of structure shall be1:3:6 mix by volume of 2000 psi compressive strength in accordance with Section3300 Cast-in-Place Concrete.

2.9. ADMIXTURES

1. Admixtures may be used only with the written approval of the Engineer.

2.10. WALL TIES

1. Wall ties as described in Section 4050 Basic Masonry Materials and Methods.

2.11. INSULATION

Insulation to be inserted into the cavities or applied to faces of brick work or block work shall be correctly executed in accordance with the manufacturer's instructions. Where foam insulation is to be inserted into cavities, holes and openings shall be sealed prior to injection to prevent seepage of the foam.

Loose fill insulation shall be poured into cavities form the top of each wall section completed, where required, and shall be allowed to form its natural density, and shall not be tamped.

Where insulation boards are specified, proper anchorage to walls is essential. Refer to Section 7200: Building Insulation of these specifications, type and installation procedures.

2.12. SCAFFOLDING

Contractor shall provide safe scaffolding of adequate strength for use of workmen at all levels and heights at his own expense. Scaffolding which is unsafe in the opinion of the Engineer shall not be used until it has been strengthened and made safe for use of workmen. Cost of scaffolding etc., shall be included by the Contractor in the unit rate for masonry items.

Damage to masonry form scaffolding or from any other subject shall be repaired by the Contractor at his own cost.

2.13. OTHER MATERIALS

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

2.14. TESTING

The Contractor will submit samples of all materials such as bricks, blocks, metal wall ties, rawal plugs etc. along with their technical data, catalogue cuts, testing results etc. etc. for the approval of the Engineer who may require to get the material tested by an independent Testing Laboratory to be approved by the Engineer. Blocks and Bricks will be required to be tested as and when delivered to the site. All testing will be carried out at the Contractor's cost. Periodical testing of Blocks will be in accordance to BS 2028. Blocks and bricks will be tested for compressive strength, efflorescence, dimensions, water absorption, manufacturing process, density, surface texture, moisture movement, cement, aggregate and water.

3. EXECUTION

3.1. SURFACE CONDITIONS

1. Inspection:

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

   b) Verify that unit masonry can be completed in accordance with pertinent codes and regulations and the original design.

2. Discrepancies:

   a) In the event of discrepancy, immediately notify the Engineer.

   b) Do not proceed with installation in areas of discrepancy until they have been completely resolved.

3. Environmental Conditions:

   During hot weather protect masonry construction from direct exposure to wind and sun when erected in an ambient air temperature above 32 C (90 F) in the shade with a relative humidity less than 50%.

3.2.
COORDINATION

1. Carefully coordinate with other trades to ensure proper and adequate interface with them and the work of this Section.

3.3.
MIXING MORTAR

1. General:

   a) Use a mechanical mixer of one sack minimum capacity. Hand mixing will be permitted provided quantities of materials and water are accurately controlled, and that method of mixing is approved by Engineer.

   b) Mix mortar at least three minutes after materials have been added.

   c) Mix only as much mortar as can be used in one hour after water has been first mixed into the batch.

2. Retempering:

   Do not retemper mortar.

3. Mortar Mixes:

   a) Mix proportions by volume:

      i) Interior and Exterior work

         1:4 (cement sand)

   b) Use cement mortar for parapets and stacks.

3.4.
INSTALLATION

1. General:

   a) All masonry laid plumb, true to line, with level and accurately spaced courses and reveals, with corner plumb and true, and with each course breaking joints with the course below. Bond shall be kept plumb throughout. Units with greater than 12 percent absorption shall be wetted before laying.

   b) Concrete blocks for wall construction at jambs to openings and at piers to be grouted.

   c) Block walls of 8 ins (200 mm) thickness exceeding 24 feet (7.3 meters) length shall be supported at intermediate points, not exceeding 12 feet, (3.6 meters) with two 12 ins by 12 ins (300mm x 300mm) masonry piers bonded to wall. Install a continuous vertical mortar joint between piers.

   d) Gaps of less than 8 ins (200mm) between tops of masonry and underside of

structure shall be completed with cut masonry units or built flush with concrete.

e) The methods and equipment used for transporting the masonry units and mortar shall be such as will not damage the units nor delay the use of mixed mortar. Units shall not be placed during rains sufficiently heavy or prolonged to wash the mortar form the brick. Mortar already spread which becomes diluted by rain shall be removed and replaced before continuing with the work.

2. Laying up:

a) Place units in mortar with full trowelled bed and head joints.

b) Align all vertical cells to maintain a clear, unobstructed system of flues, or shafts. Clean out as work proceeds.

c) Mortar work to be in accordance with B.S. CP 121 section 4.4.

d) When laying fresh units to set or partially set masonry, clean surfaces of those previously installed and remove loose mortar prior to laying fresh units.

e) The masonry work shall be carried up in uniform manner and no portion shall be carried out more than one meter above the adjoining one at any time. All masonry shall be kept strictly true and square and the whole properly bonded together and levelled around each floor.

f) Block shall be laid with mortar joints as shown on the drawings or as directed by the Engineer. Both bed and vertical joints shall be 6mm in thickness completely filled with cement mortar as specified herein, and each block shall be added firmly taping 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 block masonry shall be installed as the work progresses. At the completion of the work all holes or defective mortar joints shall be cut out and re-pointed.

g) The exterior faces of the walls shall be finished by striking the joints as the work proceeds. The joints shall be struck by raking the green mortar after the block work has been laid and finishing the joint with a pointing tool. Horizontal joints shall be struck to form a weathered joint and vertical joints shall be struck with a V notch.

Care shall be taken that the striking tools do not develop a cutting edge as the object of striking the joint is to compress the mortar into the joints.

3. Built-in Work:

a) Work required to be "built-in" and/or incorporated in any masonry construction as work progresses, includes all anchors, expansion joint shields, barrier fins, loose lintels, bearing plates, structural steel bucks, door and window frames, access doors and frames, wall plugs and flashingetc.

b) Avoid cutting and patching unless directed by Engineer.

c) Set hold-fasts, anchors and other items required by this and other parts of these Specifications.

d) Solidly grout spaces around items and backs of metal door frames.

e) Build-in pipe chases as required by Other Contractors. Cutting of masonry after laying shall be only as directed by Engineer.

f) Build-in short lengths of drain pipe, to walls, outside of buildings for surface water drainage transfer as described in Section 2700: Concrete Walks Roadways, Curbs and Gutters.

g) Masonry bases or concrete masonry units under equipment, except those built on rough slabs; and other accessories; unless specifically indicated otherwise on the Drawings, the spaces around all built-in equipment unless provided by others i.e. mechanical trades, shall be filled in solid with appropriate masonry material and/or concrete so indicated on Drawings, also all unit steel door bucks shall be filled in solidly with masonry and cement mortar.

4. Dowels and wall ties:

a) Install projecting reinforcing bar dowel anchors into beams, columns and slabs and grout into masonry. Bars to be drilled and grouted into structural members, as specified in the structural specification/drawings.

b) Embed wall ties 3 ins. (75mm) into each bearing of double skin walls, at 18 ins. (450 mm) centres vertically and 24 ins. (600 mm) horizontally, staggered pattern.

5. Damproofing:

Damp proof courses shall be laid on an even mortar bed, free form projections which may puncture the materials. Where the damp-proof course is to be stepped only flexible membranes shall be used. Damp-proof course unless otherwise specified shall consist of Class 'C' (3000 psi) Cement Concrete 2ins (50mm) thick, mixed with approved quality water proofing compound as per manufacturers specifications and shall be laid at required level as per drawings and instructions of the Engineer. The D.P.C. shall be tamped, consolidated, leveled and edges and corners made to the requirements of drawings and shall include finishing and curing. The cost of D.P.C will be assumed to be part of cost for unit Masonry.

Install vertical damp-proof membrane and horizontal damp-proof course as described in Section 7100, Damproofing & Water Proofing.

6. Joints and weep holes:

i) Joints for blockwork shall be flush.

ii) Install weep holes as shown on Drawings.

7. Tolerances:

Unit masonry shall be erected plumb and true to line and level with a maximum variation of 1/8 in. (3mm) in 10 ft. (3 m).

3.5. GROUTING

1. Timing:

   i) Do not grout until masonry has cured at least 24 hours.

   ii) Consolidate grout at time of pouring by puddling and filling cells of masonry, and then reconsolidating later by puddling before the plasticity is lost.

3.6. CURING AND REPAIRS

1. All unit masonry shall be watered cured and shall be kept wet for at least seven days, by an approved method which will keep all surfaces to be cured continuously wet. Water used for curing shall meet the requirements of these Specifications for water used in the manufacturer of masonry units.

2. If, after the completion of any masonry work, the units are not in alignment or level, or does not, conform to the lines and grades shown on the drawings or showsa 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.

3.7. CLEANING & PROTECTION

1. Inspection:

Upon completion of the Work of this Section, make a thorough inspection of installed unit masonry and verify that units and joints have been installed in accordance with the provisions of this section; make necessary adjustments.

2. Protection:

   a) Protect sills, ledges and surrounding work from mortar drippings or other damage during masonry construction. Remove misplaced mortar or grout immediately.

   b) Wrap wood mullions and other built-in wood items with 4 mm. Polythene sheeting and remove at completion of work.

   c) Cover tops of uncompleted walls with non-staining waterproof coverings when work is not in progress.

3. Cleaning:

a) Clean surfaces of unit masonry as required for proper application of the specified finishes.

b) Cut out and re-point defective joints.

c) Upon completion of Work to this Section, promptly remove from the Job Site mortar droppings, broken units debris arising from the work of this Section, and tools and equipment, leaving all areas in a neat and orderly condition to the approval of the Engineer.

4. MEASUREMENT AND PAYMENT

4.1 GENERAL

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

1. Chiselling of masonry, wherever required.
2. Providing and fixing all joint reinforcing bars and dovetail anchors.
3. Providing and filling class 'D' concrete in the cavity of hollow block masonry.
4. Providing and laying damp proof courses, horizontal and vertical water proofing/damp-proofing insulation where directed.
5. Providing and installing expansion joint in masonry, units.

4.2. SOLID BLOCK MASONRY

1. Measurement:

In case of different thickness of slab/beams/columns in different areas or rooms or for any other reasons, whatsoever, if chiselling of masonry is required, the Contractor shall do so at his own cost. Where for any reason whatsoever, the height of the wall is short of ceiling height, the actual height shall be made good with class 'C' (3000) nominal mix concrete. This concrete shall neither be measured norbe paid under item of concrete but will be paid for under the item of wall masonry.Similarly, where the lintel heights are such that the contractor has to chisel the masonry or provide cast-in-place concrete to make up the height of the course, no payment will be made for chiselling, but where such cast-in-place concrete is provided, payment for the same will be made at the unit rate of masonry.

Measurement for acceptable completed works of solid block masonry will be made on the basis of number of Sq.ft (sq. meter) provided and installed in position as

shown on the drawings or as directed by the Engineer. Each measurement shall be taken to the nearest 1/2 in. (10mm.). All openings and lintel left in the masonry wall will be deducted.

2. Payment:

Payment will be made for acceptable measured quantity of solid block masonry work on basis of unit rate per sq. meter quoted in the Bill of Quantities and shall constitute full compensation for all the works related to the item.

4.3.
HOLLOW BLOCK MASONRY

1. Measurement:
Measurement for acceptable completed works of hollow block masonry wall will be made on the basis of number of sq. metre provided and installed in position as shown on the Drawings or as directed by the Engineer. Each measurement shall be made to the nearest 10mm. All openings left in the masonry will be deducted. Solid block masonry around openings and lintel shall not be measured separately. It shall be included in the measurement of hollow block masonry for payment.

2. Payment

Payment will be made for acceptable measured quantity of hollow block masonry works on the basis of unit rate per sq. meter quoted in the Bill of Quantities and shall constitute full compensation for all the works related to the item.

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1. GENERAL

1.1 DESCRIPTION

1. Work included:

Under this Section includes the supply and installation of waterproofing tank lining, vertical damp-proof membranes and damp-proof courses as indicated on Drawings and as follows:

a) Vertical damp-proofing:

To the exterior faces of concrete walls to water tank, swimming pools, concrete planters, pool machine rooms, lift pits, exterior walls below grade at basements and to outer faces of inner skins to external walls.

b) Horizontal damp-proof course:

To base of exterior wall above grade, over lintels, at parapets to exterior wall and under copings but not limited to same.

c) Waterproof membrane:

To areas like SOG, retaining walls, roof/attic slab, terraces, planters and gutters underground water reservoirs, swimming pool and where floor drains are indicated on Mechanical or Architectural Drawings or as directed by Engineer.

d) Swimming pool membrane:

To interior faces of outer concrete walls and slabs of swimming and wading pools.

1.2. QUALITY ASSURANCE

1. Qualifications of installers:

   a) The installer shall be currently approved by the manufacturer of the selected membrane or surface waterproof coating material.

   b) For installation of membranes and application of surface waterproof coatings use only competent and skilled tradesmen completely familiar with the products, and the manufacturer's current recommended methods.

2. Manufacturer's certification:

Prior to start of installation of the Work to this Section, engage at the Job Site, a representative of the manufacturer of the damp/waterproofing membrane or surface waterproof coating material and the tank liner to inspect and certify that:

a) Surfaces to which the waterproofing/dam-proofing is to be applied are in a condition suitable for this application.

b) Materials to be installed comply with the requirements of this Section of these Specifications.

c) Materials to be installed are in complete accordance with the manufacturer's current recommendations.

1.3 SUBMITTALS

1. Within 90 days after the award of Contract and before any material is delivered to the Job Site submit to Engineer, for approval in accordance with these Specifications, complete design data for inner water tank liner and pool membrane. Describe and illustrate details of application including jointing, special junctions with adjacent materials, mixing, curing and special preparatory measures.

2. Manufacturer's certification:

   Upon completion of this portion of the Work, and as a condition of its acceptance, deliver to the Engineer 2 copies of the certification described in Article 1.2.2, each copy signed by an officer of the firm manufacturing the waterproofing/damp-proofing materials.

3. Guarantee:

   Upon completion of this portion of the Work, and as a condition of its acceptance, deliver to the Engineer a written guarantee signed by the Contractor and endorsed by the waterproofing/damp-proofing and tank liner materials manufacturers guaranteeing that the installed materials will remain intact and free from leaks for a period of at least 10 years following date of installation.

1.4. PRODUCT HANDLING

1. Protection:

   Protect waterproof/damp-proof materials before, during and after installation and protect the installed work and materials of other trades.

2. Repair:

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

2. PRODUCTS

2.1. DAMP-PROOF MEMBRANE

1. a) Damp-proofing and Waterproofing Asphalt Primer: priming oil shall be made by the manufacturer of the bitumen compound.

   b) Bitumen: " Hycarb AHS " by National Petrocarbon Ltd., Karachi.

   c) Bituthene 3000 or Master pren or Equivalent.

   d) Bruch bond of Fospak or Brushcrete of FEB.

2.2. HORIZONTAL DAMP-PROOF COURSE

1. Same material as article 2.1 of this Section.

2.3. INTERNAL TANK FINISH PODIUM ETC

1. Cement Plaster (if required). Use Acrylic reinforced cementitious, flexible coating.Acceptable products are:

   Cementitious waterproofing system from Sika./BASF,or Aquafin or Fospak or approved equivalent by the Enginner.

2.4. WATERPROOF MEMBRANE

Torch applied waterproof membrane over lean concrete and over pile caps external surfaces of retaining wall and Underground water tank walls. Acceptable Products are:

Fospak
Sika
Aquafin.
Hi-Grip by Pak Hy –Oils Ltd
or as approved by the Engineer.

2.5. POOL MEMBRANE

1. Same material as Article 2.4 of this Section.

3. EXECUTION

3.1. PREPARATION

1. Concrete shall have full 28-day cure prior to application of membrane or surface coating.

2. Concrete and masonry surfaces shall be free of roughness, voids and projections. Voids shall be grouted in accordance with Section 3300 on Cast-in-Place Concrete or substrate plastered in accordance with Section 9200 on plaster work, at Contractor's own cost.

3. Remove laitance, loose aggregate, form release agents or other surface treatments as well as dust, oil, grease or other contaminants which would affect complete bonding of membrane or surface coatings to concrete and/or masonry surfaces.

4. Do not apply material to wet surfaces, unless directed otherwise. Ensure areas adjacent to surfaces of application are kept dry. Dewater in accordance with Section 2140: Dewatering.

5. Do not apply bitumen when its temperature is above 205^0 C (401 ^{0}F). It shall be kept from being heated in excess of 245^0 C (473 ^{0}F), or as recommended by the manufacturer.

6. Apply waterproofing/damp-proofing membrane on primed surfaces only in accordance with Manufacturer's specifications.

3.2. DAMP-PROOF MEMBRANE

1. Install damp-proof membranes as follows:

   a) Prime surface with a uniform coating of asphalt primer at the rate of 5 litres (1.1 gals) per 10 sq. meters (12 sq.yds), or as recommend by the manufacturer.

   b) Apply vertical Damp-proofing to a thickness of 90 mil. or 1/16 in. with 6 ins lap at joints where end of previous application is dry. Apply 2 coat fillets at internal angles and overlaps at horizontal damp-proof courses. This work to be protected or covered after deemed complete by Engineer.

   c) Embed and joint insulation boards tightly butted and with staggered joints into final layer of bitumen. For this process bitumen shall not exceed 266 F (130^o C).

3.3. HORIZONTAL DAMP-PROOF COURSE

1. Install damp-proof courses as follows:

   a) Ensure full grouting and projecting reinforcement is complete before primer is applied.

   b) Primer coat as Article 3.2.

   c) Uniform layer of P.B.4 to a total thickness of 120 mil. or 1/8 in. applied in 3 coats. Apply 2 coat fillets at internal angles, and at base angles.

   d) Set DPC 1/2 in. back from outer face of wall to allow for pointing, and extend 6 ins minimum up or over vertical adjacent surface.

3.4. TANK FINISH PODIUM ETC.

1. This surface coating shall be installed directly to the unfinished concrete floor, walls and ceilings or on the plastered surfaces (if required). Prepare in accordancewith Article 3.1. Apply cement plaster (if required) as described in Section 9200: Plaster works. Use material as specified in Article 2.3. or as approved by the Engineer in accordance with the Manufacturer's specifications.

3.5. WATERPROOF MEMBRANE

   a) All concrete and metal surfaces such as drains, pipes, etc. shall be cleaned of oil rust, scale and other foreign matter. Rough area and honeycombed concrete must be repaired prior to installation at contractor's own cost.

   b) Substrates to receive membrane shall be smooth and perfectly dry prior to application of membrane.

   c) At joints (and cracks) structural specifications to be followed.

   d) Apply the membrane as specified in Article 2.4. in accordance with the Manufacturer's specifications.

3.6.
POOL MEMBRANE

1. Install pool membrane as follows:

    a) This membrane shall be installed directly over inner of outer pool wall. Preparation shall be in accordance with Article 3.1.

    b) Same as Article 3.5.1a of this Section.

    c) Same as Article 3.5.1b of this Section.

    d) Same as Article 3.5.1c of this Section.

    e) Same as Article 3.5.1d of this Section.

3.7.
CLEANING & PROTECTION

1. Upon completion of Work to this Section, promptly clean shed surfaces of debris, stains and equipment, leaving areas in a neat and orderly condition to approval of Engineer.

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1. GENERAL

1.1 DESCRIPTION

1. Work included:

   a) Work under this Section includes the supply and installation of all materials under the finished concrete roof deck, slab, terraces/planter, as indicated on the drawings but subject to the restrictions described in item 1.2.

   b) The metal seam roof is referred to in this Section of these Specification as uninsulated roofs.

2. Work not included:

   Sheet metal flashings around curbs to mechanical equipment and over pads to same. Refer to Mechanical Works Contract.

1.2. QUALITY ASSURANCE

1. Restrictions of Specification:

   Use only the methods and materials described in this Section of these Specifications to fulfil the requirements of this contract.

2. Qualifications of installers:

   a) The roofing installer shall be currently approved by the manufacturer of the selected roofing.

   b) For installation of membrane roofing, use only competent and skilled roofers completely familiar with the products, and the manufacturer's current recommended methods of installation.

3. Manufacturer's Certification:

   Prior to start of installation of the Work of this Section, engage at the Job Site, a representative of the manufacturer of the membrane roofing, to inspect and certify that:

   a) Surfaces to which the membrane roofing is to be applied are in a condition suitable for this application.

   b) Materials to be installed comply with the requirements of this Section of these Specifications.

c) Materials to be installed are in complete accordance with the manufacturer's current recommendations.

1.3. SUBMITTALS

1. Manufacturer's certification:

   Upon completion of this portion of the Work, and as a condition of its acceptance, deliver to the Engineer 2 copies of the certification described in this Section, each copy signed by an officer of the firm manufacturing the membrane roofing system.

2. Guarantee:

   Upon completion of this portion of the Work, and as a condition of its acceptance, deliver to the Engineer a written guarantee signed by the Installer and endorsed by the membrane roofing manufacturer guaranteeing that the installed membrane roofing will remain intact and free from leaks for a period of at least seven years following date of installation.

3. Samples:

   Submit samples of roofing material for quality of the product for approval complete with manufacturer's specification data.

1.4. PRODUCT HANDLING

1. Protection:

   Protect roofing materials before, during, and after installation and protect installed work and materials of other trades

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

3. Shipping and Storage:

   Roofing material shall be packed in hay and shipped in crates adequately to prevent shifting. Once on the site, they shall be stored on wood sleepers near the point of intended use. Roofing membranes shall be in their original packing and stored in a dry place till the time of installation.

2. PRODUCTS

2.1. MATERIALS

1. Roof Coating:

   a) Coating to roofs over slab, and terraces/planters shall be cold brushed applied material Aquafin 2K / M by Shomburg or Sika Seal 105 by Sika Group or approved equivalent applied as per manufacturer's recommendations.

2. Sand and Cement to requirements of Section for Cast in Place Concrete.

3. Mortar materials and colour for cement tiles shall be same specified by theEngineer.

4. Insulation: Moulded polystyrene board, as described in Section 7200 for Insulation.

5. Roofing Tiles:

   a) Locally made Pre-cast roof tiles 24"x24"x2" (600mm x 600mm x 50mm) minimum. thick of durable quality suitable for roof application. Colour to match approved sample.

   b) Ingredients: Cement tiles shall consist of cement, fine sand and water all in measured amounts.

   c) Moulding: Tiles shall be shaped by inserting into moulds. Irregular surfaces shall be finished by hand tooling, provided such tooling has no visible effects after firing.

   d) Defects: Deformed items shall be discarded. Rough surfaces may be ground smooth with written agreement of the Engineer. Tolerances upto 1/16" (1.56mm) total variation in any dimension will be allowed.

   e) Colour: To match approved sample. Discoloration will be a basis of rejection for any cement tile.

   f) Formula: A written description of the process for making approved cement tiles shall be given to the Engineer.

6. Concrete and mix design for upstand curbs at attic perimeters and around roof penetration shall be the same as pertinent data of Section on Cast-in-place Concrete. Use ordinary Portland cement.

2.2.
OTHER MATERIALS

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

3.
EXECUTION
3.1.
SURFACE CONDITIONS

1. Inspection:

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

2. Discrepancies:

   a) In the event of discrepancy, immediately notify the Engineer.

   b) Do not proceed with installation in areas of discrepancy until they have been fully resolved.

3.2.
LAYING SEQUENCE

1. General roof areas:

   i) Sand and cement sloping screed.

   ii) Roof Coating: Same as 2.1 above

   iii) Insulation: Moulded polystyrene of 32 kg/M^3 density raped in 6 Mil. Polythene sheet.

   vi) Loose Pre-cast concrete tiles

3.3.
ROOF MEMBRANE TYPE ECOGUM 4P TORCH-ON-MEMBRANE

1. Membrane materials shall be applied to surfaces as per the Manufacturer's instructions.

   a) All concrete and metal surfaces such as drains, pipes etc. shall be clean of oil, rust, scale and other foreign matter. Rough area and honeycombed concrete must be repaired prior to installation.

   b) At joints (and cracks) structural specifications to be followed.

Not Applicable

c) Institute all required procedures for protection of completed membrane during installation of membrane and throughout remainder of Construction period. Do not allow any type of traffic on unprotected membrane.

3.4. INSULATION

1. Lay boards staggered and with easily butted joints unbonded to roof membrane. Entire surface of roof area shall be flush with edges aligned.

2. Do necessary cutting around protrusions and upstands.

3. a) Prevent disfigurement and damage to insulation boards from point loads during installation and afford same protection while subsequent materials are placed on top.

   b) Damaged or dented boards shall be replaced with new ones.

   c) Do not leave boards exposed to sunlight or uncovered at the end of the day.

3.5. SCREEDING

1. Mix to consist of one part Portland cement to three (2) parts Sand and six (4) parts Coarse aggregate to Engineers approval.

2. Wet sand and cement sloping screed before installing mortar mix.

3. Spread and place mortar mix to conform with slopes indicated on Drawings, minimum thickness of 3" (75mm). Apply in alternate bays not exceeding 250 sq.ft. (232.23 sq. m.). Form canted fillets at upstands

4. Screeding and tamping shall be done immediately after spreading to achieve prescribed slopes.

5. Mix shall then be smoothed and consolidated to a uniform close textured surface with a wood float, to remove high and low spots exceeding 1/4 in. (6 mm) in 10 ft. (3 m). Avoid excessive floating.

6. Showing signs of laitance will be subject to rejection by the Engineer. These faulty areas shall be replaced at no additional cost to the Employer.

7. Screed layer shall be cured for a minimum of 7 days after finishing an as described in Section for Cast-in-place concrete.

8. Allow sufficient time for material to thoroughly harden and ensure surface is dry before allowing other work to be carried out.

3.6.
ROOF FINISH

1. Lay cement roof tiles, where indicated over mortar mix.

    a) Loosely laid tiles with joints butted and aligned in both directions but not coincidental with those of the insulation. Set out tiles to roof areas so that dimensions remaining at perimeter walls, to receive half size.

    b) Cut tiles square to face to a tolerance of 1/8 in (3mm). Cutting shall be kept to a minimum.

    c) Mortar shall be a mix of one (1) part cement to four (4) parts sand.

    d) Apply sufficient mortar at joints.

    e) Ensure alignment is correct with adjacent tiles and evidence of movement or rocking is eliminated.

2. Following setting of flags and tiles poured, concrete edging/upstands shall be installed reinforced with expanded metal lath, lapped and secured under precast copings. Ensure that lathing is well supported and set back 1/2 in. (12mm) from finished face of concrete. Profile of edging upstand shall be as shown on Drawings including canted fillet.

3.7.
ROOF SCUPPERS

1. At general roof areas and uninsulated roof areas with roof scupper outlets apply expanded metal pebble stops and pebbles as shown on Drawings.

    a) Expanded metal pebble stops shall be shaped and liberally coated with bitumen prior to installation.

    b) Embed pebble stops into a coating of hot bitumen, over ply roofing felt, extending bitumen 6 ins (150mm) beyond area to be covered by metal. Ensure no sharp edges are protruding through surface of roofing.

    d) After completion of general roof finishes lay pebbles into areas designated for same as shown on Drawings.

3.8.
TOLERANCES

1. Deviations exceeding 1/4 in. in 10 ft (6mm in 3 Meter) applied in all directions willnot be accepted.

3.9.
CLEANING

1. Upon completion of the work of this Section immediately remove debris, excess materials and smears that may remain.

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1. GENERAL

1.1 DESCRIPTION

1. Work included:

The purpose of caulking in this Work is to provide a positive barrier against penetration of air and moisture at joints between items where caulking is essential to continued integrity of the barrier. Caulking will normally be performed under the work of various Sections of these Specifications but shall be performed in strict accordance with the provisions of this Section. Following locations shall require cacking

a) Periphery of wood and metal frames in exterior and interior walls including doors and windows.

b) Joints between cement plaster and dissimilar materials.

c) Joints between concrete or masonry and dissimilar materials.

d) Joints between glass and glazing beads to exterior windows.

e) Internal angles as follows:

i) Wall and floor finish joints with bathtubs.

ii) Wall and floor finish joints with WC's and squat toilets

iii) Wall to wall and floor to wall junctions in showers.

f) Concrete road joints.

g) Other locations as directed by Engineer.

1.2. QUALITY ASSURANCE

1. Qualification of applicators:

Installation of caulking shall be performed only by workmen thoroughly skilled andspecially trained in the techniques of caulking, and who are completely familiar with the published recommendations of the manufacturer of the caulking material being used.

2. Rejection of installed caulking:

Indication of lack of skill on the part of caulking installers shall be sufficient grounds for the Engineer to reject installed caulking and to require its immediate removal and complete recaulking at no additional cost to the Employer.

1.3. SUBMITTALS

1. Samples submit manufacturers technical data for product required :

   Within 120 days after award of the contract and before any sealants are delivered to the Job Site submit 3 ins (75 mm) strips of each specified type in available colours for selections by Engineer, applied to pieces of hardboard, concrete, and aluminum. Supply also a small sample in a sealed container.

1. Protection:

   a) Deliver materials with each container bearing an unbroken seal and manufacturer's label.

   b) Protect caulking materials before, during, and after installation and protect installed work and materials of other trades.

2. Replacements:

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

3. Storage:

   a) Store caulking materials and equipment under conditions recommended by its manufacturer.

   b) Do not use materials stored for a period of time exceeding the maximum recommended shelf-life of the material.

2. PRODUCTS

2.1. CAULKING MATERIALS

1. Caulking Sealants: These shall be non-sagging type, non-staining, neutral or other colour approved by Engineer where exposed to view, and shall be as follows or specifically approved type by Engineer:

Type 1

Silicone low modulus one part, 'NITOSEAL 125 by FOSROC or other approved equivalent to periphery of wood and metal frames in exterior walls including windows, doors, etc. Also, to precast concrete unit jointing, vertical exterior expansion joints, but not limited to same.

Type 2

Acrylic emulsion based one part, 'NITOSEAL 100/105 by FOSROC or other approved equivalent for joints around window and door frames, brickwork and blockwork.

Type 3

Silicone elastomeric one-part, mildview resistant, moisture curing to showers, toilets and bathtubs or other approved equivalent. Use NITOSEAL 130 by FOSROC, or equivalent.

Type 4

Polyurethane multi part, 'NITOSEAL 225/240 by FOSROC or other approved equivalent to interior masonry expansion joints, joints between interior framed units and their openings, behind door frames to refrigerated refuse room and where sealant is required to receive paint.

Type 5

Liquid Polysulphide Polymer, two part, 'THIOFLEX 600 by FOSROC, or other approved equivalent, for structural expansion and others relief joints.

2. Joint backing:

Where indicated on Drawings and/or directed by Engineer use closed cell foam rod polyethylene, expanded polyurethane neoprene or butyl rubber round solid rod joint backing, in joints over 1/8 in.(3 mm), circular in section, capable of being installed under at least 25% compression or equal as approved in advance by Engineer.

3. Bond breaker:

Polyethylene tape or Pressure sensitive plastic tape or masking tape placed between sealant and joint backing which will not bond to sealant, where required.

2.2. CAULKING EQUIPMENT

1. Caulking equipment to be as recommended by the manufacturer of the caulking material being installed.

2.3. OTHER MATERIALS

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

3. EXECUTION

3.1. SURFACE CONDITIONS

1. Inspection:

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

b) Verify that caulking may be installed in accordance with the manufacturer's recommendations.

2. Discrepancies:

a) In the event of discrepancy, immediately notify the Engineer.

b) Do not proceed with installation in areas of discrepancy until they have been fully resolved.

3.2. PREPARATION

1. Remove dust, paint, loose mortar and other foreign matter. Dry joint surfaces.

2. Remove rust, mill scale and coatings from ferrous metals by wire brush, grinding or sandblasting.

3. Remove oil, grease and other coatings from non-ferrous metals with solutions to Engineer's approval.

4. Prepare concrete, masonry, glazed and vitreous surfaces to sealant manufacturer's instructions.

5. Examine joint sizes and correct to achieve depth ratio ½ of joint width.

6. Install joint backing to achieve correct joint depth. Where joints exceed 1/8 in. (3 mm) width use rod type backing.

7. Where necessary to prevent staining, mask adjacent surfaces with tape prior to priming, if required, and caulking.

8. Apply bond breaker tape where required to manufacturer's instructions.

9. Prime sides of joints to manufacturer's instructions immediately prior to caulking, where required.

3.3. BACK-UP MATERIALS

1. Verify the compatibility of joint backing material with caulking before installation.

3.4. APPLICATION

1. Carefully study the Drawings, furnishing and installing proper caulking at each point where called for and at other points where caulking is essential in maintaining the continued integrity of the watertight barrier.

2. Install caulking in strict accordance with the manufacturer's recommendations, taking care to produce beads of proper width and depth, to tool as recommended by the manufacturer, and to immediately remove all surplus caulking.

3. Apply sealants, primers, if required, joint backing and/or bond breakers to manufacturer's instructions. Apply sealant using a gun with proper size nozzle. Use sufficient pressures to fill voids and joints solid. Superficial pointing with skin bead is not acceptable.

4. Form surface of sealant with full bead, smooth, free from ridges, wrinkles, sags, air pockets, embedded impurities. Neatly tool to within 1/16 in. (2 mm) of the surface.

5. Apply sealant to around perimeter joints between exterior windows/door frames to adjacent building components, to control joints in masonry walls, interior corners to showers, around all edges of bathtubs, WC. fixtures and elsewhere indicated on Drawings. Apply sealant to glazing conditions as described in Section 8.5 of these Specifications.

3.5. CLEANING

1. Clean adjacent surfaces immediately and leave work neat and clean. Remove excess and droppings, using recommended cleaners as work progresses. Remove masking tape after tooling of joints.

4. *METHOD OF MEASUREMENT*

Joint Sealers to be measured by length.

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PART 1
GENERAL

1.1 Description

1. Work included:

Building insulation required for this Work includes, but is not necessarily limited to:

a) All External Walls.

b) Building Roof.

c) Refrigerated Refuse room walls, ceiling and door.

d) or specified in drawing

1.2 Product Handling

1. Protection:

a) Deliver materials to the Job Site and store in a safe dry place with all labels intactand legible at time of installation.

b) Protect building insulation materials before, during, and after installation and protect the installed work and materials of other trades.

c) Do not leave insulation exposed to sunlight. Keep covered with clear or light colored waterproof material. Apply finish material soon after installation of the insulation. Brush off any sunlight degraded surface material prior to adhering insulation.

2. Replacements and acceptability:

Panels chipped, cracked or squashed shall be rejected. In the event of damage, immediately make repairs and replacements to approval of Engineer, at no additional cost to Employer.

PART 2

MATERIAL

2.1 Insulation

1. Type 1

a) Self-extinguishing extruded closed cell high density Polystyrene Board of Diamond Jumbolon or approved equivalent polystyrene molded bead board minimum density 2lbs. per cu.ft (32-35 kg/m) density, for roofs, terraces/planters, external walls, cavity walls and Rammed earth walls etc. according to the drawings / details.

2.2 Fastening

1. Flexible faced insulations shall be fastened with staples.

2.3 Adhesive & Tapes

1. Polystyrene Type Insulations:

   Bedding and jointing material as described in other Sections of these Specifications.

2. Flexible Faced Insulations:

   Foil tape for joints and punctures as recommended by insulation manufacturer.

3. Rigid Mineral-Fibred Boards:

   Bedding and jointing adhesive as recommended by insulation manufacturer.

2.4 Other Materials

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

PART 3

EXECUTION

3.1 Surface Conditions

1. Inspection:

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

   b) Verify that building insulation may be installed in accordance with the original design and the manufacturer's recommendations.

2. Discrepancies:

   a) In the event of discrepancy, immediately notify the Engineer.

   b) Do not proceed with installation in areas of discrepancy until they have been fully resolved.

3.2 Installation

1. Roof:

   Refer to Section 7560 Membrane Roofing.

2. Refrigerated Refuse Room:

   Refer to Section on Refrigerated Refuse Room.

3. Insulation facing flanges shall be stapled to framing material and foil taped to form complete seal. Tape any punctured facing material.

4. Refrigerated Refuse Room Doors:

Cut, bed and joint insulation boards within doors in adhesive.

3.3 Inspection

1. Upon completion of the installation, visually inspect each area and verify that insulation iscomplete and properly installed.

4.0 METHOD OF MEASUREMENT

Refer Section 7100: Damp proofing & Waterproofing

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PART 1
GENERAL

1.1 Description

Needle Punched non-woven manufactured

- From 100% Virgin Polypropylene staple fibres
- Weight: 500 gsm, 5.9 meter wide, 80 meter long
- Thickness: 4.1 mm (under 2 kPa)

Tensile Strength – MD	EN ISO 10319	39 kN/m
Tensile Strength - XD	EN ISO 10319	39 kN/m
Elongation at break – MD	EN ISO 10319	70 %
Elongation at break – XD	EN ISO 10319	75 %
CBR Puncture Resistance	EN ISO 12236	6300 N
Dynamic Cone Drop	EN ISO 13433	6 mm
Permeability	EN ISO 11058	40 m/s. 10^{-3}
Waterflow normal to the plane	EN ISO 11058	40 l/m^2.s
Characteristic Opening Size	EN ISO 12956	60 µm

The geotextile fabric shall be UV stabilized and inert to chemicals commonly encountered in soil and water.

1.2 DURABILITY

- Predicted to be durable for a minimum of 25 years in all natural soils
- Natural UV light: Retained Strength of > 80% after 50 MJ/m2 exposures.
- Moisture: Does not absorb moisture
- Rot, Mildew: Unaffected
- Natural occurring acids and alkali: Unaffected
- Oxydation Resistance EN ISO 13438: Retained Strength >90% at (110±1) °C after 14 days exposure.
- Chemical Resistance EN 14030: Excellent
- Microbiological Resistance EN 12225: Excellent

Geotextile rolls shall be furnished with suitable wrapping for protection and each roll shall be labeled and identified for field identification as well as for inventory and quality control purposes.

The surface to receive the geotextile fabric shall be prepared to a relatively smooth condition, free of obtrusions, depressions, and debris. Geotextile installation shall proceed in the direction of construction. Longitudinal joints in the fabric shall have a minimum overlap of 30cm, sewn or otherwise specified by the Engineer. In the event construction machinery is used to place the fabric, the working platform for the machinery shall be the soil and not the previously laid geotextile.

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PART 1
GENERAL

1.1 Description

- Fiber Bonding: Thermally Bonded
- Polymer: 100% Polypropylene, continuous filament and UV Stabilised
- Fiber diameter: 40 - 50 micron
- Roll Size: 4.5-meter width, 100-meter length = 450 Sqm Roll
- Durability: 100 years in all-natural soils
- According to Quality system ISO 9001, ISO 14001
- Oxidation Resistance EN ISO 13438: 100% retained strength
- Chemical Resistance EN 14030: 100% retained strength
- Microbiological Resistance EN 12225: 100% retained strength

Property	Standards	Value
Area Weight (g/m^2)	EN ISO 9864	190
Thickness under $2kN/m^2$ (mm)	EN ISO 9863-I	0.57
Thickness under $200kN/m^2$ (mm)	EN ISO 9863-I	0.48
Mechanical Properties		
Energy Absorption (kJ/m^2)	EN ISO 10319	5.8
Tensile strength (kN/m)	ASTM D4595	13.1
Elongation (%)	ASTM D4595	52
Tensile Strength at 5% (kN/m)	ASTM D4595	5.7
Puncture strength (N)	ASTM D6241	1850
Tear strength (N)	ASTM D4533	400
Puncture US Road (N)	ASTM D4833	370
Dynamic Cone Puncture (mm)	EN ISO 13433	22
Hydraulic Properties		
Opening Size $O_{90\ Wet}$ (µm)	EN ISO 12956	80
Opening Size $O_{95\ Dry}$ (µm)	ASTM D4751	100
US Sieve	ASTM D4751	140
Permittivity (1/s)	ASTM D4491	0.65
Permeability (V_{H50}) (10^{-3}mm/s)	EN ISO 11058	35
Flow rate at 10cm WH ($l/(m^2.s)$	BS 6906-3	60
Permeability at $20\ kN/m^2$ (10^{-4}m/s)	DIN 60500-4	1.9
Permeability at $200\ kN/m^2$ (10^{-4}m/s)	DIN 60500-4	1.4

1.2 Execution

Geotextile rolls shall be furnished with suitable wrapping for protection and each roll shall be labelled and identified for field identification as well as for inventory and quality control purposes.

The surface to receive the geotextile fabric shall be prepared to a relatively smooth condition, free of obtrusions, depressions, and debris. Geotextile installation shall proceed in the direction of construction. Longitudinal joints in the fabric shall have a minimum overlap of 30cm, sewn or otherwise specified by the Engineer. In the event construction machinery is used to place the fabric, the working platform for the machinery shall be the soil and not the previously laid geotextile.

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PART 1
GENERAL

1.1 Description

Fibrillated Polypropylene Fibre for concrete reinforcing: Concrete shall be treated with Fibrillated Polypropylene synthetic reinforcing Fibres when indicated on the drawings or as otherwise specified by the Architect/Consultant in accordance with the fibre manufacturer's recommendations.

a. Synthetic reinforcing fibres shall be manufactured from virgin polypropylene.
b. The recommended dosage is 2.7 kg per cubic meter (4.5 lb per cubic yard) of concrete.
c. The Fibrillated Polypropylene Fibres shall be of 50mm length.
d. Fibre supplier shall provide Fibrillated polypropylene fibre in pre-portioned packet for each batch of concrete mix.
e. Fibre supplier shall provide technical assistance, if required.
f. All fibres must meet or exceed the standards and specifications set forth in ACI 544, Fibre Reinforced Concrete. The fibre should be manufactured from 100% virgin homopolymer to meet ASTM C-1116.
g. Listed below are the minimum properties of the polypropylene fibres for use. All fibres must meet or exceed the characteristics described in ACI-544, IR, table 4.1, Fibre Reinforced Concrete.

    1. Tensile Strength of granule: 6000 psi
    2. Tensile Strength of Polypropylene fibre: 60,000 psi
    3. Elongation at break: 12%
    4. Fibre: 100% Fibrillated Polypropylene
    5. Lengths: 50 mm
    6. Absorption: Nil
    7. Specific gravity: 0.9
    8. Ignition point: 593 °C
    9. Melting point: 160-170 °C
    10. Heat & UV stabilization: Long term
    11. Thermal conductivity: Low
    12. Electrical conductivity: Low
    13. Color: Transparent
    14. Salt resistance: High
    15. Acid resistance: High
    16. Alkali resistance: 100% (alkali proof)

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PART 1
GENERAL

1.1 Description

Needle Punched non-woven manufactured

- From 100% Virgin Polypropylene staple fibres
- Weight: 150 gsm, 5.9 meter wide, 100 meter long
- Thickness: 1.9 mm (under 2 kPa)

Tensile Strength – MD	EN ISO 10319	11.5 kN/m
Tensile Strength - XD	EN ISO 10319	11.5 kN/m
Elongation at break – MD	EN ISO 10319	65 %
Elongation at break – XD	EN ISO 10319	70 %
CBR Puncture Resistance	EN ISO 12236	1850 N
Dynamic Cone Drop	EN ISO 13433	22 mm
Permeability	EN ISO 11058	95 m/s. 10^{-3}
Waterflow normal to the plane	EN ISO 11058	95 l/m^2.s
Characteristic Opening Size	EN ISO 12956	110 µm

The geotextile fabric shall be UV stabilized and inert to chemicals commonly encountered in soil and water.

1.2 Durability

- Predicted to be durable for a minimum of 25 years in all natural soils
- Natural UV light: Retained Strength of > 80% after 50 MJ/m2 exposures.
- Moisture: Does not absorb moisture
- Rot, Mildew: Unaffected
- Natural occurring acids and alkali: Unaffected
- Oxydation Resistance EN ISO 13438: Retained Strength >90% at (110±1) °C after 14 days exposure.
- Chemical Resistance EN 14030: Excellent
- Microbiological Resistance EN 12225: Excellent

Geotextile rolls shall be furnished with suitable wrapping for protection and each roll shall be labeled and identified for field identification as well as for inventory and quality control purposes.

The surface to receive the geotextile fabric shall be prepared to a relatively smooth condition, free of obtrusions, depressions, and debris. Geotextile installation shall proceed in the direction of construction. Longitudinal joints in the fabric shall have a minimum overlap of 30cm, sewn or otherwise specified by the Engineer. In the event construction machinery is used to place the

fabric, the working platform for the machinery shall be the soil and not the previously laid geotextile.

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1. GENERAL

1.1 DESCRIPTION

1. Work included:

   Work of this Section includes the supply and application of plaster materials and accessories for interior and exterior finishes indicated on the Drawings and Schedules and these Specifications.

1.2. QUALITY ASSURANCE

1. Qualifications of installers:

   a) For application of coatings, use only thoroughly trained and experienced plasterers who are completely familiar with the requirements of this Work and the recommendations contained in the referenced Standards.

   b) In acceptance or rejection of installed materials, no allowance will be made for lack of skill on the part of workmen.

1.3. SUBMITTALS

1. Samples:

   Within 120 days after award of Contract, and before any material for this work is delivered to the Job Site, submit to the Engineer, in accordance with the provisions of these Specifications, mock-ups of the proposed plaster surfaces and accessories, etc.

1.4. PRODUCT HANDLING

1. Delivery and storage:

   a) Deliver materials of this Section to the Job Site in their original unopened containers with labels intact and legible at time of use. Where material is delivered loose, store as directed by Engineer.

   b) Store materials under cover to prevent damage and contamination. Store only the specified materials at the Job Site.

2. Protection:

Protect materials of this Section before, during, and after installation and protect installed work and materials of other trades.

3. Replacements:

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

2. PRODUCTS

2.1. MATERIALS

1. Portland Cement: Ordinary and white conforming to P.S.232 or B.S. 12/ ASTM C-150

2. Sand: Clean, sharp, angular, free from alkali, silt or organic matter, to conform to B.S. 1198 – 1200 or the draft Pakistan Standard "Sand for Plaster" (ASTM C-805)

3. Water: Potable, clean, free from deleterious amount of oils, salts, alkali, organic matter and other harmful materials conforming to B.S. 3148.

4. Colour Pigment: Salt-free, inorganic. Type and amount to be approved by Engineer.

5. Accessories:

a) Expanded metal lath to be flat rib diamond mesh of 1/4" short way type, galvanized to B.S. 729, conforming to B.S. 1369. Use BB 263, 2.25 lbs per sq. yds (1.22 Kg/m2) for external use and reinforcement of joints and BB 264, 3 lbs. per sq. yds (1.63 Kg/m2) for suspended plaster ceilings. Paint lath with zinc rich primer for internal conditions.

b) i) Running and furring channels to be 16 gauge. cold rolled steel galvanized to B.S. 729.

i) Minimum weight per lineal foot: Furring channels 3/4 in. (18mm) depth - 0.3 lbs. (0.136 kg) Runner channels of 1-1/2 in.(38mm) depth - 0.475 lbs. (0.216 kg) or 2 ins (50mm) depth - 0.54 lbs. (0.245 Kg)

ii) Minimum width of flanges 7/16 in.(12mm)

c) Plaster stops: 26 gauge. steel with 3 -1/8 in.(78mm) expanded metal flanges, size to suit plaster depth, galvanized to B.S. 729.

d) Tie wire to be 18 ga. annealed steel wire galvanized to B.S. 443.

e) Ceiling hanger:

i) 8 ga. annealed steel wire galvanized to B.S. 443.

ii) 1/8 in.(3mm) by 1 in.(25mm) flat mild steel strip or 1/4 in. (6mm) diameter steel rods, both galvanized to B.S. 729.

f) Fastening such as expansion bolts, galvanized nails, metal trim and other accessories to Engineer's approval.

6. Materials and workmanship for plaster not explained in these Specifications shall comply with the requirements of B.S.5262 and 5492.

2.2. ADDITIVES

Additives for controlling the setting and working characteristics of plaster, or for imparting anti-corrosion, fungicidal or water proofing properties, shall be added to the plaster strictly in accordance with the particular manufacturer's written instructions.

2.3. OTHER MATERIALS

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

3. EXECUTION
3.1. SURFACE CONDITIONS

1. Inspection and Preparation: (ASTM C-926)

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

b) Concrete surfaces to be plastered shall be cleaned to remove grease, form oil and other impurities which will otherwise adversely affect the adhesion of plaster to the surface. Surfaces of concrete work if so required by Engineer, shall be hacked by approved means to give the required key for plastering.

c) Surfaces shall be washed with clean water and kept damp for 2 hours before further treatment. Surfaces thus prepared shall be treated uniformlywith a cement and sand slurry of one-part cement, one-part sand mix before application of plaster.

d) Application should not be undertaken if work is exposed to dry hot winds, where temperature is above 32 C (90 F), in the shade, and relative humidity is below 50%. Extreme caution should be taken to avoid rapid setting of mixture and resultant shrinkage cracks. Refrain from excessive trowelling.

e) Do not apply coatings when temperature is below 4 C (39 F) or for at least 4 to 6 days following, to ensure that conditions will permit the curing treatment specified.

2. Discrepancies:

a) In the event of discrepancy, immediately notify Engineer.

b) Do not proceed with installation in areas of discrepancy until they have been fully resolved.

3.2. WORKMANSHIP

1. Proportioning and mixing:

a) Measurement of materials by volume shall be of known capacity to maintain consistent proportions. No lumpy or cracked material shall be used. Mixing equipment, boxes and tools shall be clean. Materials shall be proportioned as specified or as directed by the Engineer. Mixing shall be continuous until complete and ingredients are evenly distributed.

b) Only limited water shall be used for proper workability. Mortar shall be consumed within thirty minutes of mixing. Retempering will not permitted. Mortar which has begun to stiffen shall be discarded.

c) Plaster ingredients shall be thoroughly mixed by hand on a clean platform or by mechanical mixer.

2. Expanded metal lath:

a) Before plastering, wherever reinforced concrete meets block masonry at a flush condition and at every cutting for joint of electrical conduits, install 12 ins (300mm) wide continuous strip of expanded metal lath, attached with galvanized nails, to both surfaces, covering joint completely, toprevent cracking.

3. Control joints:

a) Strike ‘V’ depressions, where required to create controlled crack lines in finish.

b) Install plaster stops in ceilings to end plaster material or to create control joints.

4. Accessories:

Use galvanized wire dowel pushed into hollow of bead to maintain true alignment at splices.

5. Beads & Profiles:

Angle beads, corner beads, stop beads, architrave 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, allbeads & profiles shall be perforated at edges to ensure good adhesion of plaster work. Thickness and dimensions shall suit particular locations and plaster work thickness.

Nails for fixing metal lathing shall be galvanized and have either clout heads or small flat heads to suit particular locations.

All angle beads, stop beads, architrave, depth gauge beads, and the like are to be fixed in accordance with the manufacturer's instructions.

6. Internal plasterwork:

a) Where indicated on Drawings or Room Finishes Schedules, provide trowelled finish plaster with galvanized iron Corner Beads as per latest B.S. specification Corner Beads will be provided to columns, wall ends, corners, edges, openings and joints etc. for protection of plaster work.

b) Installation of Ceiling Suspension Hanger wires:

i) Attach to hanger inserts in concrete.

ii) Space hangers 48 ins (1200mm) o.c. and within 3 ins(75mm) of perimeter walls. Double up hanger wire or decrease spacing of hangers at light fixtures or where additional loads are located.

iii) Locate hangers within 3 ins. (75mm) of ends of main runner channels.

Main runner channels:

i) Spacing: 48 ins(1200mm) o.c. or as noted otherwise on the Drawings.

ii) Locate within 6 ins. (150mm) of parallel walls.

iii) Splicing: overlap ends a minimum of 12 ins, (300mm) interlock flanges, secure splice near end of each channel with tie wire.

iv) Channels shall not be restrained by perimeter wall.

Cross furring - 3/4 in.(18mm) channels:

i) Space 16 ins (400mm) o.c., wire tie to main runner channels.

ii) Furrings shall not be restrained by perimeter wall.

c) Metal lath installation:

i) Install with long dimension running perpendicular to furring channels and other supports.

ii) Tie to 3/4 in.(18mm) furring channels with single strand of wire, spacing ties not more than 6 ins (150mm) o.c. on each channel or other support.

iii) Lap lath with 1 ins. (25mm) laps. Side laps shall be tied @ 9 ins (225mm) o.c.

d) Application of material:

i) Plaster mix shall comprise of one-part Portland cement and four parts sand.

ii) Total thickness shall not be less than 1/2 in.(12mm) over concrete and masonry surfaces, and 3/4 in.(18mm) over metal lath backing.

iii) Plaster shall be applied with sufficient material and pressure to form a good bond or key. Application shall be a minimum of two coats unless directed otherwise by Engineer. Surface of the first shall be scratched before second coat applied

iv) Plaster shall be in plumb, free of voids, finished smooth, with a steel trowel or finished textured with wood trowel as indicated on Room Finishes Schedules and Drawings, and to Engineer's approval. Edges and corners shall be straight.

v) Variation of colour and or texture on a wall will be the sole cause for rejection of entire wall by Engineer.

vi) Work shall be cured using sprayed water for a minimum of 8 days. The ring/watering of plastered surface shall start immediately after the surface is set i.e. 4-5 hours from the time of finishing, depending upon the temperature and wind condition.

d) Tolerances:

Deviations exceeding 1/8 in. (3mm) under a straight edge 10 ft. (3000mm) applied in all directions will not be accepted for cement plaster surfaces.

7. External plasterwork:

a) Plaster to be applied with a mix of one-part Portland cement and four parts sand, minimum thickness of 3/4 in. (18mm) Apply with sufficient pressure to completely embed. Trowel and cross scratch in horizontal direction. Ensure that base coat completely embeds expanded metal lath where applied.

b) Maintain continuous moist for 8 days. Allow surface to dry after curing, to develop proper adherence, before applying second coat.

c) Tolerances shall be as described for internal plasterwork.

8. Plasterwork to underground water tank and water pond shall be as follows:

a) Install as per pertinent for External Plasterwork.

b) Finish to be with a smooth trowel.

c) Apply 3/4" (18mm) thickness to walls and 1 1/2" (38mm) thickness to floors of water tanks (if required) and ponds.

d) Waterproofing to be applied in accordance with manufacturer's instructions in accordance with Division 7100.

e) Color pigment and marble powder not required for these items.

3.3.
CLEANING UP

1. General:

Prevent the accumulation of scraps and debris arising from the Work of this section. Maintain premises in a neat and orderly condition at all times. In the eventof spilling or splashing material onto other surfaces, immediately remove the sameand traces of residue to the approval of Engineer.

4.
METHOD OF MEASUREMENT

FINISHES

All sections related to Finishes comply with this Section of measurement:

Generally

Work shall be measured flat without addition for laps or seams; finishes on corrugated or ornamental surfaces shall each be so described.

Curved, spherical and conical work shall each be so described.
Internal and external work shall each be so described.

Backgrounds

Backgrounds shall be measured with the finishing to which they relate.

Finishing

Unless otherwise stated, finishing shall be measured by area, classified as follows:

1. Floors, which shall include landings.
2. Walls, which shall include returns, reveals of openings or recesses and attached and unattached columns
3. Ceilings, which shall include attached and unattached beams and soffits of staircases
4. Staircases, which shall include treads, risers and edges of landings but exclude soffits.

Skirting, bands, strings, coverings to kerbs, mouldings, coves, channels or the like shall be measured by length.

Sundries

Expansion joint covers, non-slip inserts dividing strips, metal angle beads, lathing at junction of differing backgrounds or the like shall be understood to be included with the finishing or backgrounds on which they occur.

Suspended ceilings

Suspended ceilings shall be measured by area irrespective of drop and classified as follows:
1. Ceilings
2. Up stands
3. Bulkheads

Decorations

Decorations on different surfaces shall each be given separately.

Details shall be given of any special method of application (for example, spraying).
Unless otherwise stated, decorations shall be measured by area, classified as follows:

1. Floors, which shall include landings.
2. Walls, which shall include returns, reveals of openings or recesses and attached and unattached columns.
3. Ceilings, which shall include attached and unattached beams and soffits of staircases.
4. Staircases, which shall include treads, risers, strings and edges of landings but exclude soffits.
5. Cornices.
6. General surfaces, which shall include doors, close-type fencing or the like; glazed general surfaces (measured flat over glass) shall be so described.
7. Isolated general surfaces, which shall include door frames, linings, sub-frames of a differing material to the window, skirting, rails, architraves, bars, posts, balusters or the like.
8. Windows (measured flat over glass, frames, mullions, transomes and architraves), which shall include glazed partitions or the like, but exclude sub-frames of a differing material to the window; edges of slash shall be understood to be included.
9. Radiators, measured over the area of heating surface.
10. Gutters, measured inside and out.
11. Large pipes (that is, pipes with an internal diameter exceeding 60mm), including trunking or the like, unless measured as incidental work; hangers, supports or the like (except common supports to services) shall be understood to be included.
12. Structural metalwork, which shall include roof trusses.

Decoration on small pipes (that is, pipes with an internal diameter of 60mm or less) unless measured as incidental work, shall be measured by length; hangers, supports or the like (except common supports to services) shall be understood to be included.

Decoration on gratings, rainwater heads or the like shall each be enumerated separately, irrespective of size.

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PART 1
GENERAL;

1. 1 DESCRIPTION:

1. Work included

Work in this Section includes providing and installing the following:

i. Concrete paving, Brick Paving, Sandstone paving, and pool edging including skirtings related items and bedding, where shown on Drawings.

ii. Masonry accessories necessary to complete the Work of this Section.

iii. Base courses.

iv. Cutting and patching of Work of this Section as required by the work of other trades.

v. Cleaning and pointing of Work of this Section exposed to view.

vi. Related work

a) For adjacent in-situ and precast concrete items refer to Concrete Section.

b) For adjacent tile work refer to Section 9300 (Tile Work).

c) Surface drain rock marked as 'Pebbles' on Drawings is described in Section Landscaping.

d) For concrete sub-bases and their base courses required under paving refer to Concrete section, Excavation and Earthwork Section.

1. 2 QUALITY ASSURANCE:

1. Qualification of workmen:

a) For cutting and placing of unit materials, use only skilled masons who are thoroughly experienced with the materials and methods specified and thoroughly familiar with the design requirements.

b) In acceptance or rejection of installed paving units, no allowance will be made for lack of skill on the part of workmen.

c) Provide one skilled mason who shall be present at all times during execution of the Work of this Section and who shall personally direct the execution of this portion of the work.

1. 2 SUBMITTALS:

1. Samples:

a) Within 120 days after award of Contract, and before any materials are delivered to the Job Site, submit samples of the proposed units to the Engineer for his approval in accordance with these Specifications.

b) Samples shall indicate the total colour range, and be supplied in 4 ft. x 4 ft. (1.2m x 1.2m) squares or as required by Engineer.

c) Samples of other materials to be used and samples for testing shall be submitted as requested by the Engineer.

d) Submit samples of Grasscrete units and concrete Brick pavers

1.3 PRODUCT HANDLING:

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

PART 2
PRODUCTS:

2.1 ACCEPTABLE MANUFACTURERS:

1. Subject to compliance with requirements, provide products of one of the following:
   a) Envicrete
   b) Magnacrete.
   c) Banu Mukhtar
   d) First Floor or approved by Architect

2.2 CONCRETE PAVERS:

1. Units to be 100% solid:
   a) Sizes should be 8" x 4" x 3" (200 x100 x 75 mm), Weight 3.8 kg approximate or 8" x 4" x 2.5" (200 x 100 x 62 mm), Weight 2.9 kg approximate or any other size.

   b) Average compressive strength should be 4000 psi or 28 N/mm2

   c) Material should be a mixture of sand, cement and aggregates, in necessary approved colours and additives of texture, tint and durability.

   d) It should be resistant to attack by oils, grease and other petroleum based fuels and free from all types of salts.

   e) The surface texture will be abrasive, and have a non slip finish to the approval of the Engineer.

2.3 PRECAST GLASSCRETE UNIT:

1. Grasscrete units are manufactured from Portland Cement complying with B.S. 12 with a minimum cement content of 320 kg/m3. Coarse and fine aggregate employed confirm to the requirements of B.S. 882. Steel mesh reinforcement to B.S. 4483.

a) Manufacture: machine made using high frequency vibration and low water/cement ratio permitting rapid demoulding.

b) Grasscrete pavers shall be 2'-0" x 1'-4" x 4" (600 mm x 400 mm x 100 mm) deep with five longitudinal and two transverse ribs, each block completely enclosing four grass cells. The area available for grass at the upper surface shall not be less than 56%, and the area of concrete available to transmit load to the underlying layers shall not be less than 90% of the total block area.

c) Grasscrete pavers shall be placed closely together on a 10-20 mm. layer of sharp sand for leveling, spread on the compacted sub-base composed of 6 ins (150 mm) of quarry waste or similar approved unwashed material of 3 ins (75 mm) down size containing fine soil or loam.

d) Clean friable soil or soil with a peat mixture should be levelled off 1 1/4" (32 mm) below the top surface, sown with grass seed and covered with a thin layer of fine soil and levelled with a hard broom. The level shall be about 3/4" (19 mm) below top surface. Seed shall be sown while soil is still loose after filling.

2.4 SAND STONE:

1. Stone paving, shall be cut stone, mill finished to specific sizes, squared to dimensions each way. Slightly textured finish.

2. Pool edges to be as per details shown on the drawings. Curves and corners to be mitred. Inside and outside edges at corners and changes in direction to curved to eliminate acute angles.

3. Sizes:

   i) Lengths and widths of Stone pavers, and special shapes shall be as shown on Drawings.

2.5 MORTAR & CONCRETE MATERIAL:

1. Ordinary Portland cement to B.S. 12. Use non stating type for stonework.

2. Sand to be clean, sharp, angular, free from alkali, silt or organic matter. Comply with BS 1198-1200.

3. Course Aggregate refer to Section 3300 Cast-in-Place Concrete.

   a) Colour pigment for pavers shall be as described under Section 4200 Unit Masonry.

   b) Colour pigment for stone paving and precast concrete flag shall be added at Engineers discretion or as described under Section on Unit Masonry.

2.6 GRANULAR BASE:

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

2.7 CAULKING:

1. Refer to Section 7900 Joint Sealants for caulking materials.

2.8 OTHER MATERIAL:

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

PART 3
EXECUTION:

3.1 SURFACE CONDITIONS:

1. Inspection:

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

3.2 EXCAVATION:

1. The natural subgrade shall be prepared in accordance with the cross-section shown on the plans. Soft and yielding spots or other unsuitable material shall be removed and replaced with suitable type. The subgrade shall be compacted and finished to a firm, smooth surface. Refer to Section 2300 Earthworks, for pertinent data.

3.3 BASE COURSE:

1. Apply a base course to areas receiving paving and flags on grade.

2. For paving on concrete sub-base this article does not apply. Concrete sub-base is described under Section 2510 Concrete Walks, Roadways, Curbs and Gutters.

3. When laying base course the alignment shall be controlled by an approved method, from Engineer.

4. Install 6 ins (150 mm) minimum thickness of crushed rock aggregate to B.S. 63 and roll the surface to a smooth and uniform texture, free from lumps, rock pockets, soft spots and spongy areas. Compact with a smooth wheel roller having a weight of 120 lbs per in. width to density specified in Section 2300 Earthworks.

5. Place 1-1/2 ins (38 mm) blinding concrete over crushed rock base under paving adjacent to roadways. Bring to an even surface. Mix to be 1:4:8 or as specified in the Structural Specification.

3.4 MIXES:

1. Mixes general:

a) Use the same manufactured brands and sources for mortar material to ensure uniformity of mix.

b) Mix mortar ingredients thoroughly in quantities needed for immediate use. Mixing shall be done by machine.

c) Mix mortar in mechanical mixer until materials are homogeneously blended but not less than three (3) minutes after materials are in the mixer.

d) Add colour pigment where exposed mortar joints occur, as required by Engineer.

e) Refer to pertinent parts of this Section for mix types.

3.5 CEMENT TILES PAVERS:

1. This part is pertinent to laying different sizes of cement tile pavers in patterns as shown on Drawings.

2. Mortar to be a semi-dry mix for pavers laid on horizontal surfaces. Mix to consist of one part Portland cement to 3 parts sand aggregate with colour pigment added to match face tile work joints.

3. Units shall be laid out so that at end conditions no unit have to be cut to a dimension less than 3 ins. (75 mm). Mortar joints shall be according to the detail shown on the drawings.

4. Spread and place mortar mix to at least 1-1/2 ins (38 mm) thickness. Use hand rake, making sure mix does not become compressed. Place units in bonding pattern, as indicated on Drawings, working from hard edge. Pavers laid on edge shall be set 1/2 in. (12 mm) above finish grade and those laid flat 1/4 in. (6 mm) above finish grade. Sweep joints full of mortar mix. Tamp units by an approved method, to attain finish grade. Readjust units which may have been disrupted during tamping. Spray entire approved surface area with fine spray of water to ensure saturation of the joints and bedding material. Grout and point joints similar to face tile work, or as directed by Engineer. Finished surfaces shall be aligned to designated finish grade. Check units for evidence of rocking or movement; correct as required.

3.6 STONE PAVING:

1. This part is pertinent to laying different types of Stone paving including strips and steps in patterns, where applicable as shown on Drawings.

2. Mortar mix to be 1:3 as described for cement tile pavers or as specified in the structural specifications.

3. Units shall be laid out so that at end conditions no unit shall be smaller than half size. Mortar joint as shown on the Drawings.

4. Spread and place mortar mix to at least 1 in. thickness. Use a hand rake, making sure mix does not become compressed. Place units in bonding pattern, as indicated on Drawings, working to a hard edge and set 1/4 in. (6 mm) above finish grade. Sweep joints full of mortar mix. Tamp units by an approved method to attain finish grade. Readjust units which may have been disrupted during tamping. Spray entire approved surface area with fine spray of water to ensure saturation of the joints and bedding material. Grout and pointjoints to 1/8 in. (3 mm) below finish grade of flags or as directed by Engineers. Finished

surfaces shall be aligned with designated finish grade. Check flags with adjacent units to ensure there is no evidence of rocking or movement; correct as required.

a) Step units to be cut to largest possible sizes, thus creating the least, if any intermediate joints.

b) Bed step units on 1 in. (25 mm) mortar mix, set to 1/8 in. per ft. (3mm per 300 mm) slope from back to front edge. Grout and point joints with mortar.

3.7 CONCRETE PAVING:

1. Preparation of sub-grade

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

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

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

2 Preparation of sub-base

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

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

Granular material Type 1*
Soil Cement
Cement bound granular material
Lean concrete
Wet mix macadam
Wet lean concrete

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

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

The top surface of the sub-base should be finished to tolerance of + 3/4" (19 mm.). It should be close-knit to prevent the loss of laying course material, and free of debris or mud.

3. Edge Restraint

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

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

4. Preparation of laying course

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

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

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

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

This will normally be in the order of 1/2 in-3/4 in (12-19mm) when compacted to 2 ins (50 mm) and 9-14 mm when compacted to 30 mm.

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

5. Bond patterns

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

6. Laying the Pavers

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

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

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

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

7. Compacting

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

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

8. Brushing

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

3.8 CURING:

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

3.9 CAULKING:

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

3.10 PROTECTION:

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

3.11 TOLERANCES:

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

3.12 CLEANING:

1. Upon completion of the work of this Section immediately remove debris, excess materials and smears that may remain.

2. Point or replace defective mortar to match existing, as required by Engineer.

3. Scrub surfaces to be cleaned using a cleaning solution which will not harm finishedmaterial. Check with manufacturer for acceptable solution. Clean a trial test area and obtain approval to proceed.

4. Use an abundant amount of water do cleaning in accordance with Engineer’s instructions.

5. Repeat cleaning operations as often as necessary, until work is to meet Engineer’s approval.

PART 4

METHOD OF PAYMENT;

1 Payment made as per describe in BOQ item.

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PART 1.
GENERAL

1.1
DESCRIPTION

1. Work included.

   a) This work of providing and installing concrete walkways, roadways, curbs, curb / gutters, walls copings, concrete posts, drainage trenches and covers, water courses, base courses and foundations to same, as shown on Drawings.

   b) Curbs / gutters, curbs, copings, concrete posts and drainage trench units to be precast items.

   c) Concrete slabs forming bases for paving Work.

   d) Non metallic surface drainage pipes required to complete exterior landscaping.

2. Work not included:

   Provision and setting of cast iron surface drainage pipes required under parts of the building or connecting surface water drainage trenches. Refer to Plumbing Contract.

3. Related Work:

   a) For adjacent paving refer to Section 2780 Unit Paving.

   b) For adjacent blockwork walling refer to Section 4200 Unit Masonry.

   c) For adjacent precast concrete steps refer to Section 2780 Unit Paving.

   d) Surface drainrock is described in Section 2900 Landscaping.

   e) Miscellaneous metal required for supporting or joining units described in this Section are described under Section 5500 Metal Fabrications.

   f) For details of excavation, filling and grading not described here refer to Section 2300 Earthworks.

1.2.
QUALITY ASSURANCE

1. Qualification of workmen :

   a) Provide at least one person who shall be thoroughly trained and experienced in the skills required, be completely familiar with the design

and application of the Work described for this Section, be present during progress of the Work and direct work performed under this Section.

b) For actual finishing of concrete surfaces and operation of the required equipment, use only personnel thoroughly trained and experienced in the skills required.

1. Make all relevant submittals affecting the work of this Section as described in pertinent Sections of Division 3 of Concrete.

2. Submit 4 ft x 4 ft (1.2m x 1.2m) panel samples of pigmented concrete showing finishes described in this Section, within 120 days after the award of Contract, to Engineer for his approval.

1.3.
PRODUCT
HANDLING

1. Refer to pertinent Sections of Division 3 Concrete.

PART 2.
MATERIALS
2.1.
CONCRETE FORMWORK

1. Refer to Division 3 Concrete Formwork.

2.2.
STEEL REINFORCEMENT

1. Refer to Division 3 Concrete Reinforcement.

2.3.
IN SITU CONCRETE

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

2.4.
DAMPROOFIN
G

1. Refer to section 7100 Damproofing and Waterproofing for horizontal damproof courses under copings and wherelse shown on Drawings

2.5.
BASE MATERIALS

1. Aggregate for bases under walks to be 1 / 2 in. to 2 ins (12mm to 50mm) size crushed stone, rock or broken brick approved by Engineer.

2. Granular material behind low retaining walls shall be crushed rock or stone and sand, free of dirt or extraneous matter, graded in even proportions and sized as follows :

   i) Type 1 6 ins to 4 ins (150mm to 100mm)
   ii) Type 2 1 -1 / 2 ins to 1 / 4 in. (37mm to 6mm)
   iii) Type 3 sand, graded 1 / 4 in/ down (6mm down)

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

2.6.
DRAIN PIPES

1. This item includes short lengths of non-metallic pipe for rubble drains carrying percolated water from behind the walls or transfering surface water through walls above grade.

2. Concrete pipes shall be cylindrical with plain butt ends to diameters and lengths shown on Drawings. Comply with pertinent requirements of B.S. 556.

3. Vitrified clayware pipes, similar to those used for soil drains, shall be to diameters and lengths shown on Drawings. Comply with pertinent requirements of B.S. 65.

4. Mesh used at ends of rubble drains shall be expanded metal lath of flat diamond mesh type weighing a minimum of 0.37 lbs per sq. ft. and galvanized to B.S. 729.

2.7.
MORTAR MATERIALS

1. a) Ordinary Portland cement as described in Section 3300 for Cast-in-Place Concrete.

   b) Sand to be clean, sharp angular, free from alkali, slit or organic matter. Comply with BS 1198 – 1200.

2.8.
DOWELS AND ANCHORS

1. Refer to Section 5500 for Metal Fabrications.

2.9.
CONCRETE UNITS

1. Precast concrete curbs and curb / gutters to comply with B.S. 340. Curbs to corners, turning spaces etc to be curved to radii shown on Drawings. Fabricate copings, posts and drainage trenches, etc. in accordance with pertinent data of Section 3400 Precast Concrete.

2. Copings shall be cast in 18 in (450 mm) min. lengths.

2.10.
CONCRETE WALL FINISH

1. For finishing of exposed concrete walls and foundations below masonry and above grade, refer to relevant section of Division 9 Section 9200 Internal and External Plasterwork.

2.11.
CAULKING

1. Refer to Section 7900 Joint Sealers.

2.12.
OTHER MATERIALS

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

PART 3.
EXECUTIO
N

3.1.
SURFACE CONDITIONS

1. Inspection :

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

   b) Verify that materials may be installed in strict accordance with the original design, pertinent codes and regulations, and pertinent portions of the referenced Standards.

2. Discrepancies :

   a) In the event of discrepancy, immediately notify the Engineer.

b) Do not proceed with installation in areas of discrepancy until they have been fully resolved.

3.2. EXCAVATION

1. This article is pertinent to all items of this Section unless otherwise described.

2. The natural subgrade shall be prepared in accordance with the cross section shown on plans. Soft and yielding spots or other unsuitable materials shall be removed and replaced with suitable type. The subgrade shall be compacted and finished to a firm smooth surface. Refer to Section 2300 Excavation and Earthwork for pertinent data.

3. At road excavation remove a minimum of 1 ft of top soil form existing grade before earth filling and compacting is carried out.

3.3. PLACEMENT OF BASE COURSE

1. Concrete walks and concrete sub-bases :

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

   b) When laying base course the alignment shall be controlled by an approved method, from Engineer.

   c) Install 6 ins (150 mm) minimum thickness of crushed rock aggregate to BS 6f3 and roll the surface to a smooth and uniform texture, free from lumps rock pockets, soft sports and spongy areas. Compact with smooth wheel roller having a weight of 120 lbs per in. width to density specified in Section 2300 Earthworks.

   d) Place 3 ins (75mm) blinding concrete over base, under walks adjacent to roadways and bring to an even surface. Mix to be 1:4:8.

2. Curbs, gutters and roadway :

   a) Apply a layer of 3 ins to 4 ins (75mm to 100 mm) hardcore evenly over sub-grade. Compact and blind with two passes of a smooth wheel roller of 6 - 8 tonnes (13220 - 18210 lbs). Repeat process until a fully compacted, dense close-knit surface is obtained. Finer material being added as required. Total thickness of base to be 6 ins. (150 mm). Density for compaction shall be as specified in Section 2300 Earthworks.

b) Place 3 ins. (75mm) blinding concrete over base and bring to an even surface. Compressive strength of concrete shall be 2000 p.s.i. minimum.

c) Precast concrete curbs shall be set on a 6 ins (150 mm) of bed of 1:6 by volume all-in concrete mix, haunched up at back.

3.4.
FORMS

1. Forms to be wood, straight and free from wrap, and of sufficient strength to resist springing during the process of depositing the concrete against them. Use 1 in (25mm) minimum surface wooden planks. Thickness less than 1 in (25mm) may be used for short radii. Ensure that divider plates or other devices holding forms in place do not cause planes of weakness and cracking of concrete. Form depth to be equal to depth to be equal to depth of curbing, gutter, wall or paved walkway and securely fastened at the top.

2. Forms to be securely staked, braced, held firmly to the required line and grade, and be sufficiently tight to prevent leakage of mortar.

3. Forms to be cleaned and oiled before the concrete is placed against them.

3.5.
RUBBLE DRAINS

1. Position rubble drains as shown on drawings or as required by Engineer for proper drainage of water from behind the walls.

2. Adequately support pipe drains with concrete benching and secure to forms before casting coerce walls.

3. Ensure that pipes passing through blockwork are located correctly

4. Wrap expanded metal across end of pipe and wire tie before placement of graded aggregate to prevent backfill from entering pipe.

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

3.6.
PLACING CONCRETE

1. GENERAL :

a) Refer to pertinent data of Section for Cast-in-Place Concrete for construction joints, where and if required.

b) For flat areas, complete panels between expansion joints with same or successive pours. Do not commence pouring panels which cannot be completed the same working day.

2. Insitu walls and curbs :

   Placement of insitu work to conform to pertinent data of Section 3.3 Cast-in-Place Concrete. Install steel dowels to key walls to footings as shown on Drawing.

3. Walkways, roadways and concrete sub-bases :

   a) Base courses and forms to be checked and approved by Engineer before concrete is placed.

   b) Set reinforcement, where required, as per Drawings and in accordance with Section 3300 Concrete Reinforcement.

   c) Concrete to be placed on moist base and deposited to 8 ins. depth or as indicated on Drawings , as specified in Section 3300. Cast-in-Place Concrete.

3.7.
EXPANSION AND CONTRACTION JOINTS

1. Install as indicated or directed as follows:

   a) Expansions joints at maximum 20 ft. (6 meters) intervals, as required

   b) Transverse contractions joints 5 ft. (1.5 meters) intervals (exceptroadway).

   c) Roadway expansion joints shall occur at joints with brick border strips.

   d) Roadway control joint locations are shown on Drawings, if not then it should be placed as per instructions of the Engineer.

2. Where walkway is adjacent to curb, make expansion joints of curb, gutters and walkway coincide.

3. Install expansion joints around manholes or other penetrations and at joints adjacent to concrete curbs, buildings, or permanent structure.

4. Install softwood strips at expansion joints in accordance with Structural Drawings. Permanent strips to be immersed in water for 48 hours prior to placing, and set down sufficient to allow finishing sealant to be placed.

5. Transverse contraction joints to be 1/2 in (12mm) wide tooled ‘U’ shaped depressions.

3.8.
GRANULAR BACKFILLING

1. Granular material shall be placed behind retaining walls for percolation of water through to rubble drains. Material shall be placed in layers simultaneously with general fill, and such that filling is stable.

2. Placing shall be as follows :

   a) Type 1 stones shall be hand packed behind walls to a thickness of 1 ft. (0.3 meters)

   b) Type 2 stones placed behind Type 1 to a thickness or 1 ft. (0.3 meters).

   c) Type 3, sand, placed behind Type 2 to a thickness of 1 ft. (0.3 meters) and above.

3.9.
DAMPROOF COURSE

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

3.10
PRECAST UNIT PLACEMENT

1. Pertinent data of Section 3400 Precast Concrete relating to installation shall applyto this article.

2. a) Embed and joint in cement sand mortar mix 1:3 by volume, precastconcrete curbs, copings, gutters and drainage trench units at locations shown on Drawings. Install dowels and anchors to copings as indicated on Drawings, min. 2anchors per unit. This operation shall precede the placement of adjacent paved surfaces.

   b) Placement of units shall be on sufficient bed material to allow all tamping and to attain finish grades shown on Drawings.

3.11
HOT WEATHER REQUIREMENTS

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

3.12.
COLD WEATHER

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

3.13.
FINISHING CAST-IN-PLACE CONCRETE

1. Finish exposed surfaces smooth and uniform, free of open texturing and exposed aggregate, while concrete is still finishing: Do not use neat cement as a drier to facilitate finishing. Broom by lightly combing with a medium-stiff broom, after trowelling is complete. Round edges at joints with a 1/2 in. (12 mm) radius edging tool. Wood trowel finish all other exposed surfaces unless specified otherwise.

2. Cure and protect concrete in accordance with Section 3300.

3. Where occuring, forms shall be removed within 24 hours after placing of concrete. Minor defects shall be rectified and, where necessary, filled withmortar composed of one part Portland Cement and two parts of fine aggregate. Cure as described in item 2.

4. Finish exposed concrete surfaces below masonry and above finished levels in accordance with Division 9 External finish work

3.14. BACKFILLING

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

3.15. CAULKING

1. Caulking installed under this Section shall be in accordance with Section 7900 Sealants.

2. Install caulking material at:

   a) Joints between edge of building and adjacent hard surfaces installedunder this Section.

   b) Roadway expansion joints.

   c) Other locations shown on Drawings.

3.16. TOLERANCES

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

3.17. CLEANING UP

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

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PART 1
GENERAL:

1. 1 DESCRIPTION:

Work included:

1. Provision of materials and installation of:

   a) Filling and grading base courses.

   b) Lawn planting including protection.

   c) Pebble drain rock around buildings.

2. Related Work:

   a) Refer to other sections of this Division for adjacent landscaping work.

   b) Refer to Section 2300 Excavation and Earthwork for items not covered by this Section.

   c) Refer to Section 7100 and Section 3300 for waterproofing and concrete work to tanks.

1.2 SURVEY:

1. The Contractor shall carry out a survey of the property. If as a result of this survey, discrepancies are found which will affect the landscaping design, the Contractor shall immediately inform the Engineer. Contractor will also propose measures by which any such discrepancies may be resolved. Do not carry out any work on Site until approval of Engineer has been obtained.

1.3 JOB CONDITIONS:

1. Dust control:

   a) Control dust on and near the Work and near off-site borrow areas if such dust is caused by the Contractor's operations during performance of the Work or ifresulting from the condition in which the Contractor leaves the Site.

   b) Thoroughly moisten surfaces as required to prevent dust being a nuisance to the public, neighbors, and concurrent performance of other work on the Site.

2. Protection:

   a) Protect materials of this Section before during, and after installation protect objects and/or materials designated to remain.

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

PART 2
PRODUCTS:

2.1 FILL MATERIAL

1. Refer to Section 2300 Excavation and Earthwork for fill material for subgrades.

   i Topsoil furnished from one source shall be typical sterile, sandy soil obtained from well-drained and possessing characteristics of representative soils in the project vicinity that produce vigorous plant growth.

   ii Topsoil shall be free of subsoil, brush, organic litter, objectionable weeds, clods, shale, large stones, roots or other material 1/2 in.(12 mm) in diameter or more, or any substance which might be harmful to plant growth or be a hindrance to raking, planting and maintenance operations.

   iii 10 cubic feet (0.28 cubic meter) of topsoil shall be submitted for approval by Engineer.

2.2 WEED KILLER:

1. Weed killer to be Chlorate of Soda mixed 1 lb to 1 gal. (1 kg to 10 liters) of water applied to 10.5 sq.yds (8.78 m2) or as approved by Engineer.

2.3 LAWN MATERIALS:

i Fertilizer:

Decomposed organic manure subject to approval by Engineer.

ii. Sweet soil:

Sweet soil shall have an organic content of 25%, which shall consist of well decomposed organic manure. Manure shall be mixed on Site. Mixture and mixing process to be approved by Engineer.

iii Grass seed shall be a mixture of current season's crop. Seed which has become wet, moldy or otherwise damaged will be rejected. Actual mixture to be approved by Engineer.

2.4 DRAIN ROCK:

i Stones placed in areas marked 'Pebbles' on Drawings shall be hard, durable, oval or round river stones free from organic material or other deleterious substances. Sizes shall be between 3 ins and 6 ins. (75mm and 150 mm).

ii Stones placed under item 'a' are described and installed under Excavation and Earthwork section.

2.5 OTHER MATERIALS:

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

PART 3
EXECUTION:

3.1 GENERAL:

i. Familiarization:

Prior to work of this Section, become thoroughly familiar with the Site, Site conditions, and portions of the Work falling within this Section.

ii. Backfilling:

General provisions of backfilling shall be in accordance with Excavation and Earthwork section.

iii. Excavation and Preparation of Subgrades:

Pertinent data of Section 2300 Excavation and Earthwork shall apply to this Section.

3.2 TOP SOIL INVESTIGATION:

1. Backfill with topsoil in 'Green areas' marked on Drawings, in layers of 9 ins. (225 mm) Water each layer, do not tamp.

2. Backfill topsoil around tree pits under direction of Landscape Contractor/Consultant or Engineer.

3.3 LAWN PLANTING:

1. General:

i Lawn shall be planted according to acceptable Standard practice in order to ensure a completely healthy grass cover. Clarify these Standards with Engineer before proceeding with installation.

ii No lawn shall be planted when the temperature are above 90 F (32 C) or if the ground is in a muddy condition, or other conditions that are deemed unsuitable by Engineer.

2. Planting preparation:

i Contractor shall be responsible for preparation of lawn area and planting of lawn.

ii Prepared surface shall be free from rivulets, crusting and caking. Subgrade soil shall be scarified to a 12 ins (300 mm) minimum depth and brought to a true and uniform grade before dumping and spreading of sweet soil.

iii Lawn areas are to be brought up to within 3 ins (75 mm) of exis- ting grades with sweet soil in accordance with the levels indicated on Drawings.

iv Should the existing grades be at the proposed levels, the soil must be "trenched or plowed" 12 ins (300 mm) deep over the entire surface. Unsuitable soil must be removed and replaced with sweet soil.

v Sweet soil shall be placed in "Grass" areas indicated on Drawings and raked. Stones in excess of 1 in. (25 mm) diameter and rubbish shall be removed. Do not spread sweet soil in muddy state.

vi Sweet soil shall have a minimum thickness of 12 ins (300 mm) after natural settlement and light rolling, and shall conform to finish grades and levels shown on Drawings. Finish grades shall be refined under the supervision of Engineer.

vii Cover sweet soil with 3 ins (75 mm) of fertilizer and mix into top 3 ins. (75 mm).

viii Additional sweet soil shall be deposited, to correct settlement and erosion up to the date of acceptance at the Substantial Completion Inspection.

ix The lawn bed shall be fine graded to remove ridges and depressions.

x Surface irregularities resulting from these operations shall be leveled to prevent depressions. Grades shall be adjusted to assure that, after natural settlement and light rolling, they will be 1 in. (25 mm) below adjoining paved areas.

xi Rolling shall be carried out in transverse directions. The roller shall be a water ballast hand roller weighing maximum 200 lbs and minimum 150 lbs. Rolling shall be in such a manner so as to eliminate the necessity for retreating on finished grade.

xii Should there be a time lapse for any reason between final bed preparation and planting, the ground shall be restored to a loose friable condition.

xiii Sweet soil surface shall be moistened with a fine spray of water immediately before planting.

xiv Extreme care shall be taken during planting to ensure that no change shall occur in the finished grade.

3.4 TREE PLANTING:

1. General: Planting Trees with making Pits and filling Sweet Earth.
   Average Height: 1800mm
   Stem Size: 100mm Dia

- Vinca Minor
- Willow
- Citrus
- Jacaranda
- Laburnum
- Rosa Banksiae
- Alstonia
- Poplar
- Sheesham
- Neem
- Champa
- Sumbul

- Cyprus
- Banyan
- Or as Approved by the Architect

3.5 LAWN AND TREE MAINTENANCE & PROTECTION:

1. Maintenance by Contractor shall begin immediately after the planting operation is completed and shall continue until acceptance at commissioning. Any replacements, adjustments or maintenance of lawns shall be at no additional cost to Employer for a period of 12 (Twelve) months after commissioning.

   a) Lawn and Trees shall be maintained by watering, weed eradication, cutting, trimming, repair of erosion, and reseeding where required to establish a uniform, knitted turf. Renew or replace faulty work without additional cost to Employer.

   b) Initial watering of lawns and Trees shall be at 2-day intervals for a period of 18 days from time of planting. At each watering, 1/4 in. (6 mm) of water shall be applied or supplement natural rain to the equivalent of 1/4 in. (6mm)

   c) Watering shall continue after 18 days period to maintain turf in thriving condition. After grass has started, areas which fall to show uniform stand of grass shall be planted repeatedly until satisfactory growth of grass is achieved.

   d) Equipment used to maintain grass areas shall be approved by Engineer.

   e) At time of first cutting and subsequent cuttings, the mower blades shall be set at a minimum height of 1-1/2 ins. (38 mm) Grass shall be cut first when it reaches a height of 4 ins. (100 mm) Regular cutting shall be done every 2 weeks until grass cover is established.

   f) Final grading shall be carried out only after a 12 week establishment period. Contract shall allow for rolling after a further 3 month period if instructed to do so by Engineer.

2. Lay evenly mixed river stones placed approximately level with edges of border coping and to approximate depth of 6 ins to 8 (150mm 200mm)ins in areas marked ‘Pebbles’ on Drawings.

3.6 CLEANING UP:

1. Upon completion of the work of this Section immediately remove debris and excess materials from the Site.

PART 4
METHOD OF MEASUREMENT;

1. Paid as specified in BOQ.

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PART 1 GENERAL

1.1 DESCRIPTION

A. Work included:
1. Parking line striping.
2. Directional markings and lettering.
3. Wheel stops.

B. Related work: Painting other than the work of this Section.

1.2 ENVIRONMENTAL REQUIREMENTS

1.2.1 Do not apply paint when the ambient temperature is below 55 deg. F. nor when there is a probability that the temperature could fall below that point. Do not apply paint when the pavement is damp nor when there is a probability of rain.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Dunn-Edwards Corp., (800) 537-4098.

B. Frazee Paint and Wall Covering, (800) 826-9048; or

C. ICI Paints, (323) 793-0001; or

D. Thompson Building Materials, (909) 350-3000.

2.2 TRAFFIC PAINT

2.2.1 Dunn-Edwards Vin-L-Stripe W801 Series epoxy modified acrylic latex. .

2.2.2 Frazee 506 Acrylic Traffic Line Paint.

2.2.3 ICI:
2.2.3.1 7000 Premium Series.
2.2.3.2 3000 Handicapped Blue.

2.2.4 Colors:
2.2.4.1 Text, parking stall striping, directional arrows and driving lane dividers: White.
2.2.4.2 No parking zone markings: Yellow.
2.2.4.3 Handicap zone markings: Blue.
2.2.4.4 No parking curb: Red.
2.2.4.5 Blue paint for symbol of accessibility: Match color no. 15090 Federal Standard 595A as specified in Section 2-1720 of CCR Title 24 Handicap Regulations (similar to Royal Blue).

2.3 EQUIPMENT

2.3.1 Pressurized, self-contained paint machine capable of applying a straight line from 2" to 6" wide,

with consistent coverage of a minimum of 150 sq. ft. per gal.

2.4 WHEEL STOPS

2.4.1 Thompson precast concrete parking lot bumpers using 3,000 psi concrete and complete with 5/8" diameter steel pins.

2.4.2 Epoxy adhesive: A high viscosity, standard set, epoxy paste complying with ASTM D 281, D 476; Test Method No. California 425; Federal Standard No. 595.

PART 3 EXECUTION

3.1 TRAFFIC PAINTING

A. Prepare areas having oil and grease deposits by washing with a TSP solution or by using high pressure spray and detergent followed by a clear water rinse. Clean surfaces with excess dust and dirt build-up with water spray.

B. Machine paint to the length, width and patterns indicated on the drawings.

1. Paint lines 4" wide at a minimum rate of one gal. per 150 sq. ft.. Finish straight and true without holidays or cat's whiskers.

2. Paint direction arrows for in and out traffic flow, curb markings, text, no parking or fire access areas and parking space numbers.

3. International symbol of accessibility: Apply international symbol of accessibility on pavement surface. The surface of each accessible parking space or stall shall have a surface identification duplicating either of the following schemes:

a. By outlining or painting the stall or space in blue and outlining on the ground in the stall or space in white or suitable contrasting color a profile view depicting a wheelchair with occupant. The profile view shall be located so that it is visible to a traffic enforcement officer when a vehicle is properly parked in the space and shall be 36" high by 36" wide.

b. By outlining a profile view of a wheelchair with occupant in white on blue background. The profile view shall be located so that it is visible to a traffic enforcement officer when a vehicle is properly parked in the space and shall be 36" high by 36" wide.

C. Prevent overspray and dripping paint on the paving. Keep paving clean and free of paints ports.

D. Application:

1. Apply the white traffic paint in one coat at 10 -15 mils wet film thickness.
2. Apply the handicap blue traffic paint in one coat at 8 - 10 mils wet film thickness.

3.2 WHEEL STOPS

3.2.1 Install in accordance with manufacturer's recommendations to assure proper anchorage in a

neat, straight and true manner.

3.2.2 Install wheel stops with epoxy adhesive where steel rebar anchors cannot be installed.

3.3 PROTECT AND CLEAN

3.3.1 Protect: Protect work and work of other trades. Furnish and place drop cloths and masking to protect work during execution. Remove all paint droppings and repair all injured surfaces ina manner satisfactory to Architect. Do not allow traffic on painted surfaces until paint isdry.

3.3.2 Clean: Upon completion of work, remove paint spots from surfaces adjacent to those painted or finished and remove rubbish, paint cans and accumulated materials. Leave work clean, aligned and in condition acceptable to the Architect.

END OF SECTION

CIVIL & ARCHITECTURE VENDOR'S LIST

S.No.	Description	Manufacturer as Per Design Specifications	Local Representative / Vendor
1	Cement	M/s. DG Cement	Mr. Ammar (0323-3212322)
		M/s. Attock Cement	
		M/s. Power Cement	Mr. Taha (0333-3036434)
		M/s. Lucky Cement	Mr. Umair Khan (0321-2821837)
		Or other equivalent approved by the Consultant / Engineer	
2	Steel Reinforcement	M/s. Amreli Steels	Mr. Naveed Ansari (0324-5979184)
		M/s. Agha Steels	
		M/s. Union Steel	Mr. Zain (0331-8753823)
		M/s. Faizan Steel	Mr. Khurram (0333-4934931)
		Or other equivalent approved by the Consultant / Engineer	
3	Porcelain & Ceramic Tiles (Flooring & Dado)	M/s. Master Tiles	Mr. Hammad (0330-6277222)
		M/s. Shabbir Tiles	Mr. Hassan (0301-8262553)
		M/s. White Horse	Mr. Waqas (0332-2498637)
		M/s. City Tiles	Mr. Yasir Taqi (0324-2043171)
		M/s. Granitto Tiles	Mr. Hassan (0321-9222863)
		M/s. Benitoz Homes	Mr. Abdul Qadir (0300-8211840)
		M/s. H & H Ceramics	Mr. Danish (0321-2491656)
		Or other equivalent approved by the Consultant / Engineer	
4	Marble / Granite / Stone (Flooring, Wall Cladding, Kitchen & Vanity Countertop etc.) - type and sourcing of marble / granite / stone as per finishing schedule	M/s. Inexterior	Mr. Fahad (0340-1118887)
		M/s. Marble World	Mr. Hasham Farooq (0340-7866381)
		M/s. Stone City	Mr. Muneeb Haque (0340-1118886)
		Or other equivalent approved by the Consultant / Engineer	
5	Carpet Tiles & Wooden Flooring	M/s. Pak Carpet Industries	Mr. Imran (0333-3802017)
		M/s. Seenqaaf Industrial Co.	
		Or other equivalent approved by the Consultant / Engineer	
6	FibreGlass Chairs	M/s. Techno FRP Services	Mr. Shahid Hussain (0321-9252436)
		M/s. Hasan Trading Co.	Mr. Hassan (0336-2707272)
		Or other equivalent approved by the Consultant / Engineer	
7	UPVC & Aluminum Doors, Windows, Ventilators etc.	M/s. Explore Interior	Mr. Navaid Farooqui (0300-2284822)
		M/s. Maptech	Mr. Khalid Hussain (0333-6699955)
		M/s. Hitech Engineering Services	Mr. Adil Kushtiwala (0300-8200506)
		M/.s JAGW AlucoGlass System	Mr. Nadeem (0335-1371047)
		Or other equivalent approved by the Consultant / Engineer	
8	ACP Cladding	M/s. Hitech Engineering Services	Mr. Adil Kushtiwala (0300-8200506)
		M/.s JAGW AlucoGlass System	Mr. Nadeem (0335-1371047)
		Or other equivalent approved by the Consultant / Engineer	
9	Termite Proofing	Mirage	Mr. Badar Jamal (0336-6822155)
		Agenda 25 EC	Mr. Arif Akhtar (0300-8939992)
		Termicure 25 EC	Mr. Arif Akhtar (0300-8939992)
		Or other equivalent approved by the Consultant / Engineer	
10	Solid & Hollow Blocks	M/s. BES Block	Mr. Shahid (0300-2307353)
		M/s. Megnacrete	Mr. Abdullah Shahid (0300-2019122)
		M/s.Envicrete	Mr. Rasheed (0331-2356101)
		M/s. Banu Mukhtar	Mr. Kamran Tola (0300-8270087)
		M/s. Caracrete Industries	Mr. Adeel (0321-2696795)
		Or other equivalent approved by the Consultant / Engineer	
11	Bricks, Brick Tiles and Brick Jali	M/s. Tasneem Bricks	Mr. Shakil (0307-2824771)
		M/s. Al-Nasir Bricks	Mr. Liaquat Malik (0303-7733567)
		Or other equivalent approved by the Consultant / Engineer	
12	Water Proofing (Bitumen, Torch Applied Membrane, Crystalline, Cementatious, Floor Hardner, Waterstopper)	M/s. Fospak	Mr. Faheem (0300-8250632)
		M/s. Sika	Mr. Mansoor Raza (0300-8430092)
		M/s. Aqaufin	Ms. Kashmala (0301-8283272)
		M/s. Mitchell Construction Chemicals	Mr. Usman (0342-2839291)
		M/s. Ressichem	Mr. Hussain Zulfiqar (0309-7772464)

CGD CONSULTING (PVT) LIMITED CGDC

CIVIL & ARCHITECTURE VENDOR'S LIST

S.No.	Description	Manufacturer as Per Design Specifications	Local Representative / Vendor
		M/s. Pak Hy-Oils Limited	Mr. Samad (0332-2900799)
		M/s. Mega Sealers	Ms. Mantasha Khan (0318-3880161)
		M/s. Professional Sealers	Mr.Fahad A. Khan (0321-1110475
		Or other equivalent approved by the Consultant / Engineer	
13	Geotextile and Geomembranes (Typer Geotextile, PVC Geomembrane, Needle Punched Geotextile etc.)	M/s. Matrixx	Mr. Babar Farid (0300-2038112)
		M/s. Fospak	Mr. Faheem (0300-8250632)
		M/s. Sika	Mr. Mansoor Raza (0300-8430092)
		M/s. Mega Sealers	Ms. Mantasha Khan (0318-3880161)
		Or other equivalent approved by the Consultant / Engineer	
14	Polypropylene Fibre	M/s. Matrixx	Mr. Babar Farid (0300-2038112)
		M/s. Fospak	Mr. Faheem (0300-8250632)
		M/s. Sika	Mr. Mansoor Raza (0300-8430092)
		M/s. Mega Sealers	Ms. Mantasha Khan (0318-3880161)
		Or other equivalent approved by the Consultant / Engineer	
15	Acrylic Base / Weather Shield / Reflective Paint (Local)	M/s. Akzo Nobel	Mr. Raza Aziz (0300-0606867)
		M/.s Nippon	
		M/s. Jotun	Mr. Usama Amir (0345-8475791)
		M/s. Berger	
		M/s. Gobis	
16	Gypsum / MR Boards	M/s. United Gypsum	Mr. Ayaz Saleem (0300-0566855)
		M/s. Lodhia Gypsum Industries Pvt. Ltd.	Mr. Kamran Sheikh (0301-8734684)
		M/s. Thermec Engineering Company	Mr. Saad (0300-8238934)
		Or other equivalent approved by the Consultant / Engineer	
17	Glass Partition (Plain & Tempered)	M/s. Ghani Glass	Mr. Kashif (0300-8251049) Mr. Ahmed (0302-9257887)
		M/s. Tariq Float Glass	
		Or other equivalent approved by the Consultant / Engineer	
18	Fibre Reinforce Polymer Sheet (Corrugated Double Sided Finish)	M/s. Master Composite	Mr. Waqas Ahmed (0345-2030093)
		Or other equivalent approved by the Consultant / Engineer	
19	GRC (Glass Fibre Reinforced Concrete) Mesh	M/s. Cara Tiles	Mr. Ataullah (0309-3338673)
		Or other equivalent approved by the Consultant / Engineer	
20	C.C. Tiles, Pavers, Kerbstone, Terracota Tiles, Kaprail & C.C Coping etc.	M/s. Envicrete	Mr. Rasheed (0331-2356101)
		M/s. Magnacrete	Mr. Abdullah Shahid (0300-2019122)
		M/s. Cara Tiles	Mr. Ataullah (0309-3338673)
		M/s. Caracrete Industries	Mr. Adeel (0321-2696795)
		M/s. Matrixx	Mr. Irfanuddin (0300-2038114)
		M/s. Banu Mukhtar	Mr. Kamran Tola (0300-8270087)
		M/s. First Floor	Mr. Usman Elahi Faruqi (0300-8293156)
		M/s. Rockerete	Ms.Laiba Sajid (0330-2241281)
		M/s. Pak Tiles	Mr. Shahzad (0300-4617715)
		Or other equivalent approved by the Consultant / Engineer	
21	Keystone	M/s. Envicrete	Mr. Rasheed (0331-2356101)
		M/s. Caracrete Industries	Mr. Adeel (0321-2696795)
		Or other equivalent approved by the Consultant / Engineer	
22	Ready Mix Concrete	M/s. Allied Materials (Private Limited)	Mr. Humayun Shamsi (0346-2425828)
		M/s. King Enterprises	Mr. Arif (0333-2288537)
		Or other equivalent approved by the Consultant / Engineer	
23	Gazebo's & Wood Works	M/s. Sindh Wood Works Enterprises Pvt. Ltd.	Mr. Irfan Khan (0334-3237281)
		Or other equivalent approved by the Consultant / Engineer	
24	Prefabricated Security Cabin	M/s. Porta Cabin	Mr. Riaz (0300-4577603)
		Or other equivalent approved by the Consultant / Engineer	
25	Fabrication Works (MS, S.S, C.I, G.I etc)	M/s. Fancy Iron Grill Works	Mr. Rasheed (0333-2644422)
		M/s. Junaid Casting Iron Works	Mr. Zahid Khilji (0300-8299756)
		M/s. The Protectors	Mr. Zafar Rehmatullah (0300-8284740)
		Or other equivalent approved by the Consultant / Engineer	

CGD CONSULTING (PVT) LIMITED CGDC

CIVIL & ARCHITECTURE VENDOR'S LIST

S.No.	Description	Manufacturer as Per Design Specifications	Local Representative / Vendor
26	Tensile Fabric Canopy	M/s. Urban Objects	Mr. Sohail Raees (0333-2158844)
		M/s. The Protectors	Mr. Zafar Rehmatullah (0300-8284740)
		Or other equivalent approved by the Consultant / Engineer	
27	Asphalt Batching Plant	M/s. King Enterprises	Mr. Saleem (0300-8217994)
		M/s. Bakhri Ahmed Khan	Mr. Haji Abdul Majeed (0300-2019513)
		Or other equivalent approved by the Consultant / Engineer	
28	Concrete Admixture	M/s.Sika	Mr. Mansoor Raza (0300-8430092)
		M/s. Fospak	Mr. Faheem (0300-8250632)
		M/s. Ressichem	Mr. Hussain Zulfiqar (0309-7772464)
		M/s. Mega Sealers	Ms. Mantasha Khan (0318-3880161)
		M/s. Aquafin	Ms. Kashmala (0301-8283272)
		Or other equivalent approved by the Consultant / Engineer	
29	Horticulture Works (Sweet Earth, Cow Dung, Ground Covers, Trees, Shurubs, Plants, Flowers, Grass, Planters etc.)	M/s. Greenland Services	Mr. Munir Nauroz (0332-2149962)
		M/s. Rohan and Co.	Mr. Amjad (0300-2366102)
		M/s. Green Concepts	Mr. Khalid Zubari (0321-8292580)
		Or other equivalent approved by the Consultant / Engineer	
30	Road Signs, Lane Markings, Studs, Cateyes, Speed Breakers etc.	M/s. S.K Associate	Mr. Sahir Khan (0312-2818168)
		M/s. NH Enterprises	Mr. Nadeem (0333-3516881)
		Or other equivalent approved by the Consultant / Engineer	
31	Bridges & Buildings Expansion Joints (Local / Imported)	M/s. Pioneer Techniques	Mr. Sheraz Ahmed Siddiqui (0300-9279057)
		M/s. HRM Associates (Arfen Tukey)	Ms. Fahmina (0309-3331738)
		Or other equivalent approved by the Consultant / Engineer	
32	Bearing Pads	M/s. Pioneer Techniques	Mr. Sheraz Ahmed Siddiqui (0300-9279057)
		M/s. HRM Associates (Arfen Tukey)	Ms. Fahmina (0309-3331738)
		Or other equivalent approved by the Consultant / Engineer	
33	FRP Gratings & Manhole Cover (Local / Imported)	M/s. HRM Associates (Kompozit Kimya)	Ms. Fahmina (0309-3331738)
		M/s. Mentor Building Materials	Mr. Shahid Ali Khan (0321-2595775)
		M/s. Fibre Craft Industries	Mr. Nadeem Asghar (0300-8403969)
		Or other equivalent approved by the Consultant / Engineer	



Technical Specifications:

Road, Bridges and Infrastructure Works

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SECTION - 0110

DIVERSION AND TRAFFIC CONTROL PLAN

01 GENERAL

The Contractor shall be responsible to provide a comprehensive traffic control plan for the safety of vehicular and pedestrian traffic during construction. A working drawing for this purpose shall be submitted to the Engineer for approval. The Traffic Control Devices shall comprise but not be limited to Barricades/ Fences, Cones, Warning Signs, Warning Lights etc. The Contractor will specify the number and details of the traffic control devices, he intends to use in the traffic control plan. Items that should be considered in preparing traffic control plans include the following:

(a) The Contractor shall construct detour roads as per approved road pavement section.

(b) Detour alignment and surface that will allow traffic to pass smoothly around the work zones. The surface of the travelled way, whether located within the construction area or on a detour, should be maintained in a condition that will permit the safe movement of traffic at a reasonable speed.

(c) Adequate tapers are needed for lane drops or at locations where traffic must be shifted laterally.

(d) Adequate traffic control devices and pavement markings for complete day and night effectiveness must be provided, including specification of temporary marking materials that can be removed when traffic lane patterns change.

(e) Roadway illumination and warning lights should be used where required. Steady burning lights are used to delineate a continuous travel path through or around a work zone. The very short “on” time of flashing lights does not enable motorists to focus on the light and make a depth perception estimate. The use of flashers is limited to marking a single hazards, marking the start of a section using steady burn lights, and for use with traffic control signs.

(f) The location of cones, delineators, drums, barriers, or barricades, as means of channelizing traffic, should be detailed in the traffic control plans when special conditions exist or it not shown in the standard plans.

(g) If not provided for in the specifications, requirements regarding the removal of signs and markings from the job site, when they are no longer needed, should be noted on the traffic control plans.

02 MEASUREMENT & PAYMENT

No payment shall be made for the works involved within the scope of this section of specification.

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

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.

2. GENERAL

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.

Contractor shall protect the environmental interests and HSE regulations at camp and works sites during execution of the contractual work.

3. CODES AND STANDARD

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

4. MAINTENANCE

The Contractor shall furnish, make arrangements for, and carry out proper and adequate maintenance of the Contractor’s Camp areas at such camp to provide a neat, well-kept camp in all respects with pleasant and healthy surroundings and conditions for all occupants of their camp.

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.

5. MEASUREMENT AND PAYMENT

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

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

SECTION - 0130

STAKE-OUT SURVEY

1. SCOPE

Under this item the Contractor shall make the stakeout 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 stakeout 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 Contract.

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 stakeout 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 stakeout survey work shall be referenced to the centerlines 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 stakeout 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 benchmarks 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 stakeout 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. MEASUREMENT AND PAYMENT

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

SECTION - 0150

CLEARING AND GRUBBING

1. SCOPE

The clearing and grubbing shall consist of clearing the designated area of all trees, down timber, snags, bush, other vegetation, rubbish and all other objectionable material, and shall include grubbing stumps, roots, and matted roots, and disposal of all spoil material resulting from the clearing and grubbing. It shall also include the removal and disposal of structures that protrude, encroach upon, or otherwise obstruct the work, except when otherwise provided for on the plans or directed by the Engineer to be saved. The scope of this section of specifications is covered with detailed specifications laid down herein.

2. LIMIT OF AREA

2.1 Location of Works

The Engineer will define the limit of areas where clearing and grubbing is to be done. Normally it will include all land within the right of way and all other construction area including ditches, detours, minor road crossings and other areas shown on the plans or as specified or as directed by the Engineer. The Engineer will designate the fences, structures and debris and trees and bushes to be cleared where grubbing is not required. It shall not include clearing and grubbing of borrow or other pit areas from which material is secured. It shall include the leveling or removal of all bunds or mounds within the right of way unless otherwise directed by the Engineer.

2.2 Grubbing and Cutting

All roots and stumps within the limits of the site shall be grubbed and excavated unless otherwise specified or approved by the Engineer.

2.3 Disposal

All wood and bush shall be burned or otherwise disposed off within fifteen (15) days after cutting or felling unless otherwise approved. No tree trunks, stumps or other debris shall be left within Site unless approved in writing by the Engineer. The location of disposal areas shall be within or outside the limits of the project or as approved in writing by the Engineer and shall be acquired by the Contractor at his own expense. Any useable material shall remain the property of the Employer.

2.4 Protection and Restoration

The Contractor shall prevent all damage to pipes, conduits, wires, cables or structures above or below ground. No land monuments, property markers, or official datum points shall be damaged or removed until the Engineer has witnessed or otherwise referred their location and approved their removal. The Contractor shall so control his operations as to prevent damage to trees and shrubs, which are to be preserved. Protection may include fences and boards lashed to trees to prevent damage from machine operations. The Contractor shall protect the environmental interests / conditions of the areas of camp and work site. The existing covered or open benchmarks should be relocated as directed by the Engineer. In the event that anything specified herein to be saved and protected is damaged by the Contractor; such damages shall immediately be repaired or replaced by the Contractor at his own cost to the satisfaction of the Engineer. All areas cleared and grubbed must be approved by the Engineer or Engineer's Representative before the start of cleaning operations.

3. MEASUREMENT AND PAYMENT

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

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

SECTION – 0160

STRIPPING OF TOP SOIL

01. SCOPE

The work under this section of the specifications shall consist of furnishing all plant, labour and equipment and performing all operations in connection with stripping of top soil, removal and disposal of unsuitable and surplus material in accordance with the specification and the lines, grades and levels as shown on the drawings or as directed by the Engineer.

02. EXECUTION

The Contractor shall jointly survey the area designated by the Engineer and prepare the survey drawings showing pre work levels and cross-section and submit to the Engineer for approval prior to start of any stripping of top soil.

All suitable material from stripping of top soil shall be transported to and placed in fill areas or stock piled as directed by the Engineer. All material declared by the Engineer as unsuitable or surplus shall be removed from the site and disposed off to areas as designated by the Engineer.

The Contractor shall carryout the stripping of topsoil in areas designated on the drawings and to thickness shown on the drawing. Any area which shall be stripped to thickness more than specified shall be approved by the Engineer prior to the start of the work. All related drawings shall be submitted for the approval of the Engineer before stripping operations are started. Over stripping unless otherwise directed shall not be acceptable and the Contractor shall backfill to the required levels and grades and compact to 95% of maximum dry density as determined by ASTM D 1557 at his own expense.

The finished grade surface shall be smooth and even and tolerance from required grade shall not be more than 25mm.

03. MEASUREMENT AND PAYMENT

3.1 General

Except otherwise specified herein or elsewhere in the Contract Documents, no separate 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.

3.1.1 Transporting and stock piling of stripped material at approved locations.

3.1.2 Disposal of unsuitable & surplus material to designated places.

3.1.3 Any fill with approved material necessitated by over stripping due to fault or convenience of the contractor.

3.2 Stripping of top soil

3.2.1 Measurement

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

Measurement of acceptably completed works of stripping/ excavation of topsoil will be made on the basis of actual volume in cubic meter properly stripped/ excavated. It shall be calculated/ measured from pre work levels and levels shown on the drawing.

3.2.2 Payment

Payment will be made for acceptable measured quantities of soil stripped/excavated in cubic meter quoted in the Bill of Quantities and shall constitute full compensation for all the works related to the item.

SECTION - 0170

LEVELLING AND GRADING

01. SCOPE

1.1 The work to be done under this section of the specifications consists of performing all earth work required for levelling & grading the area in accordance with required levels, elevations and grades shown on the Drawing/Plans or as established by the Engineer. The work to be done by the Contractor shall include performing the required cutting to line, levels, grade and filling the area to the desired levels and grades; providing and transporting labour, excavating, grading, levelling, and watering and all incidental operations required in performing the work as specified herein.

1.2 Levelling and grading work shall be performed after completing the clearing and grubbing.

1.3 During the progress of the works, if by reason of delay, effects of bad weather; rainfall, or from any cause whatsoever, any levels, grades or profiles of the area are changed, the Contractor shall, at his own cost, be liable to bring the area to the required levels and profiles as shown on the Drawings or as directed by the Engineer.

1.4 Prior to commencement of work the Contractor shall submit for approval of the Engineer complete proposal with regard to methodology he proposes to adopt for cut and fill for levelling and grading works giving due consideration to the site configuration and the required levels and lines shown on the drawing.

02. APPLICABLE STANDARDS

2.1 Materials, construction and testing shall comply with the following codes and standards:

ASTM C 136 Sieve or screen analysis of fine and coarse aggregate.

ASTM D 422 Test for Liquid Limit on Soil

ASTM D 424 Test for Plastic Limit

03. GENERAL

3.1 The Contractor shall submit, a detailed list of plant and equipment which he shall undertake to bring to the site and to carrry out the work. The list shall satisfy the Engineer as to type, size and quantity.

3.2 The Contractor shall jointly survey the Project area marked on the drawings or any area designated by the Engineer and prepare the survey drawings showing pre work levels of natural ground profile and cross-sections and submit to the Engineer for approval prior to start of any earthwork operation. Clearing grubbing shall be done in accordance with the provision of section 0150.

3.3 Existing utilities which are to remain in service or to be relocated and to remain in service until relocation, are to be determined by the Contractor.

3.4 All suitable material from cut/excavations shall be transported to and placed in fill areas or stockpiled at locations designated by the Engineer.

04. SITE PREPARATION

4.1 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.

4.2 The Contractor shall construct and maintain accurate bench marks so that the lines and levels can be easily checked by the Engineer.

4.3 Levelling and grading of the designated area shall be done by means of levelling equipment and grading machines. The Contractor shall be responsible for the required construction and stability of the grades in conformity with the Drawings/Plans or as determined by the Engineer.

05. CUT

5.1 Classifications of Cut

No classification shall be made of any material cut/excavated as to its class, nature, origin or conditions.

5.2 Disposal of Cut Material

Suitable materials derived from cut shall be used for filling the depressions or low lying areas; any surplus or unsuitable material shall be disposed off by the Contractor, in spoil banks, waste area as designated and directed by the Engineer.

5.3 Tolerance

Finished surface shall be smooth / even and shall not vary more than 30mm from true grade as established by grade hubs.

5.4 Extra Cut/Excavation

In the event the Contractor cuts/excavates any area to a level lower than the required, he shall re-instate such areas to the required density levels and grades. No extra payment will be made to the Contractor on this account.

06. FILL

6.1 Fill Materials

Areas requiring filling shall be filled with select material obtained from the required cut / excavations and material obtained by stripping of top soil from areas designated as paved. The fill material shall be free from objectionable material and to the satisfaction of the Engineer. Filling shall be carried out in successive layers and compacted to 85% dry density as per laboratory test ASTM D 1557, not exceeding 200 mm. The Contractor shall not place fill material during periods of rain.

6.2 Haul

All hauling will be considered a necessary and incidental part of the work.

6.3 Tolerances

Finished surface shall be smooth and even and shall not vary more than 30 mm from true grade as established by grade hubs.

07. QUALITY CONTROL

Field inspection will be carried out jointly by the contractor and the Engineer. Contractor shall facilitate the inspection and the performance of tests and bear all costs thereof. A

copy of all test shall be submitted to the Engineer for approval. Tests shall be performed in accordance with the following test procedure and frequency of testing.

A. Gradation:

ASTM D-422 one initial series for each material from each source and then locally.

08. 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 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 item of the Bills of Quantities.

8.1.1 Any fill with approved material necessitated by over cut/excavation due to fault or convenience of the contractor.

8.1.2 Stock piling of the cut/excavated material at approved locations within project boundary and transporting back suitable material to places requiring fill.

8.1.3 Laboratory and field tests stipulated in these specifications.

8.1.4 Disposal of rejected unsuitable and surplus cut material within 10 kilometers free haulage limit along the most direct route from the boundary of the project.

8.1.5 Transporting approved quality fill material from within the project boundary.

8.1.6 Rolling, levelling, watering & compacting cut & fill the excavated and fill areas to required density.

8.2 Levelling and Grading

8.2.1 Measurement

Measurement of acceptably completed works of levelling and grading will be made on the basis of net actual area in square metre in accordance with the line level and grade shown on the drawings or as directed by the Engineer.,

8.2.2 Payment

Payment will be made for acceptable measured quantity as provided above of levelling and grading in cut/fill on the basis of unit rate per square metre quoted in the Bill of Quantities and shall constitute full compensation of all the works related to the item.

SECTION – 0200

DISMANTLING WORKS

1. SCOPE

The work covered by this Section of the Specifications consists of furnishing all plant, labour, equipment, appliances and performing all operations in connection with demolition/ dismantling and removal of existing asphalt road, pavement, kerbs, medians, foundations, shop approaches/plate forms, buildings, trees, plants, removal of services with accessories and concrete/ block masonry structures including disposal of demolished/ dismantled and removed material to designated places. Whole work shall be done in accordance with these specifications and as directed by the Engineer.

2. PROCEDURES

2.1 The Engineer will define the limits where demolition/ dismantling and removal activity is to be done and shall approve the procedures/methods to be adopted by the Contractor. The Contractor shall layout the boundaries/limits for Engineer's checking and approval before commencing dismantling work.

2.2 Whole work shall be performed in an orderly manner and the Contractor shall take all necessary precautions and expedients to prevent damages to the adjacent structures, installed equipment/machinery, pipes, conduits, any other installation etc. Any damage caused to the structures and installations due to negligence of the Contractor during demolition/ dismantled and removal operations shall be repaired/replaced by the Contractor at his cost and to the satisfaction of the Engineer.

3. DEMOLITION OF ROAD,PAVEMENT AND CONCRETE/ MASONRY WORKS

The Contractor shall demolish road pavement and concrete / masonry / flooring works to the line and depth as shown on the Drawings or as directed by the Engineer. Explosives shall not be used to remove the plain and reinforced cement concrete or any other material whatsoever. Mechanically operated brakers, concrete saws, chipping hammers or other approved methods shall be employed for cutting. Care shall be taken that existing services and structures are not damaged. It shall be the responsibility of the Contractor to replace at his cost any services, Structures damaged by the Contractor due to his negligence during cutting operations or thereafter until the whole of cut parts/areas are restored to original condition to the satisfaction of the Engineer.

4. REMOVAL & SHIFTING OF TREES

The trees of specified girths shall be replanted at the designated places as directed by the Engineer, these large trees shall be excavated around the tree, but not less than 200mm, in such a manner that the roots of trees should not be cut or exposed to atmosphere, sufficient native soil should remain adhesive to the roots of tree.

Immediately prior to shipping all plants shall be inspected, dug, prepared and packed with care and skill in accordance with the recognized standard practice for the kinds of plants concerned.

During transportation all plants shall be packed adequately to ensure protection from sun, wind, climatic or seasonal injuries. Tarpaulins and other covers shall be placed over plants when they are transported by trucks for more than 10 km.

Roots system of all plants shall not be permitted to dry out at any time and shall not be exposed to excessive heat or to freezing temperature.

Immediately after digging and prior to packing in moss or other suitable materials, roots shall be dipped in a solution of humectant. All earth-balls shall be firmed and intact and

contained in hessian or palm bark. Do not drop balled or burlapped stock at any time. All balled and hessian covered plants and container growth plants shall at all times be handled by the ball or by the container and not by the plant stem. The head of each tree shall be carefully tied to prevent fracture of branches.

If soil or the habit of root growth is such that the final roots are not adequately protected, wrap exposed root systems in hessian and prevent from drying.

The moisture of retained soil shall be protected by wrapping up the hessin cloth immediately after it has been uprooted, before transporting to the designated places or at temporary stack yard. The maximum time of stacking of any tree shall not exceed more than 2 days.

The new location of tree shall be excavated upto the depth / height of root mass, so that the no any portion shall remain above the ground level, which was initially rested below ground level.

The Contractor shall arrange all required watering, pesticides, fertilizers etc. for the shifted tree, without any additional cost to employer.

5. TUCKING OF EXISTING ROAD

The existing pavement surface shall be tucked off manually by the means of pickaxes, to make the asphalt surface sufficient rough to make bond with the new asphalt course.

The minimum depth of tucking shall not be less than 50mm and these shall not be less than twenty tucks per square meter. The surface shall be cleaned out after dismantling and dismantled material shall be disposed off at the places as designated by the Engineer.

6. CLEARANCE OF GREEN AREA

The bushes/plants in existing green area shall be cleared off upto the roots and the surface shall smoothen and cleared from all debris and any organic material before receiving new layer.

7. REMOVAL OF EXISTING SERVICES/ UTILITIES

7.1 The Contractor shall mark all the services/ utilities falling within the ROW. After getting approval from the Engineer, the contractor shall remove all such services/ utilities as per the requirement/ specifications of the relative department whose utilities/ services are being removed/ shifted.

8. DISPOSAL

8.1 All debris materials resulting from demolition / dismantling works shall be disposed off to places designated by the Engineer in the manner of disposition required and directed by the Engineer.

8.2 All useable materials resulting from demolition and removal shall remain the property of the Employer and shall be stacked at designated places.

8.3 The Contractor shall segregate the useable materials as directed by the Engineer and stack at designated places.

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 items related to this section. The cost thereof shall be deemed to have been included in the quoted unit rate of the items of the Bill of Quantities under this section.

9.1.1 Temporary diversion and safety measures, Demarkation / layouts etc.

9.1.2 Loading, unloading, transportation and disposal of demolished/ dismantled/ removed/ useable material to the place designated by the Engineer.

9.1.3 Permissions/approvals, if required, from the relative department and information to the stack holders.

9.1.4 Stacking of all useable material to the place designated by the Engineer.

9.1.5 Earth work

9.1.6 hessian cloth, plaster of paris etc

9.1.7 Repair / finishing of adjacent component of dismantled structure.

9.2 **Asphalt Concrete Pavement/Tucking**

9.2.1 Measurement

Measurement of acceptably completed works of demolition of existing asphalt concrete pavement/tucking works will be made on the basis of number of Square metre of the pavement actually demolished, shown on the Drawings or as directed by the Engineer.

9.2.2 Payment

Payment will be made for acceptable measured quantity of demolition of existing asphalt concrete pavement/tucking on the basis of unit rate per square metre quoted in the Bill of Quantities & shall constitute full compensation for all the works related to the item.

9.3 **Dismantling of Existing Structures / footpath / platforms**

9.3.1 Measurement

Measurement of acceptably completed works of dismantling of existing structures/footpath/platforms will be made the basis of unit rate per square metre quoted in the Bill of Quantities & shall constitute full compensation for all the works related to the item.

9.3.2 Pavement

Payment will be made for acceptable measured quantity of dismantling /demolition of existing structures/footpath/platforms on the basis of unit rate quoted in the Bill of Quantities & shall constitute full compensation for all the works related to the item.

9.4 **Removal of existing Electrical / Telephone and Lighting poles, Traffic signs, Sign boards and Traffic Signals**

9.4.1 Measurement

Measurement of acceptably completed works of removal of existing electrical, telephone and lighting poles, Traffic signs, Sign boards and Traffic Signals including foundations, cables and accessories will be on the basis of actual number of poles removed as shown on the Drawings or as directed by the Engineer. All poles & cables shall be stacked at

designated place as directed by the Engineer. Care shall be taken to avoid the damage to the useable material

9.4.2 Pavement

Payment will be made for acceptable measured quantity of existing electrical, telephone and lighting poles, Traffic signs, Sign boards and Traffic Signals removed on the basis of unit rate per number quoted in the Bill of Quantities & shall constitute full compensation for all the works related to the item.

9.5 **Removal & Shifting of Trees**

9.5.1 Measurement

Measurement for acceptably completed works of removal and shifting of existing trees will be made on the basis of number of the trees removed and shifted as directed by the Engineer.

9.5.2 Payment

Payment will be made for acceptable measured quantity of removal and shifting of trees on the basis of unit rate per number quoted in the Bill of Quantities and shall constitute full compensation for all the works related to the item.

9.6 **Dismantling, Raising / Lowering of Existing Manholes**

9.6.1 Measurement

Measurement for acceptably completed works of dismantling, raising / lowering of existing manholes will be made on the basis of number of the manholes removed and shifted as directed by the Engineer.

9.6.2 Payment

Payment will be made for acceptable measured work of dismantling, raising / lowering of existing manholes will be made on the basis of unit rate per number quoted in the Bill of Quantities and shall constitute full compensation for all the works related to the item.

9.7 **Dismantling / Removal of Iron Grill / Barbed wire**

9.7.1 Measurement

Measurement for acceptably completed works of dismantling / removal of iron grill / barbed wire including foundations will be made on the basis of running meter dismantled and removed and shifted as directed by the Engineer.

9.7.2 Payment

Payment will be made for acceptably measured work of dismantling / removal of iron grill / barbed wire including foundations will be made on the basis of unit rate per meter quoted in the Bill of Quantities and shall constitute full compensation for all the works related to the item.

9.8 **Sub base and Base Course**

9.8.1 Measurement

Measurement of acceptably completed works of demolition, dismantling and removal of existing Sub base and Base Course works will be made on the basis of number of Cubic

metre of the Sub base and Base Course actually demolished, shown on the Drawings or as directed by the Engineer.

9.8.2 Payment

Payment will be made for acceptable measured quantity of demolition dismantling and removal of existing Sub base and Base Course on the basis of unit rate per cubic metre quoted in the Bill of Quantities & shall constitute full compensation for all the works related to the item.

9.9 **Dismantling / Removal of median**

9.9.1 Measurement

Measurement for acceptably completed works of dismantling / removal of median will be made on the basis of running meter dismantled and removed and shifted as directed by the Engineer.

9.9.2 Payment

Payment will be made for acceptably measured work of dismantling / removal of median will be made on the basis of unit rate per meter quoted in the Bill of Quantities and shall constitute full compensation for all the works related to the item.

9.10 **RCC & PCC Work**

9.10.1 Measurement

Measurement of acceptably completed works of RCC & PCC will be made on the basis of number of Cubic metre of the RCC & PCC actually demolished, shown on the Drawings or as directed by the Engineer.

9.10.2 Payment

Payment will be made for acceptable measured quantity of demolition dismantling and removal of RCC & PCC work on the basis of unit rate per cubic metre quoted in the Bill of Quantities & shall constitute full compensation for all the works related to the item.

SECTION – 1100

EARTHWORKS

01. SCOPE

Earthwork will consist of all necessary work for the excavation and placing in embankment or backfill or disposal by dumping of earth, rock or other material from or to the roadway or adjacent thereto or from borrow areas, including the excavation of side and interception ditches, the removal of unsuitable subgrade material, the formation of laybyes, the widening of cuts and the flattening of cut slopes whether to obtain material for embankments of backfill, or to increase the stability of the slopes, clearing and grubbing, the selective removal of trees, stripping and the removal of existing obstructions within the approved cross section for excavation, in accordance with these specifications and in conformity with the lines, grades, sections and dimensions shown on the drawings or as directed by the Engineer.

02. SOIL INFORMATION

Any information concerning the properties of the soil or sub soil and other geotechnical information shown on the drawing or other documents forming part of the contract is for information only. The contractor is obliged to make his own assessment of site conditions prevailing. No claim for extra cost or time extension will be entertained based on the information provided.

The Contractor shall be deemed to have visited the site prior to making his bid and shall ascertain the nature of the earth and rock, its quantity, locations and suitability to meet the specified requirements, and he shall base his bid estimates solely on his own soil investigation. After the award of the contract no claim for a revision of bid prices depending on the sources of soil information will be entertained.

03. EXPLOSIVES

Where explosives are used the Contractor shall provide suitable buildings or warehouses in approved positions for the storage or explosives, which shall be stored in the manner and quantity approved by the Engineer or as per relative laws of government. Such storage places shall be accessible only to authorized personnel. They shall be properly marked, all doors or accesses thereto shall be constructed of materials as directed by the Engineer and provided with secure locks and all necessary means for preventing access by unauthorized persons. The Contractor shall be responsible for the prevention of any unauthorized issue or improper use of any explosives. The handling of explosives shall be entrusted only to experienced and responsible men, to the satisfaction of the Engineer and in conformity with the statutory regulations.

All drilling and blasting shall be done in such a manner as to bring the excavation as close as possible to the required cross sections, and to disturb as little as possible the material to be left in place. Blasting by means of drill holes, tunnels, or any other method shall be performed at the entire risk and responsibility of the Contractor who shall have no claim to payment for extra work occasioned by breakage outside the approved cross-sections or dimensions.

The greatest care shall be taken by the Contractor during all blasting operations to ensure that no injury be done to persons or damage to property or to the finished work. Shots shall be properly loaded and capped, and only a moderate charge shall be used

in each hole. A record of all explosives used, showing locations and amounts, shall be kept by the Contractor for checking by the Engineer.

Where directed by the Engineer, the Contractor shall provide heavy mesh blasting mat for protection of persons, property and the work. If necessary, blasting shall be restricted to time prescribed by the Engineer.

The Engineer may prohibit and order the rock to be excavated by other means, if, in his opinion, it would be dangerous to persons or adjacent structures, or is being carried out in a reckless manner. If traffic on the road has to be interrupted, the Contractor shall obtain approval of his schedule for such interruption from the proper authorities and shall satisfy the Engineer that he has obtained it. No extra payment shall be admissible for such arrangements as described here above.

04. REMOVAL OF EXISTING OBSTRUCTIONS

The pay items under Items 101, 103, 105, 106, 107 and 108 shall include the cost of removal of all material regardless of his nature, encountered within the limits of the approved cross-section, including the removal and disposal, as required by the Engineer, of existing brick, stone, concrete or masonry, rock boulders or fragments, old pavements, culverts, bridges or parts thereof, retaining walls or any other material encountered during the excavation, unless a separate item exists for such features.

05. REMOVAL OR DIVERSION OF WATER

Except where provided for, no separate payment will be made for control of or removal of water during or after earthwork operations. The cost of sheeting, shoring, cofferdams, pumping and draining shall be included in the bid prices for earthwork. The Contractor shall provided necessary facilities of dewatering and for draining or diverting watercourses when necessary for the protection of the contract work or where required by the Engineer.

The Contractor shall provide such drainage outlet ditches or canals as may be necessary to effect proper drainage before rain is expected. Such drainage ditches or canals for protection of work during construction and their maintenance and clearing to make them continuously effective during the work shall not be separately, but shall be deemed to be included in other items of work. The Contractor shall also provide, fix maintain and operate such engines, pumps, hoses, chutes and other appliances as the necessary to keep the accumulated water at a level required for the safety of the structures as directed by the Engineer.

06. DITCHES

The Contractor shall construct side ditches, interception ditches, any inlet and outlet ditches as shown on the Drawings or where ordered by the Engineer, whether for temporary or permanent drainage. In order to keep water away from the embankment, subgrade, and / or pavement during construction, the Contractor shall at all times ensure adequate drainage by scheduling ditch and outlet so that the drainage is operative before work is stated on the embankment, subgrade or pavement. He shall clean and trim all such drainage ditches from time to time, so that there may be free flow of water throughout the whole period of the Contract. Ditches shall first be trimmed according to approved cross-sections, and final trimming, including the repair of any damage that may have been done during the construction work, shall be carried out after completion of the other construction work and shall be condition for final approval and acceptance.

Unless otherwise specified no separate payment will be made for the excavation of side ditches, interception ditches, inlet and outlet ditches but such payment will be made under item 105 or 106 whichever applicable.

Where indicated on the drawings or when required by the Engineer, the Contractor shall take cross-sections of existing stream channels, and in collaboration with the Engineer, mark them with details of the excavation required for the relocation of the stream channel. Work shall not be proceed without written approval of the marked cross-sections by the Engineer.

07. EXCAVATION FOR CULVERTS

Except where otherwise specified excavation and backfill for culvert and drainage pipes, except granular backfill to under drains, will not be paid for separately, but shall be considered as a subsidiary obligation of the Contractor covered under the contract price for the various classes of pipe culvert as provided in Item 501.

08. LANDSLIDES, BENCHES, FLATTENING OF SLOPES

The Engineer may order the removal of material resulting from landslides, the construction of benches in above the cut slopes or in the embankment slope or where in his opinion the slope shows signs of instability, the flattening of the slope. Payment of all such work shall be at contract prices in item 106 or 108 as the case may be.

09. SURVEY AND LEVELING PRIOR TO COMMENCE OF EARTHWORK

The Contractor shall be responsible for the setting out of the work in accordance with Clause 17 of the General Conditions of Contract. Notwithstanding that project drawings have been issued to the Contractor, the Contractor shall also be responsible for taking joint cross-sections on the proposed alignment of the road, submitting three copies of the plotted cross-sections and longitudinal profile to the Engineer and obtaining the approval of the Engineer to such cross-section and longitudinal profile before any work in connection with Earthwork is commenced. These cross-sections and longitudinal provide that shall be in the form and manner as instructed in writing by the Engineer.

10. COMPACTION OF NATURAL GROUND

The natural ground or surface ready for construction purposes after clearing and grubbing, or stripping, (if required) will be considered as (natural) Ground for the purpose of this item. The compaction of natural ground shall be carried out through a written order by the Engineer.

11. CONSTRUCTION REQUIREMENTS

Up to a depth of twenty (20) cm below the natural ground, all sods and vegetable matters shall be removed and clear surface shall be broken up by ploughing and scarifying to compact to the degree as defined below:-

For height of Embankment below sub grade level.	**Percent of Maximum Dry Density as determined by AASHTO T-180.***
0 to 30 cm	95
30 to 75 cm	93
Over 75 cm	90
Below the foundation of structures	95

12. Compaction of original ground surface in areas of high water levels and salinity

Compaction of the natural ground surface in such areas will be difficult if not impossible. See Items 108, etc. under Formation of Embankment for construction requirements under these conditions, where compaction of Natural Ground shall not be carried out.

13. ROADWAY AND BORROW EXCAVATION FOR EMBANKMENT

The work shall consist of excavating the roadway and borrow pits, removal and satisfactory disposal of all materials taken from within the limits of the work, also such excavation as is necessary for inlet and outlet ditches of structures and shall include all excavation, shaping and sloping for the construction, preparation of all embankment, subgrade, shoulders, intersections and approaches as directed and in conformity to the alignment, grade, level and cross-sections shown on the plans or established by the Engineer.

14. CLASSIFICATION OF EXCAVATION

14.1 Road Way Excavation

Roadway Excavation shall comprise all excavation that is not classified as structural excavation carried out within the limits of roadway including permanent drainage ditches and side slopes in cut.

Roadway Excavation shall further, be classified as Common Excavation", or "Rock Excavation", (common excavation shall include all the materials of whatever nature encountered but not including rock excavation).

a) Common Excavation

Common excavation shall consist of the removal and satisfactory disposal of all eolian, alluvial and residual materials, inplace unaltered and unweathered strata, which are not firm or rigid enough to possess all the characteristics of ”Rock Excavation". Boulders of less than one quarter (1/4) cubic meter volume shall also be classified as "Common Excavation". Eolian and alluvial materials consist of gravel, shale, volcanic ash, loess, dunes and, loams, sands and clays or any combination of these materials, and termed as Common Excavation.

b) Rock Excavation

This includes firm and rigid igneous, metamorphic and sedimentary rocks. Boulders larger than quarter (1/4) cubic meter in volume will also be considered as "Rock Excavation", provided these are firm and stable lying in continuous bed and constitute more than 50% by volume as compared to other type of materials in the total mass.

The classification of Hard, Medium or Soft Rock shall be same as described under item 106.2 of General Specifications.

14.2 Borrow Excavation

Borrow Excavation shall comprise all excavation taken from borrow pits. Material from borrow pits shall normally be used for the construction of embankment or for the backfill when there is no material available from roadway excavation or structural excavation. Permission to use material from borrowpit shall first be obtained in writing from the Engineer. Nevertheless the total quantity of material from roadway excavation and structural excavation after deduction of the material declared unsuitable by the Engineer, shall be considered available for use in the work, and any material used from borrow pits for formation of embankment shall not be measured for payment.

In making his bid, the Contractor shall inspect the site and prepare his estimate of the haulage cost on the basis of his own survey of the possible nature and locations of the borrow pits. Their distance from the work sites shall not be grounds for extra payment or revision of the contract price.

The consent of the landowner or tenant for excavating the borrow material and hauling along private access roads shall be secured by the Contractor who shall, if required, pay for such concession. Borrow pits shall be left in a condition acceptable to the landowner and / or tenant and the Engineer.

14.3 Structural Excavation

The description method of measurement and payment of this section shall conform to as specified in item 107.

15. CONSTRUCTION REQUIREMENTS

All material removed from excavation shall be used in the formation of embankment, subgrade, shoulders, and at such other places as directed, unless it is declared unsuitable and ordered to waste by the Engineer. No excavated material shall be wasted without written permission from the Engineer, and when such material is to be wasted, it shall be so placed that it will present a neat appearance and not offer any danger to abutting property.

The material shall be declared unsuitable if the soaked CBR (96 hours) is less than five (5) percent or if fails under A-6 or A-7 of AASHTO soil classification.

During construction of the roadway, the road bed shall be maintained in such a condition that it will be well drained at all times.

All slopes, except in solid rock or other material shall be trimmed precisely as per cross-sections, and care must be exercised that no material shall be loosened beyond the required slopes. In blasting rock slopes, a reasonably uniform face shall be left, regardless of whether or not the excavation is carried beyond the specified side slope. All breakage and slides shall be removed by the contractor and disposed of as directed by the Engineer.

Rock, shale and other unsuitable road bed material encountered in cuts shall be excavated to required width and depth indicated on the plans or as otherwise directed. Any overbreakage below the depth shown on the plans will not be paid for. Backfill of

the overcut shall be of approved earth material and shall have the same density requirements as specified on the plans and shall be at the expense of contractor.

Borrowpits shall be located so that the nearest edge of the pit is at least thirty (30) meters from the roadway toe of slope unless otherwise directed by the Engineer.

Permission to use any borrow material, including its suitability, shall be obtained in writing from the Engineer before execution of work. It is responsibility of the contractor to submit a request for test at least fifteen (15) working days prior to the day the contractor intends to begin taking material from the borrow area.

In no case shall borrow material be obtained from downstream of any hydraulic structure. However the borrowpit may be established at five hundred (500) meters upstream of the hydraulic structure. The side slopes of the pits or channels shall be constructed as shown on the plans or directed by the Engineer. In no case the side slopes of borrow pit be steeper than a slope; 1:5 (V:H).

Upon abandonment of borrow pit or quarry area, the contractor shall, at his own expense, clean and trim the borrow pit or quarry area, the right of way, and adjoining properties which were occupied during execution of work, all to the satisfaction of the Engineer.

All drilling and blasting shall be done in such a manner as will most nearly complete the excavation to the required grade line, and produce the least disturbance of the material to be left in place. Blasting by means of drill holes or any other methods shall be performed at the entire risk and responsibility of the contractor. Care shall be taken to ensure that no injury be done to persons or properties or to the finished work. Blasting shall be restricted to the hours prescribed by the local authorities or the Engineer.

Where between two successive cross-sections of the road, the properties of rock boulders, in sizes larger than a one quarter (1/4) of a cubic meter, to earth is more than 50%, the excavation will be considered wholly as rock.

Rock material above ground level such as stones, boulders, piles of stone, and dry stones walling whose individual sizes are greater than one quarter of a cubic meter shall be removed and disposed of if directed in writing by the Engineer and shall be paid under relevant item of work in the Bill of Quantities.

16. EXCAVATION OF UNSUITABLE OR SURPLUS MATERIAL

The work shall consist of excavation and disposal of unsuitable or surplus material arising from roadway excavation, which is declared in writing by the Engineer to be unsuitable for use or surplus to the requirements of the project, When excavation of unsuitable material requires special attention for a known condition on a specific project, construction requirements and payment shall be covered under relevant Provisions.

17. CONSTRUCTION REQUIREMENTS

All suitable material excavated within the limits and scope of the project shall be used in the most effective manner for the formation of the embankment, for widening of roadway, for backfill, or for other work included in the contract.

Any material surplus to these requirements or any material declared in writing by the Engineer to be unsuitable shall be disposed of and levelled in thin layers by the Contractor outside the right of way within 7 Km of excavation. The Engineer shall decide regarding the unsuitability of the material by conducting appropriate laboratory tests.

When unsuitable materials are ordered to be removed and replaced, the soil left in place shall be compacted to a depth of twenty (20) cm to the density prescribed under Item 108.3.1. Payment for such compaction shall be included in the contract prices for the excavation materials.

If the unsuitable material, which is to be removed, is below standing water level and the replacement material is gravel or a similar self-draining material of at least thirty (30) cm in depth, the compaction may be dispensed with if approved by the Engineer.

Rock excavation shall be classified as under:

a) Hard Rock

Any rock which can not be removed with Ripper of a 200 H.P. Bulldozer and constitutes a firm and continuous bed of rock only.

b) Medium Rock

Any rock which can not be removed with the blade of 200 H.P. Bulldozer but can be removed by the ripper, will be termed as Medium Rock, irrespective of the fact that it is removed by blasting.

c) Soft Rock

Any rock which can be removed with the blade of a 200 H.P. Bulldozer. This item will be termed as Soft Rock, irrespective of the fact that it is removed by blasting.

18. STRUCTURAL EXCAVATION AND BACKFILL

Structural excavation shall include the removal of ail material of whatever nature, necessary for the construction of foundations of bridges, culverts, retaining walls, headwalls, wing walls, catch basins, manholes, inlets and other structures not otherwise provided for in these specifications and in accordance with the plans or as directed by the Engineer. It shall include the furnishing of all necessary equipment and construction of all cribs, cofferdams, caissons, dewatering, sheeting, shoring etc., which may be necessary for the execution of the work. It shall also include the subsequent removal of cofferdams and cribs and the placement of all necessary backfill at hereinafter specified. It shall also include the disposing of excavated material, which is not required for backfill, in a manner and in locations so as not to affect the carrying capacity of any channel and not to be unsightly.

19.1 MATERIAL REQUIREMENT FOR BACKFILL

19.1 Backfill around structure

Backfill around structure shall be made with the following material.

a. Granular backfill of selected material as specified here under
b. Common backfill shall be carried out from excavated material or any other borrow material approved by the Engineer.

19.2 Grading backfill

Granular backfill material shall meet the following requirements.

a) Grading Requirement

mm	Inch.	A	B
25	V1	100	100
19	3 / 4”	60-100	75-100
4.75	No.4	50-85	55-100
2.0	No.10	40-70	40-100
0.425	NO.40	25-45	20-50
0.075	No.200	0-15	5-15

b) Material satisfying the requirements of coarse sand failing udder. soil classification A-3 (AASHTO). In case, coarse sand is utilised for granular fill it shall be ensured that the same is confined properly with approved material.

c) The material shall have a Plasticity Index of not more than size (6) as determined by AASHTO T-89 and T-90.

19.3 Common backfill

Use of excavated material as backfill may be allowed under this item. Use of borrow material for common backfill shall be allowed subject to approval of borrow material by the Engineer.

19.4 Rock backfill

Rock material of small size shall be permitted in the backfilling of structures or walls subject to the approval of methodology by the Engineer.

20. CONSTRUCTION REQUIREMENTS

20.1 Structural excavation

a) General

All substructures, where practicable, shall be constructed in open excavation and, where necessary, the excavation shall be shored, braced, or protected by cofferdams in accordance with approved methods. When footings can be placed in the dry without the use of cribs or cofferdams, backforms may be omitted with the approval of the Engineer, and the entire excavation filled with lean concrete to the required elevation of the top of the footing. The additional concrete shall be at the expense of the Contractor.

In case the contractor has excavated additional volumes than specified thereunder, the contractor shall at his own expense backfill the volume with approved material as directed by Engineer.

The classification of Hard, Medium or Soft Rock shall be same as described under item 106.2 of General Specifications.

b) Preservation of channel

Unless otherwise specified, no excavation shall be made outside of caissons, cribs, cofferdams, piling, or sheeting, and the natural stream bed adjacent to the structure shall not be disturbed without permission from the Engineer. If any excavation or dredging is made at the site of the structure before caissons, cribs or cofferdams are in place, the Contractor shall, without extra charge, after the foundation base. is in place, backfill all such excavation to the original ground surface or river bed with material approved by the Engineer. Material deposited within the stream area from foundation or other excavation or from filling of cofferdams shall be removed and the stream bed freed from obstruction thereby.

c) Depth of Footings

The elevation of the bottoms of footings, as shown on the drawings, shall be considered as approximate only and the Engineer may order, in writing, such changes in dimensions or elevation of footings as may be necessary to secure a satisfactory foundation.

d) Preparation of Foundations of Footings

i) All rock or other hard foundation material shall be freed from all loose material, cleaned and cut to a firm surface, levelled, stepped, or roughened, as may be directed by the Engineer.

ii) When masonry is to rest on an excavated surface other than rock special, care shall be taken not to disturb the bottom of the excavation, and the final levelling of the grade shall not be made until just before the masonry is to be placed.

e) Cofferdams and Cribs

i). For substructure work, the contractor shall submit, upon request, drawings showing his proposed method of cofferdams construction and other details left open to his choice or not fully shown on the Engineer's drawings. The Contractor shall not start work until the Engineer has approved such drawings.

ii). Cofferdams and cribs for foundation construction shall be carried to adequate depths and heights, be safely designed and constructed, and be made as water tight as is necessary for the p roper performance of the work which must be done inside them. In general, the interior dimensions of cofferdams and cribs shall be such as to give sufficient clearance for the construction of forms and the inspection of their exteriors, and to permit pumping outside the forms. Cofferdams or cribs, which are tilted or moved laterally during the process of sinking, shall be righted,

reset, or enlarged so as to provide the necessary clearance and this shall be solely at the expense of the Contractor.

iii) When conditions are encountered which, in the opinion of the Engineer, render it impracticable to dewater the foundation before placing masonry, he may require the construction of a concrete foundation seal of such dimensions as may be necessary. The foundation water shall then be pumped out and the balance of the masonry placed in the dry. When weighted cribs are employed and the weight is utilized to partially overcome the hydrostatic pressure acting against the bottom of the foundation seal, special anchorage such as dowels or keys shall be provided to transfer the entire weight of the crib into the foundation seal. During the placing of a foundation seal, the elevation of the water inside the cofferdam shall be controlled to prevent any flow through the seal, and if the cofferdam is to remain in place, it shall be vented or ported at low water level.

iv) Cofferdams or cribs shall be constructed so as to protect green concrete against damage from a sudden rising of the stream or river and to prevent damage to the foundation by erosion. No timber or bracing shall be left in cofferdams or cribs in such a way as to extend into the substructure masonry without written permission from the Engineer.

v) Unless otherwise provided, cofferdams of cribs with all sheeting and bracing shall be removed after the completion of the substructure, care being taken not to disturb or otherwise injure the finished masonry.

f) Pumping

i) Pumping from the interior of any foundation enclosure shall be done in such a manner as to preclude the possibility of the movement of water through any fresh concrete. No pumping of water will be permitted during the placing of concrete or for a period of at least twenty four (24) hours thereafter, unless it is done from a suitable sump pit separated from the concrete work by a watertight wall or other effective means.

ii) Pumping to unwater a sealed cofferdam shall not commence until the seal has set sufficiently to with stand the hydrostatic pressure.

g) Inspection

After each excavation is completed the Contractor shall notify the Engineer, and no concrete or masonry shall be placed until the Engineer has approved the depth of the excavation and the character of the foundation material.

In case if an existing structure is to be replaced with a new structure the quantities for dismantling the structure shall be paid under item 510 (Dismantling of structures) and additional excavation required shall be carried out under this item.

h) Classification of Excavation

Classification of excavation shall be made as described under items 106.2 of this Specification.

21. Excavation in Embankments

Unless otherwise. specified, the Contractor may choose with the approval of the Engineer to excavate for structures, culverts, and pipe culverts after the embankment has been placed. Any space remaining after the placing of such structures or culverts shall be filled with material approved by the Engineer and compacted as follows:

Layers of not more than 20 cm in loose thickness shall be placed and compacted in succession, with mechanical tampers, plate compactors or hand guided rollers operated transversely to the roadway, to the densities specified in the item 108.3.1. Moisture content shall be adjusted as directed by the Engineer. Proper benching shall be made to ensure bonding of existing and new material without any extra payment.

The excavation in embankment and the placing of backfill for the purposes described above shall not constitute any claim for payment also if sand or granular backfill is used by the contractor for his convenience, no extra payment will be made.

22. Backfill

a) Granular backfill where-ever directed shall be placed in the position and in the required depth, shown on the drawings or where and as required in writing by the Engineer and it shall be well compacted in layers not exceeding twenty (20) cm in thickness to 100 percent of Max. dry density as per AASHTO T-180 (D). In case of water logged areas the thickness of the layer shall not exceed fifty (50) centimeters or as directed by the Engineer. Volume of granular fill around structures shall be calculated within the vertical limits of approved 'excavation for such a structure, where as the horizontal limits shall be those as specified on drawings.

b) Common backfill shall consist of earth free from large lumps, wood and other organic materials and of a quality acceptable to the Engineer. It shall be placed in the position and to the required depths shown on the Drawings and / or as required in writing by the Engineer and it shall be well compacted in layers not to exceed twenty (20) cms in depth to the density, 95 percent of maximum dry density as per AASHTO T- 80 (D).

c) The rock backfill material whose individual sizes are not more than 30 cm shall be placed in the position to the required depth as specified and the voids shall be filled in layer of fine material approved by the Engineer. The compacting efforts shall be made so as to achieve the desired compaction approved visually by the Engineer. The depth of the layer in any case shall not exceed sixty (60) centimeters. However in water logged areas, the thickness may be increased as directed by the Engineer. Rock backfill will not be placed within two meters from concrete face of any structure.

d) All spaces excavated and not occupied by abutments, piers or other permanent work shall be refilled with earth or granular fill as approved by the Engineer up to the surface of the surrounding ground, with a sufficient allowance for settlement. All such backfill shall be thoroughly compacted and, in general, its top surface shall be neatly graded.

e) The fill behind abutments and wing walls of ail bridge structures shall be deposited in well-compacted, horizontal layers not to exceed twenty (20) cm. in thickness. The common backfill in front of such units shall be placed first to prevent the possibility of forward movement.

Special precautions shall be taken to prevent any wedging action against the masonry, and the slope bounding the excavation for abutments and wing walls shall be destroyed by stepping or roughening to prevent wedge action. Jetting of the fill behind abutments and wing walls will not be permitted.

f) Fill placed around culverts and piers shall be deposited on both sides to approximately the same elevation at the same time. Where the Contractor does not have proper equipments to ensure compaction in restricted areas, Engineer may allow backfill with sand saturation method, at no extra cost to the Client.

g) Adequate provision shall be made for the through drainage of all backfill. French drains shall be placed as weep holes.

h) No backfill shall be placed against concrete or masonry structure before fourteen (14) days of placement and backfilling shall be carried out on both sides of the structure simultaneously.

23. FORMATION OF EMBANKMENT

This work shall consist of formation of embankment, including preparation of area for placing and compaction of embankment material in layers and in holes, pits and other depressions within the roadway area in accordance with the specifications and in conformity with the lines, grades, thickness and typical cross-section shown on the plans r established by the Engineer.

23.1 MATERIAL REQUIREMENTS

Material for embankment shall consist of suitable material excavated from borrow, roadway excavation or structural excavation and shall include all lead and lift. Borrow material will be used only when material obtained from roadway or structural excavation is not suitable or is deficient for embankment formation and shall include all lead and lift.

The material under this item shall conform to the following specification.

a) Contractor shall use AASHTO Class A-1, A-2, A-3, A-4 or A-5 soil as specified in AASHTO M-145 or other material approved by the Engineer.

b) CBR of the material shall not be less than five (5) percent, determined in accordance with AASHTO TA 93. CBR value shall be obtained at a density corresponding to the degree of compaction required for the corresponding layer.

c) Swell value of the material for embankment formation shall not exceed five tenth (0.5) percent. However, while establishing the swell value, surcharge weights representing the overburden will be used. In case sandy material is used for embankment formation, it shall be properly confined at no extra payment with a material and to the extent as approved by the Engineer and sandy material shall not be used on slopes of embankment.

d) In areas subject to flood and prolonged inundation of the embankment, such as at bridge sites, the material used in embankment, unless rock, shall be AASHTO Class A1 (a), A1 (b) and A-2-4, soils. Other soils may be used only with the written consent of Engineer.

24. CONSTRUCTION REQUIREMENTS

24.1 Formation of Embankment with Borrow Common Material

Material for embankment, obtained and approved as provided above, shall be placed in horizontal layers of uniform thickness and in conformity with the lines, grades, sections and dimensions shown on the Drawings or as required by the Engineer. The layers of loose material other than rock shall be not more than 20 cm. thick, unless otherwise allowed by the Engineer after a trial section is prepared and approved.

The material placed in layers and that scarified to the designated depth for formation of embankment shall be compacted to the density specified below:

Depth in Centimeters Density below subgrade level	**Percent of Maximum Dry as determined by AASHTO T-180.***
0 to 30	95
30 to 75	93
Over 75	90

* Method 'B' or 'D' whichever is applicable, or corresponding relative Density in case of sand fill.

In-place density determinations of the compacted layers shall be made in accordance with AASHTO T-191 or other approved methods. For all soils, with the exception of rock fill materials, containing more than 10% oversize particles (retained on 3/4 inch/ 19 mm sieve), the in-place density thus obtained shall be adjusted to account for such oversize particles or as directed by the Engineer. Subsequent layers shall not be placed and compacted unless the previous layer has been properly compacted and accepted by the Engineer.

Material for embankment at locations inaccessible to normal compacting equipment shall be placed in horizontal layers of loose material not more than 15 centimeters thick and compacted to the densities specified above by the use of mechanical tempers, or other appropriate equipment.

The compaction of the embankment shall be carried out at the designated moisture content consistent with the available compacting equipment.

Embankment material that does not contain sufficient moisture to obtain the required compaction shall be given additional moisture by means of approved sprinklers and mixing. Material containing more than the optimum moisture may not, without written approval of the Engineer, be incorporated in the embankment until it has been sufficiently dried out. The drying of wet material may be expedited by scarification, disking or other approved methods.

When materials of widely divergent characteristics, such as clay and chalk or sand, drawn from different sources, are to be used in the embankment they shall be deposited in alternate layers of the same material over the full width of the embankment to depths approved by the Engineer. Rock, clay or other material shall be broken up, and no accumulation of lumps or boulders in the embankment will be permitted. No surplus material shall be permitted to be left at the toe of embankment or at the top of cut sections.

Side slopes shall be neatly trimmed to the lines and slopes shown on the drawings or as directed by the Engineer, and the finished work shall be left in a neat and acceptable condition.

24.2 Formation of Embankment with Rock Material

Embankment formed of material consisting predominantly of rock fragment of such size that the material cannot be placed in layers of the thickness prescribed without crushing, pulverizing or further breaking d6wn the pieces, such material may be placed in layers not exceeding in thickness than the approximate average size of the rocks except that no layer shall exceed eighty (80) centimeters of loose measurement and compacted by a vibratory roller with the minimum mass as shown in the following table.

Mass per meter width of vibrating roll (Kg / M)	Depth of fill layer (mm)	Number of passes of the roller on each layer
2300 – 2900	400	5
2900 – 3600	500	5
2600 – 4300	600	5
4300 – 500	700	5
>5000	800	5

The material shall be carefully placed in layers, so that all larger stones will be well distributed and voids completely filled with smaller stones, clean small spells, shale, earth, sand, gravel, to form a solid mass. After placing rock material, surface shall be covered with a layer of fine material having thickness less than twenty (20) centimeters. Such fine - material shall be reserved from roadway excavation by the Contractor. Should such material be available but not' reserved, Contractor will supply and place borrow material for forming smooth grade without extra payment.

Each layer shall be bladed or levelled with motor grader, bulldozer or similar equipment capable of shifting and forming the layer into a neat and orderly condition. No rock larger than eight (8) centimeters in any dimension shall be placed in the top fifteen (15) centimeters of embankment unless otherwise allowed by the Engineer.

Material for each layer should be consolidated with heavy weight vibratory roller until settlement as checked between two consecutive passes of roller is less that one (1) percent of the layer thickness. In evaluation of settlement, survey points should be established and rolling continued until difference of levels as checked after two consecutive passes is less than one (1) percent of the total layer thickness. More over initial rolling of overlaid fine material shall be done without watering to ensure their

intrusion in voids of rock layer beneath. Watering shall be done when voids are properly filled.

Embankments, which are formed of material that contain rock but also contain sufficient compactable material other than rock or other hard material to make rolling feasible, shall be placed and compacted in the manner prescribed above and to the point when settlement is within above mentioned requirement. Compaction test will be made whenever the Engineer determines they are feasible and necessary. Each layer must be approved by the Engineer before the next layer is placed.

When rock to be incorporated in fill is composed largely of weak or friable material, the rock shall be reduced to a maximum size not exceeding fifty (50) percent of the thickness of the layer being placed.

24.3 Formation of Embankment on Steep Slopes

Where embankments are to be constructed on steep slope, hill sides or where new fill is to be placed and compacted against existing pavement or where embankment is to be built along one half the width at a time, the original slope of the hill side, of existing pavement or adjacent to half width of embankment shall be cut in steps of twenty (20) centimeters depth. Benching shall be of sufficient width to permit operation of equipment possible during placing and compaction of material.

Cut material shall be incorporated with the new embankment material and compacted in horizontal layers. No extra payment will be allowed for such an operation.

24.4 Formation of Embankment on Existing Roads

Before fill is placed and compacted on an existing roadway, the existing embankment and / or pavement may be levelled by cutting, rooting or scarifying by approved mechanical means to a level to be determined by the Engineer. The earth, old asphalt or other material arising as a result of this operation will be declared either suitable or unsuitable, for use in the embankment or other items, by the Engineer. If the material is declared suitable it will be measured under relative item and if it is declared unsuitable, it will be measured under item 106a.

24.5 Formation of Embankment in Water Logged Areas

Where embankments are to be placed in water logged areas and which are inaccessible to heavy construction equipment, a special working platform shall be first established, consisting of a blanket of fill material placed on top of the soft layer. The material of the working table shall consist of normal or processed granular fill, obtained from borrow excavation. This material shall conform to the following specifications:

Sieve Description	**Percentage of Weight Passing Mesh Sieve, AASHTO T-27**
3 inch (75 mm)	100

The remaining grading shall be such as to avoid intrusion into the working platform material of subgrade or natural ground surface material. For this condition to be met it will be required that the ratio.

$$\frac{D_{15}\text{(Working Platform Material)}}{D_{85}\text{ (Natural Ground Material)}} \quad \text{is less than 5.}$$

D_{85} and D_{15} mean the particle diameters corresponding to 85% and 15%, respectively, passing (by weight) in a grain size analysis.

Construction of this working table shall proceed from one edge of the soft area by using the fill as a ramp for further material transport.

The thickness of the working table as prescribed above shall be approximately 0.5 meter unless directed otherwise by the Engineer, and the width shall be that of the embankment. The placement and compaction of the working table shall be carried out by use of light equipment, as directed by the Engineer.

No density requirements are specified for the working platform, however, subsequent layers above it shall be compacted to the densities specified in Item 108.3.1.

24.6 General Requirements

To avoid interference with the construction of bridge abutments and wing walls, the Contractor shall at points determined by the Engineer, suspend work on embankments and / or in cuts forming the approaches to any such structure until such time as the construction of the later is sufficiently advanced to permit the completion of the approaches without the risk of interference or damage to the bridge works. The cost of such suspension of work shall be included` in the contract unit prices for embankment. In carrying embankments up to or over bridges, culverts or pipe drainage, care shall be taken by the Contractor to have the embankments brought to equally on both sides and over the top of any such structure. Contractor shall make special arrangements to ensure proper compaction in restricted spaces and around structures. No compensation shall be made to the Contractor for working in narrow or otherwise restricted areas.

When as a result of settlement, an embankment requires the addition of material up to 30 cm in thickness to bring it up to the required grade level, the top of the embankment shall be thoroughly scarified before the additional materials being placed, without extra payment to Contractor for the scarification.

The Contractor shall be responsible for the stability of all embankments and shall replace any portions that in the opinion of the Engineer have been damaged or displaced due to carelessness or neglect on the part of the Contractor. Embankment material which may be lost or displaced as a result of natural causes such as storms, cloud-burst or as a result of unavoidable movement or settlement of the ground or foundation upon which the embankment is constructed shall be replaced by the Contractor with acceptable material from excavation or borrow. No additional compensation will be allowed for the replacement.

During construction, the roadway shall be kept in shape and drained out at all times. When unsuitable material has been placed in the embankment by the Contractor, he shall remove it without extra payment.

25.0 SUBGRADE PREPARATION

The subgrade preparation shall be that part of the work on which, the subbase is placed or, in the absence of subbase, act as the base of the pavement structure. It shall extend to the full width of the road bed including the shoulders and laybyes as indicated on the Drawings or as specified herein.

25.1 CONSTRUCTION REQUIREMENT

25.1.1 Prior Work

Before commencing the work all culverts, drains, ditches including fully compacted backfill over them outlets for drainage, head walls / wing walls of culverts and any other minor structure below thirty (30) centimeters of existing subgrade level or all structures which will be below thirty (30) centimeters of newly placed subgrade level, shall be in such operative conditions as to ensure prompt and effective drainage and to avoid damage to subgrade by surface water. No work of subgrade preparation will be started before the prior work herein described have been approved by the Engineer.

25.1.2 Compaction Requirement

All materials down to a depth of 30 cm below the subgrade level in earth-cut or embankment shall be compacted to at least 95 percent of the maximum dry density as determined according to AASHTO T-180 Method 'B' or V whichever is applicable, or corresponding Relative Density as per D4254-83 (ASTM).

25.1.3 Subgrade Preparation in Earth Cut

In case bottom of subgrade level is within thirty (30) cm of the natural ground, the surface shall be scarified, broken up, adjusted to moisture content and compacted to minimum density of ninety five (95) percent of the maximum dry density as determined by AASHTO T-180 Method D. Subsequent layer of approved material shall be incorporated to ensure that the depth of subgrade layer is thirty (30) cm.

In case, the bottom of subgrade 4 s below the natural ground by more than thirty (30) cm, the material above the top of subgrade shall be removed and subsequent layer of thirty (30) cm shall be scarified, broken up, adjusted to moisture content and compacted to the same degree of compaction as described above.

In case, unsuitable material is encountered at the sub grade level within a depth of thirty (30) cm, the same shall be removed in total and replaced by the approved material. The contractor shall be paid for removal of unsuitable material as per pay Item 106a and for replacement of approved material, the payment will be made under pay Item 108c.

25.1.4 Subgrade Preparation in Rock Cut

Excavation in rock shall extend to the subgrade level as shown on drawings. Rock shall be undercut nearly to required elevation and sections shown on the plans or as directed by the Engineer. Transverse and longitudinal profiles checked by template shall be accurate to the requirement. Cuts below subgrade level shall be backfilled with selected subbase material and compacted to minimum ninety eight (98) percent of the maximum dry density as determined by AASHTO T-180, method U. No compensation shall be made to the Contractor for over-cut or remedial measures as described above.

No rock shall be higher than two (2) centimeters above the under cut section elevation. The under cut material shall be placed in embankment or disposed of at the direction of Engineer.

25.1.5 Subgrade in Embankment

When the subgrade is formed in embankment, its width shall be the full width of top of embankment and material placed in the upper part of embankment down to a depth of thirty (30) centimeters below subgrade level shall meet compaction requirement of 109.2.2. Soils having a minimum value of C.B.R of seven (7) percent and swell value of not more than 0.3 percent shall be used. C.B.R less than seven (7)% may be used in case, the design allows for it. Unsuitable material if encountered within the existing formation layer as per laboratory specified test, shall be removed, disposed of and replaced by suitable one as per direction of the Engineer of which the payment will be made under relevant items of work.

Rollers and other equipments of approved size and type, accepted by the Engineer, shall be used for compaction. Water shall be added to obtain optimum moisture content; if necessary. Contractor shall ensure proper compaction in restricted areas by use of special equipments and rollers. No compensation shall be made for extra work due to restricted space.

Performance of this item of work shall not be paid for under this section but shall be deemed to be covered by the contract price for pay item 108a, through 108e, Formation of Embankment.

25.1.6 Subgrade Level in Existing Road

Where indicated on the Drawings or directed by the Engineer that the existing road surface is to be used as the subgrade, the correct elevation on which the base or subbase is to be laid shall be obtained, where necessary, either by means of levelling course or by excavation. The levelling course shall be constructed to the requirements of the Engineer and paid for under the appropriate Pay Item involved. Excavation shall include disposal of any surplus material in the adjacent embankment or elsewhere as directed by the Engineer.

In case, the design level of subgrade is within 30 cm of the existing ground/road then the item shall be measured and paid accordingly.

25.1.7 Subgrade Reinforcement

When the width of the existing pavement, either to be scarified or not, is insufficient to contain the subbase or base to be placed upon it, the Engineer may order to strengthen and support the subbase or base on one or both sides of the existing pavement. This

work shall consist of the removal and disposal of any unsuitable material and its replacements with suitable material to such width and depth as required by the Engineer.

The excavated material shall, if declared suitable for use elsewhere in the embankment by the Engineer be so used, and payment for its removal shall be covered under the contract price of Pay Item No. 108a; if declared unsuitable it shall be disposed of and paid as provided in Item 106a. The finished compacted surface of the subgrade shall be as specified in Item 109.2.3.

25.1.8 Protection of Compacted Work

Any part of the subgrade that has been completed shall be protected and kept well drained. Any damage resulting from carelessness of the Contractor shall be repaired as directed by the Engineer without additional payment.

The Contractor shall be responsible for all the consequences of traffic being admitted to the subgrade. He shall repair any ruts or ridges occasioned by his own traffic or that of others by reshaping and compacting with rollers of the size and type necessary for such repair. He shall limit the area of subgrade preparation to an area easily maintained with the equipment available. Subgrade preparation and subbase or base placing shall be arranged to follow each other closely. The subgrade, when prepared too soon in relation to the placing of the subbase, is liable to deteriorate, and in such case the Contractor shall, with ' out additional payment, repair, reroll, or recompact the subgrade as may be necessary to restore it to the state specified herein.

25.1.9 Templates and Straightedges

The Contractor shall provide for the use of the Engineer, satisfactory templates and straightedges in sufficient numbers to check the accuracy of the work, as provided in these specifications and no subsequent work shall be permitted until the subgrade levels have been checked and approved by the Engineer. For tolerances, referred to the, 'Table for Allowable Tolerances" in these specifications.

26.0 IMPROVED SUBGRADE

This work shall consist of the formation of the roadbed, under subbase or base course as the case may be, with an approved blend of materials, uniformly mixed, compacted, shaped and finished to the lines, grades and typical cross-sections shown on the Drawings, or in thickness as directed by the Engineer.

Improved subgrade as herein referred to may be defined as material suitable for embankment to which better quality of material is blended in proper proportion to improve its strength properties or performance.

26.1 MATERIAL REQUIREMENTS

The major component of improved subgrade shall consist of material conforming to Item 108.2 - Material requirements for embankment."

The blending material shall be any soil that classifies as A-l(a), A-l(b), A2-4 or A-3 according to AASHTO M-145 with PI of not more than 6.

The blended mixture when compacted to ninety five (95) percent of the maximum dry density determined by AASHTO T 180-D Method, shall exhibit a laboratory soaked CBR (96 hours) of not less than 20, or as specified in the drawings.

26.2 CONSTRUCTION REQUIREMENTS

26.2.1 Preparation

The surface of the roadbed on which the improved subgrade is to be constructed shall be compacted to the density specified under Item 108.3. 1.

26.2.2 Proportioning of Material

Prior to start of construction, the proportion of each material to be incorporated for improved subgrade shall be established as approved by the Engineer. The Engineer shall specify a single percentage of each material to be blended and shall establish the gradation of the resulting mixtures alongwith the ranges of permissible gradation tolerances to obtain the required CBR for the improved subgrade.

The blend proportions thus established shall apply only when each material to be used is obtained from same source. Should a change in source of material be made, a new proportion shall be established. When unsatisfactory results or other conditions make it necessary, the Engineer may require additional laboratory tests.

26.2.3 Mixing and Spreading

Improved subgrade may be constructed with any combination of machines or equipment that will yield results meeting these specifications.

a) Stationary Plant Method

The soil ingredients and water shall be mixed in an approved mixing plant (Pug Mill). The plant shall be equipped with feeding and metering devices that Will add the materials to be blended in the specified quantities. Water shall be added during the mixing operation in the quantity required for proper compaction, which is approximately optimum moisture content plus or minus two (2) percent. The mixing time shall be that which is required to secure a uniform mixture. After mixing, the blended material shall be transported to the job site while it contains the sufficient moisture and shall be placed on the roadbed by means of an approved mechanical spreader. The mixture shall be spread at rate that will produce a uniform compacted thickness conforming to the required grade and cross-section. Compaction shall start as soon as possible after spreading and shall continue until the specified relative compaction is achieved.

b) Travelling Plant Method

The travelling plant shall be either a flat transverse shaft type or a windrow type pugmill. After the materials have been placed by a mechanical spreader or windrow sizing device the materials shall be uniformly mixed by the travelling mixing plant. During the mixing operation, water shall be added as necessary to bring the moisture content of the mixture to the percentage suitable for proper compaction.

c) Road Mix Method

The materials shall be transported to the site and spread in layers on the roadbed in the quantities required to produce the specified blend. After the materials for each lift have been spread, the materials shall be mixed by motor graders and other approved equipment until the mixture is uniform throughout.

During mixing operation, water shall be added as necessary to bring the moisture content to the proper percentage.

26.2.4 Compaction

Unless otherwise permitted by the Engineer based on the performance of the compacting equipment used as determined from the trial section, each layer of improved subgrade shall be placed in horizontal layers of uniform loose thickness not exceeding twenty (20) centimeters. Each layer shall be compacted to the density conforming to the requirements specified in Item 108.3.1.

In-place density determinations of the compacted layers shall be made in accordance with AASHTO T-191, T-238 or other approved methods.

26.2.5 Trail Sections

Prior to the formation of the improved subgrade, the Contractor shall construct three trial sections of 200 meter length one (1) for each blend of improved material proposed to be incorporated for improved subgrade, or as directed by the Engineer. The compacting equipment to be used in the trial sections shall be the same equipment that the Contractor intends to use for main work, accepted by the Engineer.

The object of these trials is to determine the proper moisture content, the relationship between the number ' of passes of compacting equipment, density obtained for the blended material, and to establish the optimum lift thickness that can be effectively compacted with the equipment used. No separate payment will be made for this work, which will be regarded as a subsidiary obligation of the Contractor under pay Item No. 110.

26.2.6 Protection of Completed Work

Any part of the completed improved subgrade shall be protected and well drained and any damage shall be repaired as directed by the Engineer without additional payment.

The Contractor shall be responsible for all the consequences of traffic being admitted to the improved subgrade. He shall repair any ruts or ridges occasioned by his own traffic or that of others by reshaping and compacting with rollers of the size and type necessary for such repair. He shall limit the improved subgrade preparation to an area easily maintained with the equipment available. Subgrade preparation and placement of succeeding layer to follow each other closely. The improved subgrade, when prepared too soon in relation to the placing of the layer above it, is liable to deteriorate, and in such case the Contractor shall, without additional payment, repair,

reroll, or recompact the improved subgrade as may be necessary to restore it to the state specified herein.

26.2.7 Templates and Straightedges

The Contractor shall provide for the use of the Engineer, satisfactory templates and straightedges in sufficient numbers to check the accuracy of the work, as provided in these specifications and no subsequent work shall be permitted until the improved subgrade level have been checked and approved by the Engineer.

26.2.8 Tolerance

The allowable tolerances for the finished improved subgrade surface prior to placing the overlying subbase, base or asphaltic concrete course are given in the relevant, -Fable for Allowable Tolerances" in these specifications.

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27. MEASUREMENT AND PAYMENT

27.1 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.

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

27.1.2 Any fill with approved material necessitated by over excavation due to fault or convenience of the Contractor except under structural members.

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

27.1.4 Specified foundation bed preparation.

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

27.1.6 Providing approved quality fill/backfill material obtained from excavated material as designated by the Engineer.

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

27.1.8 All laboratory and field tests stipulated in these specifications.

27.1.9 Disposal of rejected surplus and unsuitable excavated material at designated place or as directed by the Engineer. No compensation of any lead/lift is admissible and rates quoted shall be deemed to include the same.

27.1.10 De-watering where required to keep the excavated areas dry for pavements, structures and foundations during construction.

27.1.11 All costs of every nature required to complete the job inclusive of borrow area’s royalty charges.

27.1.12 Scarifying & compaction of ground.

27.1.13 Maintaining environmental conditions of the areas. Any damages to the local environmental interest shall be repaired by the Contractor at his own expense / cost.

27.2 Excavation

27.2.1 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 in accordance with lines of concrete.

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 meter of material excavated for foundation and service trenches as shown on the Drawings or as directed by the Engineer.

27.2.2 **Payment**

Payment will be made for acceptably measured quantity of excavation on the basis of unit rate per cubic meter quoted in the Bill of Quantities and shall constitute full compensation for all the works related to the item, including but not limiting to back filling.

27.3 Backfill/Fills (for Structures)

27.3.1 Measurement

Measurement for acceptably completed backfill/fill works will be made on the basis of number of cubic meter of compacted backfill/fill in position in accordance with the lines, levels and grade as shown on Drawings or as directed by the Engineer.

27.3.2 Payment

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

27.4 Embankment (Road)

27.4.1 Measurement

Measurement for acceptably completed work of constructing embankment will be made on the basis of actual volume of compacted embankment in position in accordance with the lines, levels and grade as shown on Drawings or as directed by the Engineer.

27.4.2 Payment

Payment will be made for acceptable measured quantity of compacted fill for formation of embankment on the basis of unit rate per cubic meter 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 to be performed under this item shall consist of supplying all labour, materials and plant and the performance of all work necessary for lowering and continuously controlling the piezometric levels of the ground water in the subsurface material as well as the control and handling of surface water, in such a manner as to maintain the bottom and slopes of the excavations for the structure's in a stable condition, and to permit the structures excavation and construction to be performed in the dry.

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

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

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

2. DEWATERING PLANS

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

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

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

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

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

3. DESIGN OF DEWATERING SYSTEM

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

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

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

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

The Engineer's approval of the installed Dewatering System will be based on the demonstrated performance of the system and the effectiveness with which it satisfies the requirements for dewatering the areas during the entire period of the Contract.

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

4. DEWATERING THE EXCAVATION

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

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

The Dewatering System shall be designed to operate on a continuous basis in such a manner that during excavation, the water level as observed in all piezometers installed near the prevailing excavation level, is at least one meter below the prevailing excavation level. If the water level observed in any or all of the piezometers is higher than the specified, the excavation shall be halted until remedial measures to the Dewatering System have been effected and the specified water levels in the piezometers attained or until the Contractor demonstrates to the satisfaction of the Engineer that it is safe to proceed with the excavation. Piezometer tips shall be installed near the bottom of the hole drilled for that purpose.

During construction of structures and subsequent backfill placement and associated work operations, the dewatering System shall operate on a continuous basis in such a manner

that the water level, as observed in the piezometers located below the level of construction and backfill - placement remains at least one meter below the lowest point of construction and backfill - placement and the water level in the piezometers is maintained at such level till the concrete, if any, has sufficiently hardened and until in the opinion of the Engineer, it is safe to allow the water level to rise up to a pre-determined level.

The Dewatering System shall be maintained in operating condition so as to achieve the specified results until the construction of the structures and the backfill placement at all points, installation of machinery and other associated equipment and embedded parts has reached a stage when, in the opinion of the Engineer Dewatering system shall shut off in stages as directed by the Engineer.

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

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

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

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

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

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

5. OPERATIONS

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

In order to ascertain the continuous effectiveness of the Dewatering System, the Contractor shall supply all equipment and perform all work necessary to obtain and correlate records of the water elevation in each of the piezometeric observation wells as well as records of the discharges from the Dewatering System. These data shall be obtained on a continuous basis and shall be properly compiled and copies of the compiled data shall be submitted to the Engineer daily, or as required. The Contractor shall also keep the Engineer advised, on a daily or as required basis, on the equipment being utilized to affect the required results during the entire period when the Dewatering System is in operation.

6. MEASUREMENTS AND PAYMENT

Payment for dewatering item shall be made on lump sum bid price basis. This payment will include, but be not limited to, all costs incurred in connection with provision, installation, operation and maintenance, etc. of the complete Dewatering System consisting of basic Dewatering System, Standby dewatering system together with Standby Power arrangements. The item also includes transportation of all plant, equipment, supplies and personnel to the site and making all the necessary arrangements for satisfactory performance of the Dewatering System as specified and directed by the Engineer. The provision of safety measures required for excavation work and any insurance, premium paid to cover the life and property shall also be considered as part of this item for the purpose of payment. All the cost incurred on designing of the Dewatering System will be deemed to be included under this item for payment.

Any payment against this item shall be made only against prior submission of a Bank Guarantee in favour of Employer, to be supplied by the Contractor for the full amount of the price of Dewatering as per B.O.Q item. The Bank Guarantee will be released only after the Engineer has issued a certificate that the item of Dewatering has been completed in all respects and that dewatering is no longer required.

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

6.1 The first payment equal to 25% of the lump sum amount of dewatering item will be made after the Contractor has brought on the site. All the material and dewatering equipment in accordance with his approved scheme of dewatering and after the Contractor has submitted a Bank Guarantee for the full amount of the Dewatering item.

6.2 The second payment equal to 25% of the dewatering item will be made after the dewatering system has been installed and the Contractor has demonstrated its performance to the satisfaction of the Engineer.

6.3 The remaining amount may be paid to the Contractor in equal monthly installments divided over the total period of the Dewatering. This period shall be determined by the Engineer based on proposed Construction Schedule.

6.4 If at any time the Engineer is not satisfied with the performance of Dewatering System installed and operated by the Contractor, and if in the opinion of the Engineer it is necessary to make substantial changes in the Dewatering System to achieve the desired results, the Employer will be entitled to encash the Bank Guarantee to the extent of all monies already paid to the Contractor under the B.O.Q. Item for Dewatering.

SECTION - 1520

PILING WORK

1. SCOPE

1.1 General

The work under this section of specification shall consists of furnishing all plant, labour, equipment, appliances and material and performing all operations necessary for the execution of the works as contained in this section in accordance with the specifications and as per drawings and/or as directed by the Engineer, including the following for a complete job.

1.1.1 Drilling of boreholes below existing ground level of the diameter and lengths as shown on the drawings or as directed by the Engineer.

1.1.2 Supply, fabrication and placement of reinforcing steel bar cage for piles as shown on the drawings and in accordance with section 2200.

1.1.3 Supply and placement of concrete by tremie for construction of piles, in accordance with section 2300.

1.1.4 Pile lengths shown on the drawings are tentative, and may be revised during the execution of piling work.

2. SUBMITTALS

2.1 Refer to Section 0100 "General Requirements".

2.2 Submit details and drawings for the following activities:

- Drilling of boreholes.
- Methodology & procedure of placing reinforcement and concrete for constructing the piles.

3. SUPERVISORY STAFF

The contractor shall have at site, at all times, only qualified, experienced, orderly and thoroughly competent persons, who shall conduct and supervise all work related to construction of piles. Since the construction of piles requires special knowledge and utmost care, the contractor shall have at least one qualified and experienced Engineer specialized in this fieldwork who shall be present full time during execution.

4. LOCATION OF PILES

The location of piles shall be established by the Contractor as shown on the drawing or as directed by the Engineer, from the reference points provided by the Engineer. Establishing the pile locations accurately in the field shall be the sole responsibility of the Contractor.

The Contractor shall carry out levelling survey and provide ground elevation and tip/top elevation of each pile. The elevations shall be given with respect to a reference bench mark provided by the Engineer.

5. NUMBER, DIAMETER AND LENGTH OF PILES

The piles shall be constructed true to line, level and profiles as shown on the drawings or as directed by the Engineer.

The piles shall have specified diameter and length as shown on the drawings or as directed by the Engineer.

The Engineer may direct the positions, the number, diameter and length of piles to be changed at his discretion and according to design requirements during the progress of work.

6. MOBILISATIONS AND DEMOBILISATION

Mobilization shall consist of the delivery at the site of all plant, equipment and materials supplies in satisfactory working order. Adequate plant and equipment shall be employed at site. Mobilization shall also include the shifting of necessary plant, equipment including drilling rig and necessary materials/supplies from one pile location to other within the site and setting up of such equipment in satisfactory manner at each location.

Demobilization shall consist of the removal from site of all plant, equipment and materials after completion of the work and leaving the site clear, clean and tidy.

No separate payment shall be made for mobilisation and demobilisation.

7. DRILLING OF BOREHOLES IN SOIL/ROCK

7.1 Boring

Due to possibility of encountering underground services during drilling of boreholes for piles it would be necessary to excavate a pit (2.5m deep)at each borehole location prior to commencement of drilling operation. No separate payment shall be made for excavating the pits. In spite of this precaution, the drilling in the top 5m shall be advanced carefully. The responsibility of avoiding hitting / damaging any underground services rest with the Contractor. In case of accidentally hitting / damaging underground services occurs, the some shall be repaired / restored by the Contractor at no cost to the employer.

The Contractor shall use percussion or any other method as approved by the Engineer for drilling of boreholes. The Contractor shall mobilize at site adequate drilling equipment for smooth, continuous and timely execution of work. All materials, tools, plants and equipment shall be provided by the Contractor to the satisfaction of the Engineer, cost of which shall be deemed to have been included in the rate of boring for R.C.C. bored cast-in-situ piles.

7.2 Stabilizing the Holes

The Contractor shall ensure at all times that the hole does not collapse during and after boring. The temporary casing required to stabilize the boreholes shall be made of cylindrical steel pipes of inside diameter equal to the pile diameter and shall have sufficient strength so as to maintain position and shape during drilling operations. It shall also be free from distortion and shall be of uniform cross-section throughout each continuous length. The casing throughout should be water tight. The casing may be omitted only where it can be shown to the satisfaction of the Engineer that lowering of reinforcement cage and concreting operations will not entrain soil from the sides of the hole by caving. It shall be the Contractor's responsibility to pull out the casing from the holes at the time of concreting of piles. Casing should be pulled out carefully so that reinforcement cage and the concrete is not lifted with the casing. No extra payment shall be made for supply, inserting & pulling out the casing or for leaving the same inside the hole. The Contractor may use bentonite or cement slurry or any other drilling method with written approval from the Engineer.

It may also be noted that no extra payment shall be made for using bentonite or cement slurry or adopting alternative drilling method for advancing the boreholes in satisfactory manner.

7.3. **Clean-Out at the Bottom of Piles**

After the bore has reached its final penetration as stipulated on the drawings and as may be additionally ordered by the Engineer on the basis of data obtained in the field, it shall be thoroughly cleaned of all loose material and made ready to receive the reinforcement cage and concrete, to the satisfaction of the Engineer.

7.4 **Collection and Preservation of Samples from Boreholes**

The Contractor shall keep a complete bore hole log with visual classification of each borehole supported by an adequate number of samples preserved, sealed and labelled in plastic jars. In this context, an adequate number of samples shall mean not less than one sample for every 3 metres of boreholes and in addition not less than one sample at every significant change in soil strata.

No payment shall be made for obtaining and preserving the soil/rock samples from boreholes.

8. **TOLERANCES**

Tolerance in plan position, verticality and lateral deviation and deviation in the level of the pile shall be as follows:

- Plan position at pile top ± 75 mm
- Pile head level ± 25 mm
- Verticality 1:50

9. **DISPOSAL OF DRILLING MATERIAL**

The sub-surface material obtained from drilling shall be disposed off to the areas designated by the Engineer in a suitable manner.

10. **REINFORCEMENT IN PILES**

Steel reinforcement shall be provided in piles in accordance with Section 2200. Circular concrete spacers shall be provided at appropriate spacing to ensure cover for concrete.

11. **CONCRETE IN PILES**

Concrete of specified class as mentioned on the drawing shall be provided and filled in bore holes by tremie in one go. The concrete for piles shall be in accordance with the relevant technical specifications given in Section 2300 and as shown on the drawings. The slump of concrete shall be 125 to 150mm, Admixture shall be used in manufacturing concrete to obtain required slump, improve workability and avoid segregation.

As a pile is completed, the projected length shall be immediately and carefully protected from any condition that will damage or adversely affect the hardening of concrete.

It may be noted that drilling of boreholes for adjacent piles within a clear radius of 3.5 meter of a concreted pile shall not commence until 48 hours have elapsed after completion of concreting.

During the course of construction, the Contractor will always ensure that no part of the structure is loaded beyond its design capacity.

12. **RECORD AND REPORTS**

12.1 **Records**

The Contractor shall keep accurate records of all the works accomplished under this section of the specifications. All such records shall be preserved in good condition and order by the Contractor until they are delivered and accepted by the Engineer. The Engineer shall have the right to examine such records at any time prior to their delivery to him.

The following information shall be included in the records for each pile:

- Pile number and elevation of top and bottom of piles.
- Elevation of existing ground level at each pile location.
- Type of drilling operations.
- Date and time by depths when drilling operations were performed and piles constructed. Time consumed in concreting each pile.
- Type of soil/rock encountered in the hole including borelog.
- Total depth of each bore hole.
- Theoretical volume of concrete required and the volume of concrete actually consumed in each pile.
- Quantity of constituents for each batch of mix, water cement ratio and the results of all quality control tests.
- Details of reinforcement.
- Remarks concerning any unusual occurrence during drilling and concreting.

The presence of Engineer's Representative or the keeping of separate records by his representative shall not relieve the Contractor of the responsibility for the work specified in this clause.

12.2 **Reports**

Reports of construction of each pile shall be communicated to the Engineer as follows:

- Reports as the work proceeds.
- The records as specified above in duplicate not later than 24 hours after the completion of each borehole and concreting of piles.
- 6 copies of the final report of the works within one month of the completion of the last pile.

The final report shall include:

- Layout showing the "As-built" arrangement of piles.
- Observations and results of laboratory tests regarding quality control of concrete.
- Contractor's evaluation of test results.

13. **CUTTING OF PILE HEADS**

The pile heads shall be cut to the bottom of pile caps and the cut shall be smooth and horizontal. Due care shall be taken for protecting the edges and reinforcement. No separate payment shall be made for this work.

14. DUMMY CLASS "E" CONCRETE

If due to unavoidable circumstances there is a delay in construction of pile caps then the exposed steel reinforcing bars of piles shall be covered with Class "E" concrete using appropriate formwork, as approved by the Engineer.

15. LOAD TESTING OF TEST PILES

15.1 General

a) The Contractor shall submit his plans for performing load test on test piles for approval.

b) Pile load test shall be conducted up to the maximum specified load.

c) The Contractor shall be responsible for bringing all equipment labour and other supplies to the site for a complete job and for satisfactory execution of the test according to ASTM D 1143-82, and as directed by the Engineer.

d) The Contractor shall submit to the Engineer an up to date calibration certificate from a laboratory approved by the Engineer, showing correctness of the manometer (pressure gauge) to be used with the hydraulic jack. Preferably the pressure gauge shall be calibrated with the hydraulic jack installed during calibration in the approved laboratory.

e) The Contractor shall submit details of his method of pile load test prior to start of test for approval of the Engineer, which will include drawing and back-up calculations to ensure stability and adequacy of the arrangement.

f) Care shall be taken to ensure the center of gravity of the loading arrangement is on the axis of the pile and that the load applied by the jack is concentric with the pile.

g) The record of pile load test shall be kept on an approved format. The Contractor shall prepare load-settlement time, settlement and load time curves. For each such load test, two copies of the relevant field data and the graphs shall be supplied to the Engineer within 48 hours of the completion of that test.

The Contractor shall keep accurate record and report of load testing of piles in accordance with subsection Record & Reports. In addition the following information shall also be provided on the approved format for the test pile:

- Data and time of load testing of piles, load and settlement readings during the loading and unloading of the test pile.

- Graph for time-load settlement relationship for test.

The presence of Engineer or the keeping of separate records by his representative for the work specified in this clause. Payment will not be made for any work for which records have not been furnished by the Contractor.

15.2 Report

Report of pile load test shall be communicated to the Engineer as follows:

- Oral report as the work proceeds.

- Three copies of the final report within one week of completion of the pile load tests.

- The final report shall include:

a) Layout showing the “As built” arrangement of piles, its exact location, dimensions, length, and cut-off elevation.

b) A tabulation of the loads and settlement readings during the loading and unloading of the test pile.

c) A graphic representation of the test results in the form of time-load settlement curves.

16. MEASUREMENT AND PAYMENT

16.1 General

Except otherwise specified herein or elsewhere in the contract documents, no measurement and payment shall 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 respective items of the Bill of Quantities.

- Mobilisation and demobilisation of all plant, equipment, materials at site including shifting of necessary plant, equipment, supplies materials etc. from one pile location to another.

- Clean out at bottom of piles.

- Bentonite or cement slurry used during boring operation.

- Excavation of test pits prior to commencement of boring to avoid hitting underground services.

- Disposal of subsurface material obtained from boring/drilling to designated area as directed by the Engineer.

- Carrying out survey and levelling work for determining locations, alignment and ground elevations for each pile.

- Wastage of concrete in construction including the concrete consumed outside the theoretical lines shown on the drawings and required for proper overflow of concrete at the top to ensure complete removal of subsurface material mixed with concrete.

- Admixtures i.e. air entraining admixture, plasticizer and retarders in concrete.

- Providing and installing, supports, hooks, spacers, binding wire and laps not shown on drawings including wastage and rolling margin.

- Cutting of pile heads to the specified level. Dismantling/ cutting of dummy concrete class “E”

- Cut-off & Splicing because of Contractors fault and/or defective work.

- Cost of all concrete and steel reinforcement tests specified in the contract documents.

- Protection, curing and repair of defects.

- Providing, fixing, striking etc. of formwork, where required.

- Maintenance and submission of record and reports of work as specified in this section.

16.2 **Drilling of Boreholes in Soil/Rock for Piles**

16.2.1 Measurement

Measurement of acceptably drilled boreholes of specified diameter for construction of piles, will be made in running foot measured from pile cut-off level to the bottom of borehole, irrespective of the type of sub-surface material encountered.

16.2.2 Payment

Payment will be made for the measured quantity of borehole completed on the basis of unit rate per running foot quoted in the Bill of Quantities and shall constitute full compensation for all the works related to the item.

16.3 **Reinforced Concrete**

16.3.1 Measurement

Measurement of acceptably completed works of reinforced cement concrete in piles shall be made on the basis of running foot, from the cut-off level to the tip of pile.

16.3.2 Payment

Payment will be made for acceptable measured quantity of reinforced cement concrete in piles on the basis of unit rate per running foot quoted in the Bill of Quantities and shall constitute full compensation for all the works related to the item.

16.4 **Reinforcement**

16.4.1 Measurement

Measurement for acceptably completed works of reinforcement shall be made by weight according to bar bending schedule approved by the Engineer.

16.4.2 Payment

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

16.5 **Load Testing of Test Piles**

16.5.1 Measurement

Measurement of acceptably conducted load test will be made in numbers.

16.5.2 Payment

Payment shall be made for the acceptable measured quantity of work completed on the basis of unit rate in numbers quoted in the Bill of Quantities.

16.6 **Dummy Class "E" Concrete (Optional item)**

16.6.1 Measurement

Measurement of acceptably completed cast insitu class "E", concrete will be made in the unit of cubic foot of concrete placed in position as per drawings.

16.6.2 Payment

Payment shall be made for the acceptable measured quantity of work completed on the basis of unit rate per cubic foot quoted in the Bill of Quantities including cost of form work).

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. MATERIAL

2.1 An emulsible concentrate insecticide shall be used for dilution with water, specially formulated to prevent infestation by termites. Fuel oil will not be permitted as a diluent. Provide a working solution of the following chemical element and concentrations.

HEPTACHLOR emulsifiable to 0.5% with clean water.
Or
TERMICURE 25EC containing FIPRONIL
Or
BIFLEX with Bifenthrin Tech 25.1%
Or
Approved Equivelent

2.2 All mixing shall be done at site and mixing proportion of insecticide with water shall be in accordance with the approved manufacturer's recommendations and shall be verified by the Engineer.

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

3. QUALITY ASSURANCE

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

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

4. EXTENT OF APPLICATION

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

4.2 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.

4.3 Insecticide solution should not be applied during wet weather, or when the earth surface is excessively wet. Application should be made to all areas beneath concrete slabs-on-grade, including sidewalks and paving abutting buildings for distance of at least 6 feet beyond building line. Solution shall be applied in amounts of not less than 5 lit./ Sq.M or 5 lit./10.76 Sq.ft. of area. If applied over gravel or sand fill, application shall not be less than 7 lit./ Sq.M or 7 lit./10.76 Sq.ft. of area. Insecticide shall penetrate to a depth of 1-inch minimum in porous earth at bottom and 2 inch to 3 inch at sides of excavations.

4.4 Sides of foundation excavations, grade beam, and similar areas shall be treated with solution at a rate of 0.5 lit per square feet upon inner sides of such excavations, and at all locations where

concrete slabs for platforms and similar work 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.

4.5 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.

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

4.7 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.

5. STANDARDS

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

6. SAMPLES AND TESTS

The Contractor shall supply samples of all the materials to be used for insecticide control for approval of the Engineer and testing in accordance with the specified standards. Rejected materials shall be removed from the site immediately.

7. 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 10 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.

8. MEASUREMENT & 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 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.

8.1.1 Termite control treatment on wood works.

8.1.2 Turpentine & Water required for mixing insecticide solution.

8.1.3 Transportation of material and storage at site.

8.1.4 Anti-termite treatment on stock piled backfill material.

8.1.5 Termite control treatment to vertical surfaces.

8.2 Termite Control Treatment

8.2.1 **Measurement**

Measurement of acceptably completed works of termite control treatment will be made on the basis of number of square meter of plinth area treated of ground floor/lower floor by measuring the two dimensions (length & breadth) of treated area. No separate measurement will be made for the vertical or horizontal surfaces of the foundations.

8.2.2 **Payment**

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

8.2.2.2 For "Termite Proofing", the rate is for the unit plinth area (measured along the outside of the external walls at DPC or peripheral plinth beam level irrespective of the number of storeys in the building) and covers the followings operations:

i. Treatment of bed and sides of excavated foundation trenches.

ii. Treatment of backfill.

iii. Treatment of filled up earth.

iv. Treatment of timber to be used.

v. Treatment of surrounding areas within 10 feet of the building.

vi. Any other operation which the specialized firm may deem necessary in context to their guaranteed obligations.

SECTION - 2100

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 supply and installation of formwork for the purpose of shuttering in concreting 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

2.1 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.

2.2 The Contractor shall submit to the Engineer for his approval shop drawings for all formwork to be used in the structural members at site.

2.3 All details of formwork and the supporting systems shall be submitted by the Contractor to the Engineer who shall check their safety and approve and/or amend the same, provided however 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 or the work.

2,4 The Contractor shall furnish the construction procedures which shall include charts and diagrams as applicable and necessary, to fully explain the subject procedures, methods and equipment operation in order to allow effective review by the Engineer, assist the Testing Agency's evaluation of the work and to allow Contractor's personnel to perform work in full conformity to the Contract Documents.

3. APPLICABLE STANDARDS

Latest editions of the following are applicable to these specifications, as and where required:

ACI 301 Specifications for Structural Concrete for Buildings.

ACI 318 Building Code Requirements for Reinforced Concrete.

ACI 347R Guide to Formwork for Concrete.

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

4. MATERIALS

All materials shall conform to the requirements of ACI 347R.

4.1 **Formwork**

Forms shall be of timber, steel, plywood or other suitable materials as approved by the Engineer. Forms where used shall give the required finish to the concrete surface. Wooden forms shall be free from loose knots and shall be well seasoned.

4.2 **Form Ties**

Form ties will be designed so as not to allow abnormal form deflection, nor allow spalling of concrete upon removal. Bolts and rods that are to be completely withdrawn shall be coated with a non-staining bond breaker.

4.3 **Form Release**

Non-staining, non reactive, rust preventive and guaranteed not to affect bond of subsequent surface applications to concrete shall be used.

5. **TRANSPORTATION AND STORAGE**

5.1 **Transportation**

Care shall be taken during transportation to avoid damage to formwork materials.

5.2 **Storage**

Materials shall be stored in such a manner that access to all different materials is available. Used formwork shall be stored after cleaning and preparing for reuse.

Materials shall be stored in appropriate building or under covers and shade.

6. **WORKMANSHIP**

6.1 Formwork shall conform to the shape, lines and dimensions as shown on the drawings. Form 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. Formwork shall be tight enough to prevent loss of liquid from concrete.

6.2 Earth cuts shall not be used as forms for vertical surfaces of reinforced concrete work unless permitted by the Engineer.

6.3 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.

6.4 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.

6.5 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.

6.6 Forms shall not be reused 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 prepared before reuse.

6.7 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.

6.8 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 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.

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.

6.9 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.

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

6.11 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.

6.12 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.

6.13 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.

6.14 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 (1) a field applied, approved form oil or sealer, or (2) a factory applied non-absorptive liner. When forms are coated to prevent bond with concrete, it shall be done prior to placing of the reinforcing steel. 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.

6.15 For reinforced concrete, in no circumstances shall forms be struck until the concrete has attained 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 a longer time, as it would assist the curing.

In normal circumstances (generally where temperatures are above 10 degree C and where ordinary Portland cement is used, forms may be struck after expiry of the following periods:

-	Walls, footings, columns, vertical sides of pile caps, beams/transoms and slabs, 48 hours or as may be decided by the Engineer.		
-	Slabs	Bottom	14 days.
-	Beams/transoms, Pile caps	Bottom	21 days.

6.16 The shoring system, wherever required, shall have a capacity sufficient to resist the anticipated loads.

6.17 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.

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

6.19 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 prestressing steel. The use of spacer-blocks for 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.

6.20 The form oil or release agent shall not react with concrete to affect the strength nor shall it give any color. It shall be applied in such a manner as not to contaminate the reinforcement and other fixtures to be embedded in concrete.

6.21 Prior to placing concrete, all forms shall be inspected and all debris and extraneous matter removed.

7. MEASUREMENT AND PAYMENT

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

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 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.

British Standard

B.S 4449	Carbon steel bars for the reinforcement of concrete.
B.S 4466	Specifications for bending dimensions and scheduling of bars for the reinforcement of concrete.

ACI Standard

ACI 315	Details and detailing of concrete reinforcement.
ACI 318	Building Code Requirements for Reinforced Concrete and commentary.

ASTM Standard

A 82	Cold – Drawn steel wire for concrete reinforcement.
A 305	Minimum requirement for the deformations of deformed steel bars for concrete reinforcement.
A 615	Deformed Billet Steel Bars for Concrete Reinforcement.

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

3.1 Unless otherwise specified, all deformed reinforcing bars shall comply with the requirements of ASTM A615 Grade 60 for deformed hot rolled billet steel bars with specified minimum yield strength of 460 MPa (60000psi).

3.2 Reinforcement shall be free from all loose or flaky rust and mill scale, or coating, including ice, and any other substance that would reduce or destroy the bond.

4. COMPLIANCE WITH SPECIFICATIONS

The Contractor shall submit certificates of compliance from the manufacturer stating that the supplied reinforcement conforms to the specifications. In addition, wherever and if directed by the Engineer, conformance of the supplied reinforcing bars with the specifications shall be demonstrated by the Contractor through laboratory tests, in accordance with the relevant standards.

5. DELIVERY & STORAGE

5.1 Delivery

Steel reinforcement bars shall be kept in bundles firmly secured and tagged. Each bar or bundle of bars shall be identified by marks as per relevant standards.

5.2 Storage

Method of storage shall be approved by the Engineer. Reinforcing bars shall be stored in racks or platforms above the surface of ground and shall be protected against scaling, rusting, oiling, coatings, damage, contamination and structural defects prior to placement in works. Bars of different diameters and grades shall be so labeled and kept separately.

6. 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.

The Engineer's approval, however, will not relieve the Contractor of his responsibility in this regard.

7. FABRICATING, BENDING & PLACING

7.1 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, metal or plastic chairs and spacers or hangers of an approved pattern. Where concrete blocks are used for ensuring the cover, they shall be made of mortar not leaner than 1 part of cement to 2 parts of sand.

Where the concrete surface will be exposed to the weather in the finished structure, the portions of all accessories in contact with the formwork shall be galvanized or shall be made of plastic.

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

7.3 The cutting tolerance for all bars shall be + 25 mm

7.4 Fabrication tolerances shall be as per ACI-315

7.5 Placing tolerances shall be as per ACI-318 & 317.

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

7.7 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 columns dowels.

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

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

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

7.9 No splice of reinforcement shall be made, except as shown on the working drawings.

7.10 Welding of reinforcement shall not be done unless permitted and approved by the Engineer.

7.11 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.

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

7.13 All detailing shall be done as per ACI-315, ACI-318 and ACI-350R, as and where required.

7.14 The cage of reinforcement shall be lowered in the steel piles carefully keeping the cage concentric with the pile. Adequate spacers shall be provided around the cage to ensure the required concrete cover to be available on all sides of the cage.

7.15 Standard or actual weight whichever is lesser shall be used for calculation of weight.

8. MEASUREMENT & 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 in the quoted unit rate of the respective items of the Bill of Quantities.

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

8.1.2 Testing of plain and deformed steel bars.

8.2 Reinforcing Bars (Deformed, or plain)

8.2.1 Measurement

Measurement for acceptably completed works of reinforcing bars shall be made by weight according to bar bending schedules approved by the Engineer.

8.2.2 Payment

Payment will be made for acceptable measured quantity of reinforcement on the basis of unit rate per metric ton quoted in the Bill of Quantities and shall constitute full compensation for all the works related to the 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 in performing all operations in connection with the supply and installation of plain and reinforced concrete work complete, in strict accordance with this section of the specifications and the applicable drawings, and subject to the terms and conditions of the Contract.

2. GENERAL

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

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

2.3 For special concrete finish and for special methods of construction, formwork shop drawings shall be designed and prepared by the Contractors, 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. APPLICABLE STANDARDS

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

3.1 Pakistan Standards

P S	232	Portland Cement (ordinary & rapid hardening)
P S	243	Natural aggregates for concrete
P S	279	Abrasion of coarse aggregates by the use of Los Angeles machine.
P S	280	Determination of aggregates crushing value.
P S	281	Organic impurities in sand for concrete aggregates
P S	282	Material finer than No. 200 B.S. test sieve in aggregates.
P S	283	Soundness test for aggregates by the use of sodium sulphate or magnesium sulphate.
P S	284	Sampling aggregates for concrete.
P S	285	Sieve or screen analysis of fine and coarse aggregates.
P S	286	Description and classification of mineral aggregates.
P S	421	Sampling fresh concrete.
P S	422	Slump test for concrete.
P S	560	Making and curing concrete compression test specimen in the field.
P S	612	Sulphate-resistant portland cement type `A' and sampling fresh concrete in the laboratory.
P S	716	Mixing and sampling fresh concrete in the laboratory.
P S	717	Compacting factor test for concrete.
P S	746	Definitions and terminology of cements.
P S	849	Making and curing concrete compression test cubes.

3.2 ASTM (American Society for Testing and Materials)

C	33	Concrete Aggregates.
C	40	Organic impurities in sand for concrete.

C	78	Flexural strength of concrete.
C	87	Effect of organic impurities in fine aggregates on strength of mortar.
C	88	Soundness of aggregates.
C	94	Ready mixed Concrete.
C	117	Material finer than No.200 (0.075mm) sieve.
C	123	Light weight pieces in aggregates.
C	125	Concrete and concrete aggregates.
C	127	Specific gravity and absorption of coarse aggregate.
C	128	Specific gravity and absorption of fine aggregate.
C	131	Resistance to abrasion of small size coarse aggregate.
C	136	Sieve or screen analysis of fine and coarse aggregate.
C	142	Clay lumps and friable particles in aggregates.
C	143	Slump of portland Cement Concrete.
C	150	Portland Cement.
C	156	Water retention by concrete curing material.
C	171	Sheet material for curing concrete.
C	172	Fresh concrete sampling.
C	260	Air entraining admixture for concrete.
C	289	Potential reactivity of aggregate.
C	309	Liquid membrane forming compounds for curing concrete.
C	332	Light weight aggregates for insulating concrete.
C	494	Chemical admixtures for concrete.
C	535	Resistance to abrasion of large size coarse aggregates.
C	685	Concrete made by volumetric batching and continuous mixing.
D	75	Aggregate sampling.
D	1190	Concrete joint sealer (hot poured elastic type).
D	1751	Preformed expansion joint filler for concrete paving and structural concrete.
D	1752	Preformed sponge rubber and cork expansion joint fillers for concrete paving and structural concrete.
D	1850	Concrete joint sealer (cold application type).
E	11	Wire cloth sleeves for testing purposes.
E	96	Water vapour transmission of materials in sheet form.
E	154	Materials for use as vapour barrier under concrete slabs.
E	337	Relative humidity by wet and dry bulk psychro- meter.
C	400	Requirements for water for use in mixing and curing concrete.

3.3 British Standards

B.S	12	Portland cement, ordinary and rapid hardening.
B.S	410	Test Sieves
B.S	812	Methods for the sampling and testing of mineral aggregates, sand fillers
B.S	882	Concrete aggregates from natural sources
	1201	
B.S	1881	Methods of testing concrete.
B.S	3148	Tests for water for making concrete.
B.S	4027	Sulphate-resisting portland cement.
C.P	8110	Structural use of concrete.

3.4 ACI (American Concrete Institute)

117	Standard Specifications for tolerances for concrete construction and materials.
201.2	Guide to durable concrete.
211	Recommended practice for selecting proportions for normal and heavy weight concrete.
214	Recommended practice for evaluation of strength test results of concrete.
301	Specifications for structural concrete for building.

304 Recommended practice for measuring, mixing, transporting and placing concrete.
305 Hot weather concreting.
308 Standard practice for curing concrete.
309 Recommended practice for consolidation of concrete.
318 Building code requirement for reinforced concrete.
347R Guide to Formwork for concrete.
351.1R Grouting for support of equipment & machinery.

UBC Uniform Building Code

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

4. MATERIALS

4.1 Aggregates

4.1.1 The sources of supply of all fine and coarse aggregates shall be subject to the approval of the Engineer.

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

4.1.3 Sulphate content of aggregates shall not exceed 0.40 percent by weight for each individual source of coarse and fine aggregate. Chloride content of aggregates shall not exceed 0.05 percent by weight for each source of coarse and fine aggregate. Total sulphate (SO3) content of concrete shall not exceed 4.0 percent by weight of the cement. Total chloride content of concrete shall not exceed 0.15 percent by weight of the cement.

4.1.4 Fine aggregate shall be hard coarse sand, crushed stone or gravel screenings and shall conform to requirements of PS 243 and/or BS 882 and/or ASTM C-33.

4.1.5 Coarse aggregate shall be gravel or crush stone of hard, durable material free from laminated structure and conforming to PS 243 and/or BS 882 and/or ASTM C-33 size number 467 as follows for use in foundations:

Total Passing Sieve		Percent by weight
50.80 mm (2 in.)	:	100
38.10 mm (1.5 in.)	:	95-100
19.00 mm (0.75 in.)	:	35-70
9.51 mm (0.38 in.)	:	10-30
4.76 mm (0.19 in.)	:	0-5

Coarse aggregate for all cast-in-place concrete other than foundations shall conform to ASTM C-33 size number 6, as follows:

Total Passing Sieve		Percent by weight
25.00 mm (1. 0.in.)	:	100
19.00 mm (0.75 in.)	:	90-100
12.50 mm (0. 5 in.)	:	20-55
9.50 mm (0.38 in.)	:	0-15
4.75 mm (0.19 in)	:	0- 5

Coarse aggregate for 'concrete with reduced aggregate' shall conform to ASTM C-33 size number 6, as follows:

Sieve Designation		Percent by Weight
9.5 mm (3/8 in.)	:	100
4.35 mm (No. 4)	:	85-100
0.15 mm (No. 100)	:	10-30

4.1.6 Unless otherwise specified the nominal maximum size of aggregate for cast-in-place reinforced concrete slabs and other members, shall be 19mm, if feasible. If there are difficulties in placing such a concrete the maximum size may be restricted to 12 mm provided the requirements for strength are satisfied.

4.1.7 Except where it can be shown to the satisfaction of the Engineer that a supply of properly graded aggregate of uniform quality can be maintained over the period of the work, the grading of the aggregates shall be controlled by obtaining the 19mm maximum nominal size, the different sizes being stocked in separate stock piles and recombined in the correct proportion for each batch at the batching plant / concrete mixer. The materials shall be stock-piled for a period before use so as to drain nearly to constant moisture content (as long as site and other conditions permit, preferably for at least a day). The grading of the coarse and fine aggregates shall be tested at least once for every 100 tons supplied, to ensure that the grading is uniform and same as that of the samples used in the preliminary tests.

4.2 **Cement**

4.2.1 Cement shall be fresh and of approved origin and manufacture. It shall be one of the following as may be specified by the Engineer.

- Ordinary or Rapid Hardening Portland cement complying with the requirements of PS 232 or BS 12 or ASTM C-150. (Type -I).

- Sulphate Resisting Portland Cement complying with the requirements of PS 612 or BS 4027 ASTM C-150. (Type - V).

4.2.2 Unless otherwise specified, ordinary Portland Cement complying with the requirements of BS 12 or ASTM C-150 type-1 shall be used.

4.2.3 For fair faced concrete if required, an approved cement with a view to obtain a light shade concrete as approved by the Engineer shall be used.

4.2.4 The Contractor shall supply to the Engineer at fortnightly intervals, reports of tests for conformance with the relevant specified standard in respect of the samples of cement from the work-site. These tests shall be carried out in a laboratory approved by the Engineer.

4.2.5 Only one brand of each type of cement shall be used for concrete in any individual member of the structure. Cement shall be used in the sequence of receipt of shipment, unless otherwise directed.

4.2.6 There shall be sufficient cement at site to ensure that each section of work is completed without interruption.

4.2.7 Cement reclaimed from cleaning of bags or from leaky containers shall not be used.

4.2.8 The Contractor shall provide and erect (at his cost) in a suitable plain, dry, well ventilated, weather-proof and water proof shed of sufficient capacity to store the cement.

4.2.9 The cement shall be used as soon as possible after delivery and cement which the Engineer consider has become stale or unsuitable through absorption of moisture from the atmosphere or otherwise shall be rejected and removed immediately from the site at the Contractor's expense. Any cement in containers damaged so as to allow the contents to spill or permitting access of the atmosphere prior to opening of the container at the time of concrete mixing shall be rejected and removed immediately from the site at the Contractor's expense.

4.2.10 Mixing together of different types of cement shall not be permitted.

4.3 **Water**

Only clean water from the city supply, or from other sources approved by the Engineer shall be used. The Contractor shall supply sufficient water for all purposes, including mixing the concrete, curing and cleaning plant and tools. Where doubt exists as to the suitability of the water, it shall be tested in accordance with B.S. 3148 or CE CRD C 400. Where water can be shown to contain any sugar or an excess of acid, alkali or salt, the Engineer may refuse to permit its use.

In case of doubt, the Engineer may require that concrete mixed with water proposed to be used should be tested to have a compressive strength not lower than 90 percent of the strength of concrete mixed with distilled water.

4.4 **Additives**

If required, all additives shall be from a manufacturer approved by the Engineer.

Air Entraining Admixtures shall conform to ASTM C260. Other Admixtures shall conform to ASTM C494.

4.5 **Bitumen**

All material for bitumen shall consist of plastic bitumen grade 10/20.

4.6 **Vapour Barrier**

Polyethylene sheeting conforming with ASTM E154 and 0.2mm thick as a minimum. Other similar material having a vapour permeance rating not exceeding 0.5per meter as determined by ASTM E96, will be considered unless noted otherwise.

4.7 **Joint Fillers**

ASTM D1751, preformed, resilient bituminous type or ASTM D1752, preformed sponge rubber.

4.8 **Joint Sealants**

ASTM D1190, ASTM D3569, ASTM D3406, hot-pour type.

4.9 **Waterstops**

Provide flat, dumbbell type or center bulb type water stops at construction joints where shown. Web thickness not less than 5mm for units up to 125mm wide, and not less than 10mm for widths over 125mm. Provide polyvinyl chloride (PVC) waterstops of approved manufacturer.

4.10 **Expansion Joints**

Expansion joints shall be provided wherever indicated on the Drawings or as directed by the Engineer. In no case shall the reinforcement, corner protection angles, or other embedded items be permitted to extend continuously through any expansion joint.

All expansion joints shall carefully be placed so as not to be displaced during concreting. The method of placing the expansion joints shall be strictly in accordance with the Drawings and/or as directed by the Engineer. All materials for use in the expansion joints shall have prior approval of the Engineer before placing order for supply.

5. NOMINAL CONCRETE MIXES

5.1 Proportions of Mix

5.1.1 Cement and aggregates:

The cement, fine aggregate and the coarse aggregate shall be weighed separately. The proportions of cement to fine aggregate and coarse aggregate shall be adjusted so as to provide the concrete of the required crushing strength when tested as set out in Table 1.

5.1.2 The Contractor shall regulate and arrange mixing of the ingredients for the designed mix of the concrete by weight-batching. The cost of designing the mix shall be borne by the Contractor.

5.1.3 Water/Cement ratio:

Unless otherwise specified in these Documents/Drawings, the water/cement ratio for all structural concrete shall not exceed 0.45.

5.1.4 Workability:

Admixtures may be used where necessary to achieve required workability, with the Engineer's approval. 'Workability' shall be determined by the slump or compaction factor tests as directed by the Engineer and these shall be perform in accordance with the methods given in PS 422 and PS 177 or ASTM C-143. The slump or compaction factor for each grade of concrete shall be determined during the preliminary Test mixes and the value obtained shall not be modified without the written consent of the Engineer. Unless otherwise permitted or specified, the concrete shall be proportioned and produced to have a slump of 75 mm or less if consolidation is to be by vibration, and 100 mm or less if consolidation is to be by methods other than vibration. A tolerance of up to 25 mm above the indicated maximum shall be allowed for individual batches provided the average for all batches or the most recent 10 batches tested, whichever is fewer, does not exceed the maximum limit. Concrete of lower than usual slump may be used provided it is properly placed and consolidated, as per satisfaction of Engineer.

5.2 Strength requirements for concrete

5.2.1 Portland cement concrete when aggregates comply with B.S. 882.

5.2.2 Concrete made with Portland cement shall comply with the strength requirements of Table 1:

Table 1: Strength requirements for Portland cement concrete with aggregates complying with B.S. 882.

Class	Minimum Cube Crushing Strength at 28 days (MPa)
A1	40.0
A	31.0

B	26.0
C	21.0
D	10.50
E	7.0

5.2.3 The strengths given in Table 1 are based on the assumption that average temperature is 20 degree C. Where accurate records of temperature are kept, allowance may be made for change of temperature or the cubes may be tested at the equivalent maturity.

5.2.4 The Contractor shall submit mix design by weight for each grade of concrete. Manufacture 12 Nos. test cubes 150mm x 150mm x 150mm in accordance with the Mix design batching by weight and test 3 cubes each at 3,7, 14 & 28 days intervals in the presence of Engineer, and submit all relevant data and results of tests for approval of the Engineer. The Contractor shall obtain approval from the Engineer in writing for each Mix design before producing the actual concrete for the Works.

No payments shall be made for producing the Mix design, manufacture of test cubes and testing. The Contractor shall include this cost in the relevant item of concrete.

5.3 **Batching**

5.3.1 All cement, including cement supplied in bulk, shall be batched by weight. A bag of cement may be taken as 50 kg.

5.3.2 Aggregates shall be batched by weight, due allowance being made for water content. Aggregates may be batched by volume only with the prior permission of the Engineer. The apparatus for weight-batching may be an integral part of the mixer or a separate unit of a type approved by the Engineer. It shall be accurate within 2% and shall be checked for accuracy at least once a week.

5.3.3 The quantity of additives shall be as prescribed by the manufacturer or as directed by the Engineer.

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

5.3.5 Each batch shall be so charged into the mixer that some water will enter in advance of the cement and aggregates. Water shall continue to flow for a period which may extend to the end of the first 25 percent of the specified mixing time. Controls shall be provided to prevent batched ingredients from entering the mixer before the previous batch has been completely discharged.

5.4 **Mixing**

5.4.1 The concrete shall be mixed in an approved batch mixer. It shall be fitted with the manufacturer's plate stating the rates, capacity and the recommended number of revolutions per minute and shall be operated in accordance therewith. It shall be equipped with a suitable charging mechanism and an accurate water measuring device.

5.4.2 Mixing shall continue for the period recommended by the mixer manufacturer or until there is apparently a uniform distribution of the materials and the mass is uniform in colour, whichever period is longer. However, minimum mixing time shall not be less than $1^1/_2$ minutes.

If it is desired to use a mixing period of less than 1-1/2 minutes, the Engineer's approval shall be obtained in writing.

5.4.3 Controls shall be provided to ensure that the batch cannot be discharged until the required mixing time has elapsed. At least three quarters of the required mixing time shall take place after the last of the mixing water has been added.

5.4.4 The interior of the mixer shall be free of accumulations that will interfere with mixing action. Mixing blades shall be replaced when they have lost 10 percent of their original height.

5.4.5 Concrete shall be mixed only in quantities for immediate use. Concrete which has set shall not be retempered, but shall be discarded.

5.5 **Transporting**

5.5.1 The concrete shall be transported from the place of mixing to the place of final deposit as rapidly as practicable by means which will prevent segregation or loss of or addition to ingredients. It shall be deposited as nearly as practicable in its final position so as to avoid rehandling or flowing. All skips vehicles, or containers used for transporting the concrete shall be thoroughly clean.

5.5.2 During hot or cold weather, concrete shall be transported in deep containers, on account of their ratios of surface area to mass, which reduces the rate of loss of water by evaporation during hot weather and loss of heat during cold weather.

5.6 **Placing**

5.6.1 Before placing of concrete, formwork shall have been completed; water shall have been removed; reinforcement shall have been secured in place; expansion joint material, anchors and other embedded items shall have been kept in position; and the entire preparation shall have been approved.

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

5.6.2 In piles, once the reinforcement cage has been properly installed, and depth has been checked, recorded and approved by the Engineer, concreting operation shall be carried out. For piles, pouring of concrete shall be done by tremie. The method and equipment used shall be subjected to the prior approval of the Engineer. The tremie seal shall be affected in a manner, which will not produce undue turbulence in the water around the pipe. The discharge end of tremie pipe shall always be kept at least 1.5m in the concrete and the shaft kept full of concrete to a point well above the water surface. The tremie shall not be moved horizontally during placing operation. When concrete is filled to the require levels, adequate quantity of concrete shall be over-flown to remove any laitance or bad concrete to the satisfaction of the Engineer.

5.6.3 Concrete shall be deposited continuously, or in layer of such thickness that no concrete will be deposited on concrete which has hardened sufficiently to cause the formation of seams or planes of weakness within the section. If a section cannot be placed continuously, construction joints shall be located as shown in the Contract Documents or as approved by the Engineer. Placing shall be carried out at such a rate that the concrete, which is being integrated with fresh concrete, is still plastic. Concrete, which has partially hardened, shall not be deposited. Temporary spreaders in forms shall be removed when the concrete placing has reached an elevation rendering their services unnecessary. They may remain embedded in the concrete only if made of metal or concrete and if prior approval has been obtained.

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

5.6.5 The concrete shall be placed as soon after it has been mixed as is practicable. Once the concrete has left the mixer, no more water shall be added, although the concrete may be mixed or agitated to help maintain workability. The concrete shall not be used if, through any cause, the workability of the mix at the time of placing is too low for it to be compacted fully and to an acceptable finish by whatever means available.

The time between mixing and placing should be reduced if the mix is richer or the initial workability of the mix is lower than normal, if a rapid hardening cement or an accelerator is used, or if the work is carried out at a high temperature or exposed to a drying atmosphere.

The Contractor shall ensure that the delay between mixing and placing does not exceed 45 minutes under any circumstances. Any concrete, which does not satisfy this requirement shall be discarded.

5.6.6 Concrete shall be deposited as nearly as possible in its final position to avoid re-handling. In no circumstances may concrete be railed or made to flow along the forms by the use of vibrators. Concreting shall be carried on as a continuous operation using methods, which shall prevent segregation or loss of ingredients.

5.6.7 The free fall of concrete shall not be allowed to exceed two meter and where it is necessary for the concrete to be placed more than this depth, it shall not be dropped into its final position, but shall be placed through pipes fed by a hopper. When a pipe is used for placing concrete the lower end shall be kept inside, or close to the freshly deposited concrete. The diameter of the pipe shall be not less than 225 mm.

5.6.8 Workmen carrying concrete to the site, and all other workmen, shall move only along runways or planks placed for the purpose and no person shall be allowed to walk on the reinforcement.

5.7 Consolidation

5.7.1 All concrete shall be consolidated by vibration, spading, rodding or forking so that the concrete is thoroughly worked around the reinforcement, around embedded items, and into corners of forms, eliminating all air or stone pockets which may cause honeycombing, pitting, or planes of weakness. Only competent workmen shall operate vibrators. Use of vibrators to transport within forms shall not be allowed.

Vibrators shall be inserted and withdrawn at points approximately 450 mm apart. At each insertion, the duration shall be sufficient to consolidate the concrete but not excessive so as to cause segregation, generally from 5 to 15 sec. A spare Vibrator shall be kept on the job site during all concrete placing operations. Where the concrete is to have an as-cast finish, a full surface of mortar shall be brought against the form by the vibration process, supplemented, if necessary, by spading to work the coarse aggregate back from the formed surface.

5.7.2 If there is any tendency for the mix to segregate during consolidation, particularly if this produces excessive laitance, the mix proportions shall be modified to effect an improvement in the quality of the concrete to the satisfaction of the Engineer and in conformity with the provisions of Clause 5.

5.7.3 Vibrator shall not be allowed to contact the formwork for exposed concrete surfaces.

5.7.4 Mechanical vibrators shall be of a type approved by the Engineer to suit particular conditions.

5.7.5 Over-vibration or vibration of very wet mixes shall be avoided.

5.8 Curing and Protection

5.8.1 Beginning immediately after placement, concrete shall be protected from premature drying, excessively hot or cold temperatures and mechanical injury, and shall be maintained with minimum moisture loss at a relative constant temperature for the period necessary for hydration of the cement and hardening of the concrete. The materials and methods of curing shall be subject to approval of the Engineer.

5.8.2 For concrete surfaces not in contact with forms, one of the following procedures shall be applied immediately after completion of placement and finishing, as approved by the Engineer.

- Ponding or continuous sprinkling.

- Application of absorptive mats or fabric kept continuously wet.

- Application of waterproof sheet materials approved by the Engineer.

- Application of other moisture-retaining covering as approved.

- Application of a curing compound conforming to ASTM C309. The compound shall be applied in accordance with the recommendations of the manufacturer immediately after any water sheet, 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 proved that the curing compound will not prevent bond, or unless positive measures are taken to remove it completely from areas to receive bonded applications.

5.8.3 Moisture loss from surface placed against wooden forms or metal forms, and exposed to heating by the sun, shall be minimized by keeping the forms wet until they can be safely removed. After form removal, the concrete shall be cured until the end of the time prescribed as follows by one of the methods specified above.

5.8.4 Curing in accordance with sub-clauses above shall be continued for at least 10 days in the case of all concrete except concrete with rapid-hardening Portland Cement, for which the period shall be at least 3 days. Alternatively, if tests are made of cubes kept adjacent to the structure and cured by the same methods and to the same intensity, moisture retention measures may be terminated when the average compressive strength has reached 70 percent of the minimum specified works cube strength. If one of the first four curing procedures specified above is used initially, it may be replaced by one of the other specified procedures any time after the concrete is one day old provided the concrete is not permitted to become surface dry during the transition.

5.8.5 When the mean daily outdoor temperature is less than 5^{o}C (41^{O}F), temperature of the concrete shall be maintained between 10 and 20 degrees C (50^{O}F-68^{O}F) for the required curing period specified above.

When necessary, arrangements for heating, covering insulation or housing the concrete work shall be made in advance of placement and shall be adequate to maintain the required temperature with measures to avoid concentration of heat. Combustion heaters shall not be used during the first 24 hours, unless precautions are taken to prevent exposure of the concrete to exhaust gasses, which contain carbon dioxide.

5.8.6 When necessary, provision for wind-breaks, shading, spraying, sprinkling, ponding or wet covering with a light coloured material shall be made in advance of placement, and such protective measures shall be taken as quickly as concrete hardening and finishing operation will allow.

5.8.7 Changes in temperature of the air immediately adjacent to the concrete during and immediately following the curing period shall be kept as uniform as possible and shall not exceed 3°C (5.4°F) in any one hour or 10°C (18°F) in any 24 hour period.

5.8.8 Concrete shall be protected from damaging mechanical disturbances, such as load stresses, heavy shock and excessive vibrations, during the curing period. All finished concrete surfaces shall be protected from damage by construction equipment, materials or methods by application of curing procedures, and by rain or running water. Self-supporting structures shall not be loaded in such a way as to overstress the concrete.

5.9 **Works in Extreme Weather**

5.9.1 Unless adequate protection is provided, and approval is obtained, concrete shall not be placed during rain.

Rain water shall not be allowed to increase the mixing water nor to damage the surface finish.

5.9.2 When the temperature of the surrounding air is expected to be below 5°C during placing or within 24 hours thereafter, the temperature of the plastic concrete, as placed, shall be no lower than 13°C for sections less than 300 mm in any dimensions nor 10°C for any other sections.

When necessary, concrete material should be heated before mixing and carefully protected after placing. In general, heating of mixing water alone to about 60°C may be sufficient for this purpose. Dependence should not be placed on slat or other chemicals. Calcium chloride up to a maximum of 1-1/2 percent of the weight of cement may be used to accelerate the rate of hardening only with prior written permission of the Engineer. Use of calcium chloride in excess of 1-1/2 percent is harmful. No frozen material or concrete damaged by frost shall be removed. It is recommended that concrete exposed to the action of freezing weather should have entrained air and the water content of the mix should not exceed 25 litres per bag of cement.

If water of aggregate is heated above 38°C, the water shall be combined with the aggregate in the mixer before cement is added. Cement shall not be mixed with water or with mixtures of water and aggregate having a temperature greater than 38°C.

5.9.3 During hot weather, the temperature of the concrete as placed shall not be so high as to cause difficulty from loss of slump, flash set, or cold joints and should not exceed 32°C. For mass concreting, this temperature should not exceed 21°C. When the temperature of the concrete exceeds 32°C, precautionary measures approved by the Engineer shall be put into effect. When the temperature of the steel is greater than 50°C, steel forms and reinforcement shall be sprayed with water just prior to placing the concrete. The ingredients shall be cooled before mixing, or ice flakes, or well crushed ice may be substituted for all part of the mixing water if, due to high temperature, low slump, flash set or cold joints are encountered.

Other precautions recommended by ACI Standard 305 shall also be adopted.

5.10 **Construction Joints**

5.10.1 Concreting shall be carried out continuously up to construction joints, the position and arrangement of which shall be approved by the Engineer.

5.10.2 Joints not shown on the drawings shall be so made and located as to least impair the strength of the structures and shall need prior approval of the Engineer. In general, they shall be located near the middle of the spans of slabs and beams unless a secondary beam intersects a main beam at this point, in which case the joint in the main beam shall be offset a distance equal to twice the width of the secondary beam. Joints in walls and

columns shall be at the underside of floor slabs or beams, and at the top of footings or floor slabs. Beams, brackets, column, capitals, haunches and drop panels shall be placed at the same time as slabs. Joints shall be placed at the same time as slabs. Joints shall be perpendicular to the main reinforcement.

5.10.3 Reinforcing steel shall continue across the joints. Key and inclined dowels shall be provided as, and where directed by Engineer. Longitudinal keys at least 40 mm deep shall be provided in all joints in walls and between walls and slabs or footings.

5.10.4 When the work has to be resumed on a surface which has hardened, such surface shall be roughened in an approved manner which will expose the aggregate uniformly and will not leave laitance, loosened particles of aggregate or damaged concrete at the surface.

5.10.5 The hardened concrete of construction joints and of joints between footings and walls or columns, between walls or columns and beams or floors they support, joints in un-exposed walls and all others not mentioned herein shall be dampened (but not saturated) immediately prior to placing of fresh concrete.

5.10.6 The hardened concrete of joints in exposed work, joints in the middle of beams, and slabs; and joints in work designed to contain liquids shall be dampened (but not saturated) and then thoroughly covered with a coat of cement grout similar in proportions to the mortar in the concrete. The grout shall be as thick as possible on vertical surfaces and at least 12 mm thick on horizontal surfaces. The fresh concrete shall be placed before the grout has attained initial set.

5.10.7 When the concrete has not fully hardened, all laitance shall be removed by scrubbing the wet surface with wire or bristle, and brushed, care being taken to avoid dislodgement of particles of aggregate. The surface shall then be coated with neat cement grout. The first layer of concrete to be placed on this surface shall not exceed 150 mm in thickness, and shall be well rammed against old work, particular attention being paid to corners and closed spots.

5.10.8 Stop ends for movement joints or construction joints shall be made by splitting them along the lines of reinforcement passing through them, so that each portion can be positioned and removed separately without disturbance or shock to the reinforcement or the concrete. Stop ends made of expanded metal or similar material may only be left permanently in the concrete with prior written approval of the Engineer. Where such stop ends are used, no metal may be left permanently in the concrete closer to the surface of the concrete than the specified cover to the reinforcement. Wood strips inserted for architectural treatment shall be kerfed to permit swelling without pressure on the concrete.

5.11 Embedded Items

5.11.1 Sleeves, inserts, anchors, and embedded items required for adjoining work or for its support shall be placed prior to concreting.

All Contractors whose work is related to the concrete or must be supported by it shall be given ample notice and opportunity to introduce and/or furnish embedded items before the concrete is placed.

5.11.2 All embedded items shall be positioned accurately and supported against displacement. Voids in sleeves, inserts, and anchor slots shall be filled temporarily with approved readily removable material to prevent the entry of concrete into the voids.

5.12 Precast Concrete

5.12.1 Scope

This Sub-Section includes fabrication and installation of all precast concrete units, and related work.

5.12.2 **Material**

Cement, concrete and reinforcing steel shall conform to the applicable requirements of the IN SITU CONCRETE WORKS, except as otherwise specified herein. The Contractor shall be responsible for the design of concrete mixes and for meeting the strength requirements.

5.12.3 **Formwork**

Forms and formed surfaces shall conform to the applicable portions of the IN SITU CONCRETE WORKS, and to the following:

a. Forms shall be made and maintained to the grade, alignment and dimensions shown in the drawings.

b. Beds and forms shall be adequately cleaned before reuse.

5.12.4 **Fabrication**

a. **Precast Units** shall be of the sizes and shapes indicated on the Drawings. The finished units shall be straight and true with all edges sharp, straight and square and all flat surfaces in a true plane, such as specified in the Drawing.

b. **Tolerances:** The casting, bowing warping and dimensional tolerance for precast units shall be maintained in accordance with the following:

1. Overall dimension for widths of each unit, plus or minus 10mm; and length, plus or minus 20mm.

2. Bowing or warping: not to exceed 20mm in any direction.

3. Insert locations: Plus or minus 10mm in any direction.

c. **Reinforcement** shall be provided, where required, in precast units and shall be of sizes, shapes and spacing as shown on the Drawings.

d. **All anchors** Inserts, Lifting Devices (galvanized, if required) and similar items shall be and placed and secured in the forms prior to casting and shall be as shown on the Drawings.

e. **Concrete** shall be mixed, handled, conveyed, placed and finished in strict conformance with the applicable requirements of the IN SITU CONCRETE WORKS.

f. **Curing** of precast units shall be carried out in strict conformity with the applicable requirements of the in situ concrete works.

g. **Bearing Pad:** The bearing pad if specified on drawing shall be of a standard approved quality fully enveloped in 3mm thick neoprene all around for protection against weather. The natural rubber in the pad should have a shore hardness of 55^0 C $\pm$ 5^0 C and a shear modulus of 155 psi (1.07 MPa) for short-term movement.

5.12.5 **Identification and Marking**

Each precast member shall be marked to indicate its type, serial number and date of fabrication. Identification marks shall correspond to the drawings.

5.12.6 **Handling and Storage**

a. Precast units shall be handled, transported and stored in a manner, which will avoid undue strain, cracking, other damage. Damaged or defective units shall be repaired or replaced as directed by the Engineer.

b. Units in which the departure form true dimensions is such that they will not come together satisfactorily with adjacent units, within the limits of their allotted positions or which produce an unacceptable irregularity in the finished units of the work, shall be rejected.

5.12.7 **Cleaning**

All precast units shall be delivered to the job site in the cleanest condition possible. During installation, utmost care shall be taken to prevent staining or marring the precast units. Upon completion of the erection, the precast work shall be left clean, and free of stains and all other noticeable defects on exposed surfaces.

5.12.8 **Installation**

a. All precast work shall be accurately set in its assigned position, carefully plumbed and aligned and securely anchored to the structure in accordance with the Drawings.

b. The Contractor shall furnished and install all loose shims, wedges, leveling grout, plates, etc. for the units to be secured to the structure as indicated on the Drawings. The Contractor shall provide all other members as indicated for the attachment of the precast work to the structure, as noted on the Drawings.

5.12.9 **Testing and Inspection**

Testing and Inspection shall be done in strict conformity with the applicable requirements of the in situ concrete work.

6. **TEST OF CONCRETE QUALITY**

6.1 Sampling of concrete for testing shall be done as per relevant PS or ASTM standards and at the Engineer's direction. Making and curing of test specimens shall be in accordance with PS 560, PS 849. The Contractor shall employ a competent person, whose first duty shall be to supervise all stages of preparation and placing of the concrete. All test specimens shall be made, and site tests carried out under his direct supervision.

6.2 Preliminary 5 cube strength tests shall be performed in accordance with PS 560, PS 849 and BS1881 directed by the Engineer.

6.3 The usual test for concrete with maximum size of aggregate up to 40 mm is the 150 mm cube tested in compression. Details of making and curing compression test cubes are given in PS 560, PS 849 and B.S. 1881 and details of the testing are given in Part 8 of B.S. 1881.

6.4 For all grades / classes of concrete, preliminary cube strength test with the mixes and materials to be used shall be performed in accordance with PS 560, PS 849 and B.S. 1881 before the work is begun and subsequently whenever any change is to be made in the materials or in their proportions of materials to be used, or as required by the Engineer. The strengths shall comply with the standard of quality specified in accordance with Table 1 for preliminary tests. The cost of such testing shall be borne by the Contractor.

6.5 Test sample shall be taken at the mixer or as directed by the Engineer. The test specimens shall be cured in accordance with P.S. 560, PS 849 and B.S. 1881.

6.6 Records shall be kept of all test cubes identifying the mix used, the section of work for which the concrete was used and the date poured.

6.7 The tests shall be carried out in a laboratory approved by the Engineer. The laboratory shall be an independent organization, or such other undertakings approved by the Engineer. Original test reports received from the laboratory shall be submitted to the Engineer.

6.8 The five test cubes are to be tested for compressive strength as specified in B.S. 1881. These tests shall be carried out at site or in a laboratory approved by the Engineer. Two cubes shall be tested at the age of seven days and three at 28 days and the strengths determined are to comply with the standard of quality specified.

6.9 For all grades of concrete, the appropriate strength requirement shall considered to be satisfied if none of the strengths of the cubes are below the specified cube strength, or if the average strength of the three cubes is not less than the specified cube strength and the difference between the greatest and the least strength is not more than 10% of the average.

6.10 When the results of works cube tests show that the strength of any concrete is below that specified, the Engineer may give instructions for the whole or part of the work concerned to be removed and replaced at the expense of the Contractor. The Contractor shall bear the cost of any other part of his, or any other contractor's work, which has to be removed and replaced as a result of the defective concrete. If any mix proportion is held to have failed by the works cube tests, the Engineer may order the proportion to be changed in order to provide the specified strength.

7. FINISHING OF FORMED SURFACES

7.1 General

7.1.1 After removal of forms, the surfaces of concrete shall be given one or more of the finishes specified below in locations designated by the Contract Documents.

7.1.2 When finishing is required to match a small sample furnished to the Contractor, the sample finish shall be reproduced on an area at least 10 square meter in an inconspicuous location Designated by the Engineer before proceeding with the finish in the specified location.

7.1.3 Allowable deviations from plumb or level and from the alignment, profile grades, and dimensions are specified in clause 9. Tolerances for concrete construction defined as ‘tolerances’, are to be distinguished from irregularities in finish as described herein. The finish requirements for concrete surfaces shall be as generally specified in this clause and as indicated on the Drawings. Finishing of concrete surfaces shall be performed only by workmen who are skilled in concrete finishes. 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 herein after specified.

Surface irregularities are classified as abrupt or gradual. Offsets caused by displaced or misplaced form sheathing or lining or 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 use of a template, consisting of a straight edge or the equivalent thereof for curved surfaces. The

length of the template will be 2 metres for testing of formed surfaces and 3 metres for testing of unformed surfaces.

7.2 **As-cast Finishes**

Unless otherwise specified or indicated on the Drawings the classes of finish shall apply as follows:

7.2.1 Rough form finish:

No selected form facing materials shall be specified for rough form finish surfaces. The holes and defects shall be patched. Fins exceeding 5 mm in height shall be chipped off or rubbed off. Otherwise, surfaces shall be left with the texture imparted by the forms.

7.2.2 Fair face finish:

Fair face finish applies to concrete formed surfaces, the appearance of which is considered by the Engineer to be of special importance, such as surfaces of structures prominently exposed to public view. Location of surfaces of concrete structures requiring fair face finish are shown in the Drawings. Surface irregularities, measured as described in sub-clause 7.2.1, 'Rough form finish', all not exceed 5 mm for gradual irregularities and 2.5 mm for abrupt irregularities, except that abrupt irregularities will not be permitted at construction joints. Abrupt irregularities at construction joints and elsewhere in excess of 2.5 mm and gradual irregularities in excess of 5 mm shall be reduced by grinding so as to conform to the specified limits. Abrupt irregularities at construction joints shall be ground on 1 to 20 ratio of height to length.

Unless otherwise approved, repair of imperfections in formed concrete shall be completed within 24 hours after removal of forms. The form facing material shall produce a smooth, hard, uniform texture on the concrete. It may be plywood, hardboard, metal, plastic paper, or other approved material capable of producing the desired fair face finish. The arrangement of the facing material shall be orderly and symmetrical, with the number of seams kept to the practical minimum. It shall be supported by studs or other backing capable of preventing excessive deflection. Material with raised grain, torn surfaces, worn edge, patches, dents, or other defects, which will impair the texture of the concrete surface shall not be used. The holes and defects shall be patched. All fins shall be completely removed.

7.3 **Finishes of Unformed Surfaces:**

7.3.1 **Monolithic Concrete Floor Finish**

Where monolithic concrete floor finish is shown on the Drawings, placing shall proceed continuously for the full thickness of the course or RCC slab without change in concrete mix. Mixing water shall be the minimum required for proper placing, and will be as specified by the Engineer. After placing, floors, and other surfaces shall be floated with a wood float to a true surface and to elevation as shown on the Drawings. Where indicated on the Drawings, floor surfaces shall be steel trowel finished.

Toweling shall be the minimum amount consistent with maintaining a smooth dense surface, and shall not be done until the mortar has hardened sufficiently, to prevent excess fine material from being worked to the surface, and shall produce a dense uniform surface, free from blemishes and trowel marks.

Gradual surface irregularities shall not exceed 5 mm. The addition of water, dry cement, or dry cement mortar, to the surface of the concrete to facilitate finishing will not be permitted.

8. REPAIR OF DEFECTS

8.1 General

8.1.1 Any concrete failing to meet the specified strength or not formed as shown on drawings, concrete out of alignment, concrete with surfaces beyond required tolerances or with defective surfaces which cannot be properly repaired or patched in the opinion of the Engineer shall be removed at Contractor's cost.

The Engineer may reject any defective concrete and order it to be cut out in part or in whole and replace at the Contractor's expense.

8.1.2 All ties, bolt holes, and all repairable defective areas shall be patched immediately after form removal.

8.2 Repair of Defective Areas

8.2.1 Defective and honeycombed concrete shall be removed down to sound concrete. The area to be patched and an area at least 150 mm wide surrounding it shall be dampened to prevent absorption of water from the patching mortar. A bonding grout shall be prepared using a mix of approximately 1 part cement to 1 part fine sand passing No.25 BS Sieve and shall then be well brushed into the surface.

8.2.2 The patching mixture shall be made of the same material and of approximately the same proportions as used for the concrete, except that the coarse aggregate shall be omitted and the mortar shall consist of not less than 1 part cement to 2-1/2 parts sand by weight. White Portland cement shall be substituted for a part of the gray Portland cement on exposed concrete in order to produce a colour matching the color of the surrounding concrete, as determined by a trial patch.

8.2.3 The quantity of mixing water shall be no more than necessary for handling and placing. The patching mortar shall be mixed in advance and allowed to stand with frequent manipulation with a trowel, without addition of water, until it has reached the stiffest consistency that will permit placing.

8.2.4 After surface water has evaporated from the area to be patched, the bond coat shall be well brushed into the surface. When the bond coat begins to loose the water sheen, the premixed patching mortar shall be applied. The mortar shall be thoroughly consolidated into place and struck off so as to leave the patch slightly higher than the surrounding surface to permit initial shrinkage; it shall be left undisturbed for at least 1 hour before being finally finished. The patched area shall be kept damp for at least 7days. Metal tools shall not be used in finishing a patch in a formed wall, which will be exposed.

8.2.5 Where as-cast finishes are specified, the quantity of patched area shall be strictly limited. The combined total of patched areas in as-cast surfaces shall not exceed 0.2 square metre in each 100 square metres of as-cast surface. This is in addition to form tie patches, if the project design permits ties to fall within as-cast areas.

8.2.6 Any patches in as-cast architectural concrete shall be indistinguishable from surrounding surfaces. The mix formula for patching mortar shall be determined by trail to obtain a good colour match with the concrete when both patch and concrete are cured and dry. After initial set, surfaces of patches shall be dressed manually to obtain the same texture as surrounding surfaces.

8.2.7 Patches in architectural concrete surfaces shall be cured for at least 7 days. Patches shall be protected from premature drying to the same extent as the body of the concrete.

8.3 **Tie and Bolt Holes**

After being cleaned and thoroughly dampened, the tie and bolt holes shall be filled solid with patching mortar. If architectural appearance requires, these holes may be filled partially creating the desired round clear holes pattern on surfaces exposed to view.

8.4 **Proprietary Materials**

If permitted or required by the Engineer, proprietary compounds for adhesion or as patching ingredients may be used in lieu of or in addition to the foregoing patching procedures. Such compounds shall be used in accordance with the manufacturer's recommendations with prior approval of the Engineer.

9. CONCRETE CONSTRUCTION TOLERANCES

All tolerances shall be as per ACI 317.

Where tolerances are not stated in the specifications or drawings for any individual structure or feature thereof, maximum permissible deviations from established lines, grades, and dimensions shall conform to the following. The Contractor is expected to set and maintain concrete forms so as to ensure complete work within tolerance limits. These allowable tolerances shall not relieve the Contractor of his responsibility for correct fitting of indicated materials and components. These tolerances are not cumulative.

9.1 Variation from the plumb (or the specified batter for inclined walls). (allowable variation)

9.1.1 In the lines and surfaces of columns and walls, and in arises

In any 3 metres of length or height	6 mm
Maximum for the entire length or height	25 mm

9.1.2 For exposed corner columns, control joint grooves and other conspicuous lines

In any bay or 6 metres maximum	6 mm
Maximum for the entire length or height	13 mm

9.2 Variation from the level or from the grades indicated on the drawings.

9.2.1 In beam soffits, and in arises measured before removal of supporting shores.

In any 3 metres of length	6 mm
In any bay or in any 6 metres maximum	10 mm
Maximum for the entire length	19 mm

9.3 Variation of the linear structure lines from established position in plan and related position of columns and walls.

In any bay or 6 metres	± 13 mm
Maximum for the entire length	± 25 mm

9.4 Variation in cross-sectional dimensions of columns and beams and in the thickness of slabs and walls.

Up to 12" (300mm)	- 6 mm +10 mm
More than 12" (300mm)	- 10 mm +13 mm

9.5 **Footings**

9.5.1 Variation in dimensions in plan

Minus	13mm
Plus (plus variation applied to concrete only, not to the reinforcing bars or dowels). (formed)	50mm

9.5.2 Misplacement or eccentricity

2 percent of the footing width in the direction of misplacement but not more than (applies to concrete only, not to reinforcing bars or dowels).	+ 50mm

9.5.3 Reduction in thickness

Minus 5 percent of specified thickness

9.6 **Tolerances for precast concrete construction**

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

9.6.1	Overall dimensions of members	-1.5mm (1/16) in every 3 metres (10 ft.)
9.6.2	Cross-sectional dimensions	
	Section less than 75mm (3 in)	-1.5mm (1/16 in)
	Section over 75mm (3 in) and Less than 450mm (18 in)	-3mm (1/8 in)
	Sections over 450mm (18 in)	-6mm (1/4 in)
9.6.3	Deviations from straight line in long sections, not more than	3mm(1/8in) in every 3 metres (10 ft)
9.6.4	Deviation from specified camber	± 1.5mm (1/16) in per 3 meters (10 ft.) of span.
	Maximum differential between adjacent Units in erected position	6mm(1/4 in)

10. **ACCEPTANCE OF STRUCTURE**

10.1 **General**

10.1.1 Completed concrete work, which meets all applicable requirements will be accepted subject to the other terms of the Contract Documents.

10.1.2 Completed concrete work, which fails to meet one or more of the requirements and which has been repaired to bring it into compliance will be accepted subject to the other terms of the Contract Documents.

10.1.3 Completed concrete work, which fails to meet one or more of the requirements and which cannot be brought into compliance may be accepted or rejected as provided in these Specifications or in the Contract Documents. In this event, modifications may be required to assure that remaining work complies with the requirements.

10.2 **Dimensional Tolerances**

10.2.1 Formed surfaces resulting in concrete outlines smaller than permitted by the tolerances of clause 9 shall be considered potentially deficient in strength and subject to the provisions of sub clause 10.4.

10.2.2 Formed surfaces resulting in concrete outlines larger than permitted by the tolerances of clause 9 may be rejected and the excess material shall be subject to removal. If removal of the excess material is permitted, it shall be accomplished in such a manner as to maintain the strength of the section and to meet all other applicable requirements of function and appearance. Permission is required if excess material is to be removed in accordance with this clause.

10.2.3 Concrete members cast in the wrong location may be rejected if the strength, appearance or function of the structure is adversely affected as decided by the Engineer or if misplaced items interfere with other construction.

10.2.4 Inaccurately formed concrete surfaces exceeding the limits of Clause 9 or of Clause 6.5 of Section 'Formwork' shall be removed and replaced, and those that are exposed to view, may be rejected, or shall be repaired, or removed and replaced, as directed by the Engineer.

10.3 **Appearance**

10.3.1 Architectural concrete with surface defects exceeding the limitations described in relevant Clauses of this section shall be removed and replaced.

10.3.2 Other concrete exposed to view with defects which adversely affect the appearance of the specified finish may be repaired only by approved methods.

10.3.3 Concrete not exposed to view is not subject to rejection for reason of defective appearance.

10.4 **Strength of Structure**

10.4.1 Strength of the structure in place will be considered potentially deficient if it fails to comply with any requirements which is relevant to the strength of the structure, including but not necessarily limited to the following conditions:

- Concrete strength requirements not considered to be satisfied in accordance with Clause 6 hereof.

- Reinforcing steel size, quantity, strength, position or arrangement at variance with the requirements as specified under section 'Reinforcement' or in the Contract Documents.

- Concrete, which differs from the required dimensions or location in such a manner as to reduce the strength.

- Curing less than that specified.

- Inadequate protection of concrete from extremes of temperature during early stages of hardening and strength development.

- Mechanical injury, construction fires, premature removal of formwork, likely to result in deficient strength.

- Poor workmanship likely to result in deficient strength.

10.4.2 Structural computations and/or additional testing may be required when the strength of the structure is considered potentially deficient.

10.4.3 Core tests may be required when the strength of the concrete in place is considered deficient.

10.4.4 If core tests are inconclusive or impractical to obtain or if structural computations do not confirm the safety of the structure, load tests may be required and their results evaluated, in accordance with ACI Standard 318.

10.4.5 Concrete work judged inadequate by structural computations or by results of a load test shall be reinforced with additional construction, if so directed by the Engineer or shall be replaced, at the Contractor's expense.

10.4.6 The Contractor shall bear all costs incurred in providing the additional testing and/or computations required by this section.

11. MEASUREMENT AND PAYMENT

11.1 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.

11.1.1 Supplying, fixing, striking etc. of formwork including fair face formwork, if required.

11.1.2 Supplying and installing all type of joints in structure except expansion joints

11.1.3 All sampling, mixing, testing and concrete mix design as specified.

11.1.4 Making and testing of concrete cube specimens

11.1.5 Providing pockets and voids.

11.1.6 Anchor bolts & other embedded parts.

11.1.7 Bitumen seal in plinth protection, ramp and isolation joint as shown on the drawings.

11.1.8 Providing grooves on concrete surfaces as shown on the drawing.

11.1.9 Curing, repair work, scaffolds, water stops and admixtures.

11.1.10 Supplying admixtures, retarders and plasticizers in concrete.

11.1.11 All work items related to installation of precast member/elements in place, as shown on the drawings, unless otherwise specifically mentioned in the BOQ.

11.1.12 Supply & placing Pipe Sleeves for rain water drainage

11.2 Plain and Reinforced Concrete

11.2.1 Measurement

Concrete shall be measured as executed but no deduction shall be made to the following:

Volume of any steel embedded in the concrete.

Volume occupied by water pipes, conduits etc. not exceeding 25 square centimeters each in cross-sectional area.

Voids not exceeding 0.1 square metre. If any void exceeds 0.1 square metre total void shall be deducted.

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 deductions irrespective of size.

Concrete work shall be classified and measured separately as listed under items of Bills of Quantities.

Junction between straight and curved works shall in all cases be deemed to be included with the work in which they occur.

Measurement of walls shall be taken between attached columns or pilaster. The thickness of attached columns, or pilaster shall be taken as the combined thickness of the wall and the columns, or pilaster. Attached or isolated columns, pilaster, and the like (except where caused by openings) having a length on plan over four times the thickness and are caused by opening in wall shall be classified as walls.

Columns shall be measured from the top of 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.

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.

Measurement of acceptably completed works of plain and reinforced cement concrete will be made on the basis of number of cubic meter concrete placed and compacted in position within the neat lines of the structure as shown on the Drawings or as directed by the Engineer.

11.2.2 Payment

Payment will be made for the acceptable measured quantity of plain and reinforced cement concrete on the basis of unit rate per cubic meter quoted in the Bills of Quantities and shall constitute full compensation for all the works related to the item.

11.3 Precast Cement Concrete Planks

11.3.1 Measurement

Measurement of acceptably completed works of Precast planks shall be made on the basis of actual quantity in cubic meters of planks provided and placed in position as shown on the drawings or as directed by the Engineer. No separate measurement will be done for embedded items.

11.3.2 Payment

Payment will be made for acceptable measured quantity of precast planks on the basis of unit rate per cubic meter quoted in the Bill of Quantities and shall constitute full compensation for all the works related to the item.

11.4 Expansion Joints

11.4.1 Measurement

Measurement of acceptably completed works of expansion joints will be made on the basis of actual length in linear meter of expansion joint provided and installed in position as shown on the drawings or as directed by the Engineer.

11.4.2 Payment

Payment will be made for acceptable measured quantity of expansion joint on the basis of unit rate per meter quoted in the Bill of Quantities. The unit rate shall include the cost of supply & placing of mastic filler, mild steel plates, plug weld, angles, polyurethane foam, flats, Bitumenized filler material etc. and shall constitute full compensation for all the works related to the item.

11.5 Precast paving tiles

11.5.1 Measurement

Measurement of acceptably completed works of precast tiles will be made on the basis of actual quantity of tiles in square meter provided and fixed in position as shown on the drawings or as directed by the Engineer. No separate measurement shall be made of mortar for jointing the tiles, sand bedding, if any and sub-grade preparation.

11.5.2 Payment

Payment will be made for acceptable measured quantity of precast tiles on the basis of unit rate per square meter quoted in the Bill of Quantities. No separate payment shall be made for jointing mortar, sand bedding and subgrade preparation. Therefore the quoted rate shall constitute full compensation for all the works related to the item.

11.6 Precast Fairfaced Kerb Stones

11.6.1 Measurement

Measurement of acceptably completed works of precast fairfaced kerb stone will be made on the basis of actual length in linear meter of kerb stone casted in position or placed in position as shown on the drawings or as directed by the Engineer.

11.6.2 Payment

Payment will be made for acceptable measured quantity of kerb stones on the basis of unit rate per meter quoted in the Bill of Quantities. The unit rate shall include the cost of earth work, form work, concrete, admixture, embedded items, rebar etc. and shall constitute full compensation for all the works related to the item.

SECTION 2315

EXPANSION JOINTS

1. SCOPE

Work covered under this section of Specifications consists of furnishing and installing expansion joint complete according to the recommendations of the manufacturer and instructions by the Engineer.

2. GENERAL

Expansion joint furnished under this Specification shall be the standard products of a manufacturer regularly engaged in the production of such devices and shall be the manufacturer's latest design that complies with the specified requirements. Contractor shall submit manufacturer's Data and Test Reports for approval from Engineer prior to procurement. In addition detailed drawings and installation manual of the approved product shall also be submitted prior to installation.

3. PRODUCTS

3.1. DESIGN REQUIREMENTS

3.1.2 Expansion Control

a. Provide integrally molded units of neoprene and bonded steel components or rubber and bonded steel components, or rubber and bonded steel components, cast under pressure and heat, arranged to provide for the expansion and contraction movements of structures and having a wear-resistant surface.

b. Provide steel of sufficient strength to bridge the gap in the deck while supporting a wheel load of 94 kN over a contact area of 0.3X0.6m^2 with maximum plate deflection of 1/800 of the maximum opening when fully extended.

c. There shall not be a change in the surface configuration as a result of expansion and contraction movements.

d. Expansion and contraction movements shall be taken entirely by deformation of the neoprene or rubber.

e. Make other provisions as necessary to provide a weather-tight installation resistant to the penetration of debris.

f. Provide units which can be readily cut and fitted to curb and gutter configurations.

g. Provide for joint movements perpendicular and parallel to the joint, as shown, and for $\pm$ 6mm vertical misalignment.

The parallel movement shall allow for at least 25% of the total perpendicular movement.

h. Provide for locking or keying between seal units in each joint.

3.2 MATERIALS

Expansion joint seals for bridges shall be the Tran flex model, including kerb and gutter units, if required, as manufactured by General Tire and Rubber Co., or approved equal.

Furnish manufacturer's standard anchors, fasteners, set screws, spacers, flexible seal and filler materials, adhesive and other accessories compatible with material in contact, as shown or required for complete installations.

3.3 FABRICATION

Furnish the basic profile and operating units as shown. Select units comparable to those shown, or required, for the joint size and to absorb variations in adjacent surfaces and structural movement. Furnish the longest practicable lengths to minimize the number of end joints. Provide mitered corners where joints change direction or abut other material systems.

Reassemble items in the shop to the greatest extent possible so as to minimize field splicing and assembly of units. Disassemble units only to the extent necessary for shipping and handling limitations. Clearly match mark units for reassembly and co-ordinated installation.

4. EXECUTION

4.1 INSPECTION

Examine the areas in which, and conditions under which, expansion joint seals are to be installed. Do not proceed with the work until unsatisfactory conditions have been corrected.

4.2 INSTLLATION

Seal the joint to prevent intrusion of moisture and other contaminants.

Provide for anchoring by either bolts or studs forming a mechanical connection between components molded in the expansion joint seal and the structure.

Comply with manufacturer's written instructions and recommendation, including preparation of substrate, installations, and protection of installed units.

5. MEASUREMENT AND PAYMENT

5.1 General

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

5.1.1 Preparation of surface and sealing of joint.

5.1.2 Anchoring of joint with structure.

5.1.3 Protection of installed joint.

5.2 Expansion Joint

5.2.1 Measurement

Measurement of acceptably completed works of expansion joints will be made on the basis of running metre of the expansion joint actually provided and fixed, shown on the Drawings or as directed by the Engineer.

5.2.2 Payment

Payment will be made for acceptable measured quantity of expansion joint on the basis of unit rate per running metre quoted in the Bill of Quantities & shall constitute full compensation for all the works related to the item.

SECTION 2370

TRAFFIC MARKING & PAVEMENT STUDS

01. SCOPE

The works under this section of specification consist of providing all materials, labour and equipment for furnishing of non reflective or reflective chlorinated rubber based or thermoplastic paint material or retro reflective performed pavement marking (tape) and reflectorized pavement studs complete in all respects in accordance with this section of specification and applicable drawings and/or as directed by the Engineer**.**

The paint shall be applied in conformance to the size, shape and location of the markings as shown in the Drawings.

02 CHLORINATED RUBBER PAINT

2.1 Material Requirements

A standard and acceptable quality of Chlorinated Rubber based paint shall be used. The paint shall be ready for application and shall be of a smooth quality. The paint shall be homogeneous, well dispersed to a smooth consistency and shall not cake, liver, thicken, curdle, gel, settle badly or show any objectionable properties after period of storage not to exceed six (6) months.

Composition

a) White Traffic Paint			
i)	Pigment	Titanium Dioxide Rutile and Extenders	100%
ii)	Vehicle	Modified Chlorinated Rubber	52 ± 4
		Solvents	45 ± 4
		Additives i.e. Flow levelling, adhesion improving agents, anti-oxidants, siccatives etc.	1 – 3%
iii)	Paint Composition	Pigements	55 ± 4% by Weight
		Vehicle, Solvent and Additives	
b) White Traffic Paint			
i)	Pigment	Chrome Yellow and Extenders	100%
ii)	Vehicle	Same as for white traffice paint	55 ± 4 by Weight
iii)	Paint Composition	Pigements	45 ± 4% by Weight
		Vehicle, Solvent and Additives	
b) White Traffic Paint			
i)	Pigment	Chrome Black and Extenders	100%
ii)	Vehicle	Same as for white traffice paint	55 ± 4 by Weight
iii)	Paint Composition	Pigements	45 ± 5% by Weight
		Vehicle	

The volatile material shall be of such character that has a minimum solvent action of asphalt, and such that the resins and non-volatile components will be entirely dissolved in the volatile material, and will not precipitate from the solution on standing. The non-volatile material shall be of such quality that it will not darken or become yellow when a thin section is exposed to the sunlight.

Other pavement marking paint may be submitted by the Contractor as an alternative to the above, for the approval of the Engineer.

2.1.1 **Ballotini for Reflective Road Paint**

The grading of ballotini dispersed in the paint shall be as follows:

Sieve Sizes	**Percentage Retained**
No. 12	0
No. 20	30
No. 30	50
No. 50	80
No. 80	100

Glass beads shall conform with AASHTO Designation M-247. At least ninety (90) percent glass beads shall be transparent, reasonable spherical and free from flaws.

The proportion of ballotini to paint shall be not less than five hundred (500) grams per litre of paint.

2.2 **Photometric Requirements for Reflective Road Paint**

Other reflective road paints may be considered for use by the Engineer provided they have minimum brightness values at two tenth (0.2) degree and half (0.5) degree divergence expressed as candle power per meter per square meter of surface coating, as follows:

Colour		**White**		**Yellow**	
Divergence Angle	(Degree)	0.2	0.5	0.2	0.5
Incidence Angles	4(Degree)	237	118	129	75
Incidence Angles	40(Degree)	75	43	43	32

2.3 **CONSTRUCTION REQUIREMENTS**

Traffic markings shall be applied with approved equipment capable of applying the paint at the specified width and at the specified rate of application. In no case shall the contractor proceed with the work until the equipment, method of application and rate of application as established by a test section have been approved by the Engineer.

The painting of lane markers and traffic strips shall include the cleaning of the pavement surfaces, the application, protection and drying of the paint coatings, the protection of pedestrians, vehicular or other traffic on the pavements, the protection of all parts of the road, structures or appurtenances against disfigurement by spatters, splashes or smirches of paint or of paint materials, and the supplying of all tools, labour and traffic paint necessary for the entire work.

The paint shall not be applied during rain, wet weather, when the air is misty, or when, in the opinion of the Engineer, conditions are otherwise unfavourable for the work. Paint shall not be applied upon damp pavement surfaces, or upon pavements which have absorbed heat sufficient to cause the paint to blister and produce a porous paint film.

The application of paint shall preferably be carried out by a purpose-made machine but where brushes are used only round or oval brushes not exceeding 10 cm. in width will be permitted. The paint, when applied, shall be so applied as to produce a uniform, even coating in close contact with the surface being painted.

Traffic paint shall be applied to the pavement at a rate of one (1) litre to two and half (2.5) square meters or less. Contractor shall provide adequate arrangements that applied paint is not disfigured by moving traffic, till its complete drying and sticking to road surface.

03 HOT-APPLIED THERMOPLASTIC ROAD PAINTS

3.1 Material Requirements

3.1.1 Aggregate

The aggregate shall consist of fight coloured silica sand, calcite, quartz, calcined flint, or other material approved by the Engineer.

3.1.2 Pigment and Extender

a) White Material

The pigment shall be titanium dioxide complying with the requirements of Type A (anatase) or Type R (rutile) of BS 1851.

b) Yellow Materials

Sufficient suitable yellow pigment shall be substituted for all or part of the titanium dioxide to comply with the other requirements of this specification.

c) All Materials

The extender shall normally be whiting (i.e. calcium carbonate prepared from natural chalk) complying with the requirements of BS 1795. The manufacturer may substitute lithopone complying with the requirement of BS 296 for any or all of the whiting.

d) Binder

The binder shall consist of synthetic hydrocarbon resin, or, with the approval of the Engineer, gun or wood resin, plasticized with mineral oil.

e) Composition of mixture.

The proportions of the constituents of the mixed material as found on analysis shall comply with the requirements of Table 1.

Table 1
Proportions of Constituents of Mixture

Constituent	Percentage by Mass of Total Mixture	
	Minimum	Maximum
Binder (Resin & Oil)	18	22
Pigment	6*	-
Pigment and Extendor	18	22
Ballotini	20	-
Aggregate		
Pigment	78	82
Extender & Ballotini		

*For titanium dioxide only. No minimum is specified for yellow material.

Where specified, 10% in the case of material to which surface ballotini is to be applied by pressure application.

The grading of the combined aggregate, pigment, extender and ballotini (where specified) as found on analysis shall comply with the requirements of table 2.

Table – 2
Grading of Combined Aggregate, Pigment, Extender and Ballotini

Sieve	Percentage by Mass Passing Sprayed
2.80 mm	100
600 mm	75 – 95

3.2 **Sampling and Testing**

- **Sampling**

For the purpose of carrying out the testing, it is essential that adequate and representative samples be taken in the manner prescribed in specification BS 3262 at following stages.

a) At the manufacturer's plant.
b) After it has been re-melted by the road application contractor.

3.3.2 **Testing**

The samples shall be prepared and tested in accordance with B.S. Specification 3262 (1976) appendix A to H. The test results shall conform the following properties.

- **Softening Point**

The softening point measured in accordance with appendix C shall be not less than 65^{o}C.

- **Colour and luminance**

a) White Material

The luminance factor of white material as delivered by the manufacturer shall be measured in accordance with appendix D and shall not be less than 70 whereas the luminance factor of material obtained from an applicator or melter on site after re-melting measured in accordance with appendix D shall not be less than 65.

b) Yellow Material

The Colour of yellow material shall be approximately BS 381 C Colour No. 355, Lemon. The luminance factor of yellow material as delivered by the manufacturer shall be not less than 60 whereas the luminance factor of material obtained from an applicator or melter on site after re-melting measured in accordance with appendix D shall not be less than 55.

- **Heat Stability**

a) White Material

When tested in accordance with appendix E, the luminance factor of white material as measured in accordance with appendix D shall be not less than 65.

b) Yellow Material

When tested in accordance with appendix E, the luminance factor of yellow material as measured in accordance with appendix D shall be not less that 55.

- **Flow Resistance**

In testing the flow resistance, a cone made and tested in accordance with appendix F, shall not slump by more than 25%.

Skid Resistance

When tested in accordance with appendix G, the skid resistance of a newly laid marking prepared under the stated conditions shall be not less than 45.

3.3 **Manufacturing Packing, and Storing of Paint**

3.3.1 **Manufacturing**

The paint shall be produced in a plant owned and operated by the manufacturer following a process which has been used by the manufacturer for at least five (5) years to produce paint. The equipment for mixing and grinding shall be clean, modern, and in good condition.

3.3.2 **Packing**

- The material shall be supplied in sealed containers which do not contaminate the contents and which protect them from contamination.

- Each container shall be clearly and indelibly marked with the manufacturer's name, Batch number, date of manufacture, reflectorisation (if applicable), colour, chemical type of binder and maximum safe heating temperature.

3.3.3 **Storing**

The material shall be stored in accordance with the manufacturer's instructions and any material that is in damaged containers of which the seal has been broken, shall not be used.

3.4 **Certification**

The Contractor shall furnish a certificate from manufacturer that the material he proposes to use has the required properties, stating the maximum and minimum proportions and grading of the constituents, the acid value of the binder, the setting time, the maximum safe heating temperature, the temperature range of the apparatus and the proposed method of laying.

3.5 **Application of Material to the Road**

a) Preparation of Site

The thermoplastic paint shall only be applied to surfaces, which are clean and dry. Immediately before the application of paint, the surface shall be cleaned with mechanical broom, compressed air or other approved means to remove surplus asphalt, oils, mud, dust and other loose or adhered material. The material shall not be applied if the road surface is at a temperature of less than 50 C.

b) Preparation of Material on Site

The material shall be melted in accordance with the manufacturer's instructions in heather fitted with a mechanical stirrer to give a smooth consistency to the thermoplastic material and such that local overheating will be avoided. The temperature of the mass shall be

within the range specified by the manufacturer, and shall on no account be allowed to exceed the maximum temperature stated by the manufacturer. The molten material shall be used as expeditiously as possible, and for thermoplastic material, which has natural resin binders or is otherwise sensitive to prolonged heating, the material shall not be maintained in a molten condition for more than 4 hours.

• After transfer to the laying apparatus, the material shall be maintained within the temperature range specified by the manufacturer and stirred to maintain the right consistency for laying.

• On concrete carriageway, a tack coat compatible with the marking material shall be applied in accordance with the manufacturer's instructions prior to the application of thermoplastic material.

c. Laying

Carriageway centre lines, lane lines and edge lines shall be laid to a regular alignment by self propelled machine. Other markings may be laid by hand, hand propelled machine or self propelled machine as approved by the Engineer. The surface produced shall be uniform in texture and thickness and appreciably free from blisters and streaks.

d) Reflectorization by surface Application

When surface application of ballotini is required, additional ballotini (400 9/M2 to 500 91M2 from the machine) shall be applied by pressure concurrently with the laying of the line with sufficient, velocity to ensure retention in the surface of the line. The ballotini so sprayed shall give uniform cover and immediate reflectivity over the whole surface of the marking.

Ballotini dispensed on the surface of the markings shall conform to the following grading.

Sieve	Percentage by Mass Passing
1.7mm	100
600 μ	80 – 100
425 μ	45 – 100
300 μ	10 – 45
212 μ	0 – 25
75 μ	0 - 5

Not less than 90%, by mass of the ballotini, shall be of transparent glass, spherical in shape and not more then ten (10) percent shall be ovate in shape or have other flaws. The ballotini shall be made of soda glass.

e) Thickness

Unless otherwise approved by the Engineer, the material shall be laid to the following thicknesses.

a) Sprayed lines other than yellow. Not less than 1.5 mm.
b) Sprayed yellow edge lines not less than 0.8 mm.

The minimum thicknesses specified are exclusive of surface applied ballotini. The method of thickness measurement shall be in accordance with appendix H of BS 3262 (1976).

3.6 **Trial Section**

In no case shall the contractor proceed with the work until the equipment, method of application and rate of application conforming the required thickness (as established by a test section) have been approved by the Engineer.

04 RETROREFLECTIVE PREFORMED PAVEMENT MARKINGS

4.1 Materials - Requirements

The performed markings shall consist of white or yellow films with pigments selected to conform to standard highway colours. Ceramic and glass beads shall be incorporated to provide immediate* and continuing retroreflection. Ceramic skid particles shall be bonded to a top urethane layer to provide a skid resistant surface.

The preformed markings shall be capable of being adhered to asphalt cement concrete (ACC) or Portland Cement Concrete (PCC) by a precoated pressure sensitive adhesive. A primer may be used to precondition the pavement surface. The preformed marking film shall mold itself to pavement contours by the action of traffic. The pavement marking film wearing courses during the paving operation in accordance with the manufacturer's instructions, approved by the Engineer. Following proper application and tamping, the markings shall be immediately ready for traffic. The bidder, when bidding, shall identify proper solvents and / or primers (where necessary) for proper application, and recommendation for application that will assure effective product performance. The preformed markings shall be suitable for use for one year after the date of receipt when stored in accordance with the manufacturer's recommendations.
The marking film shall be durable retroreflective plisot polymer pavement marking film for performed longitudinal markings subject to low to medium traffic volumes and moderate wear conditions such as repeated shear action from crossover or encroachment on channelization lines.

The retroreflective pavement marking film shall consist of mixture of high quality pigmented polymeric materials, with a reflective layer of ceramic and glass beads, and a layer of skid resistant ceramic ' particles bonded to the top urethane wear surface. The film shall have a pre-coated pressure sensitive adhesive. The edges of the preformed tape shall be clear cut and true.

4.2 Colour

The daytime colour of the white film shall provide a minimum initial Luminance factor, Y, of 80, and shall conform to the following chromaticity requirements: X = 0.290, Y = 0.315; X = (Y.491, Y = 0.435; X = 0.512, Y=0.486; X = 0536, Y = 0.463.

Measurements shall be made in accordance with ASTM E 1349, using illuminate "C" and 0145 (4510) geometry. Calculations shall be in accordance with ASTM E 308 for the 20 standard observer.

4.3 Reflectance

The white and yellow films shall have the following initial minimum reflectance values as measured in accordance with the testing procedures .of ASTM D 4061. The photometric quantity to be measured shall be specific luminance (SQ, and shall be expressed as millicandals per square foot per foot-candle (mcd. ft^2) ft^{-1}). The metric ' equivalent shall be expressed as millicandals per square meter per lux (mcd. M^{-2}). $1X^{-1}$)

	White	Yellow
Entrance Angle 86.00°	86.5 °	86.5 °
Observation Angle	1.0 °	1.0 °
Specific Luminance SL [(mcd. ft^{-2}). ft^{-1}]	300	175

4.4 **Skid Resistance**

The surface of the retoreflective films shall provide an initial minimum skid resistance values of 55 BPN as measured by the British Portable Skid Tester in accordance with ASTM E 303.

4.5 **Patchability**

The pavement marking film shall be capable of use for patching worn areas of the same type of film in accordance with the manufacturer's instructions.

4.6 **Reflectance Retention**

To have a good, effective performance life, the ceramic and glass beads must be strongly bonded and not be easily removed by traffic wear. The following test shall be employed to measure reflectivity retention.

4.6.1 **Taber Abraser Simulation Test**

Using a Taber Abraser with an H-1 8 wheel and a 125 gram load, the sample shall be inspected at 200 cycles, under a microscope, to observed the extent and type of bead failure. No more than 15% of the beads shall be lost due to popout and the predominant mode of failure shall be "wear down" on the beads.

4.7 **Beads**

The size, quality and refractive index of the ceramic and glass beads shall be such that the performance requirements for the marking shall be met. The bead adhesion shall be such that beads are not easily removed when the material surface is scratched.

4.8 **Bead Retention**

The film shall be ceramic and glass bead retention qualities such that when a 2 in x 6 in. (5.08 cm x 15.24 cm) sample is bent over a 112 in. (1.27 cm) diameter-mandrel, with the 2 M. dimension perpendicular to the mandrel axis, microscopic. Examination of the area on the mandrel shall show no more than 10% of the beads with entrapment by the binder of less than 40%.

4.9 **Thickness**

The film without adhesive, shall have a minimum thickness of 0.030 in (0.76mm).

4.10 **Effective Performance Life**

The film, when applied according to the recommendations of the manufacturer, shall provide neat, durable marking that will not flow or distort due to temperature if the pavement surface remains stable. The film shall be weather resistant and through normal traffic wear shall show no fading, lifting or shrinkage which will significantly impair the intended usage of the marking throughout its useful life and shall show no significant tearing, roll back or other signs of poor adhesion.

4.11 **Installation**

The markings shall be applied in accordance with the manufacturer's instructions.

05 CEMENTATIONS MARKING COMPOUND

Cementitious marking compound shall be used for Concrete, Surface Dressing and Bitumen to provide enhanced night and wet, weather visibility. This compound will be applied at following locations:

- Kerbs - Pavements and car park areas.
- Roundabout - vertical and sloping faces.
- Traffic Islands - vertical edges and bull noses, etc.
- Traffic Dividers - black and white chevrons.
- Concrete wall and faces - on high speed intersections and traffic merging.

06 REFLECTORIZED PAVEMENT STUDS

6.1 MATERAIL REQUIREMENTS

Reflectorized Studs shall be “cat-eyes” either the ‘Flush Surface’ type of ‘Raised Profile’ type having the following characteristics.

a) ‘Flush Surface’ Type

The ‘Flush Surface’ reflector shall be the short base type having a maximum base area of 18 cm x 14 cm or as shown on the Drawings.

The base shall be formed in cast iron with adequate webbing to ensure a firm key to the road when installed.

The pad shall be highly resilient and durable rubber reinforced with canvas and shall have an anticipated life of at least five (5) years. The pad shall be so designed as to produce a self whipping action of the reflector when depressed.

The reflectors shall be made of impact and abrasion resisting glass and shall be hermetically sealed into a copper socket.

b) ‘Raised Profile’ Type

The ‘Raised Profile’ reflectors shall consist of an acrylic plastic shell filled with an adherent epoxy compound molded from methyl methacylate into the shape of a shallow frustum of a pyramid having base dimension of approximately 10 cm x 10 cm and thickness not more than two (2) cm or as shown on the drawings.

The shell contain one or two prismatic reflector each inclined at an angle of thirty (30) degree to the horizontal and having an area not less than twenty (20) square cm or as indicated on the plans.

The reflectors shall attain the following standards for their photometric and physical qualities:

i) Photometric Requirements

The reflectors shall have the following minimum Specific Intensity values (S.I) expressed as candle power per foot candle of illumination at the reflector on a plane perpendicular to the incident light.

	COLOUR		
	Crystal	Yellow	Red
Divergence Angle (in Degree)	0.20 S.I.	0.20 S.I.	0.20 S.I.
Incidence Angle			
0	3.00	1.80	0.75
20	1.20	0.72	0.30

The reflector for testing shall be located with the center of the reflecting face at a distance of one and half (1.5) m form a uniformly bright light source having an effective diameter of half (0.5) centimeter.

The width of the photocell shall be 1.27 cms and shall be shielded form stray light. The distance from the centers of the light source and photocell shall be 0.53 cms.

Failure of more than four (4) % of the reflecting faces shall be cause for rejection of the lot.

ii) Strength Requirement

The reflectors shall support a vertical load of 1000 kg when tested in the following manner.

A reflector shall be centered horizontally over the open end of a vertical positioned hollow metal cylinder seventy five (75) mm internal diameter, twenty five (25) mm high and wall thickness of six (6) mm. The load shall be applied to the top of the reflector through a six (6) mm diameter by six (6) mm high metal plug centered on top of the reflector.

Failure shall constitute either breakage or significant deformation of the marker at any load less than one thousand (1000) kg.

C) Adhesive

When 'Raised Profile' type of reflectors are used, a two-part adhesive having the following ingredients shall be applied to the stud for bonding to the pavement surface.

Package A	Kg/Litre
Epoxy Resin	0.94
Titanium Dioxide	0.07
Colloidal Silica	0.05
Talc	0.345

Package B	Kg/Litre
Modified Asphaltic Amine Hardener (Reinchold 2611)	0.24
Modified Asphaltic Amine Hardener (Reinchold 2613)	0.472
Carbon Black	0.0022
Colloidal Silica	0.04
Talc	0.650

Equal volumes of Package A & B should be mixed together until a uniform colour is obtained. No more than one quart of adhesive shall be prepared at one time.

d) Cement Mortar

Cement mortar shall consist of one (1) part Portland cement to three (3) parts of fine aggregates.

6.2 CONSTRUCTION REQUIREMENTS

6.2.1 'Flush Surface' Type

The stud shall be installed into the pavement in accordance with the manufacturer's instructions but shall also comply with the following requirements:

Cavities in the pavement shall be clearly cut to the dimension of the pavement stud and shall allow a clearance of one (1) cm around the stud base. The longitudinal center line axis of the cavity shall be the same as that required for the pavement stud when laid to correct line and direction.

The walls of the cavity shall be splayed back at an angle of approximately thirty (30) degree to the vertical to facilitate a "dove-tail" joint after the mortar has set.

The bottom of the cavity shall be leveled with asphalt concrete prior to placing the stud base, which shall be pounded into position with Pounder Foot attached to a pneumatic drill.

The depth of the cavity shall be such that when the stud base and reflectors have been installed the elevation of the floor of the lens socket shall not be greater than two (2) mm or less than one (1) mm above the pavement surface.

The stud shall be grouted into position with asphalt concrete containing fine aggregate only or with a cement mortar as described in Item 6.1 (d) above when the studs are installed into a cement concrete pavement.

6.2.2 'Raised Profile' Type

The pavement studs shall be installed in accordance with the manufacturer's instructions or to the requirements of the Engineer.

07 MEASUREMENT AND PAYMENT

7.1 General

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

7.1.1 All sampling and testing of road paint, studs.

7.1.2 Mockup specimen strip of pavement paint/ marking, and studs.

7.1.3 Surface preparation for application of road marking strips & studs.

7.1.4 All losses of material wastage, over flow, erosion or any other causes.

7.1.5 Excavating cavities, applying adhesive and mortar for studs.

7.2 **Road Marking**

7.2.1 **Measurement**

Measurement of acceptably completed works of road marking will be made on the basis of net actual area in square metre of strips painted in position as shown on the Drawing or as directed by the Engineer.

The measurement shall be made of painted areas, completed and accepted. No measurement shall be made of unauthorized areas. Paint that is applied in un-authorized areas shall be completely removed from the surface of the road to the satisfaction of the Engineer and at Contractor's expense.

7.2.2 **Payment**

Payment will be made for acceptable measured quantity of road marking on the basis of unit rate per square metre quoted in the Bill of Quantities & shall constitute full compensation for all the works related to the items.

7.3 **Pavement Studs / Wall Mounted Studs**

7.3.1 **Measurement**

Measurement of acceptably completed works of pavement studs / wall mounted studs will be made on the basis of either type of studs in numbers of "Flushed surface" or "raised Profile" type provided and installed in position as shown on the Drawing or as directed by the Engineer.

7.3.2 **Payment**

Payment will be made for acceptable measured quantity of studs on the basis of unit rate per number quoted in the Bill of Quantities & shall constitute full compensation for all the works related to the items.

SECTION 2370

TRAFFIC MARKING & PAVEMENT STUDS

01. SCOPE

The works under this section of specification consist of providing all materials, labour and equipment for furnishing of non reflective or reflective chlorinated rubber based or thermoplastic paint material or retro reflective performed pavement marking (tape) and reflectorized pavement studs complete in all respects in accordance with this section of specification and applicable drawings and/or as directed by the Engineer.

02. APPLICABLE CODES AND STANDARDS

The codes and standards applicable to only a portion of the work specified in this section are referenced in the relevant parts and clauses. Standards and codes, which are generally applicable to the work of this section, are listed hereafter in addition the recommendation of ICAO Annex 14.

Sponsor	Number	Subject
AASHTO	M 237	Epoxy Resin Adhesive for Bonding Traffic Markers to Hardened Concrete
AASHTO	M 247	Glass Beads Used in Traffic Paint
ASTM	D 1214	Sieve Analysis of Glass Spheres
FS	TT-B-1325	Bead, (Glass Spheres) Retro- reflective
FS	TT-P-110	Paint, Traffic Black (Non- reflectorized)

Traffic signs, road markings and pavement studs shall also be in accordance with the requirements of National Pakistan Standards.

03. SUBMITTALS

The following submittals are required:

- Manufacturer's Data including application instructions.

04. STORAGE

Store materials on the project site in sealed and labeled containers as recommended by the manufacturer and as approved.

05. PAVEMENT MARKING

5.1 MATERIAL

5.1.1 CHLORINATED RUBBER PAINT

5.1.2 Material Requirements

A standard and acceptable quality of Chlorinated Rubber based paint shall be used. The paint shall be ready for application and shall be of smooth quality. The paint shall be homogeneous,

well dispersed to a smooth consistency and shall not cake, liver, thicken, curdle, gel, settle badly or shown any objectionable properties after period of storage not exceed six (6) months.

Composition

a)	White Traffic Paint		
i)	Pigment	Titanium Dioxide Rutile & extenders	100%
ii)	Vehicle	Modified Chlorinated Rubber Plasticized and Resin Blend	52±4%
		Solvents	45±4%
		Additives i.e. Flow leveling, adhesion Improving agents, anti-oxidants, siccatives etc.	1 – 3%
iii)	Paint Composition:	Pigments	55±4% by Weight
		Vehicle, Solvent and Additives	45±5% by Weight
b)	White Traffic Paint		
i)	Pigment	Chrome Yellow and Extenders	100% by Weight
ii)	Vehicle	Same as for white traffic paint	
iii)	Paint Composition:	Pigments	55±4% by Weight
		Vehicle, Solvent and Additives	45±5% by Weight
c)	Black Traffic Paint		
i)	Pigment	Chrome Black and Extenders	100% by Weight
ii)	Vehicle	Same as for white traffic paint	
iii)	Paint Composition:	Pigments	55±4% by Weight
		Vehicle	45±5% by Weight

The volatile material shall be of such character that has a minimum solvent action of asphalt, and such that the resins and non-volatile components will be entirely dissolved in the volatile material, and will not precipitate from the solution on standing. The non-volatile material shall be of such quality that it will not darken or become yellow when a thin section is exposed to the sunlight.

Other pavement marking paint may be submitted by the Contractor as an alternative to the above, for the approval of the Engineer.

5.1.3 Ballotini for Reflective Road Paint

The grading of ballotini dispersed in the paint shall be as follows:

Sieve Sizes	Percentage Retained
No.12	0
No.20	30
No.30	50
No.50	80
No.80	100

Glass beads shall conform with AASHTO Designation M-247. At least ninety (90) percent glass beads shall be transparent, reasonable spherical and free from flaws.

The proportion of ballotini to paint shall be not less than five hundred (500) grams per litre of paint.

5.1.4 Photometric Requirements for Reflective Road Paint

Other reflective road paints may be considered for use for the Engineer provided they have minimum brightness values at two tenth (0.2) degree and half (0.5) degree divergence expressed as candle power per meter per square meter of surface coating, as follows:

		Colour			
		White		**Yellow**	
Divergence Angle	(Degree)	0.2	0.5	0.2	0.5
Incidence Angle	4 (Degree)	237	118	129	75
Incidence Angle	40 (Degree)	75	43	43	32

5.1.5 **CONSTRUCTION REQUIREMENTS**

Traffic markings shall be applied with approved equipment capable of applying the paint at the specified width and at the specified rate of application. In no case shall the contractor proceed with the work until the equipment, method of application and rate of application as established by a test section have been approved by the Engineer.

The painting of lane markers and traffic strips shall include the cleaning of the pavement surfaces, the application, protection and drying of the paint coatings, the protection of pedestrians, vehicular or other traffic on the pavements, the protection of all parts of the road, structures or appurtenances against disfigurement by spatters, splashes or smirches of paint or of paint materials, and the supplying of all tools, labour and traffic paint necessary for the entire work.

The paint shall not be applied during rain, wet weather, when the air is misty, or when, in the opinion of the Engineer, conditions are otherwise unfavorable for the work. Paint shall not be applied upon damp pavement surfaces, or upon pavements which have absorbed heat sufficient to cause the paint to blister and produce a porous paint film.

A purpose-made machine shall preferably carry out the application of paint but where brushes are used only round or oval brushes not exceeding 10 cum. in width will be permitted. The paint, when applied, shall be so applied as to produce a uniform, even coating in close contact with the surface being painted.

Traffic paint shall be applied to the pavement at a rate of one (1) litre to two and half (2.5) square meters or less. Contractor shall provide adequate arrangements that applied paint is not disfigured by moving traffic, till its complete drying and stacking to road surface.

5.2 HOT – APPLIED THERMOPLASTIC ROAD PAINTS

5.2.1 Material Requirements

5.2.1.1 Aggregate

The aggregate shall consist of light coloured silica sand, calcite, quartz, calcined flint, or other material approved by the Engineer.

5.2.1.2 Pigment and extender

a) White material

The pigment shall be titanium dioxide complying with the requirements of Type A (anatase) or Type R (rutile) of BS 1851.

b) Yellow materials

Sufficient suitable yellow pigment shall be substituted for all or part of the titanium dioxide to comply with the other requirements of this specification.

c) All materials

The extender shall normally be whiting (i.e. calcium carbonate prepared from natural chalk) complying with the requirements of BS 1795. The manufacturer may substitute lithopone complying with the requirements of BS 296 for any or all of the whiting.

d) Binder

The binder shall consist of synthetic hydrocarbon resin, or, with the approval of the Engineer, gun or wood resin, plasticized with mineral oil.

e) Composition of mixture

The proportions of the constituents of the mixed material as found on analysis shall comply with the requirements of table 1.

TABLE 1, PROPORTIONS OF CONSTITUENTS OF MIXTURE

Constituent	Percentage of mass of total mixture	
	Minimum	Maximum
Binder (resin and oil)	18	22
Pigment	6*	-
Pigment and extender	18	22
Ballotini	20	-
Aggregate Pigment Extender & ballotini	78	82

* For titanium dioxide only. No minimum is specified for yellow material.

Where specified, 10% in the case of material to which surface ballotini is to be applied by pressure application.

The grading of the combined aggregate, pigment, extender and ballotini (where specified) as found on analysis shall comply with the requirements of table 2.

TABLE 2, GRADING OF COMBINED AGGREGATE, PIGMENT EXTENDER AND BALLOTINI

Sieve	Percentage by mass passing Sprayed
2.80 mm	100
600 um	75 – 95

5.2.2 Sampling and Testing

5.2.2.1 Sampling

For the purpose of carrying out the testing, it is essential that adequate and representative samples be taken in the manner prescribed in specification BS 3262 at following stages.

a) At the manufacturer's plant.

b) After it has been re-melted by the road application contractor.

5.2.2.2 Testing

The samples shall be prepared and tested in accordance with B.S. Specification 3262 (1976) appendix A to H. The test results shall conform the following properties.

- Softening point

The softening point measured in accordance with appendix C shall be not less than 65^{o} C.

- Colour and luminance

a) White material

The luminance factor of white material as delivered by the manufacturer shall be measured in accordance with appendix D and shall not be less than 70 whereas the luminance factor of material obtained from an applicator or melter on site after re-melting measured in accordance with appendix D shall not be less than 65.

b) Yellow material

The Colour of yellow material shall be approximately BS 381C Colour No.355, Lemon. The luminance factor of yellow material as delivered by the manufacturer shall be not less than 60 whereas the luminance factor of material obtained from an applicator or melter on site after re-melting measured in accordance with appendix D shall not be less than 55.

- Heat Stability

a) White material

When tested in accordance with appendix E, the luminance factor of white material as measured in accordance with appendix D shall be not less than 65.

b) Yellow material

When tested in accordance with appendix E, the luminance factor of yellow material as measured in accordance with appendix D shall be not less than 55.

- Flow resistance

In testing the flow resistance, a cone made and tested in accordance with appendix F, shall not slump by more than 25%.

- Skid resistance

When tested in accordance with appendix G, the skid resistance of a newly laid marking prepared under the stated conditions shall be not less than 45.

5.2.3 Manufacturing, Packing & Storing of Paint

5.2.3.1 Manufacturing

The paint shall be produced in a plant owned and operated by the manufacturer following a process which has been used by the manufacturer for at least five (5) years to produce paint. The equipment for mixing and grinding shall be clean, modern, and in good condition.

5.2.3.2 Packing

- The material shall be supplied in sealed containers which do not contaminate the contents and which protect them from contamination.
- Each container shall be clearly and indelibly marked with the manufacturer's name, Batch number, date of manufacture, reflectorisation (if applicable), colour, chemical type of binder and maximum safe heating temperature.

5.2.3.3 Storing

The material shall be stored in accordance with the manufacturer's instructions and any material that is in damaged containers of which the seal has been broken, shall not be used.

5.2.3.4 Certification

The Contractor shall furnish a certificate from manufacturer that the material he proposes to use has the required properties, stating the maximum and minimum proportions and grading of the constituents, the acid value of the binder, the setting time, the maximum safe heating temperature, the temperature range of the apparatus and the proposed method of laying.

5.2.3.5 Application of Material to the Road

a) Preparation of site

The thermoplastic paint shall only be applied to surfaces, which are clean and dry. Immediately before the application of paint, the surface shall be cleaned with mechanical broom, compressed air or other approved means to remove surplus asphalt, oils, mud, dust and other loose or

adhered material. The material shall not be applied if the road surface is at a temperature of less than 5° C.

b) Preparation of material on site

The material shall be melted in accordance with the manufacturer's instructions in a heather fitted with a mechanical stirrer to give a smooth consistency to the thermoplastic material and such that local overheating will be avoided. The temperature of the mass shall be within the range specified by the manufacturer, and shall on no account be allowed to exceed the maximum temperature stated by the manufacturer. The molten material shall be used as expeditiously as possible, and for thermoplastic material, which has natural resin binders or is otherwise sensitive to prolonged heating, the material shall not be maintained in a molten condition for more than 4 hours.

- After transfer to the laying apparatus, the material shall be maintained within the temperature range specified by the manufacturer and stirred to maintain the right consistency for laying.

- On concrete carriageway, a tack coat compatible with the marking material shall be applied in accordance with the manufacturer's instructions prior to the application of thermoplastic material.

c) Laying

Carriageway center lines, lane lines and edge lines shall be laid to a regular alignment by self propelled machine. Other markings may be laid by hand, hand propelled machine or self propelled machine as approved by the Engineer. The surface produced shall be uniform in texture and thickness and appreciably free from blisters and streaks.

d) Refectorization by surface application

When surface application of ballotini is required, additional ballotini (400 g/m^2 to 500 g/m^2 from the machine) shall be applied by pressure concurrently with the laying of the line with sufficient velocity to ensure retention in the surface of the line. The ballotini so sprayed shall give uniform cover and immediate reflectivity over the whole surface of the marking.

Ballotini dispensed on the surface of the markings shall conform to the following grading.

Sieve	Percentage by mass passing
1.7 mm	100
600 µ	80 – 100
425 µ	45 – 100
300 µ	10 – 45
212 µ	0 – 25
75 µ	0 – 5

Not less than 90%, by mass of the ballotini, shall be of transparent glass, spherical in shape and not more than ten (10) percent shall be ovate in shape or have other flaws. The ballotini shall be made of soda glass.

e) Thickness

Unless otherwise approved by the Engineer, the material shall be laid to the following thicknesses.

a) Sprayed lines other than yellow. Not less than 1.5 mm.
b) Sprayed yellow edge lines not less than 0.8 mm.

The minimum thicknesses specified are exclusive of surface applied ballotini. The method of thickness measurement shall be in accordance with appendix H of BS 3262 (1976).

5.2.3.6 Trial Section

In no case shall the contractor proceed with the work until the equipment, method of application and rate of application conforming the required thickness (as established by a test section) have been approved by the Engineer.

5.3 RETOROREFLECTIVE PREFORMED PAVEMENT MARKINGS

5.3.1 Material – Requirements

The performed markings shall consist of white or yellow films with pigments selected to conform to standard highway colours. Ceramic and glass beads shall be incorporated to provide immediate and continuing retroreflection. Ceramic skid particles shall be bounded to a top urethane layer to provide a skid resistant surface.

The preformed markings shall be capable of being adhered to asphalt cement concrete (ACC) or Portland Cement Concrete (PCC) by a precoated pressure sensitive adhesive. A primer may be used to precondition the pavement surface. The primer may be sued to precondition the pavement surface. The preformed marking film shall mold itself to pavement contours by the action of traffic. The pavement marking film wearing courses during the paving operation in accordance with the manufacturer's instructions, approved by the Engineer. Following proper application and tamping, the markings shall identify proper solvents and/or primers (where necessary) for proper application, and recommendation for application that will assure effective product performance. The preformed markings shall be suitable for use for one year after the date of receipt when stored in accordance with the manufacturer's recommendations.

The marking film shall be durable retroreflective plisot polymer pavement marking film for performed longitudinal markings subject to low to medium traffic volumes and moderate wear conditions such as repeated shear action from crossover or encroachment on channelization lines.

The retroreflective pavement marking film shall consist of mixture of high-quality pigmented polymeric materials, with a reflective layer of ceramic and glass beads, and a layer of skid resistant ceramic particles bounded to the top urethane wear surface. The film shall have a pre-coated pressure sensitive adhesive. The edges of the preformed tape shall be clear cut and true.

5.3.2 Colour

The daytime colour of the white film shall provide a minimum initial Luminance factor Y, of 80, and shall conform to the following chromaticity requirements: X = 0.290, Y = 0.315, X = 0.491, Y = 0.435, X = 0.512, Y = 0.486, X = 0.526, Y = 0.463.

Measurements shall be made in accordance with ASTM E 1349, using illuminant "C" and 0/45 (45/0) geometry. Calculations shall be in accordance with ASTM E 308 for the 2^{o} standard observer.

5.3.3 Reflectance

The white and yellow films shall have the following initial minimum reflectance values as measured in accordance with the testing procedures of ASTM D 4061. The photometric quantity to be measured shall be specific luminance (SL), and shall be expressed as millicandals per square foot per foot-candle (mcd. ft^2) fc^{-1}). The metric equivalent shall be expressed as millicandals per square meter per lux (mcd. m^{-2}). lx^{-1}).

	White	Yellow
Entrance Angle 86.00°	86.5°	85.5°
Observation Angle	1.0°	1.0°
Specific Luminance	300	175
SL [(mdc. ft $^{-2}$). fc $^{-1}$]		

5.3.4 Skid Resistance

The surface of the retoreflective films shall provide an initial minimum skid resistance values of 55 BPN as measured by the British Portable Skid
Tester in accordance with ASTM E 303.

5.3.5 Patchability

The pavement marking film shall be capable of use for patching worn areas of the same type of film in accordance with the manufacturer's instructions.

5.3.6 Reflectance Retention

The have a good, effective performance life, the ceramic and glass beads must be strongly bonded and not be easily removed by traffic wear. The following test shall be employed to measure reflectivity retention.

5.3.6.1 Taber Abraser Simulation Test

Using a Taber Abraser with an H – 18 wheel and a 125 gram load, the sample shall be inspected at 200 cycles, under a microscope, to observed the extent and type of bead failure. No more than 15% of the beads shall be lost due to pop out and the predominant mode of failure shall be "wear down" on the beads.

5.3.7 Beads

The size, quality and refractive index of the ceramic and glass beads shall be such that the performance requirements for the marking shall be met. The bead adhesion shall be such that beads are not easily removed when the material surface is scratched.

5.3.8 Bead Retention

The film shall be ceramic and glass bead retention qualities such that when a 2 in x 6 in. (5.08 cm x 15.24 cm) sample is bent over a ½ in. (1.27 cm) diameter-mandrel, with the 2 in. dimension perpendicular to the mandrel axis, microscopic examination of the area on the mandrel shall show no more than 10% of the beads with entrapment by the binder of less than 40%.

5.3.9 Thickness

The film without adhesive, shall have a minimum thickness of 0.030 in (0.76mm).

5.3.10 Effective Performance Life

The film, when applied according to the recommendations of the manufacturer, shall provide neat, durable marking that will not flow or distort due to temperature if the pavement surface remains stable. The film shall be weather resistant and through normal traffic wear shall show no fading, lifting or shrinkage which will significantly impair the intended usage of the marking throughout its useful life and shall show no significant tearing, roll back or other signs of poor adhesion.

5.3.11 Installation

The markings shall be applied in accordance with the manufacturer's instructions.

5.4 CEMENTITIOUS MARKING COMPOUND

Marking compound Cementitious shall be used for Concrete, Surface Dressing and Bitumen to provide enhanced night and wet, weather visibility. This compound will be applied at following locations:

- Kerbs – Pavement and car park areas.
- Roundabout – vertical and sloping faces.
- Traffic Islands – vertical edges and bull noses, etc.
- Traffic Dividers – black & white chevrons.
- Concrete wall and faces – on high speed intersections and traffic merging.

6. REFLECTORIZED PAVEMENT STUDS

6.1 MATERAIL REQUIREMENTS

Reflectorized Studs shall be “cat-eyes” either the ‘Flush Surface’ type of ‘Raised Profile’ type having the following characteristics.

a) ‘Flush Surface’ Type

The ‘Flush Surface’ reflector shall be the short base type having a maximum base area of 18 cm x 14 cm or as shown on the Drawings.

The base shall be formed in cast iron with adequate webbing to ensure a firm key to the road when installed.

The pad shall be highly resilient and durable rubber reinforced with canvas and shall have an anticipated life of at least five (5) years. The pad shall be so designed as to produce a self whipping action of the reflector when depressed.

The reflectors shall be made of impact and abrasion resisting glass and shall be hermetically sealed into a copper socket.

b) ‘Raised Profile’ Type

The ‘Raised Profile’ reflectors shall consist of an acrylic plastic shell filled with an adherent epoxy compound molded from methyl methacylate into the shape of a shallow frustum of a pyramid having base dimension of approximately 10 cm x 10 cm and thickness not more than two (2) cm or as shown on the drawings.

The shell contain one or two prismatic reflector each inclined at an angle of thirty (30) degree to the horizontal and having an area not less than twenty (20) square cm or as indicated on the plans.

The reflectors shall attain the following standards for their photometric and physical qualities:

i) Photometric Requirements

The reflectors shall have the following minimum Specific Intensity values (S.I) expressed as candle power per foot candle of illumination at the reflector on a plane perpendicular to the incident light.

	COLOUR		
	Crystal	**Yellow**	**Red**
Divergence Angle	0.20	0.20	0.20
(in Degree)	S.I.	S.I.	S.I.
Incidence Angle			
0	3.00	1.80	0.75
20	1.20	0.72	0.30

The reflector for testing shall be located with the center of the reflecting face at a distance of one and half (1.5) m form a uniformly bright light source having an effective diameter of half (0.5) centimeter.

The width of the photocell shall be 1.27 cms and shall be shielded form stray light. The distance from the centers of the light source and photocell shall be 0.53 cms.

Failure of more than four (4) % of the reflecting faces shall be cause for rejection of the lot.

ii) **Strength Requirement**

The reflectors shall support a vertical load of 1000 kg when tested in the following manner.

A reflector shall be centered horizontally over the open end of a vertical positioned hollow metal cylinder seventy five (75) mm internal diameter, twenty five (25) mm high and wall thickness of six (6) mm. The load shall be applied to the top of the reflector through a six (6) mm diameter by six (6) mm high metal plug centered on top of the reflector.

Failure shall constitute either breakage or significant deformation of the marker at any load less than one thousand (1000) kg.

C) **Adhesive**

When 'Raised Profile' type of reflectors are used, a two-part adhesive having the following ingredients shall be applied to the stud for bonding to the pavement surface.

Package A	**Kg/Litre**
Epoxy Resin	0.94
Titanium Dioxide	0.07
Colloidal Silica	0.05
Talc	0.345

Package B	**Kg/Litre**
Modified Asphaltic Amine Hardener (Reinchold 2611)	0.24
Modified Asphaltic Amine Hardener (Reinchold 2613)	0.472
Carbon Black	0.0022
Colloidal Silica	0.04
Talc	0.650

Equal volumes of Package A & B should be mixed together until a uniform colour is obtained. No more than one quart of adhesive shall be prepared at one time.

d) Cement Mortar

Cement mortar shall consist of one (1) part Portland cement to three (3) parts of fine aggregates.

6.2 **CONSTRUCTION REQUIREMENTS**

6.2.1 **'Flush Surface' Type**

The stud shall be installed into the pavement in accordance with the manufacturer's instructions but shall also comply with the following requirements:

Cavities in the pavement shall be clearly cut to the dimension of the pavement stud and shall allow a clearance of one (1) cm around the stud base. The longitudinal center line axis of the cavity shall be the same as that required for the pavement stud when laid to correct line and direction.

The walls of the cavity shall be splayed back at an angle of approximately thirty (30) degree to the vertical to facilitate a "dove-tail" joint after the mortar has set.

The bottom of the cavity shall be leveled with asphalt concrete prior to placing the stud base, which shall be pounded into position with Pounder Foot attached to a pneumatic drill.

The depth of the cavity shall be such that when the stud base and reflectors have been installed the elevation of the floor of the lens socket shall not be greater than two (2) mm or less than one (1) mm above the pavement surface.

The stud shall be grouted into position with asphalt concrete containing fine aggregate only or with a cement mortar as described in Item 6.1 (d) above when the studs are installed into a cement concrete pavement.

6.2.2 **'Raised Profile' Type**

The pavement studs shall be installed in accordance with the manufacturer's instructions or to the requirements of the Engineer.

07 **MEASUREMENT AND PAYMENT**

7.1 **General**

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

7.1.1 All sampling and testing of road paint, studs.

7.1.2 Mockup specimen strip of pavement paint/ marking, and studs.

7.1.3 Surface preparation for application of road marking strips & studs.

7.1.4 Any loses of material wastage, over flow, erosion or any other causes.

7.1.5 Excavating cavities, applying adhesive and mortar for studs.

7.2 Road Marking Strips

7.2.1 Measurement

Measurement of acceptably completed works of road marking strips will be made on the basis of net actual area in square metre of strips painted in position as shown on the Drawing or as directed by the Engineer.

The measurement shall be made of painted areas, completed and accepted. No measurement shall be made of unauthorized areas. Paint that is applied in un-authorized areas shall be completely removed from the surface of the road to the satisfaction of the Engineer and at Contractor's expense.

7.2.2 Payment

Payment will be made for acceptable measured quantity of road marking strips on the basis of unit rate per square metre quoted in the Bill of Quantities & shall constitute full compensation for all the works related to the items.

7.3 Pavement Studs

7.3.1 Measurement

Measurement of acceptably completed works of pavement studs will be made on the basis of either type of studs in numbers of "Flushed surface" or "raised Profile" type provided and installed in position as shown on the Drawing or as directed by the Engineer.

7.3.2 Payment

Payment will be made for acceptable measured quantity of studs on the basis of unit rate per number quoted in the Bill of Quantities & shall constitute full compensation for all the works related to the items.

SECTION 2380

TRAFFIC SIGNS

01 SCOPE

This work shall consist of furnishing and installing road signs post assemblies and sign board bridges as shown on the plans and in accordance with the Specifications or as directed by the Engineer. All sign faces and lettering shall be in accordance with International sign standards, or as shown in the plans, or as directed by the Engineer. Prior to manufacture and fabrication of the signs the Contractor shall submit to the Engineer for approval, detailed drawings showing letter sizes, traffic symbols and sign layout. All signs shall be lettered in both Urdu and English. All overhead signboards on sign bridges shall be illuminated from inside.

02 MATERIALS

Materials shall be of new stock unless otherwise shown in the plans or ordered by the Engineer and shall conform to the following requirements:

A. Concrete:

Concrete shall be of the grade shown in the plans or as other wise approved by the Engineer. Materials, proportioning, mixing slump, and transporting of Portland cement concrete shall be in accordance with Section 2300 for the specific grade designated.

B. Reinforcing Steel:

Reinforcing steel shall conform to the requirements of Section 2200 "Reinforcing Steel".

C. Sign Posts:

Steel signposts shall conform to the requirements of ASTM A 53, Grade B.

D. Steel Channels:

Steel channels shall conform to the requirements of Section 3100 "Structural Steel".

E. Galvanizing:

When specified in the plans steel posts and sign board structures shall be galvanized in accordance with AASHTO M 111.

All bolts, nuts and washers shall be galvanized in accordance with ASTM A 153.

F. Sign Materials

Sign materials shall be as shown on the plans or as otherwise approved by the Engineer and shall meet the following requirements.

a) Aluminium Alloy Sheets: Aluminium alloy sheets shall conform to ASTM B 209, 6061-T6 aluminium, degreased and alodine-treated, three (3) millimeters thick, unless otherwise noted on the plans.

b) Steel Sheets: Steel sheets shall conform to the requirements of the "Specifications for Cold-Rolled Carbon Steel Sheets, Commercial Quality," ASTM A 366, sixteen (16) gauge thick unless otherwise noted on the plans.

c) Stainless Steel Bolts, Washers and Self-Locking Nuts: These items shall conform to ASTM A 276, chromium-nickel grade. Minimum yield 2,110 kilograms per square centimeter.

d) Vulcanized Fibre Washers: Fibre washers shall conform to ASTM D 710, grey, commercial grade, when shown on the plans.

e) Hard Rubber Washers: Hard rubber washers, when shown on the plans, shall be as approved by the Engineer.

f) Nylon and Neoprene Fittings: Nylon and/or neoprene washers, spacers, sleeves etc., when specified on the plans, shall be as approved by the Engineer.

g) Reflective Sheeting: Reflective sheeting shall be as shown on the plans or as otherwise approved by the Engineer.

Reflective sheeting shall consist of synthetic sheet resin or other approved noncellulostic materials, transparent plastic of each of the colours specified, and glass spheres. The glass spheres shall adhere to the synthetic sheet resin, and be embedded beneath a flexible transparent plastic film forming a smooth flat surface. The reflective sheeting shall have a precoated pressure sensitive adhesive backing, or a precoated tack-free solvent or heat activated adhesive backing. The sheeting shall adhere tightly to the prescribed surfaces when applied in accordance with the manufacturer's recommendations. The precoated adhesive shall not require additional adhesive coats on the reflective sheeting or application surface. The precoated adhesive shall form a durable bond to clean corrosion-proof metals, and shall adhere securely under normal service After forty-eight (48) hours of aging at twenty-four (24) degrees C from time of application, the precoated adhesive shall be capable of withstanding eight (8) hours of soaking in water at twenty-four (24) degrees C without appreciable decrease in adhesion. The precoated adhesive shall have no staining effect on the reflective sheeting and shall be mildew resistant. Protective liner for preventing contamination or premature adhesion shall be removable by peeling without the necessity of soaking in water or other solvents. The Contractor shall submit samples of each colour of the reflective sheeting to the Engineer for approval, prior to ordering materials.

03 EXECUTION

3.1. CONSTRUCTION REQUIREMENTS

A. Sign Faces:

a) Design: All sign faces shall be of the type, colour, design and size as shown in the plans. All signs, except as otherwise shown in the plans, shall meet the International Road Traffic Sign Standards.

b) Shop Drawings: The Contractor shall submit to the Engineer for approval, three (3) copies of drawings for all special sign faces and all sign faces bearing messages, showing the design and/or arrangement and spacing of both the Urdu and English sign messages. Official names and their English and Urdu spelling shall be as provided by the Engineer Size and style of lettering shall be as shown on the plans or as otherwise approved by the Engineer.

B. Storage of Signs:

Signs delivered for use on the project shall be stored off ground and under cover in a manner approved by the Engineer. Any sign damaged, discolored or defaced during transportation, storage or erection shall be rejected.

C. Placement and Orientation:

The Engineer will establish and mark the longitudinal location of each sign.

The sign shall be laterally positioned from the shoulder edge or kerb as shown on the plans or directed by the Engineer.

The Contractor shall stake the location of the sign supports.

The Contractor shall be responsible for the proper elevation, offset, level and orientation of all sign he erects. He shall exercise due care in the preservation of stakes for his and the Engineer's use. If any stakes are lost, damaged, displaced, or removed, the Contractor shall have them reset at his expense. Unless otherwise shown on the plans all signs shall be erected so that the edge and face of the sign are truly vertical and the face is at an angle of ninety-two (92) degrees to the centerline; that is, facing slightly away from the centerline of the lane, which the sign serves. Where lanes divide or are on sharp curves, the Contractor shall orient sign faces as indicated on the plans or by the Engineer so that they will be most effective both day and night and so as to avoid specular reflection and glare. All sign supports shall be plumbed.

D. **Footings for Posts**

Footings shall be excavated to the dimensions shown on the plans. Concrete shall be placed against the undisturbed excavated faces, except that the top 150 mm of each footing shall be formed. Forming of the entire footing will not be permitted unless approved by the Engineer. Concrete shall be thoroughly rodded and spaded so as to eliminate all voids. Tops of footings shall be finished with a wood float and all exposed edges shall be rounded with an edger. Backfill shall be thoroughly compacted by mechanical tampers and care shall be taken to prevent damage to the finished concrete. Backfill shall be brought up level with the finished ground line. Pipe post bases and/or posts set in concrete shall be firmly supported plumb and vertical and at the proper elevation.

E. **Sign Posts:**

a) General: Post lengths shown in the plans for signs are for bidding purposes only. When progress of the work permits, the Engineer will authorize the location of each sign, with the station and offset distance from the edge of pavement. The Contractor shall be responsible for determination of post lengths to provide the vertical clearance shown on the plans. Field cutting of posts shall be performed by sawing.

"Sign Post Support Assemblies" shall be fabricated as detailed on the drawings. Test specimens for pipe shall be taken at least 150 mm from one end of the pipe, instead of at the ends as specified, in ASTM A 53, Grade B. When galvanizing is specified assemblies shall be hot-dip galvanized after fabrication. All welds shall be mechanically cleaned before galvanizing. Galvanized materials on which the galvanizing has been damaged in transporting, handling, or erection will be rejected or may, with the approval of the Engineer, be repaired in the field by the zinc alloy stick method. Required field welds and adjacent areas on which the galvanizing has been damaged shall be galvanized by this same method. The zinc alloy stick shall be cast from zinc, tin, and lead in combination with fluxing ingredients. The compound shall be completely liquid at a temperature not lower than two hundred forty-six (246) degrees C. The area to be regalvanized shall be thoroughly cleaned, including the removal of slag on welds. The surface shall be heated with an oxyacetylene torch to approximately three hundred fifteen (315) degrees C, and the alloy stick rubbed over the surface to fix a deposit. While the alloy is still liquid, a clean wire brush shall be used to smooth the deposit evenly over the entire area being regalvanized. If a heavy deposit or build-up is required to match the original coating, more alloys shall be added immediately to the initial bond deposit and spread with a paddle or brush until the required thickness is obtained. Edges of drilled holes shall be coated with commercially available zinc-rich paint. Shop drawings will not be required for pipe posts but for signboard bridges and the illuminated sign boards.

The Contractor shall furnish to the Engineer, fabricators' certifications in triplicate certifying that the material supplied conforms to all of the requirements specified.

b) Painting: All posts shall be thoroughly cleaned, free from grease, scale and rust, and shall be given one coat of rust inhibitive priming paint and two coats of grey paint. Length of the posts shall be such that their top flushes with the top of the sign panel, where as bottom of sign panel is at least hundred and eighty (180) centimeters above shoulder level

F. **Fastening Signs to Sign Posts**

Signs shall be fastened to sign supports in accordance with the requirements of the plans, the recommendations of the sign manufacturer and to the satisfaction of the Engineer.

After installation of signs on their supports all bolt heads, screw heads, and washers, which are exposed on the face of the sign, shall be painted. The colour of the paint used shall be as nearly as practical the same as the colour of the background or message area at the point where the bolt, screw, or washer is exposed.

Where steel signs are mounted with aluminium hardware or where aluminium signs are mounted with steel hardware or on steel posts, approved asphalt, nylon, or neoprene insulation shall be installed at all points where dissimilar metals might come in contact.

3.2 **REPLACEMENT SIGNS**

The Contractor shall furnish replacement signs of the number and type as shown in the plans. The cost of furnishing and transporting replacement signs shall be included in other items in the Bill of Quantities.

04 **MEASUREMENT AND PAYMENT**

4.1 **General**

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

4.1.1 Earth work, bed preparation, concrete foundation, form work, rebar, bitumen coating etc.

4.1.2 Lettering, painting.

4.1.3 Fabrication & Erection.

4.2 **Traffic Signs**

4.2.1 **Measurement**

Measurement of acceptably completed works of traffic sign boards will be made on the basis of actual number of traffic sign boards provided & installed in position as shown on the drawings or as directed by the Engineer.

4.2.1 **Payment**

Payment will be made for acceptable measured quantity of traffic sign boards on the basis of unit rate per number quoted in the Bill of Quantities & shall constitute full compensation for all the works related to the items.

4.3 **Gantry Signs**

4.3.1 **Measurement**

Measurement of acceptably completed works of Gantry signs will be made on the basis of actual no. of Gantry signs provided and installed in position as shown on the drawings or as directed by the Engineer.

4.3.1 **Payment**

Payment will be made for acceptable measured quantity of gantry signs on the basis of unit rate per No. quoted in the Bill of Quantities & shall constitute full compensation for all the works related to the items.

SECTION - 2410

GRANULAR SUB-BASE COURSE, CRUSH AGGREGATE BASE COURSE AND CEMENT TREATED BASE COURSE

01. SCOPE

The work under this section of specifications consists of furnishing of all materials, plant, labour, equipment, appliances and performing all operations in connection with supply and construction of Granular Sub-Base Course, Crush Aggregate Base Course and Cement Treated Base Course complete in all respects in accordance with the specifications and in conformity with the lines, grades, thickness and cross-sections shown on the drawings and/or as directed by the Engineer.

02. MATERIALS

2.1 Aggregates

A. Source of Materials

All aggregates for use in the laying of the base course, sub-base course and cement treated base course shall be obtained only from source approved by the Engineer. The actual quarry pits or gravel deposits shall be in all cases approved by the Engineer.

The Contractor shall determine the location, suitability and quantity of material available before tendering as well as the cost and the amount of work required to crush, screen and the length of haulage to the job site. The Contractor shall also satisfy himself and make an estimate of the amount of over burden that must be removed from any quarry site and the cost of handling such overburden. He shall include all costs in his Tender price.

The Contractor shall provide to the Engineer, within thirty (30) days prior to the scheduled beginning of construction with a complete statement of the origin and composition of all stone and/or gravel aggregates to be used on the project. All material shall comply with the specified requirements for the various aggregates.

The location and the manufacture of aggregates which must meet the requirements of the Specifications is the sole responsibility of the Contractor to manufacture such aggregates at the rates and in the quantities required to complete the work within the specified Time Schedule.

The approval of the Contractor's crushing and screening plant & equipment by the Engineer shall in no way relieve the Contractor of responsibility of producing aggregates which meet the Specifications and in the quantities required for the completion of the work within the specified Time Schedule.

No aggregate producing equipment shall be put into operation prior to the approval of the equipment by the Engineer. If after the equipment is put into operation it fails to perform as proposed, the Contractor shall provide additional approved equipment or replace the original equipment with more suitable equipment, as may be directed by the Engineer.

The Contractor shall commence crushing and screening of aggregates for base course, concrete, or as otherwise may be required, immediately after the occupancy of the Project Laboratory by the Engineer and/or immediately after the Contractor receives approval of his aggregate sources.

B. Testing

In order to ascertain the properties of all aggregate materials, the Contractor shall submit for approval by the Engineer, test certificates from an approved testing laboratory for all materials intended for incorporation in the work prior to commencement of work.

Representative samples for such testing shall be taken by the Contractor, at his expense, in the presence of the Engineer, and duplicate samples shall be submitted to the Engineer for future reference.

The Contractor may, if approved by the Engineer, conduct the necessary tests in the Project Laboratory. The tests shall be conducted in the presence of the Engineer by the Contractor's Materials Engineer. The qualifications of the Contractor's Materials Engineer must be submitted to and approved by the Engineer prior to any testing operations.

This testing, whether performed at an approved testing laboratory, or in the Project Laboratory, shall be solely the Contractor's responsibility and will be at the Contractor's expense.

C. Approval and Inspection

All sources of material shall be approved by the Engineer prior to procuring or processing material from such sources. Test certificates obtained or performed by the Contractor at his expense are intended to assist the Contractor in his estimate of the location, extent and quantities which will comply with the Specifications when properly processed, and will in no way obviate the need for further testing by the Engineer. Only materials from approved sources shall be processed for incorporation into the work. Approval of specific sources of materials shall not be construed as final approval and acceptance of materials from such sources.

All processed material shall be tested and approved before being stored on the site or incorporated in the work and may be inspected and tested at any time during the progress of their preparation and use. Questionable materials, pending laboratory testing and subsequent approval, shall not be unloaded and incorporated with materials previously approved and accepted. If however, the grading and quality of the material delivered to the site do not conform to the grading and quality as previously inspected and tested, or do not comply with the Specifications, the Engineer reserves the right to reject such materials at the site of the work. Only materials conforming to the requirements of the Specifications shall be used in the work.

Samples must meet all test requirements as specified under the Specifications. The Contractor shall permit the Engineer or his designated representative to inspect any and all materials used or to be used, at any time during or after its preparation, or while being used during the process of the work or after the work has been completed. All such materials not complying with the required Specifications, whether in place or not, shall be rejected and shall be removed promptly from the work. The Contractor shall supply, or arrange with any producers or manufacturers to supply all necessary material, labour, tools and equipment for such inspection.

D. Storage

Materials shall be stored so as to ensure preservation of their specified quality and fitness for the work. They shall be placed on hard, clean surfaces and, when required by the Engineer, they shall be placed under cover. Stored materials shall be located so as to facilitate prompt inspection and control. Private property shall not be used for storage purposes without written consent of the owner.

The centre of the storage area shall be elevated and sloped to the sides so as to provide proper drainage of excess moisture. The material shall be stored in such a way as to prevent segregation and coning to ensure proper control of gradations and moisture.

Coarse aggregate storage piles shall be built-up in layers not exceeding one (1) metre. The height of a stockpile shall be limited to a maximum of five (5) metres.

The equipment and methods used for stockpiling aggregates and for removing from the stockpiles must be approved by the Engineer and shall be such that no detrimental degradation of the aggregate will result and no appreciable amount of foreign material will be incorporated into the aggregate.

The stockpile site shall be prepared by clearing and smoothing and must be approved by the Prior to any stock piling of aggregates, cross sections of the stockpile site shall be taken control points established for use in determining the quantity of subsequently stockpiled material.

2.2 Granular Sub-Base

All sub-base material shall be free from dirt, organic matter, shale or other deleterious matter and shall be of such quality that it will bind readily to form a firm, stable sub-base.

Material for sub-base shall consist of well-graded gravel with sand and silt, conforming to the following requirements:

AASHTO Sieve	Percent Passing
2 in. (50.8 mm)	100
# 4	35 - 70
# 200	0 - 15

Physical Requirements: All sub-base aggregate shall conform to the following physical rquirements.

- Liquid Limit (AASHTO T 89) 25 maximum

- Plasticity Index (AASHTO T 90) 6 maximum

- Sand Equivalent (AASHTO T 176) 25 minimum

- Loss by Abrasion (AASHTO T 96) 40 maximum

- California Bearing Ratio (CBR)
(at 100% compaction as per ASTM D1557 or
AASHTO T- 180 method ‘D’) $\geq$ 30

2.3 Aggregate Base Course

Materials shall conform to the requirements for the "Aggregate Base Course" specified. All aggregates for base course shall consist of clean, tough, durable, sharp angle fragments free of any excess of thin or elongated pieces, and reasonably free of soft, disintegrated or decomposed stone, dirt or other deleterious matter.

Crushed gravel or stone fragments for base courses shall consist of the product obtained by crushing gravel that, if directed by the Engineer, has first been screened in such a manner that not less than ninety (90) percent of the material to be crushed is retained on a one-quarter (1/4) inch sieve. The amount of crushing shall be regulated so that at least eighty (80) percent by weight, of the pieces retained on the No. 4 sieve have at least one (1) mechanically fractured face.

- Gradation: Coarse materials for base course shall be crushed rock or crushed gravel conforming to the following grading requirements:

AASHTO Sieve	Percent Passing
2 in. (50.8 mm)	100
1 1/2 in. (38.1 mm)	35 - 70
1 in. (25.4 mm)	0 - 15
1/2 in. (12.7 mm)	0 - 5

Fine materials for base course shall be quarry screenings or natural material and of suitable binding quality as approved by the Engineer. The material shall be free from foreign or organic matter, dirt, shale, clay and clay lumps, or other deleterious matter and shall conform to the following requirements:

AASHTO Sieve	Percent Passing
3/8 in. (9.5 mm)	100
No. 4	85 - 100
No. 100	10 - 30
Plasticity Index (AASHTO 90)	6 maximum
Sand Equivalent (AASHTO 176)	30 minimum

The combined material shall consist of a mixture of all aggregate uniformly graded from coarse to fine to conform to the following gradation requirements:

AASHTO Sieve	Percent Passing
2 in. (50.8 mm)	100
1 1/2 in. (38.1 mm)	60 - 90
1 in. (25.4 mm)	42 - 77
3/4 in. (19.0 mm)	35 - 70
1/2 in. (12.7 mm)	25 - 60
No. 4	15 - 40
No. 10	10 - 26
No. 40	5 - 15
No. 200	2 - 9

Acceptance: When the stationary plant method is used, the aggregate will be accepted immediately following mixing, based on periodic samples taken from the pug mill output.

Physical Requirements: All base course aggregates shall conform to the following physical requirements:

Loss of Sodium Sulfate Soundness Test (AASHTO 104)	10 percent maximum
Loss of Magnesium Sulfate Soundness Test (AASHTO 104)	12 percent maximum
Loss by Abrasion Test (AASHTO 96)	40 percent maximum
Thin and Elongated Pieces, by Weight (larger than 25 mm, thickness less than 1/5 length)	5 percent
Friable Particles (AASHTO T112)	0.25 percent maximum

When the aggregate is a total aggregate, it may be accepted at the crusher. Acceptance of the material by the Engineer does not constitute acceptance of the base course, only that the material is approved for use in the base course.

2.4 **Cement Treated Base Course**

A. Granular Material or Aggregate

Cement treated base course material shall conform to the gradation given below:

AASHTO Sieve	Percent Passing
25.4 mm (1")	90 - 100
19.0 mm (3/4")	76 - 94
12.7 mm (1")	63 - 90
No. 4	34 - 80
No. 10	22 - 60
No. 40	10 - 28
No. 80	5 - 17
No. 200	2 - 5

B. Cement

Ordinary Portland cement conforming to ASTM C 150 type II or BS 12 shall be used in cement stabilized base course.

C. Water

Water used for cement fortification and afterwards for curing shall be as specified in Section 2300 "Plain and Reinforced Concrete".

03. **EXECUTION**

3.1 **Granular Sub-Base Course**

A. Method of Construction

a) Preparing Under Lying Course: Before any sub-base material is placed, the underlying course shall be prepared and conditioned as specified. The course shall be checked and accepted by the Engineer before placing and spreading operation are started.

b) Spreading: Sub-base aggregates shall be spread on underlying course which has been approved by the Engineer.

Sub-base aggregate shall be spread on the sub-grade in layers not exceeding 150 mm compacted depth. Spreading shall be done by means of approved mechanical spreaders, distributing the material to the required width and loose thickness. Where the required sub-base thickness is greater than 150 mm, the material shall be placed in layers of equal thickness, in no case shall a layer be less than 75 mm thick. Under no circumstances shall sub-base be dumped in a pile on the sub-grade.

The material shall be handled so as to avoid segregation. Segregated materials shall be remixed until uniform. Suitable precautions shall be taken to prevent rutting of the sub-grade during the spreading of the sub-base material. No hauling or placement of material will be permitted when, in the judgment of the Engineer, the weather or road conditions are such that the hauling operations will cause cutting or rutting of the sub-grade or cause contamination of the sub-base material.

c) Compaction: The moisture content of the sub-base material shall be adjusted prior to compaction, by watering with approved sprinkler trucks or by drying out, as directed by the Engineer, to that extent required to obtain the specified density. The sub-base shall be compacted to one-hundred (100) percent of the maximum dry density as determined according to AASHTO T 180 Method D, or to ninety (90) percent of the relative density in accordance with ASTM D 2049, as deemed appropriate by the Engineer. The moisture content directed by the Engineer shall be the optimum moisture content determined from the moisture-density test performed in the laboratory on sub-base material, or as otherwise directed by the Engineer after compaction trials as specified in sub-paragraph A (d) of this section. The sub-base aggregate shall be compacted by means of approved compaction equipment progressing gradually from the outside towards the centre with each succeeding pass uniformly overlapping the previous pass. Rolling shall continue until the entire thickness of each layer is thoroughly and uniformly compacted to the specified density.

Rolling shall be accompanied by sufficient blading, in a manner approved by the Engineer, to ensure a smooth surface free from ruts or ridges and having the proper section and crown.

Any areas inaccessible to normal compaction equipment shall be compacted by means of mechanical tampers until satisfactory compaction is obtained.

Each layer of sub-base course must be completely compacted and approved by the Engineer prior to the delivery of materials for a succeeding layer of sub-base.

d) Compaction Trials: If directed by the Engineer, prior to the commencement of the sub-base or aggregate base operations, the Contractor shall construct trial lengths, not be exceed one-hundred (100) metres. The materials used in the trials shall be that approved for use as sub-base or aggregate base and the equipment used shall be that according to the Contractor's approved detailed program of work.

The object of these trials is to determine the adequacy of the Contractor's equipment, the loose measurements necessary to result in the specified compacted layer depths, the field moisture content, and the relationship between the number of compaction passes and the resulting density of the material.

The Contractor may proceed with sub-base and aggregate base work only after the methods and procedures established in the compaction trial have been approved by the Engineer.

e) Finishing: The Contractor shall program his operations to avoid the drying out of the sub-base during construction. If any layer of sub-base material, or part thereof, is permitted to dry out after compaction, or does not conform to the required density or finish, the Contractor shall, at his own expense, rework, water or recompact the material, as directed by the Engineer, to the density specified, before the next layer of sub-base or base course is super imposed thereon.

Immediately prior to the placing of the first layer of base course on the sub-base the final layer of sub-base shall be at the specified density and to the-required grade and section. In order to maintain these requirements-while placing the next course, it may be necessary to water and reshape the surface of the sub-base, which work shall be at the Contractor's expense.

The surface of the finished sub-base will be tested with a three (3) metre straight edge by the at selected locations. The variation of the surface from the testing edge of the straightedge between any two (2) contacts with the surface shall at no point exceed six (6) millimeters when placed on or parallel to the centerline or six (6) millimeters when placed to the centerline of the roadway. The sub-base shall be compacted to the thickness and cross section as shown on the plans and shall not vary by more than six (6) millimeters from the required elevation. All humps and depressions and thickness

deficiencies exceeding the specified tolerances shall be corrected by removing the defective work or by adding new material as directed by the Engineer.

f) Testing for Compaction: The frequency of inplace density testing for accepting the compacted area shall be one density test in every 300 sq. metre.

3.2 **Aggregate Base Course**

A. Method of Construction

a) Combining Aggregate and Water: Aggregate for base course shall be combined into a uniform mixture and water added either in a central mixing plant or by watering and mixing of windrows in a manner approved by the Engineer, before final placement of the material. When binder is to be added, it may be combined with the aggregate base by thoroughly mixing separate windrows of binder and aggregate base or it may be combined in the central mixing plant. Adding binder by spreading it over the aggregate windrow will not be permitted.

The moisture to the aggregates shall be that required, as designated by the Engineer, to obtain the specified density thereby preparing an aggregate completely ready for compaction after spreading on the underlying course. In no case will the wetting of aggregates in stockpiles or trucks be permitted.

b) Spreading: Unless otherwise specified, aggregate for base courses shall be delivered to the designated areas, as specified on the drawings, as a uniform mixture and shall be placed on the existing prepared underlying course in a uniform layer or layers not exceeding one hundred and fifty (150) millimeters in compacted depth, including any binder that is to be blended on the base. Spreading shall be done by means of approved self-propelled spreader box distributing the material to the required width and loose thickness. When the required base thickness is greater than one hundred-and fifty (150) millimeters the material shall be spread in layers of equal thickness.

The material shall be so handled, as to avoid segregation. If an aggregate spreader causes segregation in the material, or leaves ridges or other objectionable marks on the surface which cannot be eliminated easily or prevented by adjustment of the spreader operation, the use of such spreader shall be discontinued and the spreader replaced. All segregated material shall be removed and replaced with well graded material. No "skin" patching shall be permitted.

No hauling or placement of material will be permitted when, in the judgment of the Engineer, the weather or road conditions are such that hauling operations will cause cutting or rutting of the underlying course surface or cause contamination of the base course material.

c) Compaction: If directed by the Engineer, prior to starting the aggregate base operation, the Contractor shall construct trial lengths. Immediately after placing, the base course material shall be compacted. The material shall be compacted to a density of not less than one-hundred (100) percent of Maximum Density as determined according to ASTM D 1557. The field determination of density shall be made in accordance with ASTM D 1556.

The percent of density shall be adjusted to compensate for the weight and volume of aggregate larger than the aggregate used in the compaction control test where applicable.

Rolling shall be until the entire thickness of each layer is thoroughly and uniformly compacted to the density specified. The final rolling of the completed base course shall be done with a self-propelled roller. Rolling shall be accompanied by sufficient blading in a manner approved by the Engineer, to ensure a smooth surface, free from ruts or ridges and having the proper section and crown. When additional water is required it shall

be added in the amount and manner approved by the Engineer. Each layer of base course must be completely compacted by the Contractor and approved by the Engineer prior to the delivery of materials for a succeeding layer.

If the material for the base course is laid and compacted in more than one (1) layer, the Contractor shall plan and coordinate the work in such a manner that the previously placed and compacted layers be allowed ample time for drying and development of sufficient stability before Vehicles hauling materials for the succeeding layers, or other heavy equipment are permitted on the base. Prior to placing the succeeding layers of material, the top of the under layer shall be made sufficiently moist to ensure bond between the layers. The edges and edge slopes of the base course shall be bladed or otherwise dressed to conform to the lines dimensions shown on the plans and present straight, neat and workmanlike lines and slopes as free of loose material as practicable.

The Contractor shall also plan the work and handle the various operations so that the least amount of water will be lost by evaporation from uncompleted surfaces. If the Contractor delays placing of succeeding layers of base course material to the extent that additional water must be applied to prevent raveling or excessive dripping, the application of such water shall be at the Contractor's expense and will not be considered as the basis for a claim for additional compensation. Water shall be applied at such times and in such quantities as directed by the Engineer, and the Engineer shall have full authority to require the suspension of all other work on the project to insure the proper maintenance of previously compacted material. If after the base is compacted, any areas are above or below proper grade and true elevations, such area shall be loosened and after having had additional materials added or excess material removed, as the case may require, shall be reconstructed as described herein. If after the base is compacted, any areas fail to meet the specified density and gradation requirements, they shall be loosened or removed as directed by the Engineer and reconstructed as described before.

d) Maintenance of Base Course: Following the construction of the aggregate base, the compacted base course shall be maintained by the Contractor at his expense. The Contractor shall blade, broom and otherwise maintain the base, keeping it free from raveling, and other defects until such time as the bituminous prime or other surface is applied. Water shall be applied at such time and in such quantities as directed by the Engineer.

The Engineer shall determine when the surface of the base course is in the proper condition to permit the bituminous prime and/or surfacing to be applied. If the Contractor chooses not to apply the bituminous prime and/or surfacing at that time, he must continue to maintain the surface of the base course, including the application of necessary water, at his expense until such time as the bituminous prime and/or surfacing is applied. Any additional expense incurred by the Contractor because of his failure to apply the bituminous prime and/or surfacing when so permitted by the Engineer will not be considered as the basis for a claim for additional compensation.

e) Testing for Compaction: The frequency of inplace density testing for accepting the compacted area shall be one density test in every 300 sq. metre.

3.3 **Cement Treated Base Course (CTB)**

A. Method of Construction

a) Cement Content: The cement content shall fall within the range of 3 to 5% of the dry weight of the aggregate mixture. The optimum amount of cement within the specified range shall be determined prior to construction through laboratory tests of maximum dry density and optimum water content. Samples, from trial designs submitted for the Engineer's approval, shall have developed a seven (7) day compressive strength of 5 MN/m^2 (750 psi) minimum.

b) Mixing: Stationary plant-mixing shall be permitted for proper mixing and attaining uniform quality.

In the stationary plant mix the aggregate shall be mixed with the approved amount of Portland cement and water. The mixing shall continue until thorough and a uniform mixture has been obtained. The mixed material thus produced shall be carried to the construction site, laid on the prepared underlying course in the specified thickness and compacted. Before spreading, the underlying course must be sprinkled uniformly with water.

c) Placement: Spreader shall be capable of meeting the specified tolerances and efforts shall be directed toward eliminating finished lift levels above the design grade. Not more than sixty (60) minutes shall elapse between start of moist mixing and the start of compaction of the spread layer.

d) Compaction: Immediately following spreading of cement stabilized base course, the layer shall be thoroughly compacted. Acceptable compaction shall be determined on a lot basis, with a lot being equal to 1000 sq.m. A field density test will be taken in one fourth of a lot.

Average field density shall be a minimum of 98% of maximum dry density with no individual test below 95% in accordance with ASTM D 1556 and ASTM D 558 for moisture density relationship.

Within two hours from the commencement of wet mixing the surface shall be sealed with a pneumatic roller. Additional moisture should be applied to the surface by spraying water onto roller tires to improve surface sealing.

e) Layer Thickness: The loose thickness of CTB shall not be greater than 23.3 cms. Exact thickness shall be decided after field trial tests.

If trial section indicates that required density in one layer is not achievable, than the CTB shall be laid in two equal layers. The methodology of laying in two layers will be submitted by the Contractor for approval.

f) Curing: Moisture evaporation from the finished layer must be prevented until cement hydration is complete. Contractor may accomplish this by covering the base course with burlap fabric and maintaining it wet for five days or alternatively seal the surface with a bituminous emulsion as approved by the Engineer.

g) Tolerances: The cured base course surface shall be checked with a three (3) metre straight edge. Variations in the finished surface shall not exceed six (6) millimeters between any two surface contacts of the straight edge. No variance greater than plus five (5) millimeters or minus ten (10) millimeters from the design elevation is acceptable. All humps, depressions and thickness deficiencies exceeding the specified tolerances shall be corrected to the satisfaction of the Engineer.

h) Construction Joints: At the end of each day's work, a transverse construction joint shall be formed by cutting back into the Cement Treated Base Course (CTB) to form a true vertical surface free from loose material. The longitudinal joints shall be formed by cutting back into the compacted CTB to form a true vertical edge.

The second lane of CTB will be constructed in one hour only otherwise it will be cut and removed in that part of joint vertically.

i) A mock up specimen of the CTB shall be required before final approval.

04. MEASUREMENT AND PAYMENT

4.1 General

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

4.1.1 All sampling and testing of cement, aggregate and cement treated base course.

4.1.2 Mockup specimen strip of sub-base course, base course and cement treated base course.

4.1.3 Providing and spraying water.

4.1.4 Any loses of material which may result from shrinking, compaction, foundation settlement, wastage, over flow, erosion or any other causes.

4.1.5 Rolling and compaction.

4.1.6 Curing of cement treated base course.

4.2 Measurement

Measurement of acceptably completed works of granular sub-base course, aggregate base course and cement treated base course will be made on the basis of actual volume in cubic metre of granular sub-base course, aggregate base course and cement treated base course laid & compacted in position to the line, level & grade as shown on drawings or as directed by the Engineer.

4.3 Payment

Payment will be made for acceptable measured quantity of compacted granular sub-base course, crush aggregate base course and cement treated base course on the basis of unit rate per cubic metre quoted in the Bill of Quantities and shall constitute full compensation for all the works related to the item.

SECTION - 2415

PAVEMENT WIDENING

01 SCOPE

This work shall consist of the widening of the existing pavement and finishing of the completed work in accordance with the specifications and in conformity with the lines, grades, thickness of each pavement component and typical cross-sections shown on the plans or as directed by the Engineer.

02 MATERIALS

Materials for the construction of "Pavement Widening" shall conform to the requirements specified in relevant items of Earth work, Subbase, Base course, Prime coat, Tack coat, Asphaltic Binder and Wearing Course in these specifications.

03 EXCAVATION

The contractor shall excavate along the edge of the existing pavement for the full depth and width as indicated on the Drawings or as directed by the Engineer. The bottom of the excavation shall be compacted with rollers and / or tampers approved by the Engineer to minimum ninety five (95) % of the maximum dry density as per AASHTO T-191 method. If the plans do not call for a specific type of compaction, the subgrade, subbase or base shall be compacted by rolling with an approved type trench roller until the entire surface is smooth, firm and at the designated elevation. Adequate provisions shall be made for drainage of the excavation to prevent damage to the subgrade. Prior to placing any widening material, the trench shall be cleaned of all loose material. The edge of the existing pavement shall be thoroughly cleaned. The excavation must be approved by the Engineer, before placing any widening material. All subsequent layers shall be compacted to the degree as shown under relevant item of these specifications.

04 SPECIAL PROVISIONS FOR HANDLING TRAFFIC

Widening operations shall be permitted on only one (1) side of the pavement at a time and excavation shall be permitted only sufficiently in advance of other operations to ensure a continuity of the operations of excavating, placing widening material, and rolling.

Reflectorized barricades shall be placed along open excavation day and night. Lighting shall be placed at each barricade at night. Barricades and lights shall be approved by the Engineer. The barricades shall be placed at intervals not to exceed one hundred (100) meters or as directed by the Engineer.

The Contractor shall make adequate provision to enable traffic to cross open trenches at intersecting roads, streets and private entrances.

Partial shouldering shall be performed immediately after completion of widening of portions of the Work in order to eliminate the hazard.

No separate payment will be made for handling traffic which will be considered subsidiary to the item of "Pavement Widening."

05 **MEASUREMENT AND PAYMENT**

No separate payment shall be made for the works involved within the scope of this section of specifications unless otherwise specifically stated in the Bill of Quantities or herein. The cost thereof shall be deemed to have been included in the quoted unit rate of respective items of the Bill of Quantities.

SECTION – 2500

PRESTRESSING

1. SCOPE

The work under this section consists of furnishing all plant, labour, equipment, appliances and materials and performing all operations in connection with supply & installation of prestressing materials i.e. prestressing cables, anchorages, couplers, sheathings, grouting etc., stressing the cables in concrete girders, in strict accordance with this section of specifications and the applicable drawings, and subject to the terms and conditions of the Contract for a complete job.

2. GENERAL

The Contractor shall employ qualified and competent personnel on the work, adequately experienced in prestressing works of equal or bigger size to be incharge and to supervise the execution of the prestressing work as per above scope.

All prestressing equipment, materials, fixtures and fittings to be incorporated and used in the work shall comply exactly in all details with the description in these specifications and drawings.

All equipment and tools shall be reliable and in safe operating condition. Materials, fixtures and fittings intended to be permanently incorporated in the work shall be new, un-used and undamaged.

Samples of all materials shall be submitted at least six weeks before it is intended to commence deliveries. No deliveries in bulk shall be commenced until the approval is given in writing by the Engineer satisfying himself that the material is considered satisfactory and complies with the specifications. Materials failing to comply with the requirements of the specifications shall be removed from the site immediately.

3. MATERIALS

3.1 Prestressing Steel

Prestressing steel shall be high-tensile strand or rope conforming to ASTM Specification A-416 or BS 5896 for high tensile alloy bars as follows:

After stranding and stress relieving, physical requirements of strands shall be as follows:

i)	Minimum Ultimate tensile strength	1860 N/sq.mm
ii)	Minimum yield strength, measured by the 1.0 percent extension under load method	1860 N/sq.mm
iii)	Minimum modulus of elasticity	200 kN/sq.mm

iv)	Minimum elongation	3.5 percent in 610mm Gauge length
v)	Tolerance on Diameter	+0.66, -0.15mm

The steel shall be free from injurious defects and shall have a smooth surface. Material which shows injurious defects during or prior to its installation in the work shall be rejected.

The wire shall be supplied in coils not less than 1800mm in diameter and strand shall be furnished on reels or in compact coils having a minimum core diameter of 610mm.

The prestressing steel shall be well protected against mechanical injury during transportation. Each reel, or coil shall have a strong tag securely fastened to it showing the size, grade, specification number and the name or mark of the manufacturer.

The Engineer may call for a relaxation test on prestressing steel in case he is not satisfied with the source of manufacture. Relaxation for pretressing steel shall be measured over a period of one thousand (1000) hours in accordance with the requirements of ASTM A 416 for low relaxation steel.

3.2 Anchorages

Anchorages shall have an efficiency of at least 92% of the minimum stipulated ultimate strength of the prestressing cables, tested in unbounded state and shall comply with BS 4447. Concrete cones shall not be allowed. Locking surfaces of the anchorages shall be free from deformation, damage and rust.

3.3 Sheath

The cables shall be sheathed in an approved metal sheath which shall be hydra-rigid and adequately strong to withstand handling and placing of concrete without sagging between its supports.

Sheaths shall be made of corrugated, spirally wound, 0.25mm thick mild steel strip. These shall be undamaged, grout tight, and free from kinks, punctures and deformations.

3.4 Grout

Neat Portland Cement grout with water Cement ratio of not more than 0.50.

4. TESTING

4.1 Prestressing Steel

All wires, strands, or bars to be shipped to the site shall be tagged with its production lot number for identification purposes. Anchorage assemblies to be shipped shall be likewise identified.

All samples shall be representative of the lot to be furnished.

All of the materials specified for testing shall be furnished free of cost and shall be delivered in time for tests to be made well in advance of anticipated time of use.

The Contractor shall furnish for test the following samples selected from each lot as ordered by the Engineer. The selection of samples shall be made at the manufacturer's plant by the Engineer or his representative.

For bars to be furnished with threaded ends and nuts, one and half (1.5) M shall be clear between threads at ends.

The strand shall be accompanied by the test certificates and stress-strain graphs in respect of each size. Test samples shall be taken from each ten tons of coils or reels of the same production lot, which will be referred to as a parcel of coils or reels hereinafter.

The test certificates shall give the following information

i. Determination of the ultimate tensile strength on not less than five samples of each parcel using a gauge length of 250mm. The tests shall be plotted to give stress-strain graphs.

ii. Determination of 1% as per ASTM A416 proof stress on not less than five samples for each parcel using a gauge length of 250mm. This test may be conducted while carrying out the ultimate tensile test.

iii. Determination of reverse bend on not less than five samples for each parcel of wire coils.

iv. Determination of ultimate elongation at rupture on not less than five samples from each parcel using a gauge length of 250mm for wire and 610mm for strand. This test must be independent and must not be combined with any other test prescribed herein.

v. Determination of 1000 (one thousand) hours relaxation loss (creep of steel) at constant strain on one sample per parcel using a gauge length of 250mm or more with an initial stress of 70% (seventy percent) of the guaranteed minimum ultimate tensile strength, as stipulated in the Tables 4 and 6 of B.S. 5896.

The tests stipulated herein may be carried out at the manufacturer's own laboratories and subject to retests as directed by the Engineer or the Engineer's Representative.

Test results and test certificates applying to the general production of the manufacturer or to the order as a whole shall not be considered valid substitutes for the specific tests for each parcel stipulated herein and the wire or strand not accompanied by the specific documents stipulated herein shall not be accepted.

Prestressing Steel, as determined from test specimens, shall conform to the following:

i. **Ultimate Elongation**
The ultimate elongation of the strand shall be at least 3.5% of its initial length in a gauge length of 610mm.

ii. **Tensile Tests**
The test of ultimate tensile strength and proof stress shall be carried out in accordance with the recommendations and shall comply with the requirements of the relevant codes i.e. ASTM A421/BS5896 for wire and ASTM A416/BS5896 for strand. Such test shall not be done until 48 hours after the wires have been drawn.

5. CONSTRUCTION REQUIREMENTS

General

Unless otherwise directed by the Engineer, the Contractor shall certify to the Engineer's approval that a technician skilled in the approved prestressing method, will be available to the Contractor to aid and instruct in the use of prestressing equipment at the job site to acquire the desired results.

The details of the method of construction shall be submitted by the Contractor for approval of the Engineer before the work is started. When the method has been approved, no changes shall be made without the written consent of the Engineer.

The Contractor shall inform the Engineer of the dates, in advance, for casting of the concrete members and stressing of the tendons.

The Contractor shall send to the Engineer within seven (7) days after the transfer of stress, a certificate showing the force and strain in the tendons immediately after they were anchored.

5.1 Laying of Sheaths

The sheath shall be laid to the lines indicated on the drawings and shall be securely fixed in position with mild steel strips and binding wires. It is important to achieve smooth curves as shown on the drawings and to avoid interference between the cables and/or between the cables and the reinforcement. Minor adjustment with prior approval of the Engineer is permissible for this purpose, provided that stipulated cover is maintained throughout. The tying of the cable shall be removed as it is inserted into the sheath.

The Contractor shall submit his proposal for fixing of sheathing to the Engineer for his approval. Unless self joining sheath is used, all joints between sheathing and anchorages shall be made with approved couplers specially designed for this purpose. All sheaths shall be carefully inspected immediately prior to

concreting in order to ensure that the alignment is correct, the joint secure, and the sheath undamaged and unblocked.

5.2 Placing Steel

All steel units shall be accurately placed in the position shown on the Drawings or as directed by the Engineer and firmly held during the placing and setting of concrete.

Distance from the forms shall be maintained by stays, blocks, ties, or hangers approved by the Engineer. Blocks for holding units form contact with the forms shall be of plastic or stainless steel of approved shape and dimensions. Wooden blocks shall not be left in the concrete.

Suitable horizontal and vertical spacers shall be provided, if required, to hold the wires in place and in true position in the concrete.

5.3 Placing Concrete

Concrete shall be controlled, mixed, and handled as specified in other section of these specifications, unless otherwise specified therein.

Concrete shall not be poured in the forms until the Engineer has inspected the placement of reinforcement, sheaths, anchorages, and prestressing steel and has given his approval thereof.

The concrete shall be vibrated internally or externally, or both, as directed by the Engineer. The vibrating shall be done with care in such a manner as to avoid displacement of reinforcement, sheaths, anchorages or wires.

5.4 Prestressing Equipment

Hydraulic jacks shall be equipped with accurate pressure gauges. The Contractor may select to substitute screw jacks or other approved types. In that case, proving rings or other approved devices shall be used in connection with the jacks. All devices, whether hydraulic jack gauges or otherwise, shall be calibrated so as to permit the stress in the prestressing steel to be computed at all times. The calibration certificate shall be submitted by the Contractor to the Engineer. A certified calibration curve shall accompany each device. Safety measures shall be taken by the Contractor to prevent accidents due to possible breaking of the prestressing steel or the slipping of grips during the prestressing process.

5.5 Stressing Cables

All precast members shall be adequately braced during and after the prestressing operations.

No precast member shall be stressed prior to acquiring 75 percent of the specified 28 days strength.

Before stressing any tendons, compressed air shall be blown through the ducts in concrete formed by the sheaths. A good flow of air from free end of the duct

shall be established in order to ensure that the duct is clear and that there is no loss of air at intermediate points.

The cables shall be stressed using jacks at both ends or as specified in drawings or instructed by the Engineer. The sequence in which the cables are stressed shall follow exactly the instructions shown in the drawings and as stipulated by the Engineer in writing.

Stressing schedules are stipulated on the drawings for all cables, giving the required cable extensions and the cable forces. These schedules are based on estimated friction and other losses and on an assumed value of Young's Modulus. This value of the modulus shall be checked against that given in the manufacturer's test certificates for each individual lot and the extensions shall be adjusted accordingly before stressing is started, any adjustment being first agreed upon with the Engineer.

During stressing a careful and continuous check shall be kept on the jack forces and the extensions. Should any departure form the instructions given in the stressing schedules be required owing to unexpected variations in friction losses or for any other reasons then the Engineer shall be informed immediately. Stressing operation shall be at all times under the personal supervision of qualified personnel experienced in this class of work. Careful record of all stressing operations including pressure gauge readings, extensions, and the pull-in measured at each end shall be kept and these shall include a report on any difficulties or significant event encountered during stressing.

During the prestressing operations, all necessary precautions shall be taken to ensure the safety of workers form flying spindle, tendon or the jack in the event of a break occurring.

5.6 Cutting Cable End

After all stressing operations are completed the projecting wire or strand, unless otherwise stipulated shall be cut off approximately 40mm from the face of anchorage.

The cutting of strand shall be done either by mechanical means, for example with a high speed cutting disc designed specifically for this purpose or by using very small and very hot oxy-acetylene flame for not more then 2 seconds for each wire or strand. If flame cutting is used, it is of the utmost importance to ensure that there is no appreciable heating of the wire stubs at the anchorage. A useful check of the proper adjustment of the flame-cutting equipment is to experiment on a scrap end of wire holding the wire in the naked hand 125mm from the place where it is being flame-cut. If the hand feels the applicable heat, either during or immediately after the cutting, the too much heat is being absorbed by the strand owing to the slow speed of cutting which is usually due to an excessively large and/or insufficiently hot cutting flame. The equipment should then be readjusted and the experiment repeated until fully satisfactory performance is achieved. Periodic rechecks are advisable.

5.7 Grouting

The adequate grouting of cable ducts after stressing the cables shall be done under the supervision of qualified and competent personnel.

All cables shall be grouted soon after stressing with a neat Portland cement grout having a water/cement ratio of not more than 0.50 Grout shall be injected at a pressure of 0.2 N/sq mm.

Grout shall be mixed in a high speed motor driven mixer specially designed for this purpose and shall then be sieved into a pump unit where it shall be continuously mixed at a slow speed by means of a mechanical or hand operated agitator. The pump unit shall be of the diaphragm type, preferably motor driven, with a by-pass pipe to make possible the constant circulation of grout except when injection is actually taking place. All equipments shall be thoroughly washed with clean water at least once every three (3) hours during the grouting operations and at the end of use for each day.

Immediately before grouting, all cable ducts shall be blown through with compressed air followed by water and then a further flushing with compressed air in order to ensure that they are completely clean. If necessary, intermediate grout holes shall be used to assist in this operation. The volume of the duct space to be filled shall be estimated and checked against the volume of grout used, to ensure that these balance reasonably well. Grout shall be injected from the end points of any cable and intermediate grout holes, if any shall not be plugged until a steady flow of grout through them has been observed. The grouted member shall not be moved or disturbed after ½ an hour of grouting till upto 36 hours; it may be moved after 36 hours.

5.8 Making Good Recesses

After completing all grouting operations, the Contractor shall neatly plug the various grout holes and shall make good the recesses at the anchorages with class ‘C’ concrete all in a neat and workman like manner.

5.9 Erection of Precast Girder/Beams

Before casting the girders, the Contractor shall submit to the engineer, for his approval, a detailed scheme with description of the methods and equipment he proposes to use for handling, transporting the girders (from the casting and curing yard to the position for launching), their launching, and their placing, fixing and jointing them in their permanent positions, including all the temporary bracings to avoid girder rotation and/or buckling, and other safety precautions relating to these operations. The details of lifting attachments in the girders shall be subject to the approval of the Engineer except that the points of lifting must always be in the end zones of each girder as per specific written instructions of the Engineer.

The Contractor shall also provide methodology of erection of shuttering for cast-in-place portion of deck slab.

All cost of any damage of whatever kind caused due to negligence of the Contractor shall be borne by the Contractor and shall be made good at his expense.

6. MEASUREMENT & PAYMENT

6.1 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 Bills of Quantities.

6.1.1 Supply and installation of pre-stressing material i.e. pre-stressing cables, anchorages, sheathing etc.

6.1.2 Pre-stressing operations.

6.1.2 Cutting cable end and grouting of cable duct.

6.1.3 Submission of samples including testing.

6.1.4 Cleaning of cable ducts before placing/ insertion of grouting material.

6.1.5 Erection and launching of pre-cast girders.

6.2 Pre-stressing Strands

6.2.1 Measurement

Measurement of acceptably completed works of pre-stressing strands will be made on the basis of actual weight in tons of pre-stressing strands as shown on the Drawing or as directed by the Engineer.

6.2.2 Payment

Payment will be made for acceptable measured quantity of pre-stressing strands on the basis of unit rate per tons quoted in the Bills of Quantities and shall constitute full compensation for all works related to the item.

SECTION – 2509

BEARING PADS

1. SCOPE

The work under this section consists of furnishing all plant, labour, equipment, appliances and materials and performing all operations in connection with supply & installation of bearing pads, in strict accordance with this section of specifications and the applicable drawings, and subject to the terms and conditions of the Contract for a complete job.

2. GENERAL

Samples of al materials shall be submitted at least six weeks before it is intended to commence deliveries. No deliveries in bulk shall be commenced until the approval is given in writing by the Engineer satisfying himself that the material is considered satisfactory and complies with the specifications. Materials failing to comply with the requirements of the specifications shall be removed from the site immediately.

3. MATERIALS

All products covered under these specifications shall conform to AASHTO and BS5400 standards.

The bearing pad, shall be of a standard approved quality, comprising of an elastomer like neoprene; where the pad is reinforced by steel plates, the steel plates shall be fully enveloped in not less than 3mm thick neoprene all around for protection against weather. All metal parts of the bearings shall be protected against corrosion from prevalent environment.

4. TESTING

The elastomer, as determined from test specimens, shall conform to the following:

Test	**ASTM Designation**	**Requirements**
Tensile strength	D 412	160 Kg/sq.cm Min
Elongation at break	D412	350 Percent Min
Compression Set, 22 hrs. at 67 degree C	D 395 (Method B)	25 percent Max.
Tear Strength	D 624 (Die C)	13 Kg/sq. cm Min

Hardness (Shore A)	D 2240	60 +/ -5
Ozone resistance 20% strain, 100 hrs. at 38 degree C +/ -1 degree C	D 1149 (except) 100 +/ -20 parts per 100,000.000	No Cracks
Low temperature stiffness, Young's Modulus at 35 degree C	D 797	350 Kg/sq. cm Max
Low temperature brittleness, 5 hours at – 40 degree C	D 736	Passed

After accelerated aging in accordance with ASTM Designation D 573 for 70 hours at 100 degree C, the elastomer shall not show deterioration changes in excess of the following:

Tensile strength	+/ -15 percent
Elongation at Break	-50 percent (but not less than 300% total elongation of the material
Hardness	10 points
Shear Test (without vertical load)	7 Kg/sq. cm (Min)

Sampling shall be performed in accordance with AASHTO M251-74, as appropriate for the tests required during or immediately after manufacture.

The Contractor shall furnish to the Engineer a certification by the manufacturer that the elastomer, and fabric (if used), in the bearing pads to be furnished conforms to all of the above requirements. The certification shall be supported by a certified copy of the results of tests performed by the manufacturer upon samples of the elastomer and fabric to be used in the pads/ bearings.

The Engineer will take a sample of not less than 15 X 30 cm in size for testing from each lot of pads or batch of elastomer furnished, whichever results in the greater number of samples, The samples will be selected at random at the point of manufacture or, at the option of the Engineer at the job site. Samples taken at the job site shall consist of complete pads as detailed on the plans, and the Contractor shall furnish additional complete pads to replace those taken for testing. Pads shall be available for sampling three (3) weeks in advance of intended use. All sample pads for testing shall be furnished by the Contractor at his expense.

5. MEASUREMENT & PAYMENT

5.1 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 Bills of Quantities.

Submission of samples.

Embedding parts/ elements like MS plates, anchor bolts etc

5.2 Measurement

Measurement of acceptably completed works of bearing pads will be made on the basis of actual number of pads provided and fixed in position as shown in drawing or as directed by the Engineer.

5.3 Payment

Payment will be made for acceptable measured quantity of bearing pads 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 - 2510

PRECAST CONCRETE PAVING BLOCKS / TILES

01 SCOPE

The work shall consist of precast concrete paving blocks intended for the construction of low speed roads, parking areas, lay byes, industrial and other paved surfaces subjected to all categories of static and vehicular loading and pedestrian traffic. Paving blocks covered by these Specifications are designed to form a structural element and the surfacing of pavements, having the block to block joints filled, so as to develop frictional interlock and placed in conformity with the fines, grades, thicknesses and typical cross-section shown on the drawings or as directed by the Engineer.

02 MATERIAL REQUIRMENTS

For execution of this item provisions made in BS 6717 shall be applicable. Detailed requirement of materials and construction shall be as under:

2.1 BINDERS AND BINDER CONSTITUENTS

Paving blocks shall be made using one or more of the following binders or binder constituents complying with the requirements of the relevant standards:

Ordinary Portland Cement	BS 12
Portland Blastfurnace Cement	BS 146 : Part 2
Portland Pulverized Fuel ash Cement	BS 6588
Pulverized fuel ash	BS 3892: Part 1
Ground granulated Blast furnace slag	BS 6699

Where pulverized fuel ash is used, the proportions and properties of the combination with Portland Cement shall comply with BS 6588.

Where ground granulated blastfurnace slag is used, the proportions and properties of the combination with Portland Cement shall comply with BS 146 : Part 2.

2.2 AGGREGATES

Paving blocks shall be made using one or more of the following aggregates complying with the relevant standards:

Natural Aggregates (Crushed or Uncrushed)	BS 882 : 1983 (except grading requirements in clause 5)
Air Cooled blastfurnace slag	BS 1047 : 1083 (except grading requirements in 4.8)
Pulverized fuel ash	BS 3892 : Part-1 or Part-2
Ground granulated blastfurnace slag	BS 6699

2.2.1 Acid Soluble Material (Fine Aggregate)

When tested as described in BS 812 : Part 119, the fine aggregate (material passing a 5 mm sieve complying with BS 410) shall contain not more than 25% by mass of acid soluble material either in the fraction retained on, or in the fraction passing, a 600 μ m sieve.

2.3 WATER

The water shall be. of drinking quality or in accordance with the recommendations of appendix A of BS 3148: 1980.

2.4 ADMIXTURES AND PIGMENTS

Proprietary accelerating, retarding and water reducing agents shall comply with BS 5075: Part 1.

Pigments shall comply with BS 1014.

Calcium chloride shall comply with BS 3587

2.5 FINISHES

The finish should be agreed between the manufacturer and the Engineer.

Concrete described as "natural colour shall contain no pigment.

In composite paving blocks the surface layer shall be formed as an integral part of the block and shall be not less than 5 mm thick.

2.6 BINDER CONTENT

The cement content of the compacted concrete shall be not less than 380 kg/M^3 for equivalent durability, paving blocks made with binder constituents other than ordinary Portland cement shall have a higher binder content than paving blocks made in a similar way using only Portland Cement. The Engineer will decide the additional binder content. The compressive strength test will be the only guide to the amount of additional binder needed.

2.7 SIZES AND TOLERANCES

2.7.1 Sizes

Paving blocks shall have a work size thickness of not less than 60 mm. Type-R blocks shall be rectangular with a work size length of 200 mm and a work size width of 100 mm. Type-S blocks shall be of any shape fitting within a 295 mm square coordinating space and shall have a work size width not less than 80 mm.

The preferred work size thicknesses are 60 mm, 65 mm, 80 mm & 100 mm.

A chamfer around the wearing surface with a work size not exceeding 7 mm in width or depth shall be permitted.

All arises shall be of uniform shape.

2.7.2 Tolerances

The maximum dimensional deviations from the stated work sizes for paving blocks shall be as follows:

length	±	2mm
width	±	2mm
thickness	±	3mm

Where a paving block includes profiled sides, the profile shall not deviate from the manufacturer's specification by more than 2 mm.

2.8 COMPRESSIVE STRENGTH

The compressive strength of paving blocks shall be not less than 49 N/mM^2 and the crushing strength of any individual block shall be not less than 40 N/mM^2.

2.9 SAMPLING

The following sampling procedure shall be used for the compressive strength test.

a) Before laying paving blocks, divide each designated section, comprising not more than 5000 blocks, in a consignment into eight approximately equal groups, Clearly mark all samples at the time of sampling in such a way that the designated section or part thereof and the consignment represented by the sample are clearly defined. Take two (2) blocks from each group.

b) Dispatch the sample to the test laboratory, taking precautions to avoid damage to the paving blocks in transit. Each sample shall be accompanied by a certificate from the person responsible for taking the sample, stating that sampling was carried out in accordance with this Part of BS 6717.

c) Protect the paving blocks from damage and contamination until they have been tested. Carry out any tests as soon as possible after the sample has been taken.

2.10 MARKING

The following particulars relating to paving blocks made in accordance with this standard shall be indicated clearly on the delivery note invoice, manufacturer's or supplier's certificate or brochure supplied with the consignment of blocks:

a) The name, trade mark or other means of identification of the manufacturer.

b) The number and date of this British Standard, i.e. BS 6717 : Part 1: 1986*; or latest revision.

03 CONSTRUCTION REQUIREMENTS

3.1 Laying the Concrete Blocks

The total area to be covered with paving block shall be prepared by:

a) Compaction of subgrade
b) Laying of subbase in a thickness specified
c) Laying of crushed aggregate base or lean concrete in thickness as per typical section

3.2 Tolerance

Tolerance of these layers shall be as per applicable requirement of each item of this specifications.

Payment for each of the above item shall be made under the relative item of work.

The total area will thereby be divide with nylon strings into sectors of not more than 1.5 square meters. This shall be done to control the alignment of paving blocks and to avoid multiplication of deviation in sizes of paving blocks.

04 MEASUREMENT AND PAYMENT

4.1 General

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

4.1.1 Providing, fixing, striking etc. of formwork.

4.1.2 Curing and testing of concrete.

4.1.3 Sand cushion in bed/joints for laying paving blocks/ tiles.

4.1.4 Edge precast blocks and cut units.

4.1.5 Cast insitu concrete to stablise edge precast blocks.

4.2 Pre-Cast Concrete Paving Blocks

4.2.1 Measurement

Measurement of acceptably completed works of pre-cast concrete paving blocks will be made on the basis of actual area in square metre of concrete paving blocks provided and laid in position to the line, level and grade as shown on drawing or as directed by the Engineer.

4.2.2 Payment

Payment will be made for acceptable measured quantity of pre-cast concrete paving blocks on the basis of unit rate per square metre quoted in the Bill of Quantities and shall constitute full compensation for all the works related to the item.

4.3 Pre-Cast Concrete Paving Tiles

4.3.1 Measurement

Measurement of acceptably completed works of pre-cast concrete paving tiles will be made on the basis of actual area in square metre of concrete tiles provided and laid in position to the line, level and grade as shown on drawing or as directed by the Engineer.

4.3.2 Payment

Payment will be made for acceptable measured quantity of pre-cast concrete paving tiles on the basis of unit rate per square metre quoted in the Bill of Quantities and shall constitute full compensation for all the works related to the item.

SECTION - 2550

PRECAST PRESTRESSED CONCRETE UNITS
DOUBLE TEE ROOF SYSTEM

1.0 SCOPE

1.1 This Specification covers the supply, manufacture and installation of precast prestressed concrete units.

1.2 All work associated with this Specification shall comply with the requirements of ACI 318, except where specifically varied by this Specification.

2.0 REFERENCE CODES

The following references codes, specifications and recommended practices shall be interpreted as the minimum requirements applicable to the subject work, and no statement contained in this specification shall be construed as limiting the work to such minimum requirements.

2.1 American Concrete Institute (ACI)

Detailed recommendations for acceptable practices, while not a part of these specifications, are available in the following standards and recommendations of the American Concrete Institute. Except as specified otherwise herein, or noted on the drawings, all concrete and reinforcing steel work shall be performed in strict conformance with the below-listed standards and recommendations. The latest edition of the standard at the time of issuance of specification shall apply.

2.1.1 ACI 305R, "Recommended Practice for Hot Weather Concreting"
2.1.2 ACI 306R, "Recommended Practice for Cold Weather Concreting"
2.1.3 ACI 315, "Details and Detailing of Concrete Reinforcement"
2.1.4 ACI 318, "Building Code Requirements for Reinforced Concrete "

2.2 American Society for Testing Materials (ASTM)

The specifications of the American Society for Testing Materials referred to herein are part of these specifications. The latest revision to the specifications at the time of issuance of this specifications shall be used.

2.2.1 ASTM A36, "Standard specification for Structural Steel"
2.2.2 ASTM A153, "Zinc Coating (Hot- Dip) on Iron and Steel Hardware"
2.2.3 ASTM A416, "Specification for Uncoated Seven-Wire Stress Relieved Low Relaxation Strand for Prestressed Concrete"
2.2.4 ASTM A615, "Deformed and Plain Billet-Steel Bars for Concrete Reinforcement"
2.2.5 ASTM C31 "Method of Making and Curing Compression and Flexure Test Specimens in the Field"
2.2.6 ASTM C33, "Specifications for Concrete Aggregate"
2.2.7 ASTM C39, "Methods of Test for Compressive Strength of Molded Concrete Cylinders"
2.2.8 ASTM C42, "Methods of Obtaining and Testing Drilled Cores and Sawed Beams of Concrete"
2.2.9 ASTM C94, "Specifications for Ready-Mixed Concrete"
2.2.10 ASTM C138, "Method of Test for Weight per Cubic Foot, Yield, and Air Content (Gravimetric) of Concrete"
2.2.11 ASTM C143, "Method of Test for Slump of Portland Cement Concrete'
2.2.12 ASTM C150 "Specification for Portland Cement"
2.2.13 ASTM C172, "method of Sampling Fresh Concrete"
2.2.14 ASTM C173, "Method of Test for Air Content of Freshly Mixed Concrete by the Volumetric Method"
2.2.15 ASTM C231, "Air Content of Freshly Mixed Concrete by the Pressure Method"
2.2.16 ASTM C260, "Specification for Air-Entraining Admixtures for Concrete"
2.2.17 ASTM C309, "Specification for Liquid Membrane-Forming Compounds for Curing Concrete"
2.2.18 ASTM C494, "Specification for Chemical Admixtures for Concrete"
2.2.19 ASTM C685, "Concrete made by Volumetric Batching and Continuous Mixing"

2.3 American Welding Society

2.3.1 AWS D1.1 - Structural Welding Code - Steel

3.0 MATERIALS

All materials their handling and storage shall comply with sections 2300 of Technical Specifications of the main Contract Documents.

4.0 PROPORTIONING AND QUALITY OF MIX

4.1 General

4.1.1 Concrete for all parts of the work shall be homogeneous and, when hardened, shall have the required strength, resistance to deterioration, durability, resistance to abrasion, watertightness, appearance, and other specified properties.

4.1.2 Concrete used in the precast prestressed units shall have a minimum characteristic compressive strength of 27.6 Mpa (4000 PSI) at 28 days, and the compressive strength at transfer shall be a minimum 20.68 Mpa (3000 PSI).

4.1.3 The maximum water/cement ratio for all concrete shall be 0.50 by mass.

4.1.4 The minimum total content of cementicious material for all concrete shall be as specified in section 2300 of Technical Specifications of main Contract Documents.

4.1.5 The Contractor shall note that the strength requirements are a minimum and that other criteria may control the approved mix.

4.2 Slump

4.2.1 Slump of concrete for the precast units, as determined by ASTM C-143, shall be between 20mm and 75mm.

4.3 Selection of Proportions

4.3.1 The Contractor shall be responsible for the design and production of all concrete used in the Works. The use of ready-mixed concrete shall in no way lessen or remove this responsibility.

4.3.2 Not less than 2 weeks prior to the commencement of concreting operations the Contractor shall submit details of mix design for each specified class of concrete to the Company representative for approval. The submission shall include the following information:

(a) Class of Concrete
(b) Supplier of Concrete (if ready mixed)
(c) Proportion (by weight) of various materials comprising the mix (including any proposed admixtures)
(d) Certificates of Compliance for various materials used in the mix
(e) Target Strength
(f) Target Slump
(g) Degree of Quality Control over the mix
(h) Method of Placing

4.3.3 The Contractor shall state the proposed degree of control when details of the proposed mix design are submitted. If during the course of work this degree of control is not maintained (as evidenced by either the batching and mixing and placing methods employed, or by the strength of test cylinders taken on the Work), the Engineer/Client may withdraw approval, pending either redesign of the mix, or establishment of improved quality control, or revision to the method of placing. Where a new m 'ix design is prepared, testing of the new mix shall be carried out at the Contractor's expense.

5.0 TESTING

5.1 Sampling and Testing

5.1.1 All sampling and testing of concrete shall be done in accordance with ASTM C31, C39 and C172, by a testing Authority approved by the Engineer/Client, and the cost of all such sampling and testing shall be borne by the Contractor.

5.1.2 For every five precast units manufactured, a minimum of six standard test cylinders shall be made from mix batches as directed by the Engineer/Client. Each cylinder so cast shall be clearly marked on the side with the following information:

Mark Nos. of Precast Unit
Date of Casting
Cylinder Number

5.1.3 The Contractor shall record in a log book kept at the precasting yard the details of all cylinders cast as listed above, together with results of compressive tests on each cylinder and date of testing. The log book shall be kept up to date and all information therein shall be made available to the Engineer/Client for inspection at all times.

5.1.4. All trest cylinders shall be cured in accordance with ASTM C31.

5.1.5 Before transfer of prestress is effected, compression testing of cylinders shall be undertaken as described below to determine concrete strength.

5.1.5.1 Two Cylinders shall be tested to failure initially. If both cylinders display an acceptance strength, transfer may take place. In the vent that either one of these cylinders fails to meet the transfer strength indicated on the Drawings, further curing of the precast unit shall take place.

5.1.5.2 After adequate additional curing, two more cylinders shall be tested to determine concrete strength for transfer. A minimum of two cylinders per sample shall be tested at 28 days to determine final design strength. Erection of precast units shall not be permitted prior to satisfactory final concrete strength being demonstrated and in any case not until 30 days from casting of the units have elapsed.

5.1.6 If contractors prefers to test the concrete by cubes rather than cylinders, he shall submit applicable codes and procedures to Engineer/Client for approval,

5.1.7 All phases of precasting, including pretensioning, casting and release shall be subject to supervision. No casting of concrete shall occur prior to inspection of formwork, dimensions of cored holes and inserts, strand and reinforcing steel. In no case is transfer of prestress to be effected except in the presence of the Engineer/Client. A least twenty-four (24) hours notice shall be given to the Engineer/Client prior to an inspection being required.

5.2 Records

The Contractor shall enter into the log book kept permanently on site, the following additional information of each unit cast:

Mark number
Final Load and measured extension of each strand
Order of stressing of strands
Date of stressing of strands
Date of casting
Date transfer of prestress
Measured midspan log immediately after release of prestress

FORMWORK

6.1 The soffit formwork for units should preferably be of steel plate integral with the casting bed. Before casting each unit the levels of this formwork shall be checked and the bed adjusted if necessary to provide a horizontal surface.

6.2 Side forms may be steel, or high quality timber (preferably varnished plywood). A stripping oil shall be applied to interior surfaces of formwork before casting, but no oil shall be allowed to remain on steel reinforcement or fixtures. Any steel which has accidentally been brushed with oil during placing shall be cleaned using a suitable solvent before casting.

6.3 All chamfers shown on the Drawings shall be formed. On no account are chambers on upper surface to be made by hand. Holds made in re-usable forms for fittings which do not coincide with holes required for the new casting are to be refinished so as to provide a similar final surface finish to that which would be achieved with new forms.

6.4 The Engineer/Client shall inspect the formwork prior to casting for strength, rigidity, dimensional tolerance and surface texture. However, the responsibility for the formwork shall remain with the Contractor. Unacceptable defects arising from any of these causes shall be made good prior to casting at the Contractor's expense.

6.5 Side forms shall be stripped as soon as possible after the initial gain of strength of concrete to facilitate curing operations.

6.6 Stripping shall proceed carefully so as to prevent damage to precast units or inserts. Any method of stripping, which in the opinion of the Engineer/Client is liable to damage units, shall be discontinued.

6.7 Formwork which is intended for re-use shall be thoroughly cleaned and repaired, as necessary, as soon as possible after stripping, and handled and stored in such a manner as to minimize surface damage. In particular, timber forms shall be protected from direct sunlight to prevent opening of seams due to shrinkage of timber.

6.8 Tolerances for the manufacture of precast, prestressed units shall be as specified below:

6.8.1	Width and Depth.....	+7mm
6.8.2	Flange Thickness.....	7mm; -4mm
6.8.3	Web Thickness.....	+4mm
6.8.4	Total Length.....	+19mm
6.8.5	Variation from straight line.....	+19mm
6.8.6	Camber-Variation from design.....	+16mm
6.8.7	Position of tendons.....	+7mm
6.8.8	Location of inserts	+7mm

7.0 REINFORCEMENT AND EMBEDDED ITEMS

7.1 General

7.1.1 Reinforcing steel shall be deformed bars, grade 60 conforming with ASTM A615, or approved equal. No smooth bars will be allowed.

7.1.2 The tendons for prestressing shall be uncoated 7 wire Grade 270 (1860 Mpa) stress relieved strands of 12.7mm nominal diameter or as shown on the Drawings in accordance with ASTM A416. Minimum breaking load shall be 184 kN (41,365 lb) and minimum 0.2% proof load shall be not less than 90% of the minimum breaking load.

7.1.3 Welding of Grade 60 ASTM A615 reinforcing steel will not be permitted.

7.2 <u>Fabrication of Reinforcing Steel</u>

7.2.1 All reinforcing steel shall be bent and fabricated to tolerances given in ACI 315.

7.3 Placing of Reinforcement

7.3.1 All reinforcing steel shall be accurately located in the forms and firmly held in place before and during the placing of concrete by means of supports such as wire chairs, metal hangers, and by tieing. Tack welding will not be allowed.

7.3.2 Contractor shall furnish all accessories, such as supports, spacers, hangers, etc. necessary for the proper placing of reinforcing steel, and such accessories shall be subject to approval by Company.

7.3.3 All steel reinforcing bars, wire ties, etc., shall be clean and free from scale, dirt, oil, and loose rust.

7.3.4 All reinforcing steel shall be inspected and approved by the Engineer/Client or Inspector before the concrete is placed. The systems holding bars in place must ensure that all steel in the top surface will support the weight without displacement.

7.3.5 Bars shall be placed to the following tolerances:

7.3.5.1 Minimum concrete cover: +6mm

7.3.5.2 Uniform spacking of reinforcement from theoretical location: +5mm

7.3.5.3 Tolerance from the surface to location of reinforcing bars: +10mm

7.3.5.4 Uniform spacing of stirrups and ties from theoretical bars: +26mm

7.3.6 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 by the Company.

7.4 Quality of Prestressing Strands

7.4.1 Manufacturer's test certificates for each brand of tendons to be used in the Works shall be supplied to the Engineer/Client not less than one week before the material is to be used. In the absence of Manufacturer's test certificates, at least three (3) representative samples, each 1.5m long, from each batch of tendons and bars shall be supplied to a testing laboratory approved by the Engineer/Client. Each of the samples shall be subjected to such tests as will confirm compliance with the above Specifications. The cost of such testing shall be borne by the Contractor.

7.4.2 Any failure to achieve the specified limits shall render the batch from which the sample is drawn liable to rejection for use.

7.4.3 As soon as practicable after removal from the prestressing bed, and prior to erection, all strands in prestressed units shall be cut off flush with the beam ends. Strands may be flame cut provided the technique of cutting is tested on a loose strand to achieve the quickest possible cutting time with a minimum of heating. .

7.4.4 After cutting off excess strands for prestressed units, the exposed strand end and surrounding concrete shall be generously covered by painting with an epoxy paint approved by the Engineer/Client to prevent ingress of moisture.

7.5 Embedded Items

7.5.1 Installation of Embedded Items

7.5.1.1 Inserts, supports, hangers, pipe sleeves, conduits, drains, metal dams, anchor bolts, etc. shall be placed and secured in position by templates or other suitable means before concrete is placed.

8.0 MIXING

Mixing, transporting, placing and consolidation shall be as specified in Section 2300 of the Technical Specifications of the main Contract Documents.

9.0 TRANSFER OF PRESTRESS

9.1 When the minimum compressive strength for transfer has been demonstrated to the satisfaction of the Engineer/Client the prestress shall be transferred to the concrete.

9.2 Release from anchorages shall be done in such an order so as to prevent undue stresses in the concrete arising from excessive eccentricity.

9.3 Release of strands shall be gradual, an sudden cutting of wires will not be permitted. The Contractor shall submit details of anchorage devices and method of release to the Engineer/Client for approval.

9.4 Bolts where used shall be entirely removed prior to transfer.

9.5 After release, the hog of each unit shall be measured at midspan and recorded in the log book.

9.6 Each unit shall be thoroughly inspected after transfer for surface signs of concrete distress, and no handling shall be permitted without the approval of the Engineer/Client.

10.0 CURING OF CONCRETE

10.1 Initial setting of concrete may be accelerated by steam curing. Steam if used, shall be distributed around the precast unit in such a way as to ensure that all surfaces are uniformly exposed to the steam. Supervision of curing shall be continuously maintained to ensure a thorough and efficient procedure. Alternatively, an automatic recording device shall be fitted to the steam line which will display on a time scale, steam flow during unsupervised hours. Details of steam curing procedure shall be submitted to the Engineer/Client for approval before commencing operations.

10.2 After transfer of prestress, curing shall continue for a minimum further period of seven days. Such curing shall preferably consist of a continuous flow of sprayed water onto all surfaces of the units, but as a minimum measure, all units shall be convered by absorptive material kept permanently wet.

10.3 As an alternative to water curing, proprietary liquid membrane compounds may be used and shall conform to ASTM C309, Type 2 (white pigmented). The compound shall be applied by spraying or brushing according to the Contractor shall submit the name and Manufacturer of the proposed compound to the Engineer/Client for approval at least two (2) weeks prior to commencing concrete operations.

10.4 Curing shall continue uninterrupted over-night, during weekends and public holidays etc, for the minimum period specified.

10.5 Each precast prestressed unit produced shall be marked permanently with its identifying mark number, prior to removal from the bed.

10.6 Hot Weather Curing

10.6.1 The curing of the precast units shall conform to the previous paragraphs in this section of the specification.

10.7 <u>Cold Weather Curing</u>

10.7.1 When the mean daily temperature of the atmosphere is less than 5°C (40°F), the concrete temperature shall be maintained between 10°C (50°F) and 16°C (60°F) for a minimum period of 3 days.

10.7.2 Following the removal of temperature protection, no positive measures to prevent excessive evaporation are required as long as the temperature remians below 10°C (50°F). If the temperature rises above 50°F, the concrete shall be cured for an additional four days according to Section 12.2 of this specification.

10.7.3 When the air temperature remains below 10°C (50°F) and excessive drying is anticipated, then the concrete shall be cured

for an additional four days. Excessive drying shall be defined as follows:

Air Temperature	Concrete Temperature	Relative Humidity
10°C	10°C	less than 40%
5°C	10°C	less than 60%
5°C	5°C	less than 11

The concrete shall be water cured where no freezing is expected. Otherwise the use of curing compounds meeting the requirements of ASTM C309 shall be used for the specified curing period.

11.0 HANDLING OF PRECAST UNITS

11.1 All precast units shall be lifted only by double slinging from twin lifting devices or a suitable spreader bar and single hoist from lifting loops positioned as shown on the Drawings. No other lifting points shall be permitted. The minimum anlge of the sling shall be 45° to the horizontal.

11.2 Precast units shall be lifted by both ends simultaneously and kept near horizontal during all movements.

11.3 All precast units shall be stacked by placing soft timber packing under both end lifting points, whether during transportation or when stockpiled for subsequent use.

11.4 Under no circumstances shall any other means of stacking be adopted.

11.5 Units may be placed on top of each other, spaced by timbers at support points mentioned above, provided that the net bearing stressso produced on the lowermost unit is less than 7 Mpa, (1000 PSI) and provided that the Engineer/Client is satisfied as to the suitability of the foundation material and stability of the stacked units.

11.6 During erection, units shall be handled by slinging from lifting points only, and all movements shall be gradual and procedures used shall be such as to minimize shock loading. Precast units shall always be handled with care to avoid damage.

12.0 ERECTION OF PRESTRESSED UNITS

12.1 General

12.1.1 Any labels, loose material, dirt grease, etc., shall be removed from all surfaces of the units before erection in order to facilitate adhesion of sceed and roofing material.

12.1.2 No prestressed unit shall be considered suitable for erection into position until at least thirty (30) days after casting.

12.2 Seating of Units

12.2.1 Prior to erection of any precast unit into the Works, the bearing seats shall be carefully prepared for receival of the unit.

12.2.2 Prestressed units shall be seated as indicated on the Drawings.

12.2.3 Units having the same or similar measured midspan hog shall be placed adjacent to each other wherever possible.

12.2.4 The units shall be carefully aligned to the tolerance listed below:

12.2.4.1Depature from established alignment ..... ±19mm

12.2.5 All lifting loops shall be cut off flush with the bottom of the recess in the unit. If flame cutting is used, the operation shall be carried out by a competent operator who shall ensure that the cutting is performed quickly to reduce a minimum the heat transfer into the unit along the lifting loop. After cutting, the recesses shall be packed level with a stiff epoxy mortar approved by the Engineer/Client.

13. MEASUREMENT & PAYMENT

13.1 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.

13.1.1 Providing and fixing in position all embedded items.

13.1.2 Transportation, handling, launching, Erection, welding, hoisting, jointing and fixing in position complete.

13.1.3. All hooks and other lifting arrangements.

13.1.4 Reinforcement steel.

13.1.5 Prestressing, Prestressing wires, all prestressing embedded items, anchor bars etc.

13.1.6 Drain pipes

13.1.7 Painting to embedded parts

13.2 Double Tee Roofing

13.2.1 Measurement

Measurement of acceptably completed works of Double Tee Roofing will be made on the basis of net actual area in square foot of the roof provided, erected and installed in position as shown on the drawings or as directed by the Engineer.

13.2.2 Payment

Payment will be made for acceptable measured quantity of Double Tee Roofing 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.

SECTIONS – 3000

STRUCTURAL STEEL WORKS

1. SCOPE

The work under this section consists of furnishing all material, labour, plant, equipment and appliances, fabricating, erecting, installing, testing, painting and all other items incidental to steel work for a complete job as shown on the drawings, specified herein and/or as directed by the Engineer.

2. APPLICABLE CODES AND STANDARDS

Latest edition of the following codes and standards are applicable to the work of this section:

AASHTO	Standard Specifications for Highway Bridges.
AISC	Specifications for the design, fabrication and erection of structural steel for buildings.
AISC	Manual of steel construction, LRFD & ASD.
AISC	Code of Standard Practice, for Steel Buildings and Bridges.
AISC	Specifications for structural joints using ASTM A325 or A490 bolts.
AISC	Guide to shop painting of Structural Steel.
ASTM A6	Standard specifications for general requirements for rolled steel plates, shapes, sheets, piling and bars for structural use.
ASTM A36	Structural Steel.
ASTM A307	Carbon steel externally and internally threaded standard fasteners.
ASTM A325	High strength bolts for structural steel joints including suitable nuts and plain hardened washers.
ASTM A446	Specifications for steel sheet zinc coated (galvanized) by the hot dipped process.
ASTM A490	Quenched and tempered alloy steel bolts for structural steel joints.
ASTM A501	Hot formed welded and seamless carbon steel structural tubing.
ASTM A563	Carbon and alloy steel nuts.
ASTM A709	Standard specification for structural steel for bridges.

ASTM E109 Dry powder magnetic particle inspection.

AWS D1.1 Specifications for welding of steel structures.

AWS D1.5 Bridge Welding Code.

ANSI
B 18.2.2.1 Plain Washers.

SSPC – SP6 Steel structures painting council – surface preparation specifications.

3. MATERIALS

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

3.1 Structural Steel

- Structural steel shall conform to the requirements of ASTM A-36, or ASTM A-709.
- Steel pipes shall conform to the requirements of ASTM A501 or shall be made of plates spirally welded.
- All material shall be supplied chirpy V-Notch testing in accordance with ASTM A6, Supplementary Requirement S5.

3.2 Welding

Welding electrodes shall match the base metal and shall conform to the requirements of AWS D1.1 specifications.

3.3 High Strength Bolts

All shop connections, except as noted herein or on the drawings, shall be made with High Strength Bolts in friction type connections, or by welding.

High strength bolts, heavy hexagonal nuts and hardened washers shall conform to the requirements of ASTM A325. All field connections, except noted, shall be made with high strength bolts in friction type connection.

3.4 Washers

Washers shall conform to the requirements of ANSI B18.2.2.1 and shall be of structural grade steel appropriate for the type of bolts for which they are used. For oversized holes, the washers shall be large enough to cover the entire hole by at least 6mm or as directed by the Engineer.

3.5 **Studies**

Steel Studies Shear Connectors shall conform to the requirements of Structural Welding Code-Steel, AWS D1.1.

4. CONNECTIONS

All connections shall be designed and detailed for 75% of the effective capacity of the member. A minimum of two bolts or equivalent welding shall be used per connection.

Shop connection may be welded or bolted. Field connections shall be bolted unless noted otherwise on design drawings or approved by the engineer.

5. ALLOWABLE STRESSES

Allowable design stresses for structural steel members and their connections, including temporary bracings and shorings shall be in accordance with AISC Specifications.

6. SHOP DRAWINGS

6.1 Shop drawings shall be submitted by the Contractor, for structural steel works, for acceptance in accordance with the requirements or the Contract Documents.

6.2 Shop drawings furnished for this section shall conform to the best standards of the construction industry. Shop drawings shall be prepared by and under the supervision of competent engineering personnel. Prior to submittal, the Contractor shall check each shop drawing for compliance with the requirements of the Contract Documents.

6.3 Shop drawings shall include plans, elevations, sections and complete details to describe clearly, at an ample scale, all work to be provided. Drawings shall be accurately dimensioned and shall be noted clearly.

6.4 All connections shall be designed and detailed as, per sub-section 4 above, by the contractor on the shop drawings. Design calculations for connections shall be made as per AISC specifications and shall be submitted alongwith the shop drawings after checking and signing by the Contractor for approval of the Engineer.

6.5 The shop drawings shall include

i. An erection scheme, in suitable size, having the following information:

- Location of erection elements in respect of axis and Marks as well as picking points of these elements with respect to each other or with the existing steel or reinforced concrete structures.
- Joints showing erection welding sizes and lengths, bolts diameter and numbers.
- Chart showing list of assembling marks having columns such as Mark, Description, Quantity, Weight of each Mark, total weight and Remarks with grand total in the end.
- Chart showing List of Erection Bolts, Nuts and Washers in tabulated form, detailing information such as size, quantity, weight and their grand totals.
- Quality of materials.
- Quality and type of welding electrodes.
- Measures to be adopted against unscrewing of bolts.
- Painting instructions.
- Erection sequence.
- References to relevant drawings.
- Except in special cases all scheme drawings shall be made in single fairly thick lines.
- The recommended scale of erection scheme is 1:50, 1:100, 1:200, for joints 1:5, 1:10 or 1:20.

ii. Fabrication drawings in suitable size shall contain the following information:

- Each Shop Assembly (Mark) shall be drawn separately showing necessary lines, elevations, sections with reference to axis, center lines, location of holes, cleats, plates, lugs etc. fully dimensioned with part numbers.
- Bolts and holes sizes.
- Welding symbols and welded joints requirements, in accordance with AISC manual of steel construction and AWS specifications.

- Geometrical Setting out dimensions necessary for the assembly of an element. Location and details of joints as calculated by the Contractor.
- Instruction for welding, dimensions of weld, edge preparations methods of welding, and methods for control of distortions.
- List of symbols for bolts and holes uses.
- List of symbols for welds used.
- Edge distance (general).
- Welding sizes and lengths (general).
- Standards and quality of materials.
- Type and quality of welding electrodes.
- Tests for welding.
- Reference to related erection scheme drawings.
- Reference to design and working drawings.
- part list.
- Instructions for surface preparation, painting, primer and finish coats.

Recommended scales for fabrication drawings are preferably 1:10 or 1:20, and for joints and details 1:1, 1:2, or 1:5.

7. FABRICATION

The Contractor shall notify the Engineer about any problems or doubts/errors, if any, in the drawings for clarifications/rectification well in time to prevent any fabrication errors. Fabrication shall not be commenced until approval has been obtained from the Engineer.

7.1 Straightening of Material

Rolled material, before being worked upon shall be straightened within tolerances as per ASTM specifications A6. Straightening, necessarily shall be done by mechanical means or by the application of a limited amount of localized heat. The temperature of heated areas, as measured by approved methods, shall not exceed 1200 ^{0} F.

7.2 Cutting

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

7.3 Holes Punching/Drilling

Holes shall be punched where thickness of the material is not greater than the diameter of bolt + 3mm. Where the thickness of the material is greater the holes shall either be drilled or sub-punched and reamed to size. The die for all sub-punched holes and the drill for all sub-drilled holes shall be at least 2mm smaller than the nominal diameter of the rivet or bolt.

7.4 Welding

7.4.1 All execution and inspection of welding shall be done in accordance with the provisions of the American Welding Society Specifications. No welding for piping/electrical supports shall be made transversely to any tension flanges or beams or columns.

7.4.2 Maximum and minimum size and lengths of fillet welds shall be in accordance with AISC specifications, or as mentions on drawing.

7.4.3 Surface to be welded shall be free from loose scale, slag, rust, grease, paint or any other foreign matter.

7.4.4 Butt welds shall be full penetration welds, unless otherwise specified and permitted.

7.4.5 Avoid the use of temporary welded attachments during fabrication as much as possible. After fabrication is completed, remove flush with the base material without encroaching on the minimum required base material thickness. After the surface has been restored, examine all areas from which temporary attachments have been removed by the same methods required for permanent fillet welds.

7.4.6 Do not begin structural welding until joint elements are tacked in intimate contact and adjusted to dimensions shown with allowance for any weld shrinkage that is expected. Weld heavy sections and those having a high degree of restraint with low hydrogen type electrodes. No member shall be spliced without approval.

7.4.7 For notch-toughness specified material, all weld metal, processes and preheat requirements shall be compatible to assure notch-tough composite weld metal.

7.4.8 Shop splices of webs and flanges in built-up girder shall be made before the webs and flanges are joined to each other.

7.5 **Tolerances**

Tolerances for Structural Steel be as per AISC Specifications unless noted otherwise.

8. WELDER QUALIFICATIONS

8.1 All welders contracted to perform work shall be required to show written evidence that they have been properly tested in compliance with the approved welding procedures.

8.2 Welders shall have been qualified in the proposed procedure by an established laboratory acceptable to the Engineer within the preceding 90 days.

8.3 All welders shall be qualified for the type of weldment, grade of steel, thickness of steel, welding process and welding position that they are employed to weld. Welders and welding operators that have not been performance qualified, for all material and thickness ranges used on the job, shall be restricted to welding only that portion of the work for which they are qualified.

8.4 Engineer reserves the right to have welders or welding operators requalified or removed from the job as he deems necessary during the progress of work. Engineer's decision regarding the qualifications of any welder shall be final.

9. WELDERS IDENTIFICATION

9.1 Each welder shall be assigned a unique identifying number or symbol that he shall use to identify all welding resulting from his skills.

9.2 Stenciled markings shall be applied within 40mm of the weld using low stress concentration dies. Written symbols are also acceptable.

9.3 A record shall be kept of these symbols by the Contractor. The records shall show welder's name, symbol assigned, procedures to which qualified, employment and test dates. This record shall be available to the Engineer's Representative at all times.

10. TEST ASSEMBLY

10.1 Fabricated components such as Beams Girders, Bracing, as and where required by planning, shall be test assembled in the shop prior to transportation to site.

10.2 Test assembly work and procedure should be planned during fabrication process.

10.3 Each test assembly shall be got inspected from the Engineer's Representative and shall be dismantled only after his approval in writing.

11. SURFACE PREPARATION AND PAINTING

11.1 Surface Preparation

a) All steel shall be cleaned free from loose scale, rust, burrs slag, etc. by means of sand blasting and/or other approved means as recommended by the manufacturer of paint.

b) The sand used for this purpose shall conform to the type as specified in SSPC-SP.6. It should be free from earth, dust, clay and moisture. For this, the Contractor shall submit the gradation (no less than that passing through a 16 mesh screen U.S. sieve series) and source of sand alongwith the sample for approval by the Engineer prior to commencing the sand blasting operation.

c) The size of sand particles, air pressure and size of the hose nozzle shall be correlated to give proper and acceptable surface.

d) Material which is to be used for fabrication of components to be galvanized later on shall not be cleaned (See clause 11.3).

11.2 Painting

a) After fabrication, assembly and surface preparation all assembled units shall be given two shop coats of epoxy primer and two coats of epoxy enamel paint in the fabrication shop.

b) One final coat of epoxy enamel paint shall be applied after erection of all components.

c) The thickness of each coat of paint shall be in accordance with the paint manufacturer's recommendation.

d) All other requirements for the specified paint system shall be in accordance with the paint manufacturer's specifications/recommendations.

e) The type of primer & paints to be applied shall be as specified in clause 11.2.1.

f) The Contractor shall use the best quality of the type of paint specified and shall get the same approved by the Engineer.

g) Steel work/Surfaces not to be painted

i) Steel work to be encases/embedded in concrete or surface in contact with concrete or grout shall not be painted, but shall be given a cement wash after surface preparation.

ii) Machined finished surfaces shall not be painted but shall be coated with rust preventive compound, approved by the Engineer immediately after finishing. Such surfaces shall also be protected with wooden pads or other suitable means for transportation. Unassembled pins, keys, and bolt thread shall be greased and wrapped with moisture resistant paper.

iii) Contact surfaces of connections using high strength bolts in friction type connections shall not be painted. Such surfaces of all components after fabrication shall be cleaned free of paint. No coating whatsoever then shall be applied to such surface. The surface roughness for high strength friction grip holts is a very important factor therefore components shall not be erected unless approved by the Engineer.

11.2.1 **Primer and Paint**

11.2.1.1 **Primer:**

Primer shall be epoxy primer of a proven quality. The type of primer to be used shall be approved by the Engineer.

11.2.1.2 **Paint:**

Paint shall be epoxy enamel of a proven quality. The type of paint to be used shall be approved by the Engineer.

11.3 Galvanising (Zinc Coating)

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

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

12. INSPECTION AND TESTS

12.1 Manufacturer's Test Certificate for all material used shall be furnished by the Contractor for Engineer's scrutiny and approval.

12.2 Rolling tolerance of all shapes and profile according to AISC shall be in accordance with the provisions of ASTM A6 specifications. These shall be checked by the Contractor before commencing work and shall be rejected if found not within limits.

12.3 Materials shall be tested for conformance with the specified standards at an approved testing laboratory as and when directed by Engineer.

12.4 Contract surfaces of connections using high strength bolts in friction type connections shall be got inspected and approved from the Engineer before bolting.

12.5 All bolted connections shall be got inspected and approved from the Engineer for types, size, number of bolts and installation including tightening.

12.6 Inspection and Testing - Welding

12.6.1 General

Acceptance criteria for welding shall be as per ASTM A514 & A517.

Welding shall be inspected and tested by an approved testing laboratory during fabrication and erection of structural steel as follows:

The testing laboratory shall be responsible for conducting and interpreting the tests. It shall state in each report whether or not the test specimens conform to all requirements of the Contract Document and shall specifically note any deviations therefrom.

Certify all welders and make 100 percent visual inspections and tests as follows:

- Record types and locations of all defects found in the welding work.
- The measures required and performed to correct such defects.

In addition to the requirements of AWS D 1.1, paragraph 8.15, each weld shall be visually free of slag, inclusions and porosity.

In addition to visual inspection of all welds magnetic particle, ultra-sonic and radiographic inspection shall be made of all welds as specified below. Magnetic particle tests shall be made on the root pass and finished weld.

The method of magnetic particle test shall be in accordance with ASTM E109. Any type of crack or zone of in-complete fusion or penetration shall not be acceptable.

Radiographic testing technique and standards of acceptance shall be in accordance with AWS D 1.1.

Ultra-sonic testing shall be performed in accordance with AWS D 1.1.

Welding inspection and test report showing evidence of the quality of welding shall be submitted by the Contractor. For each section of weld inspected and tested, furnish a report which clearly identifies the work, the welder's identification, the areas of inspections and test, the acceptability of the welds, and signature of the inspector or laboratory incharge. Each report shall be completed at the time of inspection or test. For radiographic examination, furnish a complete set of radiographs in addition to the reports. All inspection and testing shall be carried out in presence of the Engineer or his representative.

12.6.2 Test Methods

Use the following test methods as specified. The following list is in descending order. When a particular test method is specified for a joint and the method is impractical to use, use the next highest method practicable. The alternative method will be subject to approval, NDT procedures and techniques shall be in accordance with AWS D 1.1, section 6.7.

a) Radiographic Method: In addition to the requirements of AWS D 1.1, comply with ASTM E94.

b) Ultrasonic method.

c) Magnetic particle method.

d) Liquid Penetration Method: Visible-dye, solvent removable method only.

12.6.3 Members Designated for Tests

a) Built – up Members:

Examine 100 percent of flange-to-flange and web-to-web welding by the radiographic method. For all web-to-flange and pipe column seam welding, examine ten percent of each welder's work as follows:

- Full penetration groove welds by the ultrasonic.

- fillet welds and partial penetration groove welds by the magnetic particle method.

b) Moment Connection Joints:

- Examine 100 percent of all flange-to-flange and web-to-web welding as follows:

  Full penetration groove welds by the ultrasonic method or other method as designated by the Engineer.

  Fillet welds and partial penetration groove welds by the magnetic particle method.

- For all web-to-flange welding, examine ten percent of each welder's work as follows:

  Full penetration groove welds by the ultrasonic method or radiographic method as approved by the Engineer.

  Fillet welds and partial penetration groove welds by the magnetic particle method.

c) Column Base Plates.

d) Bracing Connections: Examine 100 percent of all welding for connection of diagonal bracing as follows:

- Groove welds by the ultrasonic method.

- Fillet welds by the magnetic particle method.

12.6.4. Requirement for ten percent Examination

a) Examine a 300mm section of weld in each 3m increment of each welder's work as directed by the Engineer. If the examination meets the acceptance standards of AWS D 1.1, the 3m of weld represented will be accepted.

b) if the examination fails to meet the acceptance standards, examine two additional 300mm sections in the 3m increment as directed by the Engineer. If both of these examinations meet the acceptance a standards, the 3m of weld represented will be accepted. Repair the defects detected in the first examination and re-examine.

c) If one or both of the examinations fails to meet the acceptance standards, examine the remaining weld of the 3m increment. Repair the areas that do not meet the acceptance standards and re-examine.

12.6.5 Repair and Re-Testing of Welds

Repair defective welds in accordance with AWS D 1.1, or replace the weld, and Re-test repaired and replaced welds by the same method and acceptance standard used to examine the original weld. In addition, when defective welds are found, the testing laboratory shall determine the cause of the defective welding and institute immediate corrective action.

All defective welding shall be repaired or replaced at the Contractor's expense.

12.7 **Rejection**

Neither the fact that the materials have been tested nor that the manufacturers test certificates have been furnished shall effect the liberty of the Engineer to reject material found not according to these specifications.

Materials or workmanship not in conformance with the provisions of these specifications shall be rejected at any time, after delivery or during the progress of the work or the completion and erection at site.

13. ERECTION

13.1 Bracing

All steel structures shall be carried up true and plumb within the limits defined in the AISC code of standard practice, and temporary bracing shall be introduced wherever necessary to take care or all construction loads to which the structure may be subjected including the equipment and the operation of the same. Such bracing shall be left in place as long as required for safety.

Wherever piles of materials, erection equipment and other loads are carried during erection, proper provision shall be made by the Contractor to take care of the stresses resulting form such loads.

13.2 Alignment

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

13.3 Joints Using High Strength Bolts

All structural joints using high strength bolts shall be executed and inspected in accordance with "AISC Specification for structural joints using ASTM A325 or A490 bolts". High strength bolts and nuts, loosened after tightening, shall be discarded and replaced with unused bolts and nuts.

14. MEASUREMENT AND PAYMENT

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

14.1.1 Nuts, bolts, screws, washers, weld metal and welding rods.

14.1.2 Testing of materials and welds, and repair of defects.

14.1.3 Surface preparation including cleaning with sand blasting.

14.1.4 Painting including primer coats.

14.1.5 Galvanizing

14.1.6 Fabrication

14.1.7 Erection

14.2 Structural Steel Works

14.2.1 Measurement

Measurement of acceptably completed works of structural steel, will be made on the basis of weight in tonnes (1000 kg), according to approved shop drawings, after verification at site to the satisfaction of the Engineer that the items fabricated, supplied and erected in position conform with the contract and approved shop drawings.

14.2.2 Payment

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

SECTION - 3100

MISCELLANEOUS STEEL WORKS

1. SCOPE

The work covered under this section of Specifications consists of supply of all material, labour, plant, equipment and appliances required for embedded items and any other work shown in the drawings and as directed by the Engineer.

2. APPLICABLE STANDARDS

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

AISC	Code of Standard practice.
ASTM	A-36 for structural steel.
ASTM	A-53 steel pipe for railing.
AISC/SSPC	Guide to Shop painting for structural steel.
AWS	Specifications for welding of steel structures.

3. DRAWINGS.

3.1 Design Drawings.

Design working drawings shall be supplied to the Contractor. These shall contain main dimensions, sizes of members, typical details, etc.

3.2 Shop Drawings.

Shop drawings shall be prepared by the Contractor from the working drawing supplied, taking into consideration the instructions given by the Engineer and submitted to the Engineer for his approval. No work shall commence until shop drawing is approved by the Engineer.

4. MATERIAL

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

4.1 Structural Steel

Structural Steel shall conform to the requirements of ASTM A-36 or equivalent.

Pipe for hand rail shall conform to the requirements of ASTM A-53.

4.2 Welding

Welding Electrodes shall conform to the specifications for mild steel covered Arc-welding Electrodes, AWS A5.1 latest edition. Equivalent locally manufactured electrodes may be used subject to the approval of the Engineer.

5. FABRICATION

The Contractor shall notify the Engineer about any problems or doubts/errors discovered in the drawings supplied by the Engineer for clarification/rectification well in time to prevent any fabrication errors. Fabrication shall not be commenced until approval has been obtained from the Engineer.

5.1 Straightening of Material

Rolled material, before being worked upon must be straightened. Straightening, necessarily shall be done by mechanical means or by the application of a limited amount of localised heat.

5.2 Cutting

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

5.3 Holes Punching/Drilling

Holes shall be punched where thickness of the material is not greater than the diameter of bolt + 1/8 inch. Where the thickness of the material is greater, the holes shall either be drilled or sub-punched and reamed to size. The die for all sub-punched holes and the drill of all sub-drilled holes shall be at least 1/12 inch smaller than the nominal diameter of the rivet or bolt.

5.4 Welding

5.4.1 General: The execution and inspection of welding will be done in accordance with the provisions of the American Welding Society Code for Welding in Building construction, D1.1.

5.4.2 Maximum and minimum size and lengths of fillet welds shall be in accordance with AISC specifications.

Surface to be welded shall be free from loose scale, slag, rust, grease, paint or any other foreign matter except mill scale which withstands vigorous wire brushing.

5.5 Tolerances

The maximum variation in the distance from centre to centre of holes for rivets or bolts shall not be greater than 1mm.

5.6 **Methodology**

Fabrication shall be carried out using all the necessary tools, plant and equipment in accordance with methodology for fabrication approved by the Engineer.

6. INSPECTION AND TESTS

6.1 The inspection of welding shall be performed in accordance with the American Welding Society specifications, as directed by the Engineer.

6.2 Materials or workmanship not in reasonable conformance with the provisions of these specifications shall be rejected at any time during the progress of the work or the completion and erection at site.

7. ERECTION/INSTALLATION

Erection/Installation work shall be carried out by using required tools, plant and equipment in accordance with methodology for erection approved by the Engineer.

8. SURFACE PREPARATION

8.1 Surface Preparation

8.1.1 All steel shall be cleaned free from loose scale, rust, burs, slag, etc. by means of sand blasting and/or other approved means as recommended by the manufacturer of paint.

8.1.2 The sand used for this purpose should be free from earth, dust, clay and moisture. For this, the Contractor shall submit the gradation (no less than that passing through a 16 mesh screen U.S. sieve series) and source of sand along with the sample for approval of the Engineer prior to commencing the sand blasting operation.

8.1.3 The size of sand particles and air pressure size of the hose nozzle shall be correlated to give proper and acceptable surface.

8.1.4 Steel work/Surfaces not to be Painted

i) Steel work to be encased/embedded in concrete or surface in contact with concrete shall not be painted, but shall be given a cement wash after surface preparation.

ii) Bolt and nuts threads shall be protected by greasing till they are tightened and painted.

9. MEASUREMENT & 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 work 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 rates of the respective items of the Bill of Quantities.

9.1.1 Nuts, bolts, screws, rivets, heads, fillets, welds and welding rods.

9.1.2 Surface preparation, painting or galvanizing

9.1.3 All embedded parts unless otherwise specified in Bill of Quantities.

9.2 Miscellaneous Steel Works

9.2.1 Measurement

Measurement of acceptably completed Works of miscellaneous steel works will be made on the basis of weight in ton, according to approved shop drawings, after verification at site to the satisfaction of the Engineer that the items fabricated, supplied and erected in position conform with the Contract and approved shop drawing.

9.2.2 Payment

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

9.2 Hand railing

9.3.1 Measurement

Measurement of acceptably completed Works of hand railing will be made on the basis of weight in ton, according to approved shop drawings, after verification at site to the satisfaction of the Engineer that the items fabricated, supplied and erected in position conform with the Contract and approved shop drawing.

9.3.2 Payment

Payment will be made for acceptable measured quantity of MS hand railing on the basis of unit rate per weight in ton quoted in

the Bill of Quantities including base plates, vertical balustrades etc and shall constitute full compensation for all the Works related to the item.

SECTION - 4430

LIQUID WATER PROOFING

GENERAL

1. DESCRIPTION

This section covers fabricating, furnishing, and installing liquid waterproofing.

2. APPLICABLE CODES AND STANDARDS

The codes and standards applicable to only a portion of the work specified in this section are referenced in the relevant paragraphs. Codes and standards which are generally applicable to the work of this section are listed hereinafter:

Sponsor	Number	Subject
ASTM	C 836	High Solids Content, Cold Liquid-Applied Electrometric Waterproofing Membrane for Use with Separate Wearing Course.

3. SUBMITTALS

The following submittals are required:

A. Detail Drawings and/or Shop Drawings

Show edge treatment and changes in plane.

B. Manufacturer's Data

C. Installation Manuals

4. QUALITY ASSURANCE

The manufacturer shall be a firm with not less than five years of successful experience in supplying the principal materials for the required work, or with a successful record of supplying materials for not less than 46,500 m^2 of waterproofing work.

A Compatibility

Where waterproofing is to be installed beneath epoxy mortar, if waterproofing has not previously been successfully applied beneath epoxy mortar, run tests necessary to ensure compatibility and to ensure that waterproofing and tile work will not be detrimentally affected.

PRODUCTS

5. MATERIALS

A. Urethane Based Waterproofing, Two-Part (beneath ceramic tile/ ceramic /terrazzo/granite except as otherwise indicated), Type UB 2.

Polyurethane rubber based liquid materials, self-bonding to all normal substrates, compounded to be compatible with bituminous products, package in two components to be mixed at the time of use, compounded specifically for the application method to be used (by hand or spray) and for the slope of substrate, not less than 97 percent solids in the uncured blend, tested by manufacturer to comply with the following requirements for the cured membrane:

a) Tensile Strength (Minimum): 276 kPa ASTM D 412.

b) Elongation (Minimum Ultimate): 400 percent; ASTM D 412.

c) Hardness (Shore 00): 3 to 5; ASTM D 2240

d) Water Absorption (Maximum): 0.5 percent for 21 days at 24° C; ASTM D 471.

e) Low Temperature Brittleness: - 51° C; ASTM D 746

f) Heat Aging: No measurable effect from 168 hours at 70° C ASTM D 746.

C. <u>Type E1 Membrane</u>

Mameco "Vulkem 102" or other approved two-component (chemically catalized) electrometric system, not less than 1.6 mm dry film thickness, certify cured film to meet or exceed the following requirements:

a) Hardness: 50 minimum as measured by a 00 hardness gauge.

b) WVT in Perms (ASTM E 96) procedure BW, 60 mil film: 0.09 maximum.

c) Elongation (ASTM D 412): 600 TO 700 percent.

d) Tear Resistance (ASTM D 624, Die C): 11.4 – 12.3 kN/m.

e) Strength at 100 Percent Modulus (ASTM D 412): 414 kPa minimum.

f) Tensile Strength (ASTM D 412): 1.86 Mpa minimum.

g) Recovery (FS SS-S-200) 92 percent minimum.

h) Peel Adhesion After Water Immersion (ASTM C 836): 22-36 N per 25 mm.

I Water Absorption (ASTM D 471): One percent maximum weight gain.

j) Heat Aging (7 Days at 82° C): 3 percent maximum weight loss.

k) Service Temperature: - 21° C to 76 ° C.

l) Elastomer Resin Content: 25 percent minimum resin; 91 percent total solids.

D. Type E2 Membrane

Mameco "Vulkem 101" or other approved one-component (self- catalyzed) elastomeric system, not less than 1.6 mm dry film thickness: certify cured film to meet or exceed the requirements specified for Type E1 membrane, items 1 to 12.

E. Type E3 Membrane

Mameco "Vulkem 222" or other approved two-component (chemically catalyzed) tar modified elastomeric system, not less than 2.4 mm dry film thickness; certify cured film to meet or exceed following requirements:

a) Hardness (Shore 00): 50 minimum

b) WVT in perms (ASTM E 96) Procedure BW, 60 mil film: 0.09 maximum.

c) Elongation (ASTM D 412): 400 to 600 percent.

d) Tear Resistance (ASTM D 624, Die C): 7 – 9.6 kN/m

e) Strength at 100 Percent Modulus (ASTM D 412): 0.35 – 0.62 Mpa.

f) Tensile Strength (ASTM D 412): 1.5 Mpa minimum.

g) Recovery (FS SS-S200): 90 percent minimum.

h) Peel Adhesion After Water Immersion per 25 mm Width (ASTM D 836): 22-36 N.

i) Water Absorption (ASTM D 471): One percent maximum weight gain.

j) Heat Aging (7 Days at 82° C): 3 percent maximum weight loss.

k) Service Temperature: - 40° C to 49 ° C.

l) Elastomer Resin Content: 25 percent minimum resin; 98 percent total solids.

F. Type E4 Membrane

Mameco "Vulkem 201"or other approved one-component (self-catalized) tar modified elastomeric system, not less than 2.4 mm dry film thickness; certify cured film to meet or exceed following requirements:

a) Hardness (Shore 00): 50 minimum

b) WVT in Perms (ASTM E 96) Procedure A, 50 mil film: 0.09 maximum.

c) Elongation (ASTM D 412): 400 – 700 percent.

d) Tear Resistance (ASTM D 624, Die C): 7.8 kN/m.

e) Strength at 100 Percent Modulus (ASTM D 412): 0.35 MPa minimum.

f) Tensile Strength (ASTM D 412): 0.76 MPa minimum.

g) Recovery (FS SS-S-200): 90 percent minimum.

h) Peel Adhesion After Water Immersion per 25 mm Width (ASTM D 836): 22-36 N.

i) UV Resistance: Not applicable.

j) Weatherometer: Not applicable.

k) Service Temperature: - 40° C to 121° C.

l) Elastomer Resin Content: 25 percent minimum resin; 80 percent total solids.

G. Type E5 Membrane

Trowel grade with similar properties to elastomer with which it is used. Mameco "Vulkem 203" for use with tar modified systems, otherwise trowel grade "Vulkem 101" where concealed; use Mameco "Vulkem 116" or other approved urethane elastomeric sealant, meeting requirements of "Sealants" section of Division 7 where exposed.

H. Type E6 Membrane, 1 Part

Mameco "Vulkem 107" or other approved one-component (self-catalized) elastomeric system, not less than 1.6 mm dry film thickness, certify cured film to meet or exceed following requirements:

a) Hardness: 50 as measured by 00 hardness gauge.

b) WVT in Perms (ASTM E 96) Procedure A, 50 mil film: 0.09 maximum.

c) Elongation (ASTM D 412): 400 – 700 percent.

d) Tear Resistance (ASTM D 624, Die C): 7.8 kN minimum.

e) Strength at 100 Percent Modulus (ASTM D 412): 0.35 MPa minimum.

f) Tensile Strength (ASTM D 412): 0.76 MPa minimum.

g) Recovery (ES SS-S-200): 90 percent minimum.

h) Peel Adhesion After Water Immersion per 25 mm width (ASTM C 836) : 27-36 N.

i) UV Resistance: Not applicable

j) Weatherometer: Not applicable

k) Service Temperature: 40° C to 121° C.

l) Elalstomer Resin Content: 25 percent minimum resin; 98 percent total solids.

I. Miscellaneous Materials

a) Primer/Filler/Sealer: As recommended by the waterproofing manufacturer and as shown.

b) Flashing, Cant Strips, and Accessories: As recommended by the waterproofing manufacturer as shown.

c) Aggregate: Aggregate shall have a minimum hardness of 6.5 on the Mohs scale. Aggregate shall be sized as recommended by the waterproofing manufacturer so that 75 percent of each granule becomes embedded in the topcoat

EXECUTION

6. JOB CONDITIONS

A. General

Proceed with the installation of waterproofing only after the substrate construction has been completed, concrete has cured for 28 days minimum and penetrating components have been installed, so that the membrane will not be penetrated or damaged by subsequent work.

B. Inspection

Examine the substrates, adjoining construction, and the conditions under which the work is to be installed. Do not proceed with the work until unsatisfactory conditions have been corrected.

7. PREPARATION OF SUBSTRATE

A. Cleaning

Clean the substrate of dust, debris, oily materials, and other substances detrimental to the work and as recommended by the waterproofing manufacturer.

B. Accessories

Install cant strips and accessories as shown and as recommended by the waterproofing manufacturer (even though not shown) in the manner recommended by the manufacturer.

C. Flashing

Install sheet-type flashing and joint covers where shown and as recommended by the waterproofing manufacturer (even though not shown) in the manner recommended by the manufacturer. If fabric reinforcement is used, embed it in the waterproofing.

a) Except as otherwise shown, extend flashings onto perpendicular surfaces and other work penetrating the substrate to a point 100 mm from (above) the finished surface to be applied over the membrane. At door openings, extend membrane to top of concrete recess for ceramic tile. At stud partitions, extend sheet flashing up 100 mm behind lathing.

D. Expansion Joints

At locations of possible movement in the substrate construction (including cracks which have developed, construction joints, and expansion joints) prepare the substrate to in crease the waterproofing capability for bridging the movement without failure. Cover the joint to a 50 mm minimum width with either a bond-breaker elastic tape (sealed at only the edges) or a heavy coating of inert wax-type compound. Use only products which have been determined to the compatible with the waterproofing membrane.

E. Sealing

Fill voids and non moving cracks and joints in the substrate with sealant or other compound as recommended by the water proofing manufacturer for compatibility. Fill rough areas of substrate (rough within limitations specified by manufacturer) with a feathered-out coating of waterproofing, squeegee- applied to form a smooth top surface.

F. Priming

Prime substrate as recommended, and only if recommended, by the waterproofing manufacturer.

G. Masking

Mask off adjoining surfaces not to receive waterproofing to effectively prevent the spillage or migration of liquid materials outside the membrane area.

8. **INSTALLATION**

A. General

Comply with manufacturer's instructions except where more stringent requirements are shown or specified and except where project conditions require extra precautions or provisions to ensure satisfactory performance of the work.

B. Mixing

Mix separately packaged components in accordance with manufacturer's instructions.

C. Application

Apply a uniform coating of waterproofing to the substrate and adjoining surfaces indicated.

a) Apply coating either by hand or by machine spray. Comply with manufacturer's recommendations regarding indicated surfaces.

b) Provide a 1.5 mm average thickness, consisting of base and top coats where manufacturer recommends, with no variations below a 1.27 mm thickness.

c) At roof access walkway, uniformly apply an excess amount of aggregate into the top coat. When the top coat attains a tack-free condition, remove excess aggregate. Apply a compatible glaze coat of 0.25 mm average thickness.

D. Curing

Permit waterproofing to cure without delay and under conditions which will be contaminate or deteriorate the water proofing material.

9. LOCATION OF TYPES

As shown. Where kind or type of liquid waterproofing membrane is not shown or otherwise designated, use Type E1.

10. TESTING

Immediately following membrane installation and nominal cure, test horizontal surfaces for leaks in the presence of the Construction Manager by flooding the membrane to a depth of 50 mm for a period of 24 hours. Examine structure for evidence of leakage. Repair leaks, if any, and repeat test until no leakage is observed.

11. PROTECTION

Protect the work. Repair or replace damaged work as required by Construction Manager.

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 wood work regarding doors, cabinet, partitions & railing including surface finish treatment, 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.

2.1 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.

2.2 **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.

3. MATERIALS

3.1 Timber

3.1.1 Hard Wood :

Hard wood shall comprise of Oak, beech, Walnut Mahogany, Teak, Iroko and Sheesham.

3.1.2 Soft Wood:

All soft wood shall consist of pines, spruce, hemlock and douglas fir or cedrous deodara (referred in the document as deodar) having density of 500-600 kg/cu.m wood locally known as 'Partal' to be used in framing where specified.

3.1.3 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 fibre, 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.

3.1.4 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.

3.1.5 Adhesive :

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

3.1.6 Nails and Screws :

All nails and screws shall comply with requirements of BSI NO. 1202 and BSI NO. 1210 respectively.

3.2 Ply Wood

3.2.1 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.

3.2.2 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 beentreated with water resistant hot setting glue.

4. SAMPLES

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

5. FABRICATIONS

5.1 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, tenoning, grooving, matching, tonguing, housing, rebating and all operations required for the correct jointing. The Contractor shall also provide all metal plates, screws, nails and other fixing material that may be ordered by the Engineer for the proper execution of the joinery work. Fabrication that 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.

5.2 Doors

5.2.1 Verify design and size of doors required for each opening. Door thicknesses shall be 40mm unless otherwise indicated.

5.2.2 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 hardwood lipping on all edges as per details shown on the drawing.

Face Panels

- Door facing on each side of door shall consist of three or more veneered commercial plies.
- Veneer plies shall have total minimum thickness of 3mm before sanding.
- Door veneers shall be bonded to each other, and to core unit with approved adhesive and machine compressed.

6. 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.

7. WOODEN DOORS WINDOWS AND VENTILATORS

7.1 Materials

7.1.1 First class Deodor Wood as approved by the Engineer shall be used for the door frames and full/half glazed and panelled shutters.

7.1.2 The ply wood and veneering shall be of selected best quality as approved by the Engineer.

7.1.3 Architrave shall be of Deodor Wood of specified sizes and fixed as per details shown on Drawings.

7.1.4 First class deodar wood shall be used for windows and ventilators frames and shutters if any.

7.2 Ground, Blocking & Nailing Strips

Ground, blocking and nailing strips shall be provided as necessary to receive the work included herein and as required for the work of other trades.

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

7.2.1 To steel : By means of 9.53mm diameter bolts spaced not over 900 mm.

7.2.2 To concrete block : By the use of cut nails spaced not more than 400mm apart and driven directly into the block.

7.2.3 To poured concrete : By means of 6.35mm diameter galvanized expansion bolts spaced not more than 400mm apart or by any approved method.

7.3 Exterior and Interior Door Frames

All exterior and interior door frames shall be constructed of given thickness with planted on stops, 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 3ft. intervals between the top and bottom anchors.

7.4 Exterior and Interior Wooden Doors

The exterior and interior wooden door shall, unless otherwise shown or specified, be of the panelled type, flush, swing, sliding and louvered type as shown on the Drawings or as directed by the Engineer.

All the door shall conform to the following requirements:

Panelled doors shall be constructed in accordance with the requirements of Part I of British Standard Specification No. 459 with the additional requirements that panels in exterior openings shall be assembled with waterproof glue. Flush door shall comply with BSI 459 Part-2 and shall consist of solid core commercial ply veneer 40mm thick shutters as shown on drawings.

7.5 **Closet Doors**

Closet doors shall be 40mm thick commercial ply flush doors (hollow core).

7.6 **Door Window and Ventilator Shutters**

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

7.6.1 All door, window and ventilator shutters shall be fabricated in a workman like manner strictly to the correct sizes and shapes as shown on the Drawings or as directed by the Engineer.

7.6.2 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 shallbe prepared for painting or polishing.

7.6.3 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 inedges at suitable places to admit and exit air.

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

7.6.5 Completed doors shall be sound, rigid and free from defects and warp. All edges shall have hard wood lipping and shall be aligned and smooth, joints shall be closed 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.

7.7 **Fitting, Hanging and trimming**

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

Doors shall have a clearance of 4mm at sides and top unless otherwise directed by the Engineer and shall have 3mm 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.

7.8 Hardware

Hardware shall be of best quality make extra heavy duty and first class finished material as per hardware schedule shown on the drawings. The Contractor shall obtain prior approval from the Engineer for quality, shape, pattern, and brand of all the hardware materials by providing samples and catalogues, etc., and shall provide and fix only the approved hardware materials.

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

Stainless steel plates with engraved room numbers shall be provided and fixed with each door.

For details of hardware refer door, window schedule.

7.9 Quality Assurance

7.9.1 Tolerances: Doors shall be fabricated to following tolerances

- Size: Plus or minus 1.6 mm overall dimensions
- Maximum Warp: 3 mm
- Squareness: Maximum diagonal difference 3 mm (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).

7.9.2 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.

7.10 Submittals

7.10.1 Provide manufacturer's literature completely describing products.

7.10.2 Provide shop drawings showing door types, details and locations, referred to the door type and hardware group shown on door and hardware schedules.

7.10.3 Provide certificates stating that doors were constructed with timber of the species specified having moisture content and meeting equilibrium and relative humidity requirements.

7.10.4 Submit samples of face veneers for selection of colour and pattern.

7.10.5 Procurement of materials shall be made only after the shop drawings and samples have been approved by the Engineer.

7.11 **Product Delivery, Storage and Handling**

7.11.1 Deliver and store products in waterproof, protective containers with seals unbroken and labels intact until time to use.

7.11.2 Keep products dry, stack products off ground on including direct sunlight.

7.11.3 Identify type, size and location of each door before delivery in order to permit installation at correct location.

7.12 **Installation**

7.12.1 Install doors at correct openings and assure smooth swing and proper closer with frames.

7.12.2 Install finish hardware in accordance with manufacturer directions.

8. DEODAR WOOD BEADING

Deodor wood beadings shall be provided where shown on the Drawings and the schedule of finishes. These shall be installed in position as per detail shown on drawings or as per direction of the Engineer.

9. WOODEN RAILING

Material for wooden hand rail system shall be best quality Deodar wood. 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.

10. WOODEN CABINETS/SHELVES

All cabinet/shelves including fittings, fixtures and hardwares shall be supplied of approved manufacturer and shall be of best quality fabricated by using materials and details as shown on the drawings.

10.1 Shop Drawings

The Contractor shall submit detailed shop Drawings on the basis of the manufacturer's specifications including all fittings, fixtures and hardwares and the same shall be got approved from the Engineer before fabrication. Samples of materials to be used in cabinets and shelves together with specifications and literature shall be supplied to the

Engineer for his approval prior to start of the works. The color shade shall be as approved by the Engineer.

10.2 **Installation**

All cabinets and shelves shall be installed in position by the manufacturer's skilled workmen specialized in the job. Works shall be executed in accordance with approved shop drawings and the manufacturer's instructions.

The Contractor shall inspect, delivered cabinets and shelves and related parts for indication or location, size required by field measurements, finishing hardware and similar preliminary works. Verify locations for installation, required floor and wall finishes, painting and all other related work. Cabinets and shelves shall exactly flush the wall surfaces. Cut and fit accurately scribe strips at wall surfaces. Firmly attach to bases. Secure wall cabinet to blocking. Concealed fasteners, all joints surfaces shall be smooth and even. Doors and other moving parts shall exactly fit in the frame. Refit, as necessary to ensure proper and easy operation. Refit, if necessary, all cabinet and shelves hardware, test for proper operation, remove for painting and other finishing and properly replace in position with all fittings and accessories.

All work shall be thoroughly protected form damage at all times by suitable methods approved by the Engineer. Adjacent work shall similarly be protected from, damage. Any damage or disfigurement shall immediately be corrected at Contractor's expense.

11. 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.

12. SURFACE PREPARATION

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

13. MOCK-UP SAMPLE

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

The samples shall be returned to the Contractor for incorporation in the works after installation of at least 80% of the works.

14. MASTER KEY SYSTEM

The Contractor shall provide complete Master key system as directed by the Engineer, without any additional cost to Employer.

15. MEASUREMENT & 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/items of the Bill of Quantities.

15.1.1 All finished hardware fittings in carpentry and joinery works.

15.1.2 Prime coat, painting and polishing in carpentry and joinery works.

15.1.3 Anti termite/preservative treatment to wood works.

15.1.4 Adhesives

15.1.5 Timber batten, counter sunk screw, deodor wood beading and architraves.

15.1.6 SS engraved Name plates for all doors.

15.1.7 Master keys system.

15.2 Wooden Door/Windows/Partitions

15.2.1 Measurement

Measurement of acceptably completed works of all types of wooden doors/windows/partitions will be made on the basis of area in square metre of doors fabricated, provided and installed in position as shown on the Drawings or as directed by the Engineer.

15.2.2 Payment

Payment will be made for acceptable measured quantity of all types of wooden doors/windows/partitions on the basis of unit rate per square metre quoted in the Bill of Quantities and shall constitute full compensation for all the works related to the item.

SECTION - 5311

CONCRETE PIPE AND FITTINGS

1. SCOPE OF WORK

The work covered by this section of the specifications consists of furnishing all concrete pipes and pipe fittings, plant, labour, equipment, appliances and materials and in performing all operations required for installing and testing the sewer pipes in strict accordance with the specifications of this section and applicable drawings and subject to the terms and conditions of the contract.

2. MATERIALS

2.1 General

Materials shall conform to the latest referred standard specifications and other provisions stipulated herein and shall be new and unused. Prior to procurement of the materials, the Contractor shall be required to prepare and submit to the Engineer for his approval a complete schedule of materials to be used in the works together with a list of the names and addresses of the manufacturers and the trade names of the materials. The schedule shall include diagrams, drawings and such other technical data as may be required by the Engineer to satisfy himself as to the suitability, durability, quality and usefulness of the material intended to be purchased.

2.2 Sewer Pipe and Pipe Fittings

All sewer pipes and pipe fittings shall conform to ASTM designation C-14 Class IV for 200 mm & 250 mm and C-76 Class V wall 'B' type for sizes dia 300 mm or larger, latest revision of the specified standard shall be applicable in all cases.

2.3 Rubber Rings

The rubber rings to be used for jointing sewer pipes and pipe fittings shall conform to latest revision of ASTM designation C443 "Joints for Circular Concrete Sewer and Culvert Pipe using flexible Water Tight Rubber Type Gaskets".

The tongue or spigot end of each pipe shall be specially designed to form groove or offset to fit the manufacturer's rubber ring design. Rubber rings for use shall be supplied by the pipe manufacturer.

3. LAYING AND INSTALLATION

3.1 Factory Tests

The Contractor shall inform the Enginer the schedule of pipe manufacturing in the factory for this particular project. The Engineer may visit pipe factory to inspect the pipe manufacturing process. The Engineer may assign his representative to supervise the manufacturing and testing of pipes.

The Contractor shall assign his representative at factory to supervise the pipe manufacturing and quality control.

The Contractor shall arrange the following tests at factory in the presence of Engineer or his representative on selected pipe samples.

i. Three edge bearing test.
ii. Absorption Test.
iii. Permeability Test.

All the manufacturing pipes shall be individually checked for cracks and other defects before transportation to the site.

All pipes shall be properly marked at factory, to identify the project consignment.

3.2 Site Demonstration Test

3.2.1 The Contractor shall arrange the site visits of the pipe manufacturer or his representative to explain and demonstrate the pipe jointing, laying and hydraulic pressure testing procedure for all the pipe sizes, in the presence of Engineer before actual laying of sewer pipes in the trenches.

Hydraulic pressure test shall be performed on at least five aid pipe lengths jointed in a straight line with approved type rubber gaskets.

Separate demonstration test will be required for each sewer pipe size to be installed. Requirements of standard hydraulic pressure test specified in the later part of this section shall be applicable to this demonstration test.

Pipe joints and pipe surfaces shall be inspected during this demonstration. If the pipe joint are found leaking and the leakage is more than the allowable limits, the demonstration will be rejected and the Contractor will be required to remove the defective material either pipes or rubber rings whichever is applicable.

The pipes and rubber rings shall be selected at random by the Engineer from the stock lot brought at site by the Contractor. The Contractor must ensure delivery of quality material at site. The whole stock/lot shall be rejected if the pipes do not pass the demonstration test.

3.3 Transportation

Pipes shall be handled with special care during transportation to the site of work. Pipes shall be properly secured to minimize their movement. Cranes shall be preferably used for loading and unloading of pipes. Hooks shall be well padded to prevent pipe damage.

3.4 Storage

Pipes should be carefully stored to prevent damage, pipes should not rest directly on ground. Solid timbers base should be set on ground for pipe stacking. Pipes should not be stacked so high as to over load the bottom. The height of stack shall be further limited by the head room available for any fitting gear used on site. Pipe sockets should not normally rest on other pipes in the stack. The end pipes in the bottom row should be securely locked, wedges should be firmly anchored to prevent collapse of the stack.

3.5 Trenching

Pipe trenches shall be excavated upto required depth as indicated in the drawing. The bottom shall be carefully levelled. In-situ field density of trench bottom shall be determined. The bottom shall be compacted if insitu density is less than 60% of relative density as determined by ASTM D 2043. The test shall generally be carried out at spacing of 200 meters. If in some portion soft clayey material or loose material is encountered 300 mm of this material shall be replaced by specified bedding material in that reach. If excavation is carried below required depth, the excess excavated part shall be refilled with bedding material at no extra cost to the owner. No bedding material shall be placed nor any permanent work commenced until the trench has been inspected by the Engineer and his permission to proceed to the work is given.

3.6 Inspection of Pipe Before Laying

Each pipe shall be carefully examined for soundness and cleanliness immediately before laying, any defective and damaged pipe should be rejected and removed from site.

3.7 Laying

Laying shall start at the lowest point in the area in which work is being done, pipe sections shall be laid with socket upstream.

Each length of sewer between manholes shall be in a straight line and to the true alignment, position, gradient, and the inverts as shown on the Drawings, unless otherwise directed in writing and set out by the Engineer. The Contractor shall check and satisfy himself as to the correctness of the final gradient, position, and slope of the complete sewer trenches before commencing the laying operation.

At all times when the work of laying the sewer is not in progress, all openings into the pipe and the ends of the pipe in trenches shall be kept tightly closed to prevent entrance of ground water, animals and foreign materials. The Contractor shall take all necessary precautions to prevent the pipe from floating due to water entering the trench from any source, and shall assume full responsibility for any damage due to this cause and shall, at his own expense, restore and replace the pipe to its specified position and grade if it is displaced due to floating.

The Contractor shall maintain the inside of the pipe free from foreign materials and in a clean condition until the work is completed and approved by the Engineer.

Pipe and accessories shall be carefully lowered into the trench by means of derricks, ropes, belt slings, or other suitable methods. Under no circumstances shall any of the pipe and other materials be dropped or dumped into the trench. Care shall be taken to avoid abrasion of the pipe.

The full length of each section of pipe shall rest solidly up on the prepared bed of trench. Pipes that have the alignment, grades or joints disturbed after laying, shall be removed and re-laid by the Contractor at his own cost. Pipe shall not be laid in water or when trench conditions are unsuitable for the work.

3.8 Jointing

Rubber gasket joints shall be used for either tongue and groove or bell and spigot pipes.

Rubber gasket joints shall be installed on the pipe in accordance with the instructions of the gasket manufacture.

A lubricant shall be used for jointing the pipes as recommended by the rubber gasket manufacturer.

Whether the pipes are wet or dry the jointing faces and sealing rings need to be clean and free from oil, grease, tar, mud or sand particles.

In placing the pipe and making the joints care shall be taken to avoid disturbance of bedding underneath the pipe barrel. If the joints cannot be made manually, mechanical pulling devices will be needed.

4. TESTING

4.1 General

After the joints are properly fixed and before backfilling the trenches, sewers shall be tested for infiltration or ex-filtration as specified. The Contractor shall test all sewers and their branches in such lengths and time selected at or approved by the Engineer. Sections of the completed sewer shall be isolated and measurement of the infiltration or ex-filtration shall be made by approved methods used for testing of sewer lines shall be absolutely free from insoluble impurities of any kind.

Water

No chemical or adhesive shall be used for water tighting and repairing of pipes. Test reach in no case shall exceed 1500 feet.

4.2 Infiltration

Sewer line shall be tested for infiltration test when the crown of the pipe is below the ground water table. The pipe length under test shall be completely emptied before starting infiltration test. The ends should be effectively closed.

One hour after completely emptying the pipes, depth of water shall be measured at both ends of the pipe. Estimated quantity of water infiltrated shall not exceed the specified allowable limits.

4.3 Ex-filtration

The sewers which are constructed with ground water level below the crown of the pipe shall be tested for ex-filtration.

A section of sewer shall be isolated between manholes by means of expanding stoppers or other approved methods. The length to be tested should be subjected to an internal pressure test of 4 ft. head of water above the crown of pipe at the high end but not more than 20 ft. at the low end.

Quantity of water required to achieve the starting level in the test reach after 1 hour shall be measured which shall not exceed the specified allowable limits.

4.4 Allowable Infiltration or Ex-filtration

The calculated amount of infiltration or ex-filtration over a 24 hour period shall not exceed 6 litres per millimeter dia. per kilometer of sewer which rate shall be applied to the actual sewer size and length tested to determine the allowable infiltration or ex-filtration over the 24 hour period.

If the measured infiltration or ex-filtration exceeds the specified allowable limit, then the Contractor shall locate the points of leakage and make necessary repairs so as to reduce the leakage to less than the permissible maximum stated above.

4.5 Commissioning

After successful infiltration/ex-filtration testing of selected isolated pipe lengths, the contractor shall clean all the sewer lines at no extra cost with the method approved by the site Engineer prior to handing it over to the Owner.

5. MEASUREMENT AND PAYMENT

5.1 General

Except otherwise specified here in or elsewhere in the Contract document, no separate measurement and payment will be made for the under mentioned works related to the relevant items of the Bills of Quantities, but shall not be limited to the following. The cost thereof shall be deemed to have been included in the quoted unit rates of the respective items of the Bills of Quantities.

5.1.1 Submission of Samples.
5.1.2 Factory tests.
5.1.3 Site demonstration test
5.1.4 Cutting, jointing of sewer pipes.
5.1.5 Rubber rings.
5.1.6 Providing & Fixing of Concrete pipe fittings.
5.1.7 Cleaning testing and commissioning of sewer lines.
5.1.8 Testing and compaction of trench bottoms.
5.1.9 Water used for testing of sewers.

5.2 Measurement

Measurement of acceptably completed works of providing, laying, cutting and jointing of sewer pipes and pipe fittings with rubber rings including cleaning and testing of sewer lines will be made on the basis of actual length in running meter of sewer pipes as per drawing or as directed by the Engineer.

5.3 Payment

Payment will be made for acceptable measured quantity of providing, jointing, laying, cutting and jointing of sewer pipes and pipe fittings with rubber rings including cleaning and testing of sewer lines on the basis of unit rate per running meter quoted in the bills of quantities and shall constitute full compensation for all the works related to the item.

SECTION - 6411

WATER PROOFING/EXPANSION JOINT FILLING & BUILTUP 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 any floor and at any height in connection with water-proofing and built-up roofing, including water proof treatment to foundations and basement structures complete in strict accordance with this section of the specifications and the applicable drawings and subject to the terms and conditions of the Contract.

2. SUBMITTAL

2.1 Shop Drawings: Shop drawings shall be submitted showing layout and all the details for construction.

2.2 Samples of all materials proposed for use under this section, shall be submitted to the Engineer for approval.

3. MATERIALS

3.1 Bitumen 10/20 grade shall be according to BSS.

3.2 Bitumen priming oil shall be of the approved manufacturer.

3.3 HY-Grip primer or equivalent

3.4 Self adhesive membrane HY-Grip (P2000-SBS) or equivalent.

3.5 Polyethylene building film visqueen standard or approved equal. The film shall be 2mm thick.

3.6 Felt shall be asphalt impregnated jute based as per BS 747. The number of ply shall be 3 or as specified in the Drawings or as approved by the Engineer.

3.7 Cement and aggregates shall be in accordance with specifications for "Plain and reinforced concrete".

3.8 Water proofing agent shall be in accordance with specifications or as directed by the Engineer.

3.9 High Density Extruded Polystyrene (Thermopore) board shall have a density as shown on the drawings.

3.10 Polyethylene sheets 1mm thick.

3.11 400x400x50mm Precast Concrete Pavers shall be in accordance with specifications for "Precast Concrete Paving Blocks".

3.12 Polysulphide sealant of approved manufacturers

3.13 Flexible cementiteous water proofing AQUAFIN TC-07 & AQUAFIN -2K/M

3.14 Aluminium Flashling

4. **DELIVERY STORAGE AND HANDLING**

Materials shall be protected from damage during loading shipment delivery and storage Non-staining materials shall be used for blocking and packing.

5. **PREPARATORY WORK**

5.1 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.

5.2 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. **APPLICATION OF ROOFING**

The water proofing treatment of the following types to reinforced cement concrete roof slabs shall be done in the following manner as indicated on the drawings or as directed by the Engineer.

Type-I & II

6.1 Roofing shall not be applied during rain or while surfaces are damp, it shall be applied only to surfaces that are clean and dry.

6.2 Flexible cementetious water proofing membrane AQUAFIN-2K/M (SCHOMBURG GmbH or approved equivalent) to be spread @ 3.5 kg. per sq.m. in 2 (two) coats/ layers.

6.3 50mm thick high density extruded polystyrene insulation board shall be laid in places as designated on drawings or as directed by the Engineer.

6.4 1mm thick polyethylene sheet shall be over insulation board or laid in places as designated on drawings or as directed by the Engineer.

6.5 Flexible cementetious water proofing membrane AQUAFIN-TC-07 (SCHOMBURG GmbH or approved equivalent) to be spread @ 2 kg. per sq.m.

6.6 50mm thick (avg. min.) Class 'C' reinforced cement concrete screed steel trowelled finish laid in panels and slope.

6.7 10 guage WWF (welded wire mesh) 100x100mm mesh.

6.8 Joints of panels shall be filled/ coated with AQUAFIN TC-07.

6.9 Cant strips and concrete nails, aluminium flashing and polysulphide sealant in accordance with the details shown on the Drawings and as per direction of the Engineer.

7. **WATER PROOFING TREATMENT IN FOUNDATIONS AND SURFACES IN CONTACT WITH EARTH**

All surfaces to be bitumen painted shall be thoroughly cleaned of any accretion, dust, dirt etc. by scraping, wire brushing or as directed by the Engineer. The surface shall be primed with a coat or asphalt oil used at the rate of not less than 1 gallon /100 square feet. Two coats of hot bitumen paint shall be applied at the rate of 1 kg/Sq.m. each coat. The first coat shall be allowed to dry for about 6 hours before applying the second coat. During operation of painting great care shall be taken to avoid air bubbles. The manufacturers shall be taken to avoid air bubbles. The manufacturer's instructions and Engineer's directions shall be followed.

8. APPLICATION OF WATER PROOFING TO UNEDERGROUND WATER RETAINING STRUCTURES

8.1 Water proofing shall not be applied during rain or while surfaces are damp, it shall be applied only to surfaces that are clean and dry.

8.2 Hy-Grip primer or approved equivalent shall be applied as per manufacturer's recommendations.

8.3 After primer, one layers of self adhesive membrane Hy-Grip (P2000-SBS or approved equivalent) shall be applied as per manufacturer's specifications. The Contractor shall protect the membrane from damages during laying and subsequent operation and shall replace at his own cost all damaged membrane to the satisfaction of the Engineer.

9. EXPANSION JOINT FILLING

Before filling of Expansion Joint the surface shall be thoroughly cleaned and filling/packing material removed up to a depth of 50mm. Backer Rod shall then be inserted throughout the length of joint and pressed in. The joint shall then be sealed with 2 part polysulphide sealant.

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.

The rates quoted by the Contractor in the Bill of Quantities shall include work to be executed under these specification in any floor and at any height except where otherwise specifically stated in the relevant item of Bill of Quantities and the Contractor shall not be entitled to any claim or claim any compensation on this account.

10.1.1 All preparatory work, scrapping, scratching, cleaning, cant strips, gravel strips, etc.

10.1.2 Formwork

10.1.3 Roof treatment including Class 'C' cement concrete.

10.1.4 Coats of bitumen.

10.1.5 Polyethylene sheet including laps/overlaps and joints and Thermopore sheets.

10.1.6 Class 'C' cement concrete cant strip.

10.1.7 Backer rod/2 part polysulphide sealant, AQUAFIN TC-07 & Thermopore sheet filling (where ever required) in expansion joint filling.

10.1.8 Felt

10.1.9 High Density Extruded polystyrene insulation board.

10.1.10 450x450x50mm concrete pavers.

10.1.11 1mm thick polyetheylene sheets.

10.1.12 Pea Gravel

10.1.13 Aluminium Flashing

10.2 Water Proofing & Built-up Roofing

10.2.1 Measurement

Measurement of acceptably completed works respective type of water proofing & built-up roofing over roof slab will be made on the basis of net actual area in square metre as shown on the Drawings or as directed by the Engineer.

10.2.2 Payment

Payment will be made for acceptable measured quantity of respective type of water proofing & built-up roofing on the basis of unit rate per square metre quoted in the Bills of Quantities and shall constitute full compensation for all the works related to the item.

10.3 Bitumen Painting/Coating

10.3.1 Measurement

Measurement of acceptably completed works of bitumen painting/coating will be made on the basis of net actual area in square metre as shown on the Drawings or as directed by the Engineer.

10.3.2 Payment

Payment will be made for acceptable measured quantity of bitumen painting/coating on the basis of unit rate per square metre quoted in the Bills of Quantities. The unit rate shall include all cost of surface preparation and shall constitute full compensation for all the works related to the item.

SECTION - 6412

BITUMEN COATING

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 related to water proof treatment to foundations and basement structures complete in strict accordance with this section of the specifications and the applicable drawings and subject to the terms and conditions of the Contract.

2. SUBMITTAL

2.1 Samples of all materials proposed for use under this section, shall be submitted to the Engineer for approval.

3. MATERIALS

3.1 Bitumen 10/20 grade.

4. DELIVERY STORAGE AND HANDLING

Materials shall be protected from damage during loading shipment delivery and storage Non-staining materials shall be used for blocking and packing.

5. PREPARATORY WORK

5.1 All surfaces to be treated shall be dust free and dry. Application of finishes shall not start unless the preparatory work has been inspected and approved by the Engineer.

6. BITUMEN COATING/PAINTING IN FOUNDATION SUB-STRUCTURES, UNDER FLOORS

a) Bitumen Painting

All surfaces to be bitumen painted shall be thoroughly cleaned of any accretion, dust, dirt etc. by scraping, wire brushing or as directed by the Engineer. The surface shall be primed with a coat or asphalt oil used at the rate of not less than 1.08 gallon /10 square metre. Two coats of hot bitumen paint shall be applied at the rate of 1.0 kg/Sq.m. each coat. The first coat shall be allowed to dry for about 6 hours before applying the second coat. During operation of painting great care shall be taken to avoid air bubbles. The manufacturers shall be taken to avoid air bubbles. The manufacturer's instructions and Engineer's directions shall be followed.

7. MEASUREMENT AND PAYMENT

7.1 <u>General</u>

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.

7.1.1 All preparatory work, scrapping, scratching, cleaning, cant strips, gravel strips, etc.

7.1.2 Coats of bitumen.

7.2 Bitumen Painting/Coating

7.2.1 Measurement

Measurement of acceptably completed works of bitumen painting/coating will be made on the basis of net actual area in square meter as shown on the Drawings or as directed by the Engineer.

7.2.2 Payment

Payment will be made for acceptable measured quantity of bitumen painting/coating on the basis of unit rate per square meter quoted in the Bills of Quantities. The unit rate shall include all cost of surface preparation and shall constitute full compensation for all the works related to the item.

SECTION - 6521

CEMENT PLASTER

1. SCOPE

The work under this section of the Specifications consists of furnishing all plant, labour, equipment, appliances, and materials and in performing all operations in any floor and at any height connection with providing and installation of cement plaster, and specified external rendering complete in strict accordance with this section of the Specifications and the applicable drawings and subject to the terms and conditions of the Contract.

2. GENERAL

2.1 Except as may be otherwise shown on surfaces specified, all plaster work, both internal and external shall be ordinary Portland Cement plaster of the required thickness as shown on the drawings.

2.2 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. Chiseling and repairing of cement plaster shall not be permitted without the approval of the Engineer.

2.3 Sample of materials shall be submitted to the Engineer for his approval prior to use in the works.

3. MATERIAL

3.1 Cement for plaster shall be Ordinary Portland Cement (B.S 12 or P.S 232) or 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".

3.2 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.

3.3 Water for plaster shall conform to requirements specified in the section for "plain and reinforced concrete".

3.4 All materials and workmanship for plaster, not explained in these Specifications, shall comply with the requirements of relevant BS CP 211 and CP 221 as directed by the Engineer.

4. PROPORTIONING AND MIXING

4.1 Measurement of materials by volume shall be by containers of known capacity to maintain consistent proportions. No lumpy or caked material shall be used. Mixing equipment boxes and tools shall be clean. Materials shall be proportioned as specified on the Drawings, in the Bill of Quantities or as directed by the Engineer. Mixing shall be continuous until all ingredients are evenly distributed and thoroughly mixed.

4.2 Only limited water shall be added for proper workability and such quantity of mortar shall be prepared which can be consumed in thirty minutes after

preparation. Preparation of mortar in bulk quantity for use during the entire day or for any other time more than that stipulated above is expressly prohibited. Retempering shall not be permitted and all mortar which has begun to stiffen shall be discarded.

4.3 Plaster ingredients shall be thoroughly mixed either by hand on a clean cement concrete platform or by a mechanical mixer, as directed by the Engineer.

5. PREPARATION OF SURFACE TO BE PLASTERED

5.1 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.

5.2 All masonry surfaces to be plastered shall be cleaned to remove all matter, which will otherwise adversely affect the adhesion of plaster to the surface concerned. The surface shall be washed with clean water and kept damp for 24 hours before further treatment. The surface thus prepared shall be treated uniformly with cement and sand slurry. The slurry to be used shall be one part cement to one part sand by volume with water added to make a stiff creamy mix. The slurry shall be applied with a stiff brush on surface, which has previously been well wetted. The surface so treated shall be left to cure for 3 days.

6. APPLICATION OF PLASTER

6.1 The plaster of thickness less than the specified thickness shall be rejected. If the plaster is to be more than 12mm 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 plasterwork is to cover all conduits, pipes etc fixed in the walls and ceiling. Wherever specified, metal lath shall be nailed firmly before plastering is commenced. The plaster surface shall be tested frequently with a 10 feet straight edge and plumb bob.

6.2 Plaster containing cracks, blisters, pits, discolouration or any defects shall not be acceptable. Any such plaster or loose plaster shall be removed & replaced with plaster in conformity with these specifications and as additionally directed by the Engineer.

Contractor shall cut out and patch all defective work at his own cost. All damaged plaster shall be patched as directed by the Engineer. Patching plaster shall match appearance of and shall be finished level with adjoining plaster.

7. METAL LATH

Metal lathing shall be fabricated from sheet steel and shall be of uniform quality and free from flaws broken strands, cracks and corrosive pitting, shall be rectangular and true to shape and shall comply with BS-1369.

All lathing shall be galvanized. Where plastering material depends entirely on the lathing for its key, these shall be not less than two complete mesh openings per 1-1/8"in one direction and the width of the aperture shall not be less than 3/16".

Sheets shall not be less than 1.6 kg/sq.m when fabricated, using 0.7 mm thick steel sheet. Where used on smooth surfaces to form a key it shall be not less than 1.2 kg/sq.mm when fabricated, using 0.5 mm thick steel sheet. Tying wire shall be 1.2 mm diameter galvanized annealed iron wire.

Sheets shall be welded to angle iron frame as shown on drawings.

8. ANGLE AND BEADS

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.

All angle beads, stop beads, depth gauge beads and the like are to be fixed in accordance with the manufacturer's instructions, at all corners, stops, joints, etc. as per directions of Engineer In-charge.

9. INTERNAL/EXTERNAL PLASTER

9.1 Where specified in the Drawings external surface shall have an average 20mm thick plaster finish, consisting of a base coat of 1:4 cement sand mortar in Grey cement and the finish coat of smooth plaster as shown on the Drawings and as directed by the Engineer.

9.2 Where specified in the Drawings all internal plaster shall have an average 12mm thick consisting of base coat of 1:6 cement sand mortar in grey cement and finish coat of smooth plaster as shown on the Drawings and as directed by the Engineer.

9.3 Textured Plaster

Wherever specified in the drawings external textured plaster shall consist of 1:2, one part white cement & 2 parts approved shade of marble chips zero size mixed with approved pigment to achieve desired shade. Wherever shown on drawings, groves shall be provided with aluminum U/Y channels. The Contractor shall prepare mockup samples of textured plaster for the approval of Engineer. The plaster shall be applied with machines and the final rough surface/texture/shade shall be as per the approved sample, direction and approval of the Engineer.

10. CLEANING AND PROTECTION

10.1 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.

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

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

11. TOLERANCES

Surfaces of plaster work shall be finished with a true plane to correct line and level with all angle and corners to a right angle unless otherwise specified and with walls and reveals plumb and square.

Maximum permitted tolerances shall not exceed 1/8" in 6 feet variation from plumb or level in any exposed line or surface and 1/16" variation between planes of abutting edges or ends.

12. MEASUREMENT AND 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 item of the Bill of Quantities.

The rates quoted by the Contractor in the Bill of Quantities shall include work to be executed under these specification in any floor and at any height except where otherwise specifically stated in the relevant item of Bill of Quantities and the Contractor shall not be entitled to any claim or claim any compensation on this account.

12.1.1 Metal lath over reinforced concrete and masonry joint.

12.1.2 Joints, junctions, corners, beads, drip course edge, roundings, and aluminum U/Y channels in groves. Etc.

12.1.3 More than one layer due to any unevenness in the finished works and base coat plaster in textured plaster including marble chips/colour pigments.

12.1.4 Cutting & patching of all defective works.

12.1.5 Surface preparation, cleaning and protection as specified.

12.1.6 Marble chips & pigments in textured plaster.

12.1.7 Roughning of first coat of plaster before application of 2nd coat incase where overall required plaster thickness exceeds 12mm.

12.2 Plain Plaster/Textured plaster

12.2.1 Measurement

Deductions shall not be made for ends of joints, beam posts, etc., and openings not exceeding 5 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 5 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 will be made on the basis of number of square meter of the surface area plaster as shown on the Drawings, or as directed by the Engineer.

12.2.2 Payment

Payment will be made for acceptable measured quantity of plaster on the basis of unit rate per square meter quoted in the Bill of Quantities and shall constitute full compensation for all the works related to the item.

SECTION - 7111

PREPARATION OF SUB-GRADE

1. SCOPE

The work under this section of specification includes furnishing all labour, plant, equipment, appliances and materials and performing all operations in connection with Earthworks in roads, as detailed below as distinct from earthwork for structures etc. detailed in the relevant section, in accordance with this section of specifications, the applicable drawings and subject to terms and conditions of the Contract. The scope of work consists of:

1.1 Excavation of the existing ground to required levels, grades, and lines.

1.2 Removing unsuitable material from below the required gades & profiles and filling with approved material.

1.3 Transporting from approved areas, filling and compacting the fill material in depressions or in low lying areas to match with the required levels, profiles, grades, and lines.

1.4 Rolling and compacting the entire sub-grade area.

1.5 Disposal of surplus and unsuitable materials to areas upto 5 km from the work site.

2. GENERAL

The subgrade shall be formed of suitable materials free of clods, sod, roots, stumps, bushes or other objectionable materials.

The maximum dry weight density of the sub-grade shall be as determined by ASTM Designation D-1557-91. The compaction shall be done by approved methods consistent with the soil/materials to be compacted.

3. EXCAVATION AND EXCAVATED MATERIAL

3.1 All excavations shall be made to the lines, levels, profiles and grades as shown in the drawings or established by the Engineer. During progress of the work it may be found necessary or desireable by the Engineer to vary the levels, elevations and grades of the exavations from those shown in the drawings. The Contractor shall perform the excavation to the revised levels, elevations, and grades as established by the Engineer.

3.2 **<u>Classifications of Excavated Materials</u>**

No classification will be made of any material excavated as to its class, nature, origin or conditions.

No excavated material shall be classified as suitable or unsuitable.

3.3 **Disposal of Excavated Materials**

Suitable materials derived from excavations shall be used for filling the depressions or low lying areas. Any surplus or unsuitable material shall be disposed off by the Contractor, in spoil banks, waste area as directd by the Engineer, up to the limit of 5 km lead from the site of work.

3.4 **Grading of Area**

Grading of the excavated area shall be done by means of levelling equipment and grading machines. The Contractor shall be responsible for the required construction and stability of the grades and slopes of the area in conformity with the drawings.

3.5 **Extra Excavation**

In the event that the Contractor excavates any area to a level lower than the required, he shall refill the area and compact it in accordance with the stipulated levels so as to bring the area to the required levels and grades. No extra payment will be made to the Contractor on this account.

3.6 **Contractor to bear Damages**

The Contractor shall conduct all excavation operation in a safe and prudent manner in order to avoid and prevent damage to any surrounding property and to the vegetation outside the project area. All damages caused by the Contractor's operations shall be made good and repaired by the Contractor at his own expense.

4. FILLS

4.1 **Fill Material**

Areas requiring filling shall be filled with material consisting of selected material from excavations or selected materials obtained from outside sources as designated by the Engineer for the purpose and all fill materials shall be free from debries, tree roots and such other objectionable substances and to the satisfaction of the Engineer.

4.2 **Scarifying of the Surfaces**

Prior to placing first layer of filling the existing and stripped surfaces shall be scarified to a depth of not less than 100 mm and compacted to specified density. The cost thereof shall be deemed to have been included in the rates for -grade item.

4.3 **Variation in Fill Requirements**

All fill shall be done in accordance with the approved drawings. During progress of work it may be found necessary or desireable by the Engineer to vary the levels, elevations and grades of filling from those

shown in the drawings. The Contractor shall perform filling to the revised levels, elevations and grades.

4.4 **Excess Filling**

If the Contractor fills any area to the levels and grades greater than the required, he shall excavate the excess materials and dispose off as directed by the Engineer. No extra payment will be made to the Contractor on this account.

4.5 **Placement**

Filling shall be done with approved soil or with the materials obtained from the excavations as approved by the Engineer.

Fill materials shall be placed in successive layers not exceeding 200 mm in thickness (compacted thickness and each layer shall be thoroughly compacted to give the specified density. The sub-grade will be compacted at optimum moisture content. Loose pockets if any shall be cut out and refilled with selected materials in layers not more than 100 mm thick and formed to levels and grades as shown on the Drawings.

The water content of the fill, prior to and during compaction, shall be uniform throughout each lift of material. Contractor shall control the water content of fill between three percentage points below and two percentage points above the laboratory optimum water content as determined by the compaction test designated by ASTM D 1557-91.

If the water content of the fill is less than that specified, water shall be added to the fill and the fill worked with a harrow, scarifier, or other approved equipment until the water is uniformly distributed throughout the fill and the water content of the fill satisfies the requirements of these specifications.

5. ROLLING AND COMPACTION

The in-place density shall be determined by the sand cone method in accordance with AASHTO Designation T191-61. The laboratory Density is defined as the maximum dry weight in kilograme per cubic meter as determined by the ASTM D-1557-91.

The subgrade shall be compacted to achieve a minimum density equal to 95% of the maximum dry density.

Equipment, suitable and adequate for uniform compaction to the specified densities, must be on hand and approved by the Engineer before any fill operations are started by the Contractor. All compaction equipment must be in good working order and any worn or defective equipment shall immediately be replaced or repaired to the satisfaction of the Engineer. Sheepfoot rollers shall exert a pressure of not less than 21 kilograms per square centimeter (300 pounds) per tire. Smooth steel wheel rollers shall have a minimum weight of 9074 kilograms (10 tons) and shall exert a pressure of not less than 53.5 kilograms per linear centimeter (300 pounds per linear inch) of compression

wheel or roll width. Earth moving and other equipment not specifically manufactured for compaction purposes will not be considered as compaction equipment. The use of sheepfoot rollers with tamping feet worn to less then 32 square centimeters of flat end surface will not be permitted.
When the moisture content of the layer is within the limits as determined by the Engineer for proper compaction, the entire surface shall be compacted with the appropriate type of roller or compactor until the specified density has been obtained. In no case, shall the number of passes of the roller over each portion of the fill area be less than the number specified or required by the Engineer for achieving the specified density.

A pass of a piece of compaction equipment over any area is defined as a direct vertical contact of the compactor wheel, tire, drum or plate load upon all elements of that area in such a manner as to assure complete coverage of the area. No successive layers shall be placed until the layer under construction has been brought to the required density and has been approved by the Engineer.

Compaction equipment shall not operate at speeds exceeding 6.4 kilometers (4 miles) per hour. In no case, shall the rate of application of fill exceed the capacity of the compaction equipment based on the actual operating speed of that equipment, or as determined by the Engineer.

In areas inaccessible to the equipment designated in the foregoing sections, other types of compaction equipment shall be used, as approved by the Engineer. Where the impact rammer type is used, such rammer shall weigh not less than 91 kgs (200 pounds), have a ramming foot area not exceeding 516 square centimeters and be capable of delivering not less than 2.77 kilogram metres of compacting energy per blow. Where plate vibratory Where plate vibratory compactors are used, such compactors shall be capable of delivering blows of a minimum of 1134 kilograms impact at a rate of not less than 1100 blows per minute. A minimum coverage of 3 passes will be required for either rammer or vibrator equipment. For other types of compaction equipment used in areas of limited space, the minimum number of passes required on all portions of each successive layer shall be determined by the Engineer after appropriate field tests to evaluate the efficiency of the equipment. The use of hand tampers will not be permitted.

To minimise the effect of precipitation on placed fill, the surface shall be rolled smooth prior to any suspension of operations. During spreading and compacting, the fill surface shall be provided with a grade transverse to the axis of the fill, being not less than 3 percent, to ensure drainage of surface water from the fill.

If the surface of any compacted layer of fill is too dry or, in the opinion of the Engineer, too smooth to bond properly with the layer of material to be placed thereon, the layer shall be wetted and worked with a harrow, scarifier, or other approved equipment, to a sufficient depth to provide a satisfactory bonding surface, before the succeeding lift is placed.

If the surface of any compacted layer of fill is too wet to allow proper compaction of the fill to be placed thereon, it shall be reworked with harrow, disc, or other approved equipment and mixed with drier fill material to reduce the water content until it satisfies the requirements of these specifications. The reworked fill shall be recompacted to the requirement of these specifications before any succeeding lift of fill is placed thereon.

Any compacted lifts of fill which have suffered a reduction in density due to the action of precipitation, or for any other reason, shall be worked and recompacted to the requirements of these specifications by the Contractor at his own cost, before spreading and compacting operations are resumed.
Constrcution traffic shall be routed such that ruts are not formed on the surface of any layer. If ruts are formed, they shall be graded level and recompacted to the requirements of these specifications.

Any and all materials which do not meet the requirements as specified for fill and are accumulated on the surface of any lift or prepared subgrade, shall be removed by Contractor at his own cost before any material is placed in the succeeding lift.

Special care shall be exercised in placing and compacting fill material immediately adjacent to pipe to avoid damage either to the pipe or its alignment. Any pipe that is damaged or moved out of alignment, regardless of cause, shall be replaced at Contractor's expense.

Any portion of the subgrade which has, in the opinion of the Engineer, been damaged by the Contractor's equipment during his construction operations, shall be repaired and recompacted by the Contractor to the satisfaction of the Engineer and no extra payment will be made thereof.

The limits to which "Filling and backfilling at Structures" will apply shall be in accordance with the relevant section of the specifications or as required by the Engineer.

6. WATERING

Water may be applied by equipment or by labour at the locations in the amount and during the hours (including nights) as directed by the Engineer. The supply of water shall be adequate to cater for all the requirements specified herein or directed by the Engineer. The distributor used for watering shall be equipped with a spray bar and shall be of ample capacity and of such design as to ensure uniform application of water in the amounts directed by the Engineer. Water supplied through employment of labour shall also be in accordance with the directions of the Engineer.

The Contractor shall not use water from shallow, muddy or marshy surfaces. The quality of water shall be subject to the approval of the Engineer. The use of sea water shall not be permitted.

7. FINISH OF SUB-GRADE

7.1 When the sub-grade has been constructed to the required grade, line and cross-section and compacted to the required degree, the sub-grade shall present a finished surface acceptable as formation to the Engineer. The formation shall be properly shaped to a smooth uniform surface parallel to the finished surface of the road.

7.2 Sub-grade that does not conform to these specifications and the drawings shall be re-worked to the correct grade, line and cross-section as directed by the Engineer. Any work carried out in compliance with this clause shall be at the expense of the Contractor.

7.3 No material for the construction of sub-base-course shall be placed until the prepared sub-grade is upto the work and approved by the Engineer.

8. INSPECTION

Field inspection and density test shall be carried out jointly by the Contractor and the Engineer. Contractor shall facilitate the inspection and the performance of these tests and bear all costs. Sub-grade that does not conform to these specifications and the Drawings shall be re-worked and redone by the Contractor at his expense as directed by the Engineer.

9. TOLERANCES

The finished graded surface shall be smooth and even and tolerance from the required grades shall be 50 mm.

10. MEASUREMENT & PAYMENT

10.1 General

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

10.1.1 Excavation of the existing earth to required levels, grades and lines.

10.1.2 Disposal of unsuitable/surplus excavated material upto 5 Km. free haulage limit measured along the shortest route from the boundary of the site of works.

10.1.3 Sub-grade treatment including making grades, levels, profiles, camber, rounding all according to final shape shown on the Drawings.

10.1.4 Providing approved quality fill/backfill material obtained from outside sources.

10.1.5 Water, labour and equipment required for compaction of fill in preparation of sub-grade.

10.1.6 Any loss of materials resulting from shrinkage, compaction, settlement, waste, overflow, erosion etc.

10.1.7 Excavation or fill involved in smoothening and maintaining pavement sub-grade, and reshaping of placed material previously filled or excavated.

10.1.8 Any fill necessitated by over excavation by Contractor for his convenience or any cut necessitated by over filling.

10.1.9 Scarifying and compacting the excavated surface.

10.2 **Preparation of Sub-grade**

10.2.1 Measurement

Measurement of acceptably completed works of sub-grade for roads and pavement will be made on the basis of actual area in square feet compacted to lines, levels and grades as shown on the Drawing or as directed by the Engineer.

10.2.2 Payment

Payment will be made for acceptable measured quantity of sub-grade for roads and pavement 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 - 7120

SUB-BASE COURSE

1. SCOPE

Sub-base course for Roads & Pavements shall consists of furnishing, placing, and compacting suitable materials in the place designated on the plans, and in such other locations. The thickness of the sub-base course will be as shown on the Drawings or as directed by the Engineer. The work under this section of specification is detailed below:

2. MATERIALS

All materials acceptable for this item shall be sound, hard, durable stone or gravel as approved by the Engineer and shall be well graded from coarse to fine. The particles shall not exceed such size as will pass through 50.80 mm square sieve. The material shall meet the requirements of AASHTO Designation M-147-65 and shall conform to the following gradation.

Sieve Size	Percent passing by weight
(50.80 mm)	100
(25.40 mm)	90-100
No. 10	40-80
No.200	5-20

Coarse aggregates retained on the No.10 sieve shall consist of hard, durable particles or fragments of stone or gravel. It shall have a percentage of wear by the Los Angeles test in accordance with ASTM C 131-81 or AASHTO T-96 of not more than 40 percent by weight and a minimum CBR value of 20%. It shall have a percent loss at 5 cycles by the sodium sulphate Soundness Test in accordance with ASTM C 88-83 of not more than 12 by weight. Fine aggregate passing the No. 10 sieve shall consist of natural or crushed sand, and fine mineral particles passing the No. 200 sieve.

The fraction passing the No.200 sieve shall not be greater than two third of the fraction passing the No. 40 sieve. The fraction passing the No. 40 sieve shall have liquid limit not greater than 25 and plasticity index not greater than 6.

The composite material shall be free from organic matter, lumps and other objectionable and deleterious materials or substances.

Before the material is deposited in position it shall contain the amount of moisture equal to or slightly below the optimum necessary to ensure that the specified density requirements are obtained when materials are compacted. The amount of moisture required shall be approved by the Engineer.

3. CONSTRUCTION

3.1 Stockpiling and Sampling

After excavation from an approved source, and processing and mechanical blending if necessary, the material shall be stockpiled. Stockpiles shall be located at a convenient distance from the right-of-way limits of the roads. Removal of material from stockpiles for placement on the grade shall be by side excavation along nearly vertical faces for the full depth of stockpile. The use of a clamp-shell type bucket for loading the material on to trucks or the use of pan type scrapers for moving the stockpiled material to its final position as sub-base course will not be permitted. No material shall be added to the stockpile after the stockpile has been sampled for approval. Only material from approved stockpiles shall be placed on the grade for this item. The presence of any over size particles in the stockpile will be cause for rejection of the entire stockpile.

No material shall be removed for use from any stockpile until the stockpile has been sampled, tested and approved in writing by the Engineer for placement on the sub-grade. Approval of a stockpile for placement on the sub-grade shall not relieve, in any degree, the full responsibility of the Contractor to furnish, in its compacted position as sub-base course of granular materials, the final condition of which conforms to all the requirements of the specifications for this item.

In the event the Contractor uses a plant or a procedure resulting in material of uniform quality, at a rate satisfactory to the Engineer and such that satisfactory samples for tests can be obtained, the requirements for stockpiling may be waived. Prior approval of the Engineer, must be obtained and the work must be done in accordance with such conditions as may be imposed in the approval. Such waiver shall remain in force only so long as a satisfactory material is produced.

3.2 Placing & Compaction

The material shall be spread in one layer in such way that the thickness of the layer after compaction shall be the same as shown on the drawing.

Spreading from piles dumped on the roadway will not be permitted. No segregation of large or fine particles will be allowed but the material, as spread, shall be well graded with no pocket of fine material. Water shall be added in such amounts that the moisture content is within the proper limits for satisfactory compaction.

When the moisture content of the layer is within the limits for proper compaction, the entire surface shall be rolled with pneumatic tired rollers, having an operating weight of between 453.60 kgms and 1134 kgms or a smooth steel wheel roller having a minimum weight of 10 tons. Each portion of the layer shall be covered by a minimum of 8 passes of the roller, to achieve 100 % of the laboratory density determined by ASTM Designation D-1557-91 or AASHTO designation T 147.

For heavier, vibratory, or more efficient types of approved compaction equipment the minimum number of passes required on all portions of each layer shall be determined by the Engineer after appropriate field tests to evaluate the efficiency of such equipment. In limited areas, where the use of a roller is impractical, approved vibrating plate compactors shall be used to compact the material.

The surface of the finished sub-base at any point shall not vary more than 13mm above or below the true grade. The sub-base course at any location, shall be compacted, finished, and completed to the above tolerance and approved by the Engineer before any succeeding course is placed at all locations. Any depressions or holes shall be filled with approved coarse sand or screenings with the following gradings:

Sieve	Percentage	Passing
6.35 mm		100
No.4		90-100
No.16		55-75
No.50		10-30
No.100		1 - 8
No.200		2

In all cases, this sub-base course must be so thoroughly compacted that it will not weave under the roller. The layer of this sub-base course shall not be laid in excess of 150 linear metre without being compacted. No traffic or hauling other than that necessary for bringing material for the next course shall be permitted on this course. Should the sub-grade and sub-base course granular material get churned up into, or mixed with the sub-base course through any reason whatsoever, the Contractor shall, at his own expense remove such mixtures and replace with select granular material acceptable for this item. The Contractor shall assume full responsibility for any during construction and shall at his own expense, remove any and all portions of this course which do not conform to the requirements of these specifications and replace these portions with specified material at his cost.

4. SMOOTHNESS TEST

The elevations of finished sub-base shall be within plus or minus 12mm of the elevations shown on the Drawings. Any deviation in excess of this amount shall

be corrected by the Contractor by removing material, replacing with new material, or reworking existing material and compacting.

5. MEASUREMENT AND PAYMENT

5.1 General

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

5.1.1 Providing and spraying water.

5.1.2 Rolling and compaction.

5.1.3 Removal of rejected material and replacing it with approved material.

5.1.4 Any losses of material which may result from shrinkage, compaction settlement, wastage over flow erosion, leakage or any other causes.

5.1.5 Testing.

5.2 Sub-Base Course for Roads & Pavement

5.2.1 Measurement

Measurement for acceptably completed Works of sub-base course will be made on the basis of number of cubic feet in final compacted position, complete in accordance with the plan and these specifications.

5.2.2 Payment

Payment will be made for acceptable measured quantity of sub-base on the basis of unit rate per cubic feet quoted in the Bill of Quantities and shall constitute full compensation for all the works related to the item.

SECTION - 7140

BITUMINOUS CONCRETE

1. SCOPE

The work under this section of specifications includes furnishing all labour, plants, equipment, appliances and materials and performance of all operations required in connection with construction of asphalt concrete roads and pavements on prepared base course in strict accordance with this section of the specifications, applicable drawings and in conformity with the lines, grades and cross-section shown on the plans and subject to the terms and conditions of Contract.

2. PRIME COAT

2.1 Material

The material to be used for prime coat shall be MC-70 conforming ASTM D 2027-76.

2.2 Application of Prime Coat

The Contractor shall not start the work until the Engineer has approved the finish of the surface to be primed and the amount of water to be needed to moisten the surface to be primed.

The Contractor shall clean the surface to be primed of all loose materials using means approved by the Engineer. During the cleaning, the Contractor shall take all precautions to avoid formation of depressions or other damages to the approved surface and any imperfections occasioned by the work shall be corrected to the satisfaction of the Engineer at the Contractor's expense.

Before spraying the asphalt, the Contractor shall wet the surface to be primed with the approved amount of water. After all the free water has disappeared from the surface, the prime coat of cut back asphalt (MC-70) shall be evenly applied over the surface at the rate of 1.0 litres per sq.metre or as directed by the Engineer. The application of cut back asphalt shall be accomplished in a uniform manner, avoiding lapping of one application with the adjacent. In the event that it could be necessary to apply the cut back asphalt in two applications instead of one, in order to attain the required quantity, the Contractor shall accomplish the same without additional payment. The Contractor shall maintain the primed surface in perfect condition until it is paved off.

When after 24 hours it is observed that all the applied cut back asphalt has not been absorbed, the Contractor shall spread cover aggregate on super saturated areas. After all the treated areas are dry, the Contractor shall tamp or remove the cover aggregate, making the surface in perfect condition for starting the pavement operations.

3. BITUMINOUS SURFACE COURSE

The bituminous surface course shall conform with the requirements specified in sub-sections 3.0 through 5.0.

3.1 Mineral Aggregates

Mineral aggregates for the bituminous surface course shall consist of coarse aggregate, fine aggregate and filler material.

The sources or location of all aggregates and fillers proposed for use in the works shall be submitted to the Engineer for his approval before any of the materials are used in the works.

3.2 Coarse Aggregates

Coarse aggregate is defined as that aggregate which is retained on a No.7, B.S Sieve or its equivalent U.S Sieve and consists of crushed rock or crushed gravel. It shall be clean, hard, durable and of uniform quality, free from decomposed stone, organic matter, shale, clay and any other deleterious substance.

The coarse aggregate shall have the percentage of wear of not more than 40 percent when tested in accordance with ASTM Designation: C 131-81. Crushed stone or Crushed gravel, when subjected to five alterations of the Sodium Sulphate Soundness Test, using ASTM Designation C 88-83, shall have a weight loss not greater than 9 percent.

When crushed gravel is used, not less than 75 per cent by weight of the particles of each primary size shall have at least one fractured surface.

The "Aggregate crushing value" using the standard aggregate crushing test of B.S 812 shall not exceed 28 percent. The flakiness index - B.S 812 - is not to be greater than 30 percent.

3.3 Fine Aggregates

Fine aggregate is defined as the aggregate passing B.S Sieve No.7, or its equivalent. The aggregate particle shall be clean, hard, durable and free from clay, silt or any other deleterious substances, and shall consist of manufactured material derived from the crushing of rock or gravel.

3.4 Mineral Filler

Where required mineral filler shall be ordinary Portland cement.

3.5 Bitumen

The bitumen to be used in the bituminous course shall be an approved 60/70 or 80/100 penetration grade bitumen. The Contractor shall formulate and submit to the Engineer a Job mix formula that satisfies the general limits and tolerances set forth below:-

Sieve Size	Total Passing(%)
25.4 mm	100
19.05 mm	70-100
12.70 mm	55-85
9.00 mm	45-70
No. 4	30-55
No. 10	20-45
No. 40	10-25
No. 80	7-15
No. 200	4-8

These proportions may be varied according to the results of preliminary tests and material available.

The bitumen content by total weight shall be between 4.5% and 7% of the mix.

The mix shall have a minimum Marshall Stability of 682 kg when specimens are compacted with 75 blows using the Marshall test procedure and shall have a minimum flow value of 8 with a maximum flow value of 20 measured in units of 0.254mm.

The percentage of air voids shall fall within the range 3% to 5% and the percentage voids in mineral aggregate shall not be less than 15 percent.

3.6 Testing & Inspection

In order to maintain adequate control over mineral aggregates and bituminous mixtures the Contractor shall employ an asphalt technician who shall work in the Contractor's laboratory solely employed on the control of all aspects of grading and mix of the bituminous binder & wearing course while this work is proceeding on site. He shall keep such records as and when required and shall carry out such specification tests or checks as the Engineer may direct.

In order to ascertain the properties of the bitumen being used in the works the Contractor shall submit, for the approval of the Engineer, test certificate from an approved testing laboratory for all bitumen arriving on site.

All test samples, shall be prepared and tested at the Contractor's expense and the Contractor's quoted price for the work will be deemed to include all costs involved in design of the mix and for control tests during the period of the works.

3.7 Mixing

Mixing shall be carried out in an approved continuous mixer. The aggregate shall be dried to the optimum delivery temperature and batched in their correct proportions and by approved plant of sufficient capacity to provide an adequate supply of aggregates to the mixer. The

bitumen temperature shall not exceed 163°C and the mixing period to produce a uniformly consistent mix shall normally be 1 minute and on no occasion be less than 30 seconds.

3.8 **Transporting**

The transporting of bituminous material from mixing to spreading plant shall be carried out in approved clean lorries. Each lorry shall have as standard equipment a clean, whole tarpaulin that shall adequately cover the load. The Engineer may periodically inspect this transport and reject any that is not clean, tight or mechanically reliable.

3.9 **Spreading**

The bituminous concrete shall be placed in one layer at an optimum temperature of 135°C - 163°C by mechanical spreader. The plant proposed for this purpose shall be submitted to the Engineer for his approval prior to the commencement of work at site.

3.10 **Density Requirement**

The density achieved in the bituminous layer after compaction is to be at least 97% of the density achieved for the same job mix in the Marshall stability tests carried out in the laboratory. Cores are to be cut in the bituminous layer as directed by the Engineer at the Contractor's expense and the cores shall be used for density determination.

3.11 **Compaction**

After spreading, the bituminous concrete shall be compacted in the following manner:

First Stage

A three wheeled roller with a bearing pressure in the rear wheels from 1.72 - 2.40 MPa width of wheel shall be utilised, the driven wheels leading on the fresh mix. The change of direction in the rolling shall only be carried out with the steering wheel on partly consolidated mix so that the displacement of the mix is avoided.

A check shall then be made on the surface with the 3 metre straight edge, and while minor variations may be corrected by further rolling, major adjustments will require addition or sub-traction of hot material. This shall be carried out while the coat is still hot.

Second Stage

Immediately after the initial rolling a pneumatic tyred roller shall be utilised. It shall be of the self propelled type and shall weigh approximately 20 tonnes, the tyre pressure being 0.51 - 0.82 MPa.

Third Stage

The final finish shall be given with an 8-10 tonnes tandom roller. Each stage of rolling shall be carried out by passes with a half wheel width

overlap and every care must be taken that the roller does not lift the mix and that its wheels are absolutely clean. Roller must not be allowed to stand on any coat which is not completely consolidated.

3.12 **Longitudinal Joints**

While making longitudinal joints the spreader shall overlap the existing strip and sufficient material must be left on the overlap to allow for adequate compaction. Any excess material shall be carefully removed so that when rolling is carried out a thoroughly workman like-joint is left.

At the end of the day, should a longitudinal joint be left open before the adjacent section is laid, the longitudinal edge shall be carefully cut back to a straight line and the freshly cut face shall be given a tack coat of bitumen.

3.13 **Transverse Joints**

The edge of the previously laid strip shall be cut back to it's full depth and painted with hot bitumen immediately before the hot bituminous mixture is placed against it.

Both longitudinal and transverse joints shall be checked for continuity using a 3 metre straight edge immediately after rolling and any necessary correction be made at this stage.

4. BITUMEN PAVEMENT THICKNESS AND SURFACE TOLERANCE

The thickness indicated for each of the various courses of bitumen pavement is nominal thickness. The pavement shall be so constructed that the final compacted thickness is not less than the nominal thickness and does not exceed the nominal thickness indicated on the plans by more than 6 mm. Determination for final acceptance and payment will be made from cores of thickness and measurements taken of the completed pavement. The Contractor shall replace the cored material in a manner satisfactory to the Engineer. No payment will be made for the extra thickness over and above the indicated tolerance.

5. TESTING SURFACE

The surface shall be tested with 5 metre straight edge or string line placed parallel to the centre line of the road way and with a 3 metre straight edge placed transversely to the centre line of the roadway on any portion of the roadway/pavement surface. Variation exceeding 6 mm shall be satisfactorily eliminated or the pavement relaid at no additional cost.

6. OPENING TO TRAFFIC

No traffic shall be allowed on the completed courses until the permission of the Engineer has been obtained.

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 undermentioned specified works related to the relevant items of 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.

7.1.1 Providing and applying prime coat before laying bituminous surface course.

7.1.2 Any losses of materials which may result from shrinkage, compaction, foundation settlement, overflow, erosion, leakage or any other causes.

7.1.3 Providing and spraying water to clean the wheel of roller.

7.1.4 Rolling and compacting the surface.

7.1.5 Compaction, density or any other test mentioned in this section.

7.2 Bituminous Surface Course

7.2.1 Measurement

Measurement for acceptably completed works of bituminous surface course will be made on the basis of actual area in square feet of the surface course compacted with true lines and grades as shown on the Drawings.

7.2.2 Payment

Payment will be made for acceptable measured quantity of bituminous surface course 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 - 7141

BITUMINOUS SURFACE TREATMENT

1. SCOPE

The work under this section of specifications includes furnishing all labour, plants, equipment, appliances and materials and performance of all operations required in connection with construction of bituminous surface treatment for roads and pavements on prepared base course in strict accordance with this section of the specifications, applicable drawings and in conformity with the lines, grades and cross-section shown on the plans and subject to the terms and conditions of Contract.

2. BITUMINOUS SURFACE TREATMENT

2.1 Bituminous Materials

Prime Coat: The prime coat shall be medium-curing cutback asphalt consisting of an asphaltic base or an appropriate type of penetration grade asphalt fluxed with suitable petroleum distillates as directed by the Engineer. The product shall be free of water, show no separation prior to use, and shall conform to all the requirements of asphalt penetration grade asphalt.

Seal Coat: The seal coat shall be rapid-curing cutback asphalt consisting of an asphaltic base or an appropriate type penetration grade asphalt fluxed with suitable petroleum distillates as directed by the Engineer. The product shall be free of water, show no separation prior to use and shall conform to all the requirements asphalt institute, USA, for the specified or approved type.

2.2 Cover Material

Aggregate for cover material shall be screenings of crushed stone, which are clean, tough, durable and free from dirt and other objectionable matter. The percentage of wear shall not be more forty (40) as determined by AASHTO T96. When subjected to five (5) cycles of sodium-sulfate soundness testing, as determined by AASHTO T104, it shall have a weight loss not greater than (10) percent. The moisture content in the aggregate applied directly to the surface of the bituminous material shall not exceed three (3) percent by weight plus one-half (½) the water absorption of the aggregate at the time of delivery to the project. In no case shall free moisture be drawing from the truck bed. Aggregate shall conform to the following gradations and shall be approved by the Engineer.

2.3 **Aggregate Gradation**

The percentage composition by weight of aggregate shall conform to the following gradations:

U.S. Standard Sieve	Percentage Passing by Weight		
	Size No. 1	Size No. 2	Size No. 3
1”	100	-	-
¾”	090 - 100	-	-
½”	020 - 055	100	-
3/8”	000 - 015	085 – 100	100
¼”	-	-	090 - 100
No. 4	000 - 005	010 - 030	060 - 085
No. 8	-	-	-
No. 16	-	-	-
No. 200	-	-	-

The size of aggregate for seal coat shall be 3/8 inches.

The portion of aggregate retained on the 9.5mm (3/8 inch) sieve shall not contain more than fifteen (15) percent of particles by weight so flat or elongated, or both, that the ratio between the maximum and the minimum dimensions exceeds 5:1.

The nominal sizes of aggregate used for surface treatment shown against table as under:

Size No.1 – Nominal size 18 mm
Size No.2 – Nominal size 12 mm
Size No.3 – Nominal size 09 mm
Size No.4 – Nominal size 06 mm

3. EXECUTION

3.1 Bituminous Prime Coat

3.1.1 Construction Requirements

a. Preparation of Road Surfaces: It shall be the Contractor’s sole responsibility to maintain the surface in an approved condition, conforming to the required grades and sections.

Any defects, which may develop, shall be immediately corrected at the Contractor’s expense.

Prior to the application of the bituminous material, all loose materials shall be removed from the surface and the surface shall

be cleaned by means of approved mechanical sweepers or blowers and/or hand brooms, until it is as free from dust as is deemed practicable. If deemed necessary by the Engineer, and if the surface is an earth surface or a water-bound base course or subbase, the cleaned surface shall be given a light application of water and allowed to dry to a surface-dry condition before the bituminous material is applied. No traffic shall be permitted on the surface after it has been prepared to receive the bituminous material.

b. Heating of Bituminous Materials: Heating shall be with equipment as approved by the Engineer. The use of any method of agitation or heating that introduces free steam or moisture into the bituminous material is prohibited. Materials heated to temperatures above twenty-eight degree (28 °C) higher than the maximum application temperature specified shall be considered as overheated and shall be rejected until the material can be resampled and retested. The reacceptance or final rejection will be made by the Engineer on the same requirements under which the material was originally tested.

c. Temperature of Bituminous Materials at Time of Application Bituminous materials shall be applied temperature within the ranges specified by the Asphalt Institute of USA for the respective type and grade.

d. Prime Coat: The prime coat shall be applied to approved earth surfaces, water bound base courses, top of roadway shoulders, and concrete surface and pavements as soon as practicable as determined by the Engineer, after they have been prepared and are sufficiently dry.

- Areas to be primed:

  The top of earth surfaces or base courses from a point six (6) inches outside the edge of the pavement line to the like point on the opposite side of the roadway.

  The top of the shoulders from the intersection of embankment slope and top of subgrade to the edge of the pavement line.

- Application of the Prime: specified bituminous material shall be applied at the rate as directed by the Engineer, by approved pressure distributors operated by skilled workmen. The spray nozzles and spray bar shall be adjusted and frequently checked so that uniform distribution is insured. Spraying shall cease immediately upon any clogging or interference of any nozzle, and corrective measures taken before spraying is resumed.

Hand sprays will be approved only for priming small patches or inaccessible areas that cannot be primed by normal operation of the distributor.

Care shall be taken that application of bituminous material at the junction of spread is not in excess of the specified amount. Any excess shall be squeegeed from the surface when ordered by the Engineer. Any skipped areas or recognized deficiencies shall be corrected by means of approved hand sprays.

- Test Section and Rates of Application: The rate of application for prime material shall be specified by the Engineer within the limits shown below as determined from field trials conducted on a test section or sections. The Contractor shall prior to the time he intends to begin his priming operation, prepare a test section of an approved length for the determination of the rate of application for the prime coat. On projects where surfaces to be primed are constructed of difference materials, a test section for each type of material shall be prepared by the Contractor.

  The test methods shall be determined by the Engineer and performed by the Contractor in the presence of the Engineer.

  The Engineer may order subsequent test sections and/or alter the previously established rate or rates of application when the deems it necessary.

  Application Rates for bituminous material for prime coat shall range from 0.12 gal/sq.yd to 0.32 gal./sq.yd.

  In the event that it would be necessary to apply the asphalt in two applications instead of one in order to attain the required quantity or specified results the contractor shall accomplish the same without additional payment.

- Protection of Adjacent Structures: When bituminous materials are being applied, the surfaces of all structures, wheel guards, guard rail, kerbs and gutters, and other roadway appurtenances shall be protected in a manner approved by the Engineer to prevent them from being splattered with bituminous material or marred by equipment operation. In the event that any appurtenances becomes splattered or marred, the contractor shall at his own expense, remove all traces of bituminous materials, and repair all damage and leave the appurtenances in an approved conditions.

- Blotting: If deemed necessary by the Engineer after the bituminous material has been applied for forty-eight (48) hours under favourable conditions and the prime coat has not dried sufficiently that it will not be damaged by traffic, a light

applicable of aggregate shall be applied. The blotter material shall be a clean fine sand other material as approved by the Engineer. Blotting material shall be applied sparingly on only the areas that have not dried. Blotting of the prime coat shall be done only when directed by the Engineer. Normally, additional time shall be allowed for drying of the prime coat when in the opinion of the Engineer this procedure does not seriously delay subsequent operations.

- Maintenance of Prime Coat: The Contractor shall maintain the prime coat treatment and the surface of the subgrade or base course. Any area where the prime coat has been damaged by traffic or by the Contractor's operations, shall be cleaned of all lose material, the defective base course or subgrade repaired to the satisfaction of the Engineer and the prime coat reapplied. The maintenance and repair of the prime coat and the underlying subgrade or base course shall be done at the Contractor's expenses.

- Traffic Control: The Contractor shall provide detours for the traveling public and for operational use in areas where priming is being done. Where no convenient detour can be made available, the priming operation shall be confined to one-half (½) of the roadway at a time and the Contractor shall provide traffic control to the satisfaction of the Engineer.

3.1.2 Weather and Temperature Limitations

Application of prime coat shall be performed only when the surface is dry, when the atmospheric temperature is above fifteen (15 °C) and when the weather is not foggy or rainy.

4. BITUMINOUS SURFACE TREATMENT

4.1 Construction Requirements

a. Preparation of Surfaces: Surfaces shall be prepared in accordance with the requirements specified in Clause 3.1, "Bituminous Prime Coat". At the time of the application, the weather shall be warm and dry and the road surface shall be clean and dry. Spraying shall not be done unless the road temperature is above twenty (20 °C) during the spraying. Prior to applying the asphaltic material, dirt and other objectionable materials shall be removed from the surface and surface shall be primed. If so directed by the Engineer the surface shall be cleaned by power brooming or wire brush until all loose and foreign materials are removed.

b. Traffic Control: Traffic shall be detoured during execution of this work.

No separate payment shall be made for conformance to this paragraph, all items being considered subsidiary to all of the items in the Bill of Quantities.

c. Heating of Bituminous Materials: Heating shall be with equipment as approved by the Engineer.

The use of any method of agitation or heating that introduces free steam or moisture into the bituminous material is prohibited. Materials heated to temperatures above twenty-eight (28 °C) higher than the maximum application temperature specified shall be considered as overheated and shall be rejected until the material can be resampled and retested. The reacceptance or final rejection will be made by the Engineer on the same requirements under which the material was originally tested.

d. Temperature of Bituminous Materials: The temperature of bituminous materials at the time of application shall be within the ranges specified in Section 7140 “Bituminous Concrete”.

e. Prime Coat:

- General: The bituminous prime coat shall be applied to the base course as shown on the plans or as established by the Engineer. The prime coat shall be applied in accordance with the requirements specified in Section 7140, “Bituminous Concrete”.

- Rate of Application: The rate of application shall be in accordance with the requirements specified in “Bituminous Prime Coat”, Clause 3.1.

f. First Seal Coat: After the prime coat has been applied and has thoroughly penetrated the surface and cured as specified in, “Bituminous Concrete”, the Contractor shall apply the bituminous Seal Coat and shall apply the cover material and roll and manipulate the surface all in accordance with the requirements specified hereinafter:

- Application of Bituminous Material: Bituminous material shall be applied by means of a pressure distributor in a uniform, continuous spread over the section to be treated and within the temperature range specified. The quantity of bituminous material to be used per square meter shall be within the limits hereinafter specified and as directed by the Engineer.

- A strip of building paper, at least three (3) feet wide and with a length equal to that of the spray bar of the distributor plus twelve (12) inches shall be used at the beginning of each spread. If the cut-off is not positive, the use of paper may be required by the Engineer at the end of each spread. The paper shall be removed and disposed of in an approved manner. The distributor shall be moving forward at proper application speed at the time the spray bar is opened. Any skipped areas or deficiencies shall be corrected in an approved manner. Junctions of spreads shall be carefully made to assure a smooth riding surface.

- The length of spread of bituminous material shall not be in excess of which trucks loaded with cover coat material can immediately cover.

- The spread of bituminous material shall not be more than six (6) inches wider than the width covered by the cover coat material from the spreading device. Under no circumstances shall operations proceed in such manner that bituminous material will be allowed to chill, set up, dry, or otherwise impair retention of the cover coat.

- The distributor, when not spreading, shall be so designed that the spray bar or mechanism will not drip bituminous materials on the surface of the traveled way.

- Distribution of the bituminous material shall be so regulated and sufficient bituminous material left in the distributor at the end of each application so that there will be a uniform distribution of bituminous material. In no case shall the distributor be allowed to expel air with the bituminous material thereby causing uneven coverage.

- Application of Aggregate: Immediately following the application of the bituminous material, cover material shall be spread with an approved aggregate spreader in quantities as specified by the Engineer and within the limits specified herein. Spreading shall be accomplished in such a manner that the tires of the trucks or aggregate spreader at no time contact the uncovered and newly applied bituminous material. No portion of the binder shall remain uncovered for a period in excess of 20 (twenty) minutes after spraying.

- Procedures of starting, stopping or turning of any piece of equipment which results in displacement of the cover material or damage to the seal courses shall be prohibited.

- The spreading equipment shall be of such width and arrangement that as the aggregate is placed complete coverage will be obtained. No brooming dragging or blading of the cover material shall be permitted prior to initial rolling. Any arrangement of the cover material shall be done with hand methods. Overlapping the applications of cover material shall be avoided and all spillage shall be removed from the surface. Before rolling, the bituminous material shall be uniformly covered.

- When directed by the Engineer, the Contractor will be required to add bituminous material or aggregate or both bituminous material and aggregate to portions of the project. Furnishing additional bituminous material and furnishing spreading dragging and rolling of additional aggregate will not be paid for separately but will be considered as subsidiary work pertaining to the item of “Triple Bituminous Surface Treatment”.

- Manipulation: Immediately after the application of bituminous material and aggregate to the road surface and after the aggregate has been rearranged as may be necessary to provide uniform and complete coverage, the surface shall be sufficiently rolled with an approved pneumatic-tired roller to embed the aggregate thoroughly into the

bituminous material. Sufficient rollers shall be provided that the initial rolling consisting of two (2) complete coverage's with the pneumatic-tired roller shall be completed within thirty (30) minutes after the cover material is applied. The rollers shall be operated on each coverage so that each succeeding trip of the roller will overlap at least fifty (50) percent of the width of the preceding trip. No blading or dragging of the aggregate will be permitted for the first seal coat. Any rearrangement of the cover material before or during the initial rolling shall be done by approved hand methods. Rolling shall be continued after the rolling specified above is completed until a maximum amount of the aggregate is satisfactorily embedded in the bituminous material. Pneumatic-tired rollers shall be operated at a maximum speed of eight (8) kilometers per hour.

g. Second and Third Seal Cost: Immediately prior to the second application of bituminous material for sealing the surface shall be cleaned in an approved manner of all dust and excess cover material which is not embedded in the first application of bituminous material for sealing. Care shall be exercised not to dislodge any cover material which is embedded in the bituminous material. The second seal coat shall be applied as specified hereinbefore, except that immediately following completion of the initial pneumatic rolling the surface shall be rolled with an approved steel roller. Brooms or drag brooms shall not be used to shift the cover material until the initial rolling with the pneumatic-tired and steel rollers is completed and until the bituminous material has cooled and set up sufficiently to hold the cover material, preferably not earlier than the day following the application of the second seal coat. Any rearrangement of the cover material during the initial rolling shall be done by approved hand methods.

The rolling shall be longitudinal and shall commence at the outer edges of the road, overlapping the shoulders, and progress toward the center. Rolling shall continue until the entire surface has been completely covered at least two (2) times with a pneumatic-tired roller and one (1) time with a steel wheel roller. Maximum speed of rollers shall be as hereinafter specified.

- Additional Manipulation of Completed Surface: The Contractor shall manipulate the surface for a period of five (5) days after the second seal coat has been applied. The manipulate shall consist of the application of additional bituminous material or aggregate or additional dragging and rolling or all of these operations to portions of the surface that, as determined by the Engineer, require such additional treatment. The manipulation shall also include the dragging and one (1) complete rolling with the steel roller over the entire surface each day from the time, the surface is completed until and including the fifth (5^{th}) day after. A light blade equipped with broom drag shall be operated immediately ahead of the roller throughout all rolling during the manipulation period. The daily dragging and rolling under manipulation may be omitted, if in the opinion of the Engineer, the weather and roadbed conditions are such that the dragging and rolling would not be beneficial to the surface.

The third seal coat shall also be applied in a similar way, if required. Bituminous material aggregate and additional manipulation ordered by the Engineer, in this work, will not be paid for separately but will be considered subsidiary to the item of "Triple Bituminous Surface Treatment" included in the "Bill of Quantities".

h) Rates of Application: The rates of application for bituminous material and aggregate for "Bituminous surface Treatment" shall be within the following limits".

Application of	Size	Aggregate Coverage Bituminous Material			
		lbs/ft^2 (min)	lbs/ft^2 (max)	lbs/ft^2 (min)	lbs/ft^2 (max)
1st Course	1	4.5	5.5	0.37	0.46
2nd Course	2	2.5	3.0	0.18	0.32
3rd Course	3	1.4	2.5	0.14	0.18
Seal Coat with Aggregate		0.75	0.85	0.10	-

The specific rates of application of the bituminous material and aggregates will be established by the Engineer from a test section performed in general conformance to the requirements specified in Section 7140, "Bituminous Concrete" and as directed by the Engineer.

i. Final Inspection: After all other work has been completed, and prior to final inspection and acceptance the excess loose cover material along the edges of the surface shall be broomed and bladed off the shoulder to provide a definite and distinct line along the edge of the sealed surface. The tolerance limits or finishing requirements shall be same as given for bituminous wearing course.

- Working Period: All work shall be so conducted that the work of applying asphalt and aggregate and of all rolling shall be completed during the time from sunrise to sunset and under favourable weather conditions as determined by the Engineer.

5. MEASUREMENT & PAYMENT

5.1 General

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

5.1.1 Providing and spreading cover material.

5.1.2 Providing and applying prime coat before laying bituminous surface course.

5.1.3 Surface preparation

5.1.4 Any losses of materials which may result from shrinkage, compaction, foundation settlement, overflow, erosion, leakage or any other causes.

5.1.5 Providing and spraying water to clean the wheel of roller.

5.1.6 Rolling and compacting the surface.

5.1.7 Compaction, density or any other test mentioned in this section.

5.2 Bituminous Surface Treatment

5.2.1 Measurement

Measurement for acceptably completed works of bituminous surface treatment will be made on the basis of actual area in square meter of the surface course compacted with true lines and grades as shown on the Drawings.

5.2.2 Payment

Payment will be made for acceptable measured quantity of bituminous surface treatment on the basis of unit rate per square meter quoted in the Bill of Quantities and shall constitute full compensation for all the works related to the item.

SECTION - 7190

MISCELLANEOUS ROAD WORKS

1. SCOPE

The work under this section of the specifications includes furnishing all plant, labour, equipment appliances and materials and performing of all operations of miscellaneous works i.e making of precast cement concrete fairface kerb stone, Gutter Block and Edge Block complete in accordance with this section of the specifications and applicable drawings and subject to the terms and conditions of the contract. The scope of work of this section of specifications is also covered by detailed specification as laid down herein.

2. PRE CAST CEMENT CONCRETE FAIR FACED KERB STONE/GUTTER BLOCK/EDGE BLOCK

2.1 Description

Under this item the contractor shall furnish and install in position the cement concrete fair faced finished kerb stones/gutter blocks/edge stone as shown on the drawings and in accordance with these specifications.

2.2 Materials

Cement concrete fair faced finished kerb stones/gutter block/edge block shall be fair face and precast using Class 'C' concrete, conforming to the requirements as stipulated in the section "Plain and Reinforced Cement Concrete". The formwork shall conform to the requirements as stipulated in the section "Formwork".

2.3 Construction

The form facing-material shall produce a smooth, hard, uniform texture on the concrete surface. It shall be smooth plane surface timber, steel or other approved material supported by strong studs or other backings capable of preventing deflection, deformations and to give straight edges and fair finish. Concrete shall be tipped from the trolley slightly in advance of the working place and then shoveled into position. The spreading shall be carried out very carefully. Compaction shall be done with vibrator compactor. It shall operate only in the mass of the concrete and should not be allowed to strike or displace the form. The spreading and compacting shall proceed without stoppage or interruptions and continue as quickly as possible so as to ensure that the curbs are monolithic and without plane of weaknesses and fully leveled throughout its length. When the initial set takes place, the surface shall be troweled smooth with a steel trowel to make dense, neat, clean and smooth top surface.

2.4 Protections and Curing

Concrete placed within the form shall be protected from harmful injuries by heat of the sun, rain, flowing water and all kinds of disturbance and

mechanical injury and shall not be allowed to dry out from the time it is placed until the expiry of the minimum curing period of 14 days.

The Contractor shall exercise care in avoiding damage to kerbs while removing the forms. Forms may be removed when concrete has sufficiently hardened, may be in 48 hours. Under no circumstances the use of pry bars between the forms and kerbs walls will be permitted.

All formed surface defects, visible vertical surface projections and irregularities shall be removed. The entire surface shall be rubbed, if required by the Engineer, with a carborandum brick No. 16 or other abrasive material until even, smooth and uniform surface appearance is made and washed and cleaned. Plastering of surface, application of cement or other coating will not be permitted.

3. MEASUREMENT AND PAYMENT

3.1 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 BOQ. The cost thereof shall be deemed to have been included in the quoted unit rate of the respective items of the Bill of Quantities.

3.1.1 Earthworks, form work & concrete in foundations.

3.1.2 Preparation for application of paint and cleaning of pavement surfaces.

3.1.3 Cement sand mortar.

3.1.4 Fixing and installation of precast elements

4.2 Pre Cast Cement Concrete Fairfaced Kerb Stone/Edge Stone/Gutter Block

4.2.1 Measurement

Measurement of acceptably completed works of pre cast cement concrete fair faced kerb stone/Edge stone/Gutter block will be made on the basis of actual length in running metre of kerb stone/edge stone/gutter block provided and placed in position as shown on the Drawing or as directed by the Engineer.

4.2.2 Payment

Payment will be made for acceptable measured quantity of pre cast cement concrete fair faced kerb stone/edge block/gutter block on the basis of unit rate per running metre quoted in the Bill of Quantities & shall constitute full compensation for all the works related to the items.

Technical Specifications:

Wet Utility Services

SECTION – 7200
PRECAST CONCRETE UNIT RETAINING STRUCTURE

SPECIFICATION FOR SEGMENTAL CONCRETE UNIT RETAINING WALL

PART 1: GENERAL

1.01 Description

A.

Work shall consist of furnishing and construction of a ' Retaining Wall System in accordance with these specifications and in reasonably close conformity with the lines, grades, design, and dimensions shown on the plans.

B.

Work includes preparing foundation soil, furnishing and installing leveling pad, unit drainage fill and backfill to the lines and grades shown on the construction drawings.

C.

Work includes furnishing and installing geogrid soil reinforcement of the type, size, location, and lengths designated on the construction drawings.

1.02 Related Sections

A.

Section 02300 (31 00 00) - Earthwork 1.03

1.03 Reference Documents

A. American Society for Testing and Materials (ASTM)

1. ASTM C140 Sampling and Testing Concrete Masonry Units
2. ASTM C1372 Specification for Dry-Cast Segmental Retaining Wall Units
3. ASTM D422 Particle-Size Analysis of Soils
4 ASTM D3034 Polyvinyl Chloride Pipe (PVC)
5ASTM D4318 Liquid Limit, Plastic Limit and Plasticity Index of Soils
6ASTM D4475 Horizontal Shear Strength of Pultruded Reinforced Plastic Rods
7. ASTM D4476 Flexural Properties of Fiber Reinforced Pultruded Plastic Rods
8. ASTM D4595 Tensile Properties of Geotextiles - Wide Width Strip
9. ASTM D6706 Geosynthetic Pullout Resistance in Soil
10. ASTM D6916 Shear Strength Between Segmental Concrete Units

B. Geosynthetic Research Institute (GRI)

1. GRI-GG4 Determination of Long Term Design Strength of Geogrids
2. GRI-GG5 Determination of Geogrid (soil) Pullout

C. National Concrete Masonry Association (NCMA)

1. NCMA SRWU-1 Test Method for Determining Connection Strength of SRW County Materials SRW Specification Page 2 02/2016 2. NCMA SRWU-

2 Test Method for Determining Shear Strength of SRW D. Where specifications and reference documents conflict, the Wall Design Engineer shall make the final determination of applicable document.

1.04 Submittals/Certification

A. Contractor shall submit a Manufacturer's Letter of Compliance, prior to start of work, that the retaining wall system components meet the requirements of this specification and the structure design.

B. Contractor shall submit construction drawings and design calculations for the retaining wall system prepared and stamped by a Professional Engineer registered in the state of the project. The engineering designs, techniques, and material evaluations shall be in accordance with the Manufacturer's instructions, and NCMA Design Guidelines For Segmental Retaining Walls.

C. Contractor shall submit a test report documenting strength of geogrid reinforcement connection. The maximum design tensile load of the geogrid shall be equal to the laboratory tested ultimate strength of geogrid / facing unit connection at a maximum normal force limited by the "Hinge Height" of the structure divided by a safety factor of 1.5. The connection strength evaluation shall be performed in accordance with ASTM D6638 (NCMA SRWU-1)

1.05 Quality Assurance

A. Contractor shall submit a list of five (5) previously constructed projects of similar size and magnitude by the wall installer where the specific retaining wall system has been constructed successfully. Contact names and telephone numbers shall be listed for each project.

B. Contractor shall provide evidence that the design engineer has a minimum of five years of documentable experience in the design for reinforced soil structures.

C. Owner shall/may provide soil testing and quality assurance inspection during earthwork and wall construction operations. Contractor shall provide any quality control testing or inspection not provided by the Owner. Owner's quality assurance program does not relieve the contractor of responsibility for quality control and wall performance.

1.06 Delivery, Storage and Handling

A. Contractor shall check all materials upon delivery to assure that the proper type, grade, color of retaining wall system has been received.

B. Contractor shall store, handle and protect all materials from damage due to jobsite conditions and in accordance with manufacturer's recommendations. Damaged materials shall not be incorporated into the work.

C. Geosythentic shall be protected from UV exposure and the protective covering on geosythentic shall remain until immediately before installation and shall be stored at temperatures above -10 degrees F.

PART 2: PRODUCTS

2.01 Definitions

A. Modular Unit - a concrete retaining wall element machine made from Portland cement, water, and aggregates.

B. Structural Geogrid - a structural element formed by a regular network of integrally connected tensile elements with apertures of sufficient size to allow interlocking with surrounding soil, rock, or earth and function primarily as reinforcement.

C. Unit Drainage Fill - drainage aggregate, which is placed within and immediately behind the modular concrete units.

D. Reinforced Backfill - compacted soil, which is placed within the reinforced soil volume as outlined on the plans.

2.02 Segmental Retaining Wall Units

A. Acceptable manufacturer Envi Crete , Megnacrete or Equivalent as approved.

B. Modular concrete materials shall conform to the requirements of ASTM C1372 - Standard Specifications for Segmental Retaining Wall Units.

C. Modular concrete units shall conform to the following structural and geometric requirements measured in accordance with ASTM C140 Sampling and Testing Concrete Masonry Units:

1. Compressive strength: ≥ 3000 psi (21 MPa);

2. Absorption: 8 % (6% in northern states) for standard weight aggregates;

3. Dimensional tolerances: ± 1/8" (3 mm) from nominal unit dimensions not including rough split face, ±1/16" (1.5 mm) unit height - top and bottom planes

D. Color and Finish: As selected from the Manufacturer's standard options.

E. Color and Finish: As indicated on the drawings.

2.03 Shear Connectors

A. If required by the SRW system, shear connectors shall be fiberglass reinforcement rods or equivalent to provide connection between vertically and horizontally adjacent units with the following requirements:

1. Flexural Strength in accordance with ASTM D4476: 128,000 psi (882 MPa) minimum;

2. Short Beam Shear in accordance with ASTM D4475: 6,400 psi (44 MPa) minimum.

B. Shear connectors shall be capable of holding the geogrid in the proper design position during grid pre-tensioning and backfilling.

2.04 Base Leveling Pad Material

A. Material shall consist of a compacted crushed stone base or non-reinforced concrete as shown on the construction drawings

2.05 Unit Drainage Fill

A. Unit drainage fill shall consist of clean 1" (25 mm) minus crushed stone or crushed gravel meeting the following gradation tested in accordance with ASTM D-422:

Sieve Size	Percent Passing
1 inch (25 mm)	100
3/4-inch (19 mm)	75-100
No. 4	0 - 10
No. 50	0 - 5

B. One cubic foot (0.028 m3), minimum, of drainage fill shall be used for each square foot (0.093 m2) of wall face. Drainage fill shall be placed within cores of, between, and behind units to meet this requirement.

2.06 Reinforced Backfill

A. Reinforced backfill shall be free of debris and meet the following gradation tested in accordance with ASTM D-422:

Sieve Size	Percent Passing
2-inch (50 mm)	100
3/4-inch (19 mm)	100-75
No. 40	0-60
No. 200	0-35

Plasticity Index (PI) less than 15 and liquid limit less than 40 as per ASTM D- 4318

B. The maximum aggregate size shall be limited to 3/4 inch (19 mm) unless field tests have been performed to evaluate potential strength reductions to the geogrid design due to damage during construction.

C. Material can be site-excavated soils where the above requirements can be met. Unsuitable soils for backfill (high plastic clays or organic soils) shall not be used in the backfill or in the reinforced soil mass.

D. Contractor shall submit reinforced fill sample and laboratory test results to the Architect/Engineer for approval prior to the use of any proposed reinforced fill material.

2.07 Geogrid Soil Reinforcement

A. Geosynthetic reinforcement shall consist of geogrids manufactured specifically for soil reinforcement applications and shall be manufactured from high tenacity polyester yarn or high-density polyethylene. Polyester geogrid shall be knitted from high tenacity polyester filament yarn with a molecular weight exceeding 25,000 Meg/m and a carboxyl end group values less than 30. Polyester geogrid shall be coated with an impregnated PVC coating that resists peeling, cracking,

and stripping.

B. Ta, Long Term Allowable Tensile Design Load, of the geogrid material shall be determined as follows:

Ta = Tult / (RFcr*RFd*RFid*FS) Ta shall be evaluated based on a 75-year design life

1. Tult, Short Term Ultimate Tensile Strength shall be determined in accordance with ASTM D4595 or ASTM D6637. Tult is based on the minimum average roll values (MARV).
2. RFcr, Reduction Factor for Long Term Tension Creep RFcr shall be determined from 10,000-hour creep testing performed in accordance with ASTM D5262. Reduction value = 1.45 minimum.
3. RFd, Reduction Factor for Durability RFd shall be determined from polymer specific durability testing covering the range of expected soil environments. RFd = 1.10 minimum.
4. RFid, Reduction Factor for Installation Damage RFid shall be determined from product specific construction damage testing performed in accordance with ASTM D5818 (GRI-GG4). Test results shall be provided for each product to be used with project specific or more severe soil type. RFid = 1.05 minimum.
5. FS, Overall Design Factor of Safety FS shall be 1.5 unless otherwise noted for the maximum allowable working stress calculation.

C. The maximum design tensile load of the geogrid shall not exceed the laboratory tested ultimate strength of the geogrid/facing unit connection as limited by the “Hinge Height” divided by a factor of safety of 1.5. The connection strength testing and computation procedures shall be in accordance with ASTM D6638 Connection Strength between Geosynthetic Reinforcement and Segmental Concrete Units (NCMA SRWU-1).

D. Soil Interaction Coefficient, Ci Ci values shall be determined per ASTM D6706 (GRI:GG5) at a maximum 0.75-inch (19 mm) displacement.

E. Manufacturing Quality Control The geogrid manufacturer shall have a manufacturing quality control program that includes QC testing by an independent laboratory. The QC testing shall include: Tensile Strength Testing Melt Flow Index (HDPE) Molecular Weight (Polyester)

2.08 Drainage Pipe

A. If required, the drainage pipe shall be perforated or slotted PVC pipe manufactured in accordance with ASTM D-3034 or corrugated HDPE pipe manufactured in accordance with AASHTO M252.

2.09 Geotextile Filter Fabric

A. When required, Geotextile filter fabric shall be 4.0 oz/sy, polypropylene, needlepunched nonwoven fabric.

PART 3: EXECUTION

3.01 Excavation

A. Contractor shall excavate to the lines and grades shown on the construction drawings. Owner's representative shall inspect the excavation and approve prior to placement of leveling material or fill soils. Proof roll foundation area as directed to determine if remedial work is required.

B. Over-excavation and replacement of unsuitable foundation soils and replacement with approved compacted fill will be compensated as agreed upon with the Owner.

3.02 Base Leveling Pad

A. Leveling pad material shall be placed to the lines and grades shown on the construction drawings, to a minimum thickness of 6 inches (150 mm) and extend laterally a minimum of 6" (150 mm) in front and behind the modular wall unit.

B. Soil leveling pad materials shall be compacted to a minimum of 95 % Standard Proctor density per ASTM D-698 or 92% Modified Proctor Density per ASTM D1557.

C. Leveling pad shall be prepared to insure full contact to the base surface of the concrete units.

3.03 Modular Unit Installation

A. First course of units shall be placed on the leveling pad at the appropriate line and grade. Alignment and level shall be checked in all directions and insure that all units are in full contact with the base and properly seated.

B. Place the front of units side-by-side. Do not leave gaps between adjacent units. Layout of corners and curves shall be in accordance with manufacturer's recommendations.

C. Install shear/connecting devices per manufacturer's recommendations.

D. Place and compact drainage fill within and behind wall units. Place and compact backfill soil behind drainage fill. Follow wall erection and drainage fill closely with structure backfill.

E. Maximum stacked vertical height of wall units, prior to unit drainage fill and backfill placement and compaction, shall not exceed two courses.

3.04 Structural Geogrid Installation

A. Geogrid shall be oriented with the highest strength axis perpendicular to the wall alignment.

B. Geogrid reinforcement shall be placed at the strengths, lengths, and elevations shown on the construction design drawings or as directed by the Engineer.

C. The geogrid shall be laid horizontally on compacted backfill and attached to the modular wall units. Place the next course of modular concrete units over the geogrid. The geogrid shall be pulled taut, and anchored prior to backfill placement on the geogrid.

D. Geogrid reinforcements shall be continuous throughout their embedment length'

lengths, and elevations shown on the construction design drawings or as directed by the Engineer.

C. The geogrid shall be laid horizontally on compacted backfill and attached to the modular wall units. Place the next course of modular concrete units over the geogrid. The geogrid shall be pulled taut, and anchored prior to backfill placement on the geogrid. D. Geogrid reinforcements shall be continuous throughout their embedment lengths and placed side-by-side to provide 100% coverage at each level. Spliced connections between shorter pieces of geogrid or gaps between adjacent pieces of geogrid are not permitted.

3.05 Reinforced Backfill Placement

A. Reinforced backfill shall be placed, spread, and compacted in such a manner that minimizes the development of slack in the geogrid and installation damage.

B. Reinforced backfill shall be placed and compacted in lifts not to exceed 6 inches (150 mm) where hand compaction is used, or 8 - 10 inches (200 to 250 mm) where heavy compaction equipment is used. Lift thickness shall be decreased to achieve the required density as required.

C. Reinforced backfill shall be compacted to a minimum of 95 % Standard Proctor density per ASTM D-698 or 92% Modified Proctor Density per ASTM D1557. The moisture content of the backfill material prior to and during compaction shall be uniformly distributed throughout each layer and shall be dry of optimum, + 0%, - 3%.

D. Only lightweight hand-operated equipment shall be allowed within 3 feet (1m) from the tail of the modular concrete unit.

E. Tracked construction equipment shall not be operated directly upon the geogrid reinforcement. A minimum fill thickness of 6 inches (150 mm) is required prior tooperation of tracked vehicles over the geogrid. Tracked vehicle turning should be kept to a minimum to prevent tracks from displacing the fill and damaging the geogrid.

F. Rubber tired equipment may pass over geogrid reinforcement at slow speeds, less than 10 MPH (15 KPH). Sudden braking and sharp turning shall be avoided.

G. At the end of each day's operation, the Contractor shall slope the last lift of reinforced backfill away from the wall units to direct runoff away from wall face. The Contractor shall not allow surface runoff from adjacent areas to enter the wall construction site.

3.06 Cap Installation

A. Cap units shall be glued to underlying units with an all-weather adhesive recommended by the manufacturer.

3.07 As-built Construction Tolerances A. Vertical alignment: ± 1.5" (40 mm) over any 10' (3 m) distance. B. Wall Batter: within 2 degrees of design batter. C. Horizontal alignment: ± 1.5" (40 mm) over any 10' (3 m) distance. Corners, bends & curves: ± 1 ft (300 mm) to theoretical location. D. Maximum horizontal gap between erected units shall be ≤ 1/2 inch (13 mm).

Section 7210

Mechanical Stabilized Earth MSE Retaining Wall

Part 1: GENERAL

1.01 Description

A. Work shall consist of designing, furnishing and construction of a KEYSTONE Compac II unit retaining wall system in accordance with these specifications and in reasonably close conformity with the lines, grades, design and dimensions shown on the plans. No alternate wall systems will be considered.

B. Work includes preparing foundation soil, furnishing and installing leveling pad, unit facing system, unit drainage fill and reinforced backfill to the lines and grades shown on the construction drawings.

C. Work incudes furnishing and installing geogrid soil reinforcement of the type, size, location and lengths designated on the construction drawings.

1.02 Related Sections

A. Section 31 00 00 – Earthwork

1.03 Reference Documents

A. American Association of State Highway and Transportation Officials (AASHTO)

1. AASHTO M 288 Geotextile Specification for Highway Applications

B. American Society for Testing and Materials (ASTM)

1. ASTM C140 Sampling and Testing Concrete Masonry Units
2. ASTM C1372 Specification for Dry-Cast Segmental Retaining Wall Units
3. ASTM D442 Particle Size Analysis of Soils
4. ASTM D698 Laboratory Compaction Characteristics of Soil – Standard Effort
5. ASTM D1557 Laboratory Compaction Characteristics of Soil – Modified Effort
6. ASTM D4318 Liquid Limit, Plastic Limit and Plasticity Index of Soils
7. ASTM D4475 Horizontal Shear Strength of Pultruded Reinforced Plastic Rods
8. ASTM D4476 Flexural Properties of Fiber Reinforced Pultruded Plastic Rods
9. ASTM D4595 Standard Test Method for Tensile Properties of Geotextiles by Wide-Width Strip Method
10. ASTM D6638 Standard Test Method for Determining Connection Strength Between Geosynthetic Reinforcement and Segmental Concrete Units
11. ASTM D6706 Standard Test Method for Measuring Geosynthetic Pullout Resistance in Soil
12. ASTM D6916 Standard Test Method for Determining the Shear Strength Between Segmental Concrete Units

C. National Concrete Masonry Association (NCMA)

1. NCMA SRWU-1 Test Method for Determining Connection Strength of SRW
2. NCMA SRWU-2 Test Method for Determining Shear Strength of SRW

1.04 Definitions

A. Compac II Unit – a dry-stacked concrete retaining wall unit machine made from Portland cement, water, aggregates, manufactured by a licensed manufacturer of Keystone.

B. Structural Geogrid – a polymeric material formed by a regular network of connected tensile elements with apertures of sufficient size to allow interlocking with surrounding soil, rock or earth and function primarily as reinforcement.

C. Unit Drainage Fill – drainage aggregate that is placed within and immediately behind the Keystone concrete units.

D. Reinforced Backfill – compacted soil that is placed within the reinforced soil volume as outlined on the plans.

E. Retained Soil – the soil mass behind the reinforced backfill.

F. Foundation Soil – the soil mass below the leveling pad and reinforced backfill.

G. Leveling Pad – crushed stone, sand and gravel or unreinforced concrete material placed to provide a level surface for placement of the Keystone concrete units.

H. Geosynthetic Reinforcement – polymeric material designed specifically for soil reinforcement.

1.05 Submittals and Certification

A. Contractor shall submit a Manufacturer's certification, prior to the start of work, that the retaining wall system components meet the requirements of this specification and the structure design.

B. Contractor shall submit construction drawings and design calculations for the retaining wall system prepared and stamped by a Professional Engineer registered in the state of the project.

1.06 Quality Assurance

A. Contractor shall submit a list of two (2) previously constructed projects of similar size and magnitude by the wall installer where the Compac retaining wall system has been constructed successfully. Contact names and phone numbers shall be listed for each project.

B. Contractor shall provide evidence that the design engineer has a minimum of five years documented experience in the design of reinforced soil structures.

C. Owner shall/may provide quality assurance inspection and testing during earthwork and wall construction operations. Contractor shall provide all quality control testing and inspection not provided by the owner. Owner's quality assurance program does not relieve the contractor of responsibility for quality control and wall performance.

1.07 Delivery Handling and Storage

A. Contractor shall check all materials upon delivery to assure that the proper type, grade, color, and certification have been received.

B. Contractor shall protect all materials from damage due to jobsite conditions and in accordance with manufacturer's recommendations. Damaged materials shall not be incorporated into the work.

PART 2: PRODUCTS

2.01 PreCast Concrete Retaining Wall Units

A. Compac II retaining wall units shall conform to the following architectural requirements

1. Face color - concrete gray, unless otherwise specified. The Owner may specify standard manufacturers' color.
2. Tri-plane or Straight Face finish - hard split in angular tri-plane or straight face configuration. Other face finishes will not be allowed without written approval of Owner.
3. Bond configuration - running with bonds nominally located at midpoint in vertically adjacent units.
4. Exposed surfaces of units shall be free of chips, cracks or other imperfections when viewed from a distance of 20 feet (6 m) under diffused lighting.

B. Precast concrete units shall conform to the requirements of ASTM C1372 - Standard Specifications for Segmental Retaining Wall Units.

C. Precast concrete units shall conform to the following structural and geometric requirements measured in accordance with ASTM C140 Sampling and Testing Concrete Masonry Units:

1. Compressive strength: ≥ 3000 psi (21 MPa).
2. Absorption: ≤ 8 % for standard weight aggregates.
3. Dimensional tolerances: ± 1/8" (3 mm) from nominal unit dimensions not including rough split face.
4. Unit Size: 8" (203 mm) (H) x 18" (457 mm) (W) x 12" (304 mm)(D) minimum.

D. Precast concrete units shall conform to the following constructability requirements:

1. Vertical setback: 1/8 inch (3 mm) ± per course (near vertical) or 1 1/8 inch (28 mm) + per course, per the design.
2. Alignment and grid attachment mechanism - fiberglass pins, two per unit.
3. Maximum horizontal gap between erected units shall be ≤ 1/2 inch (13 mm).

2.02 Shear and Reinforcement Pin Connectors

A. Shear and reinforcement pin connectors shall be 1/2-inch (12 mm) diameter thermoset isopthalic polyester resin pultruded fiberglass reinforcement rods to provide connection between vertically and horizontally adjacent units and geosynthetic reinforcement, with the following requirements:

1. Flexural Strength in accordance with ASTM D4476: 128,000 psi (882 MPa) minimum.
2. Short Beam Shear in accordance with ASTM D4475: 6,400 psi (44 MPa) minimum.

B. Shear and reinforcement pin connectors shall be capable of holding the geogrid in the proper design position during grid pre-tensioning and backfilling.

2.03 Base Leveling Pad Material

A. Material shall consist of a compacted crushed stone base, sand and gravel or unreinforced concrete, as shown on the construction drawings.

2.04 Unit Drainage Fill

A. Unit drainage fill shall consist of clean 1 inch (25 mm) minus crushed stone or crushed gravel meeting the following gradation tested in accordance with ASTM D-422:

Sieve Size	Percent Passing
1 inch (25 mm)	100
3/4-inch (19mm)	75 – 100
No. 4 (4.75 mm)	0 – 10
No. 50 (300 um)	0 - 5

B. Drainage fill shall be placed within the cores of, between, and behind the units as indicated on the design drawings. Not less than 1.3 cubic foot (0.036 m^3), of drainage fill shall be used for each square foot (0.093 m^2) of wall face unless otherwise specified.

2.05 Reinforced Backfill

A. Reinforced backfill shall be free of debris and meet the following gradation tested in accordance with ASTM D-422:

Sieve Size	Percent Passing
1 1/2 inch (38 mm)	100
3/4-inch (19 mm)	75 – 100
No. 40 (425 um)	0 – 60
No. 200 (75 um)	0 – 35

Plasticity Index (PI) < 15 and Liquid Limit < 40, per ASTM D4318

B. The maximum aggregate size shall be limited to 3/4 inch (19 mm) unless installation damage tests have been performed to evaluate potential strength reductions to the geogrid design due to increased installation damage during construction.

C. Material can be site-excavated soils where the above requirements can be met. Soils not meeting the above criteria, including highly plastic clays and organic soils, shall not be used in the backfill or reinforced backfill soil mass.

D. Contractor shall submit reinforced fill sample and laboratory test results to the Architect/Engineer for approval, prior to the use of any proposed reinforced backfill material.

2.06 Geogrid Soil Reinforcement

A. Geosynthetic reinforcement shall consist of geogrids manufactured for soil reinforcement applications and shall be manufactured from high tenacity polyester yarn or high density polyethylene. Polyester geogrid shall be made from high tenacity polyester filament yarn with a molecular weight exceeded 25,000 g/m and with a carboxyl end group value less than 30. Polyester geogrid shall be coated with an impregnated PVC coating that resists peeling, cracking and stripping.

B. Ta – Long Term Allowable Tensile Design Load. Ta of the geogrid material shall be determined as follows: Ta = Tult/(RFcr * RFd * RFid * FS). Ta shall be evaluated based on a 75 year design life.

1. Tult – Short Term Ultimate Tensile Strength. Tult shall be determined in accordance with ASTM D4595 or ASTM D6637. Tult is based on the minimum average roll values (MARV).

2. RFcr – Reduction Factor for Long Term Tension Creep. RFcr shall be determined from 10,000 hour creep testing performed in accordance with ASTM D5262. RFcr = 1.45 minimum.

3. RFd – Reduction Factor for Durability. RFd shall be determined from polymer specific durability testing covering the range of expected soil environments. RFd = 1.10 minimum.

4. RFid – Reduction Factor for Installation Damage. RFid shall be determined from product specific construction damage testing performed in accordance with ASTM D5818. Test results shall be provided for each product to be used with project specific or more severe soil types. RFid = 1.05 minimum.

5. FS – Overall Design Factor of Safety. FS hall be 1.5 unless noted for the maximum allowable working stress calculation.

C. The maximum design tensile load of the geogrid shall not exceed the laboratory tested ultimate strength of the geogrid/facing unit connection divided by a factor of safety of 1.5. The connection strength testing and computation procedures shall be in accordance with ASTM D6638 Connection Strength between Geosynthetic Reinforcement and Segmental Concrete Units or NCMA SRWU-1.

D. Ci – Coefficient of Soil Interaction. Ci values shall be determined per ASTM D6706 at a maximum 0.75 inch (19 mm) displacement.

E. The geogrid manufacturer shall have a Manufacturing Quality Control program that includes QC testing by an independent laboratory. The QC testing shall include Tensile Strength testing, Melt Flow Index testing for HDPE geogrids and Molecular Weight testing for polyester geogrids.

2.07 Drainage Pipe

A. If required, drainage pipe shall be perforated or slotted PVC pipe manufactured in accordance with ASTM D3034 or corrugated HDPE pipe manufactured in accordance with AASHTO M252.

2.08 Geotextile Filter Fabric

A. When required, geotextile filter fabric shall be a needle-punched nonwoven fabric that meets the requirements of AASHTO M288.

PART 3: EXECUTION

3.01 Excavation

A. Contractor shall excavate to the lines and grades shown on the construction drawings. The Owner or Contractors QA/QC representative shall inspect the excavation and test the

foundation soils and approve prior to placement of the leveling pad material or fill soils. Any over-excavation required to remove unsuitable soils shall be oversized from the front of the leveling pad and back of the geogrid reinforcement.

B. Over-excavation and replacement of unsuitable soils and replacement with approved compacted fill will be compensated as agreed upon with the Owner.

3.02 Base Leveling Pad

A. Leveling pad material shall be placed to the lines and grades shown on the construction drawings to a minimum thickness of 6 inches (150 mm) and extend laterally a minimum of 6 inches in front and behind the Keystone wall unit.

B. Soil leveling pad materials shall be compacted to a minimum of 95% of Standard Proctor density per ASTM D697 or 92% Modified Proctor density per ASTM D1557.

C. Leveling pad shall be prepared to insure full contact with the base surface of the concrete units.

3.03 Precast Concrete Unit Installation

A. First course of units shall be placed on the leveling pad at the appropriate line and grade. Alignment and level shall be checked in all directions and insure that all units are in full contact with the base and properly seated.

B. Place the front of units side-by-side. Do not leave gaps between adjacent units. Layout of corners and curves shall be in accordance with manufacturer's recommendations.

C. Install shear/connecting pins per manufacturer's recommendations.

D. Place and compact drainage fill within and behind wall units. Place and compact reinforced backfill soil behind drainage fill.

E. Maximum stacked vertical height of wall units, prior to drainage fill and backfill placement and compaction, shall not exceed two courses.

3.04 Structural Geogrid Installation

A. Geogrid shall be installed with the highest strength direction perpendicular to the wall alignment.

B. Geogrid reinforcement shall be placed at the strengths, lengths and elevations shown on the construction drawings, or as directed by the engineer.

C. The geogrid shall be laid horizontally on compacted backfill and attached to the Precast Concrete wall unit pins and within 1 inch of the face of the units. Place the next course of Precast Concrete units over the geogrid. The geogrid shall be pulled taut and anchored prior to backfill placement on the geogrid.

D. Geogrid reinforcements shall be continuous throughout their embedment lengths and placed side-by-side to provide 100% coverage at each level. Spliced connections between shorter

pieces of geogrid or gaps greater than 2 inches between adjacent pieces of geogrid are not permitted.

3.05 Reinforced Backfill Placement

A. Reinforced backfill shall be placed, spread and compacted in such a manner that minimizes the development of slack in the geogrid and installation damage to the geogrid.

B. Reinforced backfill shall be placed and compacted in lifts not to exceed 6 inches (150 mm) where hand operated compaction equipment is used, or 8 – 10 inches (200 to 250 mm) where heavy compaction equipment is used. Lift thickness shall be decreased to achieve the required density, as needed.

C. Reinforced backfill shall be compacted to a minimum of 95% of Standard Proctor density per ASTM D697 or 92% Modified Proctor density per ASTM D1557. The moisture content of the reinforced backfill material during compaction shall be uniformly distributed throughout each layer and shall be dry of optimum by 0 to 3 percentage points of moisture.

D. Only hand operated compaction equipment shall be allowed within 3 feet (1 M) from the back of the Keystone concrete units.

E. Tracked construction equipment shall not be operated directly upon the geogrid reinforcement. A minimum fill thickness of 6 inches (150 mm) is required prior to operation of tracked vehicles over the geogrid. Tracked vehicle turning should be kept to a minimum to prevent tracks from displacing the fill and damaging or displacing the Keystone units or geogrid.

F. Rubber tired equipment may pass over geogrid reinforcement at slow speeds, less than 10 MPH. Sudden braking and turning shall be avoided.

G. At the end of each day's operation, the Contractor shall slope the last lift of reinforced backfill away from the wall units to direct runoff away from the wall face. The Contractor shall not allow surface runoff from adjacent areas to enter the wall construction site.

3.06 Cap Installation

A. Prior to placement of the cap units, the upper surface of the top course of wall units shall be cleaned of soil and any other material.

B. Cap units shall be adequately glued to the underlying wall units with an all-weather exterior construction adhesive.

3.07 As-built Construction Tolerances

A. Vertical alignment: ± 1.5 inches (40 mm) over any 10 foot (3 m) distance.

B. Wall batter: within 2 degrees of design batter. Overall wall batter shall be ≥ 0 degrees.

C. Horizontal alignment: ± 1.5 inches (40 mm) over any 10 foot (3 m) distance.

D. Corners and curves: ± 1 foot (300 mm) to theoretical location.

E. Maximum horizontal gap between erected units shall be ≤ 1/2 inch (13 mm).

3.08 Field Quality Control

A. Quality Assurance – The owner shall/may engage inspection and testing services, including independent laboratories, to provide quality assurance and testing services during construction. This does not relieve the Contractor from securing the necessary construction quality control testing.

B. Quality assurance should include foundation soil inspection and testing and verification of the geotechnical design parameters and verification that the contractor's quality control testing is adequate as a minimum. Quality assurance shall also include observation of the construction for general compliance with the design drawings and project specifications. Quality assurance is usually best performed by the site geotechnical engineer.

C. Quality Control – The Contractor shall engage independent inspection and testing services to perform the minimum quality control testing described in the retaining wall design plans and specifications. Only qualified and experienced technicians and engineers shall perform quality control testing and inspection services.

D. Quality control testing shall include soil and backfill testing to verify soil types and strengths, compaction and moisture conditions and verification that the retaining wall is being constructed in accordance with the design plans and specifications.

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HDPE

Technical Specifications

HIGH DENSITY POLYETHYLENE (HDPE) PIPE AND FITTINGS

PART 1 GENERAL

1.1 SECTION DESCRIPTION

1.1.1 This specification includes but is not limited to high-density polyethylene (PE 3408) pressure pipe primarily intended for the transportation of water and sewage either buried or above grade.

1.2 REFERENCES

1.2.1 AWWA C901 Polyethylene (PE) pressure Pipe & Tubing, ½ inch through 3 inch for water

1.2.2 AWWA C906 Polyethylene (PE) pressure Pipe & Fittings, 4 inch through 63 inch for water

1.2.3 ASTM D3035 Standard Spec for PE Pipe (DR-PR) Based on Controlled Outside Diameter

1.2.4 ASTM D3261 Butt Heat Fusion PE Fittings for PE Pipe & Tubing

1.2.5 ASTM D3350 Standard Specification for PE Pipe & Fittings Materials

1.2.6 ASTM D1238 Melt Flow Index

1.2.7 ASTM D1505 Density of Plastics

1.2.8 ASTM D2837 Hydrostatic Design Basis

1.2.9 NSF Std.#14 Plastic Piping Components & Related Materials

1.2.10 TR-33/2005 Generic Butt Fusion Joining Procedure for Field Joining of PE Pipe

1.3 GENERAL

1.3.1 USE

1.3.1.1 High Density Polyethylene (HDPE) pipes/fittings shall be allowed for use as water, wastewater and reclaimed water pressure pipe where compatible with the specific conditions of the project.

1.4 DOCUMENTATION

1.4.1 Documentation from the resin's manufacturer showing results of the following tests for resin identification:

1.4.1.1 Melt Flow Index ASTM D1238

1.4.1.2 Density ASTM D1505

1.5 MANUFACTURER

1.5.1 All HDPE pipe and fittings shall be from a single manufacturer, who is fully experienced, reputable and qualified in the manufacture of the HDPE pipe to be furnished. The pipe shall be designed, constructed and installed in accordance with the best practices and methods and shall comply with these Specifications.

1.6 FINISHED PRODUCT EVALUATION

1.6.1 Production staff shall check each length of pipe produced for the items listed below. The results of all measurements shall be recorded on production sheets, which become part of the manufacturer's permanent records.

1.6.1.1 Pipe in process shall be checked visually, inside and out for cosmetic defects (grooves, pits, hollows, etc.)

1.6.1.2 Pipe outside diameter shall be measured using a suitable periphery tape to ensure conformance with ASTM F714 or ASTM D3035, whichever is applicable.

1.6.1.3 Pipe wall thickness shall be measured at 12 equally spaced locations around the circumference at both ends of the pipe to ensure conformance with ASTM F714 or ASTM D3035, whichever is applicable.

1.6.1.4 Pipe length shall be measured.

1.6.1.5 Pipe marking shall be examined and checked for accuracy.

1.6.1.6 Pipe ends shall be checked to ensure they are cut square and clean.

1.6.1.7 Subject inside surface to a "reverse bend test" to ensure the pipe is free of oxidation (brittleness).

1.7 STRESS REGRESSION TESTING

1.7.1 The polyethylene pipe manufacturer shall provide certification that stress regression testing has been performed on the specific polyethylene resin being utilized in the manufacture of this product. This stress regression testing shall have been done in accordance with ASTM D2837 and the manufacturer shall provide a product supplying a minimum Hydrostatic Design Basis (HDB) of 1,600 psi as determined in accordance with ASTM D2837.

1.8 COMPATIBILITY

1.8.1 Contractor is responsible for compatibility between pipe materials, fittings and appurtenances.

1.9 WARRANTY

1.9.1 The pipe MANUFACTURER shall provide a warranty against manufacturing defects of material and workmanship for a period of ten years after the final acceptance of the project by the OWNER. The MANUFACTURER shall replace at no expense to the OWNER any defective pipe/fitting material including labor within the warranty period.

PART 2 PRODUCTS

2.1 MATERIALS FOR PIPE SIZES 4-INCH DIAMETER AND LARGER

2.1.1 Materials used for the manufacture of polyethylene pipe and fittings shall be made from a PE 3408 high density polyethylene resin compound meeting cell classification 345434C per ASTM D3350; and meeting Type lll, Class C, Category 5, Grade P34 per ASTM D1238.

2.1.2 High Density Polyethylene (HDPE) pipe shall comply with AWWA Specifications C906.

2.1.3 If rework compounds are required, only those generated in the Manufacturer's own plant from resin compounds of the same class and type from the same raw material supplier shall be used.

2.1.4 Dimensions and workmanship shall be as specified by ASTM F714. HDPE fittings and transitions shall meet ASTM D3261. HDPE pipe shall have a minimum density of 0.955 grams per cubic centimeter. All HDPE pipe and fittings shall have a Hydrostatic Design Basis (HDB) of 1,600 psi.

2.1.5 HDPE pipe and accessories 4-inch diameter and larger, shall be 160 psi at 73.4ºF meeting the requirements of Standard Dimension Ration (SDR) 17 as MINIMUM STRENGTH.

2.1.6 The pipe Manufacturer must certify compliance with the above requirements.

2.2 MATERIALS FOR PIPE SIZES 2-INCH DIAMETER AND LESS

2.2.1 Materials used for the manufacture of polyethylene pipe and fittings shall be made from a PE 3408 high density polyethylene resin compound meeting cell classification 345434C per ASTM D3350; and meeting Type lll, Class C, Category 5, Grade P34 per ASTM D1238.

2.2.2 High Density Polyethylene (HDPE) pipes shall comply with AWWA Specifications C901.

2.2.3 If rework compounds are required, only those generated in the Manufacturer's own plant from resin compounds of the same class and type from the same raw material supplier shall be used.

2.2.4 Dimensions and workmanship shall be as specified by ASTM D3035. HDPE fittings and transitions shall meet ASTM D3261. HDPE pipe shall have a minimum density of 0.955 grams per cubic centimeter. All HDPE pipe and fittings shall have a Hydrostatic Design Basis (HDB) of 1,600 psi.

2.2.5 HDPE pipe and accessories 2" and less in diameter, shall be 160 psi at 73.4ºF meeting the requirements of Standard Dimension Ration (SDR) 9 as MINIMUM STRENGTH.

2.2.6 The pipe Manufacturer must certify compliance with the above requirements.

2.3 FITTINGS

2.3.1 All molded fittings and fabricated fittings shall be fully pressure rated to match the pipe SDR pressure rating to which they are made. All fittings shall be molded or fabricated by the manufacturer. No Contractor fabricated fittings shall be used unless approved by the Engineer.

2.3.2 The manufacturer of the HDPE pipe shall supply all HDPE fittings and accessories as well as any adapters and/or specials required to perform the work as shown on the Drawings and specified herein.

2.3.3 All fittings shall be installed using butt-fused fittings, thermo-fused fittings/couplings, or flanged adapters and must be approved by the Engineer. NO size on size wet taps shall be permitted.

2.3.4 All transition from HDPE pipe to ductile iron or PVC shall be made per the approval of Engineer and per the HDPE pipe manufacturer's recommendations and specifications. A molded flange connector adapter within a carbon steel back-up ring assembly shall be used for pipe type transitions. Ductile iron back-up rings shall mate with cast iron flanges per ANSI B16.1. A 316 stainless steel back-up ring shall mate with a 316 stainless steel flange per ANSI B16.1.

2.3.4.1 Transition from HDPE to ductile iron fittings and valves shall be approved by Engineer before installation.

2.3.4.2 No solid sleeves shall be allowed between such material transitions.

2.3.4.3 The pipe supplier must certify compliance with the above requirements.

2.4 PIPE IDENTIFICATION

2.4.1 The following shall be continuously indent printed on the pipe or spaced at intervals not exceeding 5-feet:

2.4.1.1 Name and/or trademark of the pipe manufacturer.

2.4.1.2 Nominal pipe size.

2.4.1.3 Dimension ratio.

2.4.1.4 The letters PE followed by the polyethylene grade in accordance with ASTM

2.4.1.5 D1248 followed by the hydrostatic design basis in 160's of psi, e.g., PE 3408.

2.4.1.6 manufacturing standard reference, e.g., ASTM F714 or D-3035, as required.

2.4.1.7 A production code from which the date and place of manufacture can be determined.

2.4.1.8 Color Identification, either stripped by co-extruding longitudinal identifiable color markings or shall be solid in color and as follows:

i. BLUE – Potable Water

ii. GREEN – Sanitary Sewer

PART 3 EXECUTION

3.1 JOINING METHOD

3.1.1 The pipe shall be joined with butt, heat fusion joints as outlined in ASTM D2657 and conform to the Generic Butt Fusion Joining Procedure for Field Joining of Polyethylene Pipe. All joints shall be made in strict compliance with the manufacturer's recommendations. A factory qualified joining technician as designated by pipe manufacturer or experienced, trained technician shall perform all heat fusion joints.

3.1.2 Lengths of pipe shall be assembled into suitable installation lengths by the buttfusion process. All pipes so joined shall be made from the same class and type of raw material made by the same raw material supplier. Pipe shall be furnished in standard laying lengths not to exceed 50 feet and no shorter than 20 feet.

3.1.3 On days butt fusions are to be made, the following shall apply:

3.1.3.1 Heating plate surfaces shall be inspected for cuts and scrapes and shall be free of dirt and residue. Heater surfaces should be between 400^{O}F (minimum) to 450^{O}F (maximum). Measure the temperature @ 12:00, 3:00, 6:00 and 9:00 o'clock positions using a pyrometer of infrared thermometer at locations where the heating plate will contact the pipe/fitting ends. The maximum temperature difference between any two points on a single heating surface must not exceed 24^{O}F.

3.1.3.2 The fusion or test section shall be cut out after cooling completely for inspection.

3.1.3.3 The test section shall be 12" or 30 times (minimum) the wall thickness in length and 1" or 1.5 times the wall thickness in width (minimum).

3.1.3.4 The joint shall be visually inspected as to continuity of "beads" from the melted material, and for assurance of "cold joint" prevention (i.e. – joint shall have visible molded material between walls of pipe). Joint spacing between the walls of the two ends shall be a minimum of 1/16" to a maximum 3/16".

3.1.4 The polyethylene flange adapters at pipe material transitions shall be backed up by stainless steel flanges conforming to ANSI B16.1 and shaped as necessary to suit the outside dimensions of the pipe. The flange adapter assemblies shall be connected with corrosion resisting bolts and nuts of Type 316 Stainless Steel as specified in ASTM A726 and ASTM A307. All bolts shall be tightened to the manufacturer's specified torques. Bolts shall be tightened alternatively and evenly. After installation, apply a bitumastic coating to bolts and nuts.

PART 4 INSTALLATION

4.1 High Density Polyethylene (HDPE) Pipe shall be installed in accordance with the instruction of the manufacturer, as shown on the Drawings and as specified herein. A factory qualified joining technician as designated by the pipe manufacturer shall perform all heat fusion joints.

4.2 HDPE shall be installed either by Open Trench Construction or Directional Bore Method.

4.3 Care shall be taken in loading, transporting and unloading to prevent damage to the pipe.

Pipe or fitting shall not be dropped. All pipe or fitting shall be examined before installation, and no piece shall be installed which is found to be defective. Any damage to the pipe shall be repaired as directed by the Engineer. If any defective pipe is discovered after it has been installed, it shall be removed and replaced with a sound pipe in a satisfactory manner by the contractor, at his own expense.

4.4 Under no circumstances shall the pipe or accessories be dropped into the trench or forced through a directional bore upon “pull-back”.

4.5 Care shall be taken during transportation of the pipe such that it will not be cut, kinked or otherwise damaged.

4.6 Ropes, fabric or rubber protected slings and straps shall be used when handling pipes. Chains, cables or hooks inserted into the pipe ends shall not be used. Two slings spread apart shall be used for lifting each length of pipe.

4.7 Pipes shall be stored on level ground, preferably turf or sand, free of sharp objects, which could damage the pipe. Stacking of the polyethylene pipe shall be limited to a height that will not cause excessive deformation of the bottom layers of pipes under anticipated temperature conditions. Where necessary due to ground conditions, the pipe shall be stored on wooden sleepers, spaced suitably and of such width as not to allow deformation of the pipe at the point of contact with the sleeper or between supports.

4.8 Pipe shall be stored on clean level ground to prevent undue scratching or gouging. The handling of the pipe shall be in such a manner that the pipe is not damaged by dragging it over sharp and cutting objects. The maximum allowable depth of cuts, scratches or gouges on the exterior of the pipe is 5 percent of wall thickness. The interior pipe surface shall be free of cuts, gouges or scratches.

4.9 Pipe shall be laid to lines and grade shown on the Drawings with bedding and backfill as shown on the Drawings.

4.10 When laying is not in progress, including lunchtime, the open ends of the pipe shall be closed by fabricated plugs, or by other approved means.

4.11 Sections of pipe with cuts, scratches or gouges exceeding 5 percent of the pipe wall thickness shall be removed completely and the ends of the pipeline rejoined.

4.12 The pipe shall be joined by the method of thermal butt fusion. All joints shall be made in strict compliance with the manufacturer’s recommendations.

4.13 Mechanical connections of the polyethylene pipe to auxiliary equipment such as valves, pumps and tanks shall be through flanged connections which shall consists of the following:

4.13.1 A polyethylene flange shall be thermally butt-fused to the stub end of the pipe.

4.13.2 A 316 stainless steel back up ring shall mate with a 316 stainless steel flange.

4.13.3 A 316 stainless steel bolts and nuts shall be used.

4.14 Flange connections shall be provided with a full-face neoprene gasket.

4.15 All HDPE pipe must be at the temperature of the surrounding soil at the time of backfilling and compaction.

4.16 If a defective pipe is discovered after it has been installed, it shall be removed and replaced with a sound pipe in a satisfactory manner at no additional cost to the Owner.

All pipe and fittings shall be thoroughly cleaned before installation, shall be kept clean until they are used in the work and when laid, shall conform to the lines and grades required kinked or otherwise damaged.

4.17 Open Trench Installation:

4.17.1 The centerline of the pipe shall not deviate from a straight line drawn between the centers of the openings at the ends of the pipe by more than 1/16-in per foot of length. If a piece of pipe fails to meet this requirement check for straightness, it shall be rejected and removed from the site. Laying instructions of the manufacturer shall be explicitly followed.

4.17.2 Good alignment shall be preserved during installation. Deflection of the pipe shall occur only at those places on design drawings and as approved by the Engineer.

Fittings, in addition to those shown on the Drawings, shall be used only if necessary or required by the Engineer.

4.17.3 Each length of the pipe shall have the assembly mark aligned with the pipe previously laid and held securely until enough backfill has been placed to hold the pipe in place. Joints shall not be “pulled” or “cramped”.

4.17.4 Precautions shall be taken to prevent flotation of the pipe in the trench.

4.17.5 When moveable trench bracing such as trench boxes, moveable sheeting, shoring or plates are used to support the sides of the trench, care shall be taken in placing and moving the boxes or supporting bracing to prevent movement of the pipe, or disturbance of the pipe bedding and the backfill. Trench boxes, moveable sheeting, shoring or plates shall not be allowed to extend below top of the pipe.

As trench boxes, moveable sheeting, shoring or plates are moved, pipe bedding shall be placed to fill any voids created and the backfill shall be recompacted to provide uniform side support for the pipe.

4.17.6 Restrained joints shall be installed where shown on the Drawings or as directed by the Engineer.

PART 5 CLEANING

5.1 At the conclusion of the work, thoroughly clean all of the new pipe lines to remove all dirt, stones, pieces of wood or other material which may have entered during the construction period by forcing a cleaning swab through all mains 4” or greater. Flushing velocities shall be a minimum of 2.5 feet per second. Debris cleaned from the lines shall be removed from the job site.

PART 6 TESTING

6.1 Pressure testing shall be conducted per Manufacturer’s recommendations and as approved by the Engineer.

6.2 All HDPE water mains shall be disinfected prior to pressure testing as per specification.

6.3 All HDPE mains shall be field-tested. Contractor shall supply all labor, equipment, material, gages, pumps, meters and incidentals required for testing. Each main shall be pressure tested upon completion of the pipe laying and backfilling operations, including placement of any required temporary roadway surfacing.

6.4 All mains shall be tested at 150 percent of the operating design pressure of the pipe unless otherwise approved by the Engineer.

6.5 Pressure testing procedure shall be per Manufacturer's recommendations or as follows:

6.5.1 Fill line slowly with water. Maintain flow velocity less than 2 feet per second.

6.5.2 Expel air completely from the line during filling and again before applying test pressure. Air shall be expelled by means of taps at points of highest elevation.

6.5.3 Apply initial test pressure and allow to stand without makeup pressure for two to three hours, to allow for diametric expansion or pipe stretching to stabilize.

6.5.4 After this equilibrium period, apply the specified test pressure and turn the pump off. The final test pressure shall be held for one to three hours.

6.5.5 Upon completion of the test, the pressure shall be bled off from a location other than the point where the pressure is monitored. The pressure drop shall be witnessed by the resident project representative at the point where the pressure is being monitored and shall show on the recorded pressure read-out submitted to the Engineer of Record.

6.6 If there are no visual leaks or significant pressure drops during the final test period, the installed pipe passes the test.

6.7 If any test of pipe laid disclosed leakage significant pressure drop greater than the manufacturer's recommended loss, the Contractor shall, at his/her own expense, locate and repair the cause of leakage and retest the line. The amount of leakage, which will be permitted, shall be in accordance with AWWA C600 Standards.

6.8 All visible leaks are to be repaired regardless of the amount of leakage.

6.9 The Contractor must submit his plan for testing to the Engineer for review at least 10 days before starting the test and shall notify ASPA Inspector a minimum of 48 hours prior to test.

END OF SPECIFICATIONS

HORIZONTAL PUMPS

HORIZONTAL CENTRIFUGAL PUMPS

1.0 GENERAL INFORMATION

1.1. This section presents the general guidelines and details of horizontal centrifugal pumps to be procured under the scope of this section and shall not be limited to the pumps specified under clause no. 3.0 below. For other horizontal centrifugal pumps in the scope of this specification, these general guidelines as specified hereinafter shall be followed.

2.0 CODES AND STANDARDS

2.1 The design, manufacture and performance of the horizontal centrifugal pumps as specified hereinafter, shall comply with the requirements of the following codes and standards and shall include all the latest amendments subsequent to the year of publication as mentioned below.

2.1.1 IS-6595 Part-2/: Horizontal Centrifugal pumps for clear, cold 1993 and fresh water.

2.1.2 IS-5120/1977: Technical requirements for Rotodynamic special Purpose pumps.

2.1.3 IS-5639/1970: Pumps for handling chemicals & corrosive liquids.

2.1.4 IS-5659/1970: Pumps for process water.

2.1.5 IS-6536/1972: Pumps for handling volatile liquids.

2.1.6 IS-9137/1978: Code for acceptance tests for centrifugal, mixed flow and axial flow pumps - Class 'C'.

2.1.7 ISO 3555/1977: Acceptance tests for centrifugal, mixed flow and BS 5316/1977 axial flow pumps - Class 'B' tests.

2.1.8 ISO 2548/1973: - Do - Class 'C' tests. BS 5316/1976

2.1.9 API-610/1989: Centrifugal pumps for general refinery services.

2.1.10 Standards of the Hydraulic Institute of USA (1983).

2.1.11 PTC 8.2/1965: Power Test Codes - Centrifugal pumps.

2.2. In case of any contradiction with the above standards and annexures, the stipulations in the annexures shall prevail and shall be binding to the Contractor.

3.0 SCOPE OF WORKS

3.1. Scope of Supply

3.1.1 The scope of supply under this section shall be as below. Items specifically not mentioned but deemed necessary by the Tenderer for making the system completely reliable and efficient shall also be included.

a) Equipment Accessories

Each pump set for all the above groups shall be supplied with the following accessories:

i) Couplings of approved design to connect pump shaft directly with the motor shaft.

ii) Vibration monitoring and analysis system mounting provision shall be provided for pumps.

iii) Sets of base plates, support plates, grounding pads, lifting lugs, eye bolts, nuts etc for each pump and motor set.

iv) Slip-on type drilled steel flanges of proper rating for both suction and discharge connections of each pump set. All the counter-flanges shall be complete with requisite number of bolts, nuts, gaskets etc.

v) Air release cocks and drain plugs for each pump set.

vi) Discharge line pressure gauge and suction line pressure/vacuum gauges complete with isolating cocks for each pump set.

vii) All internal/integral piping with valves, fittings, and pressure gauges for lubrication, cooling and sealing, wherever applicable, shall be tapped of directly from respective pump discharge.

4.0 PERFORMANCE REQUIREMENTS

4.1 Pumps shall preferably be designed to have the best efficiency at the specified duty point. The pumps shall be suitable for continuous operation at any point within the "Range of Operation" as stipulated in the annexures attached with this section.

4.2 Pumps shall preferably have a continuously rising head-capacity characteristics from the specified duty point towards shut-off point, the maximum being at shut-off to enable parallel operation. Under all circumstances, the 'range of operation' of the pumps shall exclude any unstable operating zone of the head - capacity curve.

4.3 Wherever specified in the annexures attached to this section, pumps of each category shall be suitable for parallel operation. The head vs. capacity, the BHP vs. capacity characteristics etc. shall be identical to ensure equal load sharing and trouble-free operation of any pump when the other pumps working in parallel with it trip.

4.4 The pump set along with the drive motor shall run smooth without undue noise and vibration.

5.0 DESIGN AND CONSTRUCTION

5.1 Pump Casing

5.1.1 Pump casing shall be provided with adequate number of vents and priming connections with valves unless the pump is made self- venting and priming. Casing drain, as required, shall be provided complete with drain valves.

5.1.2 Pump design must ensure that the nozzles are capable of withstanding external reactions not less than those specified in API-610.

5.1.3 In cases where an expansion joint is located at pump discharge, the pump assembly will be subjected to an additional thrust which will be transmitted to the foundation. This additional thrust shall be taken into the consideration of pump design.

5.2. Impeller

5.2.1 The rotor assembly shall be dynamically balanced and designed with critical speed substantially above the operating speed.

5.3. Wearing Rings

5.3.1 Replaceable type wearing rings shall be furnished to prevent damage to impeller and casing.

5.4. Shaft

5.4.1 Shaft size shall be selected considering that the critical speed shall be away

from the operating speed as recommended in applicable Code/Standard. The critical speed shall also be at least 10% away from runaway speed.

5.5. Shaft Sleeves

5.5.1 Renewable type fine finished shaft sleeves shall be provided at the stuffing boxes/mechanical seals. Length of the shaft sleeves must extend beyond the other faces of gland packing or seal end plate so as to distinguish between the leakage past shaft and shaft sleeve and that past the seals/glands.

5.5.2 Shaft sleeves shall be properly fastened to the shaft to prevent any leakage or loosening. Shaft and shaft sleeve assembly should ensure concentric rotation.

5.6. Bearings

5.6.1 Bearings shall be easily accessible without disturbing the pump assembly. A drain plug shall be provided at the bottom of each of the bearing housing.

5.6.2 Heavy duty sleeve/ball/roller type bearings shall be provided to take care of the radial loads.

5.6.3 In case of sleeve type radial bearings, axial thrust shall be absorbed in suitable hydraulic devices and/or thrust bearings.

5.6.4 Bearings and hydraulic devices (if provided for balancing axial thrust) shall be of adequate design for taking the entire pump load arising from all probable conditions of continuous operation.

5.6.5 The bearings shall be oil/grease lubricated. Suitable lubricating arrangement for the bearings shall be furnished with the pump complete all accessories like pump, filters, piping, fittings, valves, interlocking and supervising instruments etc. as necessary. The design shall be such that the bearing lubricant does not contaminate the liquid being pumped.

5.7.0 Stuffing Boxes

5.7.1 Stuffing box design shall permit replacement of packing without removing any part other than the gland.

5.7.2 Stuffing boxes shall be sealed /cooled by the fluid being pumped/external clear water, as specified in the Annexures. All necessary pumps, piping, fittings, valves, instruments etc. as required for safe and trouble-free operation of the pumps and as specified in the Annexures shall be included in the scope of supply.

5.8 Mechanical Seals

5.8.1 Mechanical seals shall be provided. The pump supplier shall co-ordinate with the seal maker in establishing the circulation rate for maintaining a stable film at the seal face in the chamber. The seal piping system shall form an integral part of the pump assembly.

5.8.2 When handling liquids near their boiling point, suitable arrangement for external cooling shall be provided so as to prevent flashing at the seal faces.

5.8.3 For the seals under vacuum service, the seal design must ensure sealing against atmospheric pressure, even when the pumps are not operating.

5.9. Drive Unit

5.9.1 The pumps shall be driven by electric motor or other driving equipment like diesel engine etc. directly coupled or through a gear box/belt drives. A heavy duty coupling along with coupling guard shall be provided between the pump and drive unit (except for belt drives). Belt guard shall be provided for all belt drives.

5.9.2 Unless otherwise specified, drive unit power rating shall be the maximum of the following requirements.

a) Pump shaft input power required considering the overloading of the pump assuming single pump operation in the event of tripping of one or more of the pumps operating in parallel.

b) 15% (for LT motor) or 10% (for HT motor) margin over the pump shaft input power at the rated duty point.

c) 5% margin over the maximum pump shaft input power required within the 'Range of Operation'.

6.0 INSPECTION AND TESTING

6.1 The Contractor shall carry out the following specific tests and inspections to ensure that the equipment furnished lies in strict conformance with the specification and also in accordance with applicable codes/standards and good engineering practice.

a) Identification and Testing

i) All materials used for pump construction shall be of tested quality. Material shall be tested as per the relevant standards and test certificates shall be made available to the Owner.

ii) Tests for each pump included under this section shall include but not be limited to the following :

• The entire surface of the impeller castings shall be subjected to Dye Penetration Test as per ASTM Specification no.: E165-65.

• Shaft shall be subjected to Dye Penetration and Ultrasonic Tests.

• Wearing rings shall be subjected to Dye Penetration Test.

• Verification of material, witnessing of pouring, casting and inspection of finalized fabricated/cast castings.

• Inspection of finished castings for impeller and verification of materials.

• Inspection of pump shaft and verification of material.

• Witnessing of NDT/review of NDT reports.

• Static balancing test for impeller and dynamic balancing of complete rotating parts as per ISO- 1940.

• Complete Inspection of assembled pump.

b) Hydrostatic Testing

The pump casing shall be hydrostatically tested at 150% of the shutoff pressure. Pressure shall be maintained for a period of not less than one (1) hour. While arriving at the above values maximum suction pressure shall be taken into account.

c) Performance Test at Shop

i) Each pump shall have to be tested to determine the performance curves of the pumps. These tests are to be conducted in presence of Owner's representative.

ii) Performance tests are to be conducted to cover the entire range of operation of the pumps. These shall be carried out to span 130% of rated capacity up to pump shut-off condition. A minimum of five combinations of head and capacity are to be achieved during testing to establish the performance curves, including the design capacity point, shut-off point and the two extremities of the range of operation as

specified in the annexures. After completion of performance test, all pumps shall be stripped down for inspection of internals.

iii) Tests shall be conducted with actual drive motors being furnished.

iv) NPSH tests are to be conducted on one pump of each type at 3% head drop conditions.

v) Mechanical run test shall be carried out on all pumps to determine the vibration levels, noise levels etc. This test shall be conducted at site also. However, test value at site shall be used for the acceptance of the equipment.

7.0 DRAWINGS, DATA, CURVES AND INFORMATION

7.1 The Bidder shall submit the following along with his formal proposal besides the different information plate required as indicated elsewhere in this section.

7.1.1 Drawings

a) General arrangement drawings showing the principal dimensions, weight and location of the suction and discharge connections of the pumps offered. Details of lubrication and sealing arrangement shall be included.

b) Typical cross-section drawing showing various components of the pumps offered materials of construction etc.

7.1.2 Data and Curves

a) Determination of pump total dynamic head and rated capacity as per guidelines specified in Section-I of this Volume. Detailed calculations shall be shown by the Bidder.

b) Anticipated performance curves showing the following characteristics:

i) Capacity vs. head

ii) Capacity vs. power

iii) Capacity vs. efficiency

iv) Capacity vs. NPSH required

v) System resistance curves

c) Speed vs. torque curve of the pump corresponding to recommended mode of pump starting superimposed on speed vs. torque curves of the drive unit corresponding to 80%, 90%, 100% of the rated voltage (applicable only in the cases of pumps with drive motor power rating of 100 KW and above).

7.2 The successful Bidder shall furnish the following drawings/data for Purchaser/Engineer's approval after award of the contract.

END OF SPECIFICATIONS

FIRE HYDRANT

Technical Specifications

1. SCOPE

This product specification covers post-type, dry-barrel fire hydrants with compression shut off (opening against pressure) or gate shutoff for use in water supply service in all climates, including those where freezing occurs. All products furnished shall conform to the American National Standards Institute and American Water Works Association C502-05 Standard (ANSI/AWWA C502-05) or latest revision thereof and shall be UL approved.

2. DEFINITIONS

All definitions are defined according to ANSI/AWWA C502-05.

a. Cosmetic Defect: A blemish that has no effect on the ability of a component to meet the structural design and production test requirements of this standard. Should the blemish or the activity of plugging, welding, grinding, or repairing such blemishes cause the component to fail these requirements, and then the blemish shall be considered a structural defect.

b. Structural Defect: A flaw that causes a component to fail the structural design or test requirements of this standard. This includes but is not limited to imperfections that result in leakage through the walls of a casting, failure to meet minimum wall thickness requirements, or failure to meet production tests.

c. Bury: The length of bury is the distance measured to the nearest ½ ft. from the bottom of the connecting pipe to the ground line of the hydrant.

3. GENERAL REQUIREMENTS

a. Each hydrant shall be designed for a minimum working pressure of 200 psig.

b. All parts of the hydrant shall be designed to withstand, without being functionally impaired or structurally damaged, a hydrostatic test of not less than 400 psig or twice the rated working pressure, whichever is greater, with the hydrant completely assembled and pressurized as follows:

i. With the nozzle caps in place, the main valve open, the hydrant inlet capped, and the test pressure applied to the interior of the hydrant.

ii. With the main valve closed, the hydrant inlet capped, and the test pressure applied at the hydrant inlet.

iii. The design safety factor of the operating mechanism shall not be less than 5 and shall be based on the foot-pounds of torque required for the closing and opening of the hydrant at a working pressure of 200 psig. Hydrants shall be functional and capable of being opened or closed without difficulty following an application of an operating torque of 200 lbf-ft at the operating nut in the opening direction with the hydrant fully opened and the closing direction with the hydrant fully closed. The torque requirements apply only to hydrants of 5-ft bury or less.

c. The length of bury shall be specified.

d. The fire hydrant shall have 2 hose nozzles and 1 pumper nozzle.

e. The nominal inside diameter of the hose nozzle shall be 2 ½ inches.

f. The nominal inside diameter for the pumper nozzle shall be 4 inches. h. The outlet-nozzle threads are to conform to the National Fire Protection Association (NFPA) 2003, Standard for Fire Hose Connections.

g. The nominal diameter of the main valve opening shall be 5 ¼ inches.

h. The hydrant shoe shall be provided with a 6 inches mechanical joint connection to fit the connecting pipe.

i. The fire hydrant shall open right (clockwise).

j. The color of the finish paint above the ground line shall be aluminum; however, fire hydrants for private use shall be painted red.

k. The fire hydrant shall have a non-rising stem.

l. No more than one 6" stem extension shall be provided if required to make the base of the fire hydrant grade level.

m. The bonnet section shall be designed so all bearing surfaces and stem threads are sealed in a lubricant reservoir. If oil is used as a lubricant, the reservoir shall be designed to allow for easy filling through a fitting or plug. Where grease is used as a lubricant, the reservoir will be sealed. The reservoir will be adequately sealed with "O" rings or other suitable sealing system.

n. The fire hydrant shall have a safety flange or breakaway flange at the ground line.

o. Fire hydrant nozzle cap chains shall be required and shall be attached permanently to the fire hydrant.

p. Parts that require lubrication and come into contact with water shall be lubricated with a non-toxic food grade lubricant that does not pose a health hazard to the public if consumed.

4. WORKMANSHIP

a. All foundry and machine work shall be performed in accordance with good standard practice for the class of work involved and in conformance with accepted drawings, if required. When assembled, hydrants manufactured in accordance with this specification shall be well fitted and shall operate smoothly. The body and shaft shall be watertight.

b. All parts shall conform to the required dimensions and shall be free from defects that could prevent proper functioning of the hydrant.

c. All castings shall be clean and sound without defects that will weaken their structure or impair their service.

5. PAINT

a. The exterior surface of the hydrant shall be coated with a coating. A second coat of water based or oil based enamel paint aluminum in color will then be applied from the top of the hydrant to a point 18 to 20 inches below the center line of the pumper nozzle or down to the traffic safety flange connection at the ground line.

b. All interior surfaces, machined surfaces, such as the threaded portion of the stem or stem nut, which must fit closely with the adjacent parts, shall be coated with a coating. Stem surfaces contained within a lubricant reservoir and not in contact with potable water may be free of coating.

c. The interior and exterior of the hydrant shoe shall be coated with a fusion bonded epoxy having a nominal dry film thickness of 8 mils, conforming to ANSI/AWWA C550-05.

6. TESTING AND INSPECTION

a. Each assembled hydrant shall be subjected to two shop tests under a hydrostatic pressure of 400 psig or twice the rated working pressure, whichever is greater. One test shall be made with the entire interior of the hydrant under pressure and another test made with the main valve closed and the base under pressure from the inlet side. Under the test procedure, there shall be no leakage through the main valve or seals or through the castings or the joints of the assembled hydrant. Under the test conditions, the leakage through the drain valves shall not exceed 5 fl oz/min. Other leakage or other imperfections found in either test shall be corrected or the hydrant retested. The tests shall be conducted for a sufficient time to allow a check of all points of possible leakage and for a minimum of 30 seconds after all air has been exhausted.

b. Each assembled hydrant shall be operated through a full open-close cycle when not under pressure. The torque required for performing this operation shall not exceed 20 lbf-ft.

c. All fire hydrant tests and inspections shall conform to ANSI/AWWA C502 Section 5.1 Production Testing, ANSI/AWWA C502 Section 5.2 Prototype Testing, and ANSI/AWWA C502-05 Section 5.3 Inspection and Rejection.

7. QUALITY ASSURANCE

a. Manufacturers shall have an ASME or I.S.O. 9001 registered commercial quality system or is in the process of achieving this certification. Noncompliance to this registered commercial quality system requirement will result in removal of the manufacturer's product. The defective fire hydrants will be returned to the manufacturer, freight collect, and the manufacturer shall replace the fire hydrant, freight prepaid.

END OF SPECIFICATIONS

RCC PIPE FOR SEWERAGE SYSTEM

1. SCOPE

The work covered by this section of the specifications consists in furnishing all reinforced and non-reinforced concrete pipes, plant, labour, equipment, appliances and materials and in performing all operations required for installing and testing the sewer pipes in strict accordance with the specifications of this section and the applicable drawings and subject to the terms and conditions of the contract.

2. MATERIALS

All materials used in the manufacture of reinforced cement concrete pipes for use under this contract shall conform to ASTM Designation C-76-79 and C-14 latest revision and also with the following specifications.

2.1 Cement

The Portland cement to be used in the manufacture of reinforced concrete pipe shall conform to the requirement of ASTM Designation C 150.

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.

2.3 Water

Water to be used in the manufacture of pipes shall be approved by the Engineer.

2.4 Steel Reinforcement

The material will conform to the specifications contained in section of these specifications.

3. CLASSES OF SEWER PIPE

The reinforced and non-reinforced cement concrete pipes to be furnished and installed under this contract shall conform to ASTM-C-14-Class-Ill for pipe sizes 8" and 10" and ASTM C-76 Class-ll, wall ‘B’ for pipe sizes greater than 10”.

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-76-79 or latest revision and inspection of manufactured pipes for defects and imperfections. The Contractor shall bear the cost of such tests and pay fees etc., and also pay for the carriage of such samples and all other expenses contingent to tests.

5. JOINT 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 gasket, 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 conforms 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 and not exceed 10 feet of head at which the completed sewers shall meet the infiltration or exfiltration limits set forth hereinafter.

The groove end of tongue and groove pipes shall have at least one line of wire reinforcement of 8 gauge size placed in the 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 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 lubricates 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 8" or larger diameter in accordance with the recommendations of the rubber gasket manufacturer.

INSTALLATION

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 shalt 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 or any concrete pipe.

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 or and as per applicable Variation Order.

Placing of Bedding

Crush stone of size 1" down shall be evenly spreaded over the full width of the formation in 4 inches loose layers and compacted with hand or mechanical rammers until the full thickness as shown on the drawing for the particular pipe size has been built-up and finished not more than 1/2" below level required. The Contractor should note that it is essential that the material at the sides of the pipes is adequately compacted. Before the subsequent placing of pipe surround 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.

Laying of Sewers

Neither any sewer pipe nor the bedding shall be laid or placed till the alignment of the sewer and its levels nor have gradients 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 as much 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 types designated above and shall be made in accordance with the aforesaid specifications.

TESTING OF SEWER LINES

General

All sewers built under this contract shall be tested for infiltration or exfiltration as specified below. The tests shall be made at time 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 methods.

Infiltration Tests

The sewers which are constructed with the ground water level above the crown 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.

Exfiltration Tests

The sewers which are constructed with the ground water level below the crown of the pipe 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:

i). After isolation of sewer section, it shall be filled with water to a level which is 3 ft. minimum above the crown of the sewer at the higher end of the isolated section under test.

ii), The duration of the exfiltration test shall be one hour after the filling with water has been completed,

iii). Determination of the amount of exfiltration shall be made by measuring the total loss of volume of water in the manholes.

iv). The amount of exfiltration over a 24 hour period will then be calculated from the measured logs of volume during the test observation period.

Allowable infiltration or Exfiltration

The calculated amount of infiltration or exfiltration 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 exfiltration over the 24 hour period. lf the measured infiltration or exfiltration exceeds the specified allowable limit, then the Contractor shall locate the points of leakage and make necessary repairs as to reduce the leakage to less than the permissible maximum stated above.

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.

END OF SPECIFICATIONS

VALVES

1. GATE VALVE

Gate valves shall comply with BS 5150 or relevant European Standard. All valves shall be suitable for use with water application. Valves complying with BS 5163 or relevant European Standard are acceptable provided that they also comply with BS 5150.

Specific clauses of BS 5150 are amplified as follows:

- Clause 3 Types of valves

Solid with Non-Rising Stem.

- Clause 4 Nominal Sizes

All valves shall be flanged end PN designed non-clamp type valves, Sizes as specified or indicated on the Drawings.

- Clause 5 Nominal Pressure

PN 16 unless otherwise specified or indicated on the Drawings.

- Clause 8 General

Flanged and drilled to BS 4505

- Clause 9 Body Tapping

As specified to (ISO/R7) fitted with bronze or gunmetal plug.

- Clause 14 Operation

Gate valves shall be provided with cast iron hand wheels or square heads for tee key operation as required.

The direction of operation shall be clockwise to close the valve. |

Hand wheels shall require a force not greater than 20 kg on the outer rim to operate with a balanced pressure across the valve.

Tee keys shall require a force not greater than 12 kg applied at the opposite ends of a standard key from the closed position.

- Clause 16/17, Brasses shall not contain more than 5% zinc gunmetal to BS 1400 Grade LG3; aluminum bronze or nickel copper alloy may be employed for internal components. Body and wedge shall be of spheroidal of cast grey iron.

- Clause 19 Test Certificates ;

The contractor shall provide a test certificate confirming that the valves have been tested in accordance with BS 5150 and stating the actual pressure and medium used in the test, In addition the contractor shall ensure that the Engineer has access to the manufacturer's works at all reasonable times for the purposes of inspecting the assembled valves and witnessing testing.

Material of Construction

Body, Bone, Wedge: Cl conform to BS 5150 / ASTM A48/A48M

Spindle: Forged Bronze / SS AISI 431

Seat Ring, Wedge Ring: Gunmetal / SS AISI 4314

Back seat Bush: Bronze conforming to international standards

Parameters

Type: Non-rising spindle

Nominal pressure - 2 times working pressure in pipeline

Nature of operation: Horizontal/vertical

Applicable code: As per international codes

Tests: Acceptance tests as per international codes

2. SLUICE VALVE

The gate face rings shall be securely pegged over their full circumference. Valves of 450 mm and above shall be provided with a thrust bearing arrangement for ease of operation. They shall also have renewable channel and shoe linings. The gap between the shoe and channel shall be limited to 1.5 mm. Alternatively, valve of diameter 450 mm and above may be provided with a gear arrangement for ease of operation. The operation gear of all valves shall be such that they can be opened and closed by one man against an unbalanced head 15 % in excess of the maximum specified rating. Valve and gearing shall be such as to permit manual operation in a reasonable time and not to exceed a required rim pull of 400 N. All hand wheels shall be arranged to turn in a clockwise direction for opening and counter clockwise for closing. These directions shall be indicated on the hand wheels. All valves shall be rated for not less than PN 10.

Material of Construction

Body, Bone, Wedge: Cl conform to ASTM A48/A48M

Spindle: SS AISI 431

Seat Ring, Wedge Ring: SS AISI 431

Back seat Bush: Bronze conforming to international standards

Parameters

Type: Non-rising spindle

Nominal pressure - 2 times working pressure in pipeline

Nature of operation: Horizontal/vertical

Applicable code: As per international codes

Tests: Acceptance tests as per international codes

3. AUTOMATIC AIR RELIEF VALVES

Air Relief Valve shalt be designed to meet the following conditions:

a). Discharge air during charging of the pipeline

b). Admit air during emptying of the pipeline

c). Discharge air accumulated at local peaks along the pipeline under normal operating conditions.

Conditions (a) and (b) shall be met by the employment of a large orifice capable of handling large volumes of air at a high flow rate and condition (c) by a small orifice capable of discharging small quantities of air as they accumulate.

Valves with air intake or exhaust facilities shall have approved screening arrangements to prevent the ingress of air borne sand.

a). Double Acting Air Valves

These shall combine both large and small orifices within one valve. 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.

b). Single Air Valves

These include a small orifice only, operating in a manner identical with the small orifice to a double acting valve. The nominal pressure range shall be PN 16 or as indicated on Drawings.

Body ends shall be flanged with raised faces and drilled to ANSI B 16.1 for the nominal pressure specified or indicated on the Drawings or shall be screwed 25 mm BSPTc male as indicated on the drawings.

The materials for the valves shall be as follows:

Body cover and cowl: Cast iron

Small orifice: Cast iron with gunmetal seat

Small orifice ball: Rubber covered or other approved

Large orifice: Cast iron with rubber seat

Large ball: Vulcanite covered or other approved

Each valve shall be provided with its own isolating gate valve, or cock, which will permit the removal of the entire valve whilst the pipeline is live.

Valves shall be factory finished with a two-pack epoxy paint system to the approval of the Engineer.

4. PRESSURE REDUCING VALVE

4.1. General

The Pressure — reducing valve shall reduce higher upstream pressure to lower preset pressure regardless of fluctuating demand or varying upstream pressure.

4.2. Main valve

The main valve shall be a center — guided, diaphragm actuated, globe valve of either oblique (Y) or angle pattern design. The body shall have a replaceable, raised, stainless steel seat ring. The valve shall have an unobstructed flow path, with no stem guides, bearings, or supporting ribs. The body and cover shall be Cast iron. All external bolts, nuts and studs shall be Duplex coated. All valve components shalt be accessible and serviceable without removing the valve from the pipeline.

4.3. Actuator

The actuator assembly shall be double chambered with an inherent separating partition between the lower surface of the diaphragm and main valve. The entire actuator assembly (seal disk to top cover) shall be removable from the valve as an integral unit. The stainless steel valve shaft shall be center guided by a bearing in the separating partition. The replaceable radial seal disk shall include a resilient seal and shall be capable of accepting a V-Port Throttling Plug by bolting.

4.4. Control System

The control system shall be consist of a two — way adjustable, direct acting, pressure reducing pilot valve, a needle valve, isolating check valves, and a filter. All fittings shall be forged brass or Stainless steel. The assembled valve shall be hydraulically tested and factory adjusted.

4.5. Quality assurance

The valve manufacturer shall be certified according to the ISO 9001 Quality Assurance Standard. The valve shall be complete drinking water valve according to recognized standards.

END OF SPECIFICATIONS

PIPELAYING

1. PIPELAYING

Pipes shall be laid in accordance with CP 312 and BS 8010 or relevant European Standards unless otherwise specified herein.

No metal tools or heavy objects shall be permitted to come into contact with the pipes or fittings.

Every precaution shall be taken to prevent foreign material from entering the pipes or fittings. During laying operations, no debris, tools, cloth or other material shall be placed in the pipe. Pipes and fittings, and shall be carefully cleaned before jointing.

Pipes shall be laid accurately to the lines and levels shown on the Drawings, within a tolerance of ¼ inch.

Pipe alignments shall be straight between bends or curves. Length laid to curves shall only be allowed where shown on Drawings or in accordance with detailed proposals, approved by the Engineer-in-charge.

The jointing of pipes shall be made in accordance with the requirements of the relevant Specification. The Contractor shall obtain from the manufacturer all special information regarding the handling of the pipes and the formation of the joints and he will be deemed to have made himself thoroughly conversant with all phases of laying the pipes before submitting his tender. The Contractor shall provide his supervisory staff with the manufacturer's jointing instructions.

A ‘badger’ or ‘bung’ about ¼ inch smaller than internal diameter of the pipe shall be kept in the pipe at all times pulled forward as the work progresses. When pipe laying is not in progress, including overnight, the open ends of the pipeline shall be blanked off with a temporary watertight fitting approved by the Engineer-in-charge. The pipe shall suitably held down so that the pipe does not become buoyant in the event of the trench becoming flooded.

2. DEPTH OF COVER AND MINIMUM GRADIENT

The cover above the crown of the pipe shall be as shown on the drawings but in no event shall be less than 1.0 meter.

At anchor blocks the depth of pipe shall be increased, if necessary, so that the top of the anchor block does not project above ground level.

The minimum upward gradient shall be 1 in 500 in the direction of flow, or 1 in 300 against the flow.

3. ANCHOR BLOCKS/ THRUST BLOCK

Pipework without ties shall have anchor blocks provided at bends, tees, tapers, dead ends and, where pipelines have gradients in excess of 1 in 6, at intervals as shown on the drawings. The anchor block locations shall be as shown on the Drawings, and at other locations as ordered by the Engineer-in-charge.

Anchor blocks shall be made from concrete (as per BOQ) and constructed to the dimensions shown on the Drawings. Where faces of anchor blocks are shown to bear against undisturbed ground, the Contractor shall take all necessary measures to ensure that such bearing is given over the full dimension shown.

Anchor blocks shall not be required on curved pipework formed by joining straight pipe of standard lengths, except at locations ordered by the Engineer-in-charge.

4. WASHOUTS

The design and locations of washouts are shown on the drawings. Exact positioning shall be determined with regard to topography and be to the approval of the Engineer in charge. At least feet of the washout pipework, 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 the material.

5. FLEXIBLE JOINTS AT CONCRETE STRUCTURES

Pipelines entering and leaving concrete structures shall include two flexible joints, at distances from the face of the chamber or structure as shown on the Drawings.

6. PIPELINES UNDER EXISTING ROADS

The Contractor shall programme the works to reduce disruption to road traffic to a minimum, and before any work commences in existing roads shall:

(i) Obtain the full permission and approval of all authorities concerned 'serving notices of intent to start work as may be necessary and observing all the local Laws and Regulations;

(ii) Submit details of his proposals, and obtain approval from the Engineer-in-charge.

Pipelines shall cross roads at the angles shown on the Drawings.

Excavations in roads shall be backfilled, above the level of any pipe surround, with granular bedding material, deposited in layers not exceeding 4 inches unconsolidated thickness, fully compacted and brought up to the level of the underside of the sub-base.

Where the pipe cover is less than 3 feet or where directed by the Engineer-in-charge the pipe shall be further protected by a reinforced concrete slab as shown in the drawings.

The roadway shall he reinstated using the form of construction and materials Specified by the relevant authority or as directed by the Engineer-in-charge.

7. PHOTOGRAPHIC RECORD

The Contractor shall submit with the Progress report to the Engineer three (03) sets of the Photographic Record containing first quality color photographs of all significant aspects of construction works / activities. This Photograph Record shall contain approximately (20) color with brief explanation of aspects.

END OF SPECIFICATIONS

MATERIALS (SEWERAGE SYSTEM)

1. INTRODUCTION

General

i) Plain Cement Concrete and RCC specification will be dealt as mentioned in General Specification.

ii) Reinforcement specification will be dealt as mentioned in General Specification.

iii) All materials used in the works shall be of the best quality as specified or described in the Specification, Drawings and Bills of Quantities and shall be obtained from approved manufacturers or suppliers.

iv) The Contractor shall comply with the instructions of manufacturers / suppliers in respect of use, application or installation of any materials, goods etc., required to complete the Contract. The instructions shall be relevant to the prevailing climate and environment.

v) As soon as possible after the Contract has been awarded the Contractor shall submit to the Engineer a list of suppliers from whom he proposes to purchase the material required for the works. Each supplier must be responsible to admit the Engineer, or his representative, to his premises during ordinary working hours or even in odd hours if the contract work is in progress for the purpose of obtaining samples and inspecting the works and processes. In addition, if required by the Engineer, the Contractor shall deliver samples of the materials to the office of the Engineer, or his Representative, nominated testing laboratories, or the site of the works.

vi) Samples shall be taken in accordance with the relevant British Standard and ASTM or any other whichever applicable or otherwise as directed by the Engineer, Materials subsequently supplied shall at least be equal to the approved sample in all respects. No source of supply shall be changed without prior written approval from the Engineer. Any samples not approved shall immediately be removed from the site of the works.

vii) All approvals of materials shall be obtained in writing from the Engineer. The Contractor shall not use any material in construction and installation until the Engineer has given such written approval.

2. RCC PIPES AND FITTINGS

Pipes for sewers shall be of RCC manufactured in ordinary Portland cement from approved pipe factory. The pipes shall conform in all respects to ASTM G-76 -Class-ll wall B for pine sizes 12” and greater otherwise specified in BOQ. The thickness of barrel of sewer pipe shall be 30% more than the thickness proposed in ASTM C-76 for the same internal diameter of pipe. The pipes shall be socketed for push on rubber joints. The Contractor shall submit with his tender a detailed sketch of R.C.C. pipe with statement indicating details of socketed joints and also details of reinforcement including numbers and diameter of horizontal and Spiral bars for each diameter of pipe. Also conforming, the requirements as per details given in schedule of construction or drawings if any.

Pipes less than 12” in diameter shall conform to BSS 785 and 1144 or ASTM-C-14-Class-Ill.

The Contractor shall supply the required number of rubber rings of size and dimension suitable for the diameter of pipe provided for making a fully watertight joint. The rubber ring shall comply in all respect with ASTM C1869 or equivalent, approved by the engineer.

3. BASIS OF ACCEPTANCE

Acceptance of reinforced cement concrete pipes will be on the basis of three edges bearing and material tests as per ASTM-C-76-79 or latest version 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 related to tests.

1. SHORT PIPE LENGTHS

i) Short pipes shall be supplied in specific lengths according to pipe diameter and as detailed on the Drawings and in the Bill of Quantities.

ii) Additional random short lengths of PVC lined concrete pipes of diameter less than 600mm will be necessary for completion of pipeline gaps between manholes where no cutting of pipes is permitted under normal circumstances.

2. MANHOLE COVER

i. Mild steel frame and R.C.C. cover shall be made as per drawings.

ii. 'Cover shall be fitted to matching frames and tested at the manufacturers working. Each set (cover and frame) shall be similarly numbered in a legible and permanent manner. The marked position is not to be visible when fitted in place.

iii. The Contractor shall ensure that the covers are fitted to the appropriately numbered frames after the frames have been fitted.

iv. Covers shall be lockable to the frame by means of an inside catch which is key operated.

END OF SPECIFICATIONS

LAYING, JOINTING AND TESTING OF SEWER PIPES

1. SCOPE OF WORK

This Section covers transportation of pipes and accessories to site of work, handling, cleaning, lowering in trenches, making alignment, cutting, jointing, fittings, sewer pipes mains including testing and commissioning and handing over / taking over in strict accordance with specifications and condition of the contract or as directed by the Engineer.

2. ALIGNMENT AND GRADE

The Engineer or his representative(s) shall lay the pipes in trench to the required levels slopes, lines, alignment and grades at the required location, as shown in the drawings or as directed.

3. CLEANING AND CHECKING OF PIPE AND FITTINGS

All pipes shall be brushed and wiped clean before the pipe is laid. Before laying, all pipes shall be inspected for defects and when required by the Engineer shall be tapped with a light hammer to detect cracks. The pipes and fittings if found containing any defects shall be removed from the site to be replaced with defect free items which shall be got inspected in the same way as described above and so on so forth.

4. BEDDING - MATERIALS FOR PIPES

i) The pipe bedding material will be according to specified in BOQ or on drawings.

ii) The bedding material is classified as sand or granular material applied according to the design and instructions of engineer in charge.

iii) Granular bedding material for pipes shall be free draining, broken stone or gravel mixed with free draining coarse sand. It shall be free from organic matter, clay, silt and building rubbish. Bedding material shall be capable of producing a stable formation for pipe laying and shall not be subject to bulking or settlement due to changing weather or ground water conditions after placing and consolidation.

iv) Granular bedding material shall have a compaction fraction value not exceeding 0.2 when tested as described below. .

a) For testing pipe-bedding material, a representative sample of about 40 kg shall be heaped onto a clean surface and quartered to obtain approximately 10 kg. The moisture content of the sample should not differ from that of the main body of material, at the time of use in the trench.

b) A 150 mm internal diameter open-ended cylinder, 250 mm high, shall be placed on a firm, flat surface and loosely filled, without tamping, from the 10 kg sample. Any surplus material shall be struck off level with the top of the cylinder. The area around the filled cylinder shall be cleaned of all surplus material and then lifted clear of its contents and placed alongside the material.

c) Approximately the one-quarter of the material shall then be replaced into the. cylinder and compacted by tamping vigorously with a 40 mm diameter metal rammer weighing about 1 kg until no further compaction can be obtained. This operation shall then be repeated for each of the remaining quarters, tamping the final surface as level as possible.

d) The distance from the top of the cylinder to the surface of the final layer shall then be measured and this value divided by the height of the cylinder, shall be taken as the compaction fraction.

The sewers shall be laid on proper bedding as specified below.

a) In all types of soils above water table and hard soils, which can stand vertical without, support, the sewers shall be laid on approved granular bedding. This bedding material shall consist of broken stone or gravel mixed with coarse sand. The materials grading shall be in accordance with BS EN 1295-1; 1998. The material should be free from dust, plants or any organic compound etc. The thickness of bedding material below the pipe shall be up to full width of trench and shall be thoroughly compacted up to 95 – 100% as per AASHTO Standards after laying pipes, further granular bedding shall be laid and compacted in a similar manner to fill the entire space between the pipes and un-disturbed sides of trench up to a depth equal of half (1 / 2) of the outer diameter of pipe. Adequate space as prescribed by the Engineer shall however be provided for pipe sockets at required points.

If the granular bedding material is contaminated by water, sewage or soil materials due to the collapse of the sides of the trenches it shall be removed from the trench and replaced with new material before any of the pipes are laid or re-laid.

b) Sewer in Soft-Soil below ground water table

In case the invert of pipes is below ground water table or stable strata is not available at the pipes invert level, the same shall be supported on the following bedding.

i) Concrete bedding:

In case the pipe is required to be laid below ground water table where the subsoil is unstable and may cause formation of slush during the excavation and dewatering, a bed of concrete of 1:2:4 shall be provided for laying pipes in the trenches. The thickness of this concrete bed shall be as under:

- 12" for all sewer pipes.

This concrete bed shall be laid over a stone soling 12” thick or as per instruction of the

The concrete bed shall be laid in full width of trench and adequately vibrated as per direction of the Engineer / Engineers representative present at site. Space shall however be provided for pipe sockets at required places.

After laying pipe sewer, further cement concrete of mix 4:2:4 shall be placed and vibrated in nan a similar manner to fill the entire space between the pipe and the undisturbed sides of trench up to depth equal to 1 / 4 of the outer diameter of the pipe or as directed by the Engineer in writing depending upon the stability of the strata encountered at each individual location.

The Engineer can however reduce or increase to any required extent the thickness or width of concrete or granular bedding below pipe or depth of granular bedding or concrete on the sides of pipes through instructions in writing and the Contractor shalt be paid accordingly.

In case of excessive slush formation in the bed of trench for which the Engineer, who shall be the sole judge, may instruct in writing to lay gravel or stone soling below the bed of 4 concrete. The Engineer shall do this after detailed inspection of excavated trench. The Engineer shall instruct the depth of such bed of gravel or soling in writing before laying the bedding. No payment of bedding shall be made if no such written instruction specifying depth, the Engineer specifies width and length of bedding and its location.

ii) Concrete encasing for pipes:

When directed .by the Engineer in writing, the: contractor shall encase (surround) pipe with concrete. The concrete for surrounding the pipes shall be 1:2:4 ratio (grade 30) to the dimensions given in the drawings. As directed by the Engineer, cradle supports shall be provided as under:

- The cradles shall be 300 mm wide, and a depth minimum of 200 mm. For a length of full width of trenches.
- Neither trench sides nor trench timber or sheeting is to be used in lieu of proper formwork to concrete surrounds. All Spaces at the sides or in other places shall be filled up with selected fine material and the ground made solid as the work advances. No extra payment will be made for the concrete in excess than as provided.
- Concrete shall be placed evenly over the entire width and to within 25 mm of the bottom of the pipe then, without stopping, it shall be placed gently on one side of the pipeline only and carefully worked under the pipe, ensuring that no voids are left under the pipe. The concrete shall be brought up equally on each side of the pipe to the required finished height.
- Horizontal construction joints will not be permitted in the concrete surround below half pipe height Vertical construction joints shall be formed only at each pipe joint and must extend through the blinding where appropriate. Diaphragm of approved compressible expansion jointing material cut to the exact shape of the outside face of the pipe and the bedding or surround shall be positioned and supported in contact with the end face of each socket. The contractor shall take precautions to ensure that a firm seat exists between the diaphragm and the end face of the socket and that no concrete intrudes into the joint. Flexible joint at the pipe joint should be provided all along the concrete encasing and concrete bedding as specified by Engineer.

5. PLACING AND LAYING

Pipes, specials and fittings where applicable shall be carefully lowered into the trench by means of derrick, rope, slings, or other suitable equipment. Under no circumstances shall any of the pipeline or any materials be dropped, dragged or dumped into the trench. The full length of each section of pipe shall completely rest upon the pipe bed, with recesses excavated to accommodate joints. Pipe that has the grade or joints disturbed after laying shall be taken up and relaid. Pipe shall not be laid in water or when trench conditions are unsuitable for the work. The sewer pipes shall be correctly laid in correct position, alignment, level and grade and checked so that the invert of the sewer conform to that shown on the drawings and sockets are placed on the place provided for them in the excavation and the complete sewer will have a smooth and uniform inverts. Each pipe shall be inspected for defects before being put in place.

a) In laying out pipes, fittings and specials they shall not be allowed to impede or harm traffic pedestrians or animals or to obstruct paths and access to private other property. Pipes shall not be laid out in beds of watercourses and every precaution shall be taken to preserve their sound and perfect condition before laying.

b) Trench excavation and pipe laying shall proceed in an orderly and continuous fashion working from one end of the pipeline to the other. Piecemeal excavation and pipe laying of isolated lengths will not be permitted prior to written approval of the Engineer. Similarly manhole / chamber foundation bases shall be correctly proposed to avoid cutting of pipes wherever possible.

c) Laying Pipes alongside existing pipes, service etc.

Where new pipes are to be laid alongside, over or under existing sewer, surface water drains, nullahs, water or gas mains, conduit electric cables or telephone cables, the contractor shall take care to interfere as little as possible with the existing services and connections thereto and the Contractor shall repair, or arrange for the repair of any damage at his own cost to the satisfaction of the utilities owner and the Engineer.

The contractor shall make all arrangements for supporting existing services and for temporarily dealing with the flow from any pipe, drain, nullah, channel, etc. and shall provide all troughs, pumps, plant and material necessary for this purpose without any additional cost.

d) Laying pipe under hedges, fences, walls and near trees

Where hedges are damaged or destroyed, the whole shall be restored and reinstated with two rows of the same kind as the hedges, planted in due season in topsoil 300 mm deep and fenced on each side with post and wire. Stock proof fences finished on top with one strand of galvanized barbed wire, or otherwise protected as required by the owners or occupiers and the Engineer without extra cost.

Where fences or walls are damaged or destroyed, the whole shall be restored and reinstated with like materials to the satisfaction of the owners or occupiers and the Engineer without any additional cost.

6. JOINTING

After a length of pipeline is laid in trench, the pipes, specials, and fittings, shall be jointed in accordance with the recommendation of the manufacturer of pipes.

Both sewer pipes and socketed or collared pipes shall be jointed with rubber ting. Rubber ring shall be mounted on the spigot end, socket of pipe or collar as required and pipe be pushed into socket / cement or molten bitumen shall be wound in the dowel space and joint smoothed with cement mortar one part of cement and 1-1½ parts of fine aggregate). The RCC collar shall be carefully pushed in position and the space between the pipe and the collar shall be filled and adequately caulked with cement mortar 1:1½ so that even space appears all round the external diameter of pipe. The work of jointing / working

joints shall be done only in the presence of Engineer's representative(s). Any joint not made in presence of Engineer's representative shall be rejected and will have to be dismantled and remade on the Contractor's risk and cost.

The open ends of pipes being laid for sewers after the Contractor shall not leave a day work open. These open ends shall be carefully closed adequately by wooden plug of appropriate size to stop any sand, garbage, debris, insects, animals or water entering into the pipe. No payment shall be made for such plug, which shall be watertight. The cost of providing and dismantling of such plugs shall be deemed to be included in Contractor's rate of laying and jointing of pipes or sewers.

On completion of joints in a section or whole of pipe line, backfilling shall be done for the length of pipes except joints which: shall be kept open till the pipes or sewer line is pressure tested and approved. Unless otherwise-detailed, all pipelines shall have approved flexible joints.

All joints shall be sound and watertight when subjected to Pressure test and under all working conditions. Before any pipe joint is made, the ends of the pipes to be jointed shall be thoroughly cleaned. Care shall be taken to ensure that the rubber rings, when finally fixed, shall be concentric with the pipe.

Care shall be exercised to ensure that, with flexible rubber ring joints of all types, the pipe spigots are not driven tight home. The correct Space as recommended by the manufacturer, between the spigot end and socket shoulder shall be maintained.

7. CUTTING OF PIPE

The cutting of pipe shall be done neatly without damage to the pipe So as to leave smooth end at right angles to the axis of pipes.

Pipe ends shall be properly shaped for the required joints. The contractor shall fix all manholes, Junctions, in the positions as per drawing or as directed by the Engineer and shall as far as possible select the lengths of pipes to avoid cutting to waste.

8. TESTING OF SEWER LINES

8.1. General

All sewers built under this contract shall be tested for infiltration or exfiltration as specified below. The tests shall be made at time 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 methods.

8.2. Infiltration Tests

The sewers which are constructed with the ground water level above the crown of the pipe shall be f 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.

8.3. Exfiltration Tests

The sewers which are constructed with the ground water level below the crown of the pipe 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:

i). After isolation of sewer section, it shall be filled with water to a level which is 3 ft. minimum above the crown of the sewer at the higher end of the isolated section under test.

i). The duration of the exfiltration test shall be one hour after the filling with water has been completed.

iii). Determination of the amount of exfiltration shall be made by measuring the total loss of volume of water in the manholes.

iv). The amount of exfiltration over a 24 hour period will then be calculated from the measured logs of volume during the test observation period.

8.4. Allowable Infiltration or Exfiltration

The calculated amount of infiltration or exfiltration 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 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 as to reduce the leakage to less than the permissible maximum stated above.

8.5. 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 Owner.

9. CLEANING OF EXISTING SEWERS

The Contractor is first required to check the completion of the following works before taking in hand the work of cleaning of existing branch sewers:

a) Laying, jointing and testing of new sewers.

b) Construction of sewage pumping station. -

c) Providing, installing and commissioning pumping machinery, valves, special and manifold.

d) Laying and jointing of rising main.

e) Testing of pumping machinery and rising or pressure main.

On completion of work of testing of new sewers and issue of certificate of the Engineer for satisfactory completion of the work of laying of new sewers, the Contractor shall start the work of cleaning of existing branch sewers before making connection with the new sewers. The Contractor shall undertake the following steps:

i) Each sewer shall be cleaned one by one

ii) Potable dewatering / sewage pumps of adequate capacity with stand by shall be installed at the last manhole of the branch sewer connecting with existing trunk sewer and pumping of sewage shall be done by the Contractor continuously.

iii) As the sewage level in the manhole goes down, cleaning of the manholes shall be done manually to avoid damage. The manholes shall be cleaned of all debris, sludge and any other matter lying inside while continuous pumping of sewage is done to avoid rising of sewage level. The Contractor shall provide adequate safety equipment and light for the safety of his labour and Staff. The Contractor shall be fully and solely responsible for the safety of his labour and staff and shall be wholly responsible for any mishap, damage or loss for any reason whatsoever.

iv) The Contractor shall carry out rodding of the sewers after the manholes on the branch lines are cleaned. The Contractor shalt provide all rodding equipment for cleaning of sewers.

v) The Contractor shall arrange for disposal of pumped sewage into the existing trunk sewer or new main sewers. The disposal of this pumped sewage into new sewers shall be done only after testing of the whole new system and electric connection is obtained and new pumping Station, Sewers and rising main are in full operation.

vi) The Contractor shall carry out all necessary and miscellaneous repairs to the existing manholes including replacement of manhole covers as instructed by the Engineer.

vii) On satisfactory completion of cleaning each branch sewer and written approval by the Engineer, the Contractor shall connect this cleaned branch sewer to the new main sewer through additional length of sewer. The payment for this additional sewer including excavation, dewatering laying and jointing of sewer pipes will be done on the rate applied for laying new sewers as per BOQ.

viii) In case of serious clogging of branch sewers, the Contractor shall locate the damaged part of sewer and replace this sewer on written authority of the Engineer and lay the required portion of the damage sewer as new sewer on the basis of rates provided in the BOQ and get it tested as per specification.

ix) On completion of cleaning of one branch sewer, the Contractor shall start work on other branch sewers utilizing the experience gained on previous sewers till all the branch sewers are completely cleaned, repaired and connected to the new main sewers.

10. CONSTRUCTION OF MANHOLES AND VENT SHAFTS

Contractor shall construct the manholes and vent shafts in positions as shown in drawings or where otherwise directed by the Engineer. The work of construction of manholes and vent shafts shall proceed along with the work of laying of sewer pipes. The timbering steel sheet piling and other side supports of trenches shall not be removed, dewatering .far trenches shall not be stopped and backfilling of trenches over laid sewers shall not be allowed until the manholes are fully constructed at the required places, checked, tested and approved by the Engineer.

Manholes shall be constructed concurrently with the adjacent pipe lengths. The contractor shall build in pipes and for grades as directed. Short length pipes with flexible joints shall be used immediately adjacent to manholes as detailed. Benching shall be left completely smooth to the satisfaction of the Engineer.

Manholes and vent shafts shall be constructed of cast-in-situ vibrated concrete. Dimensions and mix of concrete shall be as shown in drawings. All channels and benching shall be finished smooth and accurately shaped in accordance with the drawings. :

The manhole walls shall be constructed of fair face steel forms and no plaster will be required. However in case smooth surface is not attained inside and outside of manholes shall be plastered smoothly with 19 mm thick cement sand mortar of 1:3 using S.R. cement and the manhole shall be external surfaces. No extra payment shall be paid for this work

11. NEW MANHOLES ON EXISTING SEWER

In case new manholes are to be constructed on existing sewers either for replacement of damaged manholes or additional manholes. The Contractor shall construct these manholes as per written instructions of Engineer. The shape and size of these manholes shall be the same as the existing manholes on the existing line. Payment shall be made on the basis of actual quantity of items of work carried out by Contractor for excavation, stone soling, dewatering, reinforcement and concreting paid for such items available in BOQ.

12. MAKING CONNECTION WITH EXISTING SEWERS

After the whole work of laying, jointing and testing of new sewers, manholes, vent shafts pumping station pumping machinery and rising or pumping main is completed, tested satisfactorily and certified in writing by the Engineer, the Contractor shall start the work of making connection for the following:

i) Connecting the main sewers with the sump (wet well) of pumping Station.

ii) Connecting the existing sewers with the manholes on the new sewers if existing or required.

This work shall include laying the required connecting length of the diameter of existing sewer with the new manholes including all operations of excavations, timbering bracing dewatering, making holes in new manholes, or pumping station, laying and jointing of sewer pipes, repairing of cut portions, backfilling, testing and all other operation for a complete job of making connection of sewers with pumping station or as required.

Payment shall be made for excavation, laying sewer pipes, bedding etc. for connecting sewers on the basis of general items of work in the BOQ. The item for making connection shall include for cutting of walls for making connection, repairs of cut portions and all other miscellaneous item not covered by description of items in BOQ. After making connection and completion of repair, manholes should be water tight.

The contractor shall reinstate the surfaces over all trenches except where otherwise described. Reinstatement shall be carried out as soon as trenches or other excavations have been backfilled and thoroughly compacted as specified.

13. PAYMENT

Rate shall include for supplying, laying, jointing and testing of sewers as per rates quoted in the BOQ. The rate shall include the cost of the pipes, rubber rings, sockets, collars and all other material, equipment, plant and labour required for laying, jointing and testing of pipes or sewers for a complete job. No deduction shall be made for the manholes in the measurement for the length of sewers, of the pipe laid in continuation.

Payment for manholes and vent shafts shall be made for complete work of manholes or vent shafts as per drawings and specifications.

END OF SPECIFICATIONS

PRECAST MANHOLES

1. General

a) Precast concrete units shall be designed and fabricated by an experienced and approved precast concrete manufacturer. The manufacturer shall have been regularly and continuously engaged in the manufacture of precast concrete units similar to that indicated in the project. Specifications or drawings for at least 10 years. Contractor should submit list of manufacturer for approval from the Engineer in Charge.

b) The Contractor shall be responsible for providing adequate access to the site to facilitate hauling, Storage and proper handling of the precast concrete units.

c) Precast concrete units shall be installed to the lines, level and grades shown in drawings and specified here.

d) Precast concrete units shall be lifted by suitable lifting devices at point provided by the precast concrete producer.

e) Field modification to the product shall not retrieve the precast producer of liability regardless if such modifications result in the failure of the precast concrete unit.

Note.

i) All manhole steps shall be installed in line with the vertical side of the cone.

i) The lift inserts and holes shall be completely filled with non-shrink grout after manhole installation.

iii) All pipe entrances and connections shall conform to the specification for roads and structures.

iv) All pipe openings shall be cast to elevations Specified on sewer plans or to meet job requirements.

v) All concrete surfaces shall be internally and externally sides should be absolute fair finished.

vi) All external and internal concrete surface shall be treated with two coats of hot bituminous - emulsion of grade 60/70 at manufacturer's plant / casting yard before placement to the specified locations,

2. Submittals

Preconstruction submittals-submit quality control procedures established by the precast manufacturer.

Shop drawings for standard precast concrete units for approval by the Engineer in Charge.

Installation and construction information shall be included on shop drawings.

Details of steel reinforcement size and placement as well as Supporting design calculations shall be included in the submittal. .

3. Design / Design Criteria

Design standard precast concrete units to withstand indicated design load conditions in accordance with applicable industry design standards (ACI 318, ACI 350 ASTM & AASHTO).

Design must also consider stresses induced during handling, transportation and installation in order to avoid product cracking or other handling damage. Design loads for precast concrete units shall be indicated on the shop drawings.

The precast concrete procedure shall supply precast concrete unit design calculations and concrete mix design proportions and appropriate mix design test data. Structural design calculations shall be signed by a licensed professional Engineer.

4. Durability

Characteristics compressive cylindrical strength (fc') of precast & reinforcement concrete at 20 days shall be a minimum of 4000 Psi.

Reinforcement — all non-Pre-stressed reinforcement steel shall be deformed bars conforming to ASTM A 6145, Grade 60 having minimum yield strength of 60,000 Psi.

5. Anchorage, lifting inserts and devices

For anchors, lifting inserts and other devices, the precast concrete producer shall provide product data sheets and proper installation instructions.

The Precast concrete unit dimensions and safe working load shall be clearly indicated.

- The lift inserts and holes shall be completely filled with non-shrink grout after manhole installation.

6. Joints and Sealants

Joints and sealants between adjacent units shalt be of the type and configuration indicated on shop drawings meeting specified design and performance requirements.

The manhole joint shall be sealed by approved butyl rubber sealant. The butyl rubber sealant shall be 1" square and shall conform to ASTM C — 980 and AASHTO M — 198.

7. Test Reports

The precast concrete producer shall supply copies of material certifications and / or laboratory test reports, including mill tests and all other test data, for Portland cement, blended cement, pozzolans, ground granulated blast furnace slag, silica fume, aggregate, admixtures, and curing compound proposed for use on the project.

The precast concrete producer shall submit copies of test reports showing that the mix has been successfully tested to produce concrete with the properties specified and will be suitable for the project conditions. Such tests may include compressive strength, flexural strength, plastic or hardened air content, freeze thaw durability, abrasion and absorption. Special tests for precast concrete items shall be clearly detailed in the specification.

END OF SPECIFICATIONS

MANHOLES AND MANHOLE COVER & FRAME

SCOPE

The work to be done under this section of the specifications includes furnishing all plant, labour, equipment, application, materials and performing all operations required in connections with construction of manholes complete as specified herein, in accordance with the contract documents, as shown on the drawings or as directed by the Engineer.

CONSTRUCTION

All concrete work, steel reinforcement, pipe and pipe fitting, etc. shall be provided and constructed/installed in accordance with the relevant sections of the contract documents. Galvanized ladder rungs, heard duty C.I. cover (under traffic area) and concrete cover (under non traffic area) with C.l. frames to resist 10 Ton wheel load, making of concrete chambers and concrete benching in manholes, complete as specified in the contract documents shall be included in work to be done under this section of the specifications. Depth of manholes shall be considered as difference in elevations of top of cover and invert level of pipe.

MEASUREMENT AND PAYMENT

a) Measurement for-payment of-Manholes-shalt-be-made-on the basis-of actual number provided and constructed. The Contractor's bid against this items shall include construction of complete structures with all installations of pipe, pipe fittings, ladder rungs, cover and frames, reinforcement, concrete, steel work complete in accordance with the contract documents.
b) b) Payment of manholes shall be made at the applicable unit price per number bid as provided in the Bill of Quantities. The bid amount shall be full payment for the work specified herein.

END OF SPECIFICATIONS

IRRIGATION STANDARD SPECIFICATIONS (DISTRIBUTION NETWORK)

GENERAL NOTES

i). The irrigation system shall be fed from the underground storage tank located at the master plan, which shall be constructed in reinforced concrete.

ii). The system shall be complete with manual / automatic packaged irrigation pumping station and valves, distribution pipes, underground pipes.

1. POP-UP TYPE NOZZLE

- Pop-up type sprinklers made of high resistance and durable polymers.MPR
- Plastic and brass nozzles pressure regulation is independent of nozzle flow
- Operating range per hour (20 to 259mm/h) spacing 3 to 15ft. AR=4.6m,Q=
- Flow 790L/h, operating pressure 30psi water pressure (1-5 bars)
- Rubber grommet the easy to install and are UV resistant.
- Each pop-up sprinkler shall be provide 2" dia 18" long pvc sleeve pipe class
- "A" type as shown on drawing. Finish subject to Architect's approval.

2. PCJ DRIPPER

- The dripper compacted on-line pressure compensating and continuously
- Self-cleaning dripper. Eliminates drainage and refill effect, and improves efficiency in irrigation. The operating flow range (2.0 to 12 L/h) and operating pressure (0.5 to 4.0 bars). These drippers ensure 100% uniformity of water and nutrient's distribution along the laterals.

3. START CONNECTOR+SEAL

Connectors are made of high resistance and durable polymers. They are functional and viable, modeled upon the highest market standards and available for almost all pipe types. These are easy to install and are "UV" resistant. Start nipple 16mm-ID +rubber grommet 10.7-OD.

4. LINE END CAP

Connectors are made of high resistance and durable polymers. They are functional and viable, modeled upon the highest market standards and available for almost all pipe types. These are easy to install and are "UV" resistant. Used at the end of the dripper/sprinklers.

5. FILTER (Disc Filter)

The Disc filter have divers filtration grade ranging (100) micron-140 mesh. Two outlets options - inline or angle, highly resistant to corrosion, detachable spine, pressure differential disc compression, adapts to horizontal or vertical installation, flow rate 400-100 micron 25m^3/h (6.9 L/sec) (110gpm), maximum pressure 116psi (8 bars) filtration area.

3. PIPING FOR IRRIGATION SYSTEM

6.1 Scope

All pipe work should be installed as shown on drawings, specified herein and as instructed by Consultant.

The layout of pipe work shown on drawings are tentative and for tender purpose only. Final layout of the respective pipe work shall be made by the contractor in accordance with the equipment layout. The final layout as prepared by the contractor shall be submitted to the Engineer for approval and work shall be started on receiving approved drawings.

6.2 Piping & Fittings material

Polypropylene (PE-80) sdr-17.6 pipes a fittings confirming to BS 6572:1985 with fusion but welding jointing will be provided for Irrigation system pipes work underground as per master plan.

uPVC schedule 40 pipes a fittings with solvent joint will be used for irrigation system pipes sizes dia 1” and above

6.3 Piping Installation

The Engineer shall have the right to inspect any pipe, pipe joint, or pipe line fitting in order to check quality of materials and workmanship or system operation. Any defect should be made good by the contractor at his own expense and to the satisfaction of the Consultant.

Any pipe work fitted in any unsightly manner and not to the satisfaction of the Engineer should be removed and refitted at the contractor's own expense.

Unless specifically stated, the term "“diameter’ is the nominal diameter as designated commercially.

6.4 Masking Plates

Where pipes pass through ROADS, FOOT-PATH should be closed with 20 SWG sheet metal masking plates fitted around the pipes and over the sleeves.

6.5 Under Ground Pipe Work

Piping in ground shall be laid on a firm bed for its entire length. No separate payment shall be made for any earthwork required in connection with laying of piping in ground.

6.6 Testing Pipe Work

All water distribution system shall be hydrostatically tested whole or in part to 1-1/2 times the working pressure but not less than 150 psi. The Contractor shall pay for all devices, materials, supplies, labor and power required for the test. The test will be run for two hours at revealed by the test shall be repaired and the whole test return until the system proves to be satisfactory. The test pressure should be 150 psi and to be maintained for 4 hours.

6.7 Valves

Unless otherwise specified, valves should be of the same nominal size as the size of the pipe line to which they are connected. All valves that incorporated packed glands should be capable of having glands packed when connected in line and subject to the working line pressure.

All isolating valves shall provide tight shutoff in the closed position.

All hand wheel valves shall rotate clockwise to close the valve. Check valve should be installing in a plane only which is recommended by the manufacturer and approved by the Consultant.

Valve bonnets and covers should be easily removable and the gasket and glands should be readily renewable.

All gate and sluice valves shall incorporate guides in the body to ensure the correct position of valve discs at all times. The working parts of valves and cock should be bronze and the body casting should

be bronze for valves and cocks up to 2" connection and cast iron for valves and cock of 2-1/2" diameter connection and above.

Gland rings and spindles should be of a good running fit and stuffing boxes should be fitted with neoprene ‘O' ring seals. The exterior finish of all bronze valves bodies should be polished except otherwise specified.

Check valves up to and including 2-1/2" diameter should be of “Y” pattern swing type having regrindable bronze discs with the disc seat integral with the valve body. The disc and seat should be accessible via a screwed cap for regrinding without removal of the disc.

Isolating valves for all water piping should be full way type gate valves unless otherwise indicated and should be fitted in the following positions, whether shown on drawings or not:

- Inlet and outlet connections to pumps.

- Inlet and outlet connections to water strainers and filters

- Inlet and outlet connections to tanks.

- Inlet and outlet connections to three Port Valves.

- Bypass connection around valves and equipment.

- Branch connection from service mains.

6.8 Strainer

Strainer should be 'Y' pattern and cast iron body, working pressure should be equal to or greater than the maximum water pressure. The drain cock should be provided for cleaning purpose.

6.9 Unions and Flanges

Unions and Flanges should be furnished and installed at each threaded or flanged connection to all equipment or valves. The faces of flanges being connected should be alike in all cases. Unions and flanges should be located so that pipe can be easily disconnected for removal of equipment, valve or tank.

4. MAIN PUMP & STANDBY WITH ELETRIC MOTOR DRIVEN

Pump shall be of the horizontal type end suction case made of cast iron, free of foundry imperfections and other detrimental defects.

Impellers shall be of bronze, of the enclosed type, statically balanced. They shall be adjustable horizontally by means of an adjustable nut located on top of the driver.

Pump shaft shall be of polished stainless steel and shall be supported by bearings above and below each impeller.

The pump seal shall be mechanical type.

Motor - shall be drip proof, 2900 RPM and shall be especially selected for quiet operation. The horse power of the motor shall be of such a size as to ensure non-overloading of the motor through the capacity range of the pump.

Installation — A concrete base 6 inches higher than the surrounding floor shall be provided. Construct base and install as shown by the detail on the drawings. Provide a minimum of four 4" anchor bolts from concrete to pump base.

Controls — The pump shall be controlled by a combined manual type pump control panel. The control panel shall have an externally operated circuit breaker, a pilot light to indicate when power is on, switches or push button for manual or automatic operation, a pressure switch control for automatic operation.

8. SUBMITTALS

General: Submit listed submittals in accordance with Conditions of the Contract and Submittal Procedures Section.

Product Data: Submit product data including manufacturer's SPEC- DATA product sheet, for specific products.

9. SHOP DRAWING & AS- BUILT DRAWINGS BY THE CONTRACTOR

a) The CONTRACTOR shall keep a complete record of all piping and accessories installed within the mark any deviations adopted on the Shop Drawings.

b) After the completion of the project, the CONTRACTOR shall transfer all the relevant record on the shop drawings and submit 3 copies for approval to the CONSULTANT.

c) After receipt of approval the CONTRACTOR shall submit 3 copies each of the Approved “As Built” drawing of the CONSULTANT.

END OF SPECIFICATIONS

MECHANICAL & PLUMBING VENDOR'S LIST

S.#	NAME	MANUFACTURERS / BRANDS	COUNTRY OF ORIGIN	COUNTRY OF MANUFACTURING	LOCAL REPRESENTATIVE(S)		
					COMPANY NAME	CONTACT PERSON	CONTACT NUMBER
	MECHANICAL, PLUMBING & DRAINAGE WORKS						
1	UPVC PIPES & FITTINGS (PRESSURE PIPES, SCHEDULE 40 & 80 etc.)	DADEX	PAKISTAN	PAKISTAN	M/s. DADEX	MR. ZUBAIR SIDDIQUI	0345-3099156
		CIVIC PIPES	PAKISTAN	PAKISTAN	M/s. PELIKAN PIPE INDUSTRIES	MR. MOHSIN NAQVI	0300-3945580
		JEDDAH POLYMER	PAKISTAN	PAKISTAN	M/s.JEDDAH POLYMER	MR. MURTAZA	0300-2929079
		AGM	SAUDI ARABIA	SAUDI ARABIA	M/s. MALIK CORPORATION	MR. ABDUL MATEEN	0345-9997722
		BINA PLASTIC	MALAYSIA	MALAYSIA	M/.s CEMENTATION COMFORTS	MR. KHALID	0332-2326969
					M/s. ALFAH TRADERS		
					M/s. NATIONAL HDPE & UPVC PIPES		
		OR OTHER EQUIVALENT APPROVED BY THE CONSULTANT / ENGINEER					
2	CPVC PIPES & FITTINGS	NEROPLAST	SAUDI ARABIA	SAUDI ARABIA	M/.s BUILDCON	MR. TARIQ SHARIF	0300-0225947
		ZENT					
		AGM	SAUDI ARABIA	SAUDI ARABIA	M/s. MALIK CORPORATION	MR. ABDUL MATEEN	0345-9997722
		BAHRAIN	KINGDOM OF BAHRIAN	KINGDOM OF BAHRIAN	M/.s CEMENTATION COMFORTS	MR. KHALID	0332-2326969
		OR OTHER EQUIVALENT APPROVED BY THE CONSULTANT / ENGINEER					
3	PPR-C PIPES & FITTINGS	DADEX	PAKISTAN	PAKISTAN	M/s. DADEX	MR. ZUBAIR SIDDIQUI	0345-3099156
		CIVIC PIPES	PAKISTAN	PAKISTAN	M/s. PELIKAN PIPE INDUSTRIES	MR. MOHSIN NAQVI	0300-3945580
		RAKTHERM	UAE	UAE	M/s. MALIK TRADERS	MR. SABIR KHAN	0321-8211686
		Q-THERM	UAE	UAE	M/s. MALIK CORPORATION	MR. ABDUL MATEEN	0345-9997722
			UAE	UAE	M/s. MALIK CORPORATION	MR. ABDUL MATEEN	0345-9997722
		OR OTHER EQUIVALENT APPROVED BY THE CONSULTANT / ENGINEER					
4	HDPE PIPES & FITTINGS	DADEX	PAKISTAN	PAKISTAN	M/s. DADEX	MR. ZUBAIR SIDDIQUI	0345-3099156
		PAK ARAB	PAKISTAN	PAKISTAN	M/s. PAK ARAB	MR. FAIZAN KHAN	0345-8289318
					M/s. NATIONAL HDPE & UPVC PIPES		
		OR OTHER EQUIVALENT APPROVED BY THE CONSULTANT / ENGINEER					
5	M.S SCHEDULE 40 SEAMLESS PIPES	BAOLAI	CHINA	CHINA	M/s. CRESCENT CORPORATION	MR. ATIF MUNAWAR	0302-8443780
		PROTEK	CHINA	CHINA	M/s. SAEED SONS	MR. SAAD HUMAYUN	0320-2111305
		OR OTHER EQUIVALENT APPROVED BY THE CONSULTANT / ENGINEER					
6	M.S FITTINGS	MUELLER (Threaded) JINTAI (Welded) (AS PER APPROVED SAMPLE AFTER LAB TEST)	CHINA	CHINA	M/s. CRESCENT CORPORATION	MR. ATIF MUNAWAR	0302-8443780
		NEFT / BIS (Threaded) NEFFT (Welded) (AS PER APPROVED SAMPLE AFTER LAB TEST)	CHINA	CHINA	M/s. FAKHRI BROTHERS	MR. MUSTAFA MAJAL	0321-8297941
		OR OTHER EQUIVALENT APPROVED BY THE CONSULTANT / ENGINEER					

CGDC CONSULTING (PVT) LIMITED

MECHANICAL & PLUMBING VENDOR'S LIST

S.#	NAME	MANUFACTURERS / BRANDS	COUNTRY OF ORIGIN	COUNTRY OF MANUFACTURING	LOCAL REPRESENTATIVE(S)		
					COMPANY NAME	CONTACT PERSON	CONTACT NUMBER
7	VALVES & ACCESSORIES 1/2" to 2" Brass Body 2-1/2" to above C.I Body	GALA	CHINA	CHINA	M/s. CRESCENT CORPORATION	MR. ATIF MUNAWAR	0302-8443780
		RUB	ITALY	ITALY	M/s. SAEED SONS	MR. SAAD HUMAYUN	0320-2111305
		HATTERSLEY	CHINA	CHINA	M/s. KHAN BROTHERS	MR. ASIM	0334-3369488
			PAKISTAN	PAKISTAN	M/s. REHMAN ENGINEERING WORKS	MR. MUBASHIR	0322-2762222
		OR OTHER EQUIVALENT APPROVED BY THE CONSULTANT / ENGINEER					
8	R.C.C PIPES	RAZIA PIPES	PAKISTAN	PAKISTAN	M/s. PAKISTAN PIPE & CONSTRUCTION COMPANY (PRIVATE) LIMITED		0327-8430358
			PAKISTAN	PAKISTAN	M/s. BALOCHISTAN R.C.C PIPE FACTORY	MR. ZAMAN	0300-2616660
		OR OTHER EQUIVALENT APPROVED BY THE CONSULTANT / ENGINEER					
9	G.I PIPES	I.I.L PIPE	PAKISTAN	PAKISTAN	M/s. INTERNATIONAL INDUSTRIES LTD.	MR. AZFAR FAROOQI	0335-6600611
		OR OTHER EQUIVALENT APPROVED BY THE CONSULTANT / ENGINEER					
10	G.I FITTINGS	H.E/T.G	CHINA	CHINA	M/s. SATTAR & SONS	MR. ASAD	0331-1391530
		OR OTHER EQUIVALENT APPROVED BY THE CONSULTANT / ENGINEER					
11	PUMPS	LOWARA	ITALY	ITALY	M/s. FLUID SYSTEMS INTERNATIONAL PVT. LTD.	MR. AADIL KHAN	0307-2230774
		WILO	GERMANY	GERMANY	M/s. ZARA ENGINEERS	MR. MIFTAH ALI	0322-2887225
		GRUNDFOS	EU	EU	M/s. ORIENT ENERGY SYSTEMS	MR. HASSAN KHAN	0346-2112200
		KSB	PAKISTAN	PAKISTAN	M/s. IDEA	MR. ZAID FAREED	0300-8203317
		OR OTHER EQUIVALENT APPROVED BY THE CONSULTANT / ENGINEER					
12	C.I COVERS, GRATINGS & S.S CLEANOUT PLUGS	JAWS	PAKISTAN	PAKISTAN	M/s. JAWS TECHNICAL EXPERTS	MR. ASGHAR REHMAN	0321-5138520
		OR OTHER EQUIVALENT APPROVED BY THE CONSULTANT / ENGINEER					
13	RAIN WATER GRATINGS, FLOOR DRAINS, GULLY TRAPS & PARKING DRAINS	DADEX	PAKISTAN	PAKISTAN	M/s. DADEX	MR. ZUBAIR SIDDIQUI	0345-3099156
		DACTA (BY HEPWORTH)	UAE	UAE	M/s. BUILD CON	MR. TARIQ SHARIF	0300-0225947
		FLOWTECH	UAE	UAE	M/s. SANITARY SOLUTIONS	MR. RAHEEM KHATRI	0334-2311786
		OR OTHER EQUIVALENT APPROVED BY THE CONSULTANT / ENGINEER					
14	VALVE & SPECIAL VALVES (PVC)	ASTRAL	SPAIN	SPAIN	M/s. NETWORLD	MR. JAVED KHAN	0300-8287787
					M/s. ANNUA OLYMPIC POOL	MR. SHAHID MAHMOOD	0300-8051022
					M/s. ORIENT POOL	MR. AMIR ALI	0300-8268517
		PENTAIR	USA	USA	M/s. ANNUA OLYMPIC POOL	MR. SHAHID MAHMOOD	0300-8051022
					M/s. ORIENT POOL	MR. AMIR ALI	0300-8268517
		HAYWARD	USA	USA			
		OR OTHER EQUIVALENT APPROVED BY THE CONSULTANT / ENGINEER					
15	UPVC SCHEDULE 80 PIPES & FITTINGS	DADEX	PAKISTAN	PAKISTAN	M/s. DADEX	MR. ZUBAIR SIDDIQUI	0345-3099156
		CIVIC PIPES	PAKISTAN	PAKISTAN	M/s. CIVIC PIPES	MR. MOHSIN NAQVI	0300-3945580
		JEDDAH POLYMER	PAKISTAN	PAKISTAN	M/s.JEDDAH POLYMER	MR. MURTAZA	0300-2929079
		AGM	SAUDI ARABIA	SAUDI ARABIA	M/s. MALIK CORPORATION	MR. ABDUL MATEEN	0345-9997722
		OR OTHER EQUIVALENT APPROVED BY THE CONSULTANT / ENGINEER					
16	VALVE & SPECIAL VALVES (BRASS, C.I)	GALA	CHINA	CHINA	M/s. CRESCENT CORPORATION	MR. ATIF MUNAWAR	0302-8443780
		RUB	ITALY	ITALY	M/s. SAEED SONS	MR. SAAD HUMAYUN	0320-2111305
		HATTERSLEY	CHINA	CHINA	M/s. KHAN BROTHERS	MR. ASIM	0334-3369488
		OR OTHER EQUIVALENT APPROVED BY THE CONSULTANT / ENGINEER					

CGDC CONSULTING (PVT) LIMITED

EDUCATION CITY

INFRASTRUCTURE DEVELOPMENT OF EDUCATION CITY,KARACHI

Special Technology Zone Package 1

Road and Infrastructure works

VOLUME - III

Tender Drawings

JUNE 2026

GOVERNMENT OF SINDH

CGD CONSULTING

EDUCATION CITY KARACHI

TENDER DRAWINGS

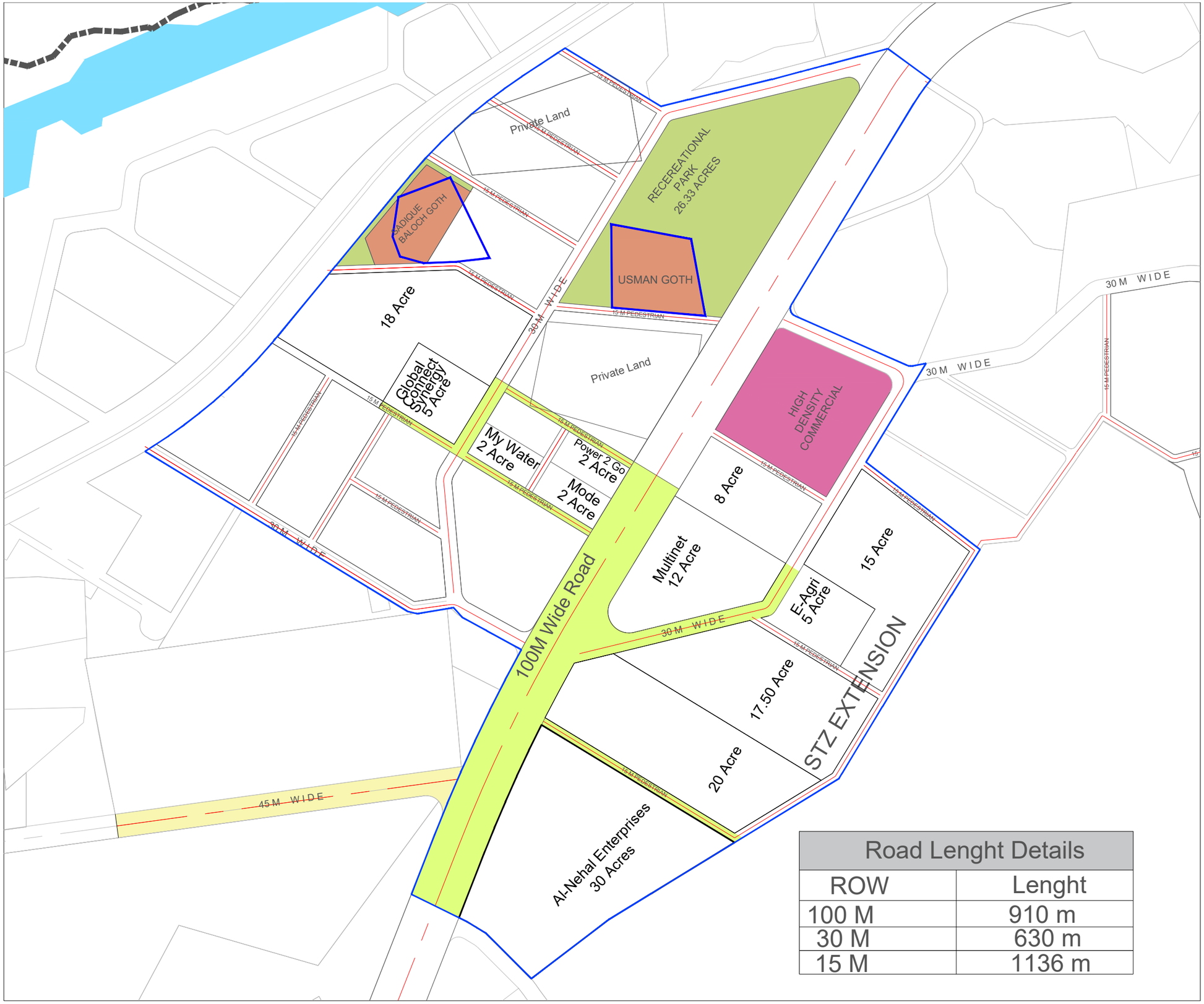
SPECIAL TECHNOLOGY ZONE (STZ)

PACKAGE 1 ROAD AND INFRASTRUTURE WORK

JUNE 2026

CGD CONSULTING
ARCHITECTURE-ENGINEERING-PLANNING-MANAGEMENT
Plot # 7-C,5th Zulfiqar Commercial Street,
Phase VIII-A, DHA,Karachi - Pakisten

PLANNING



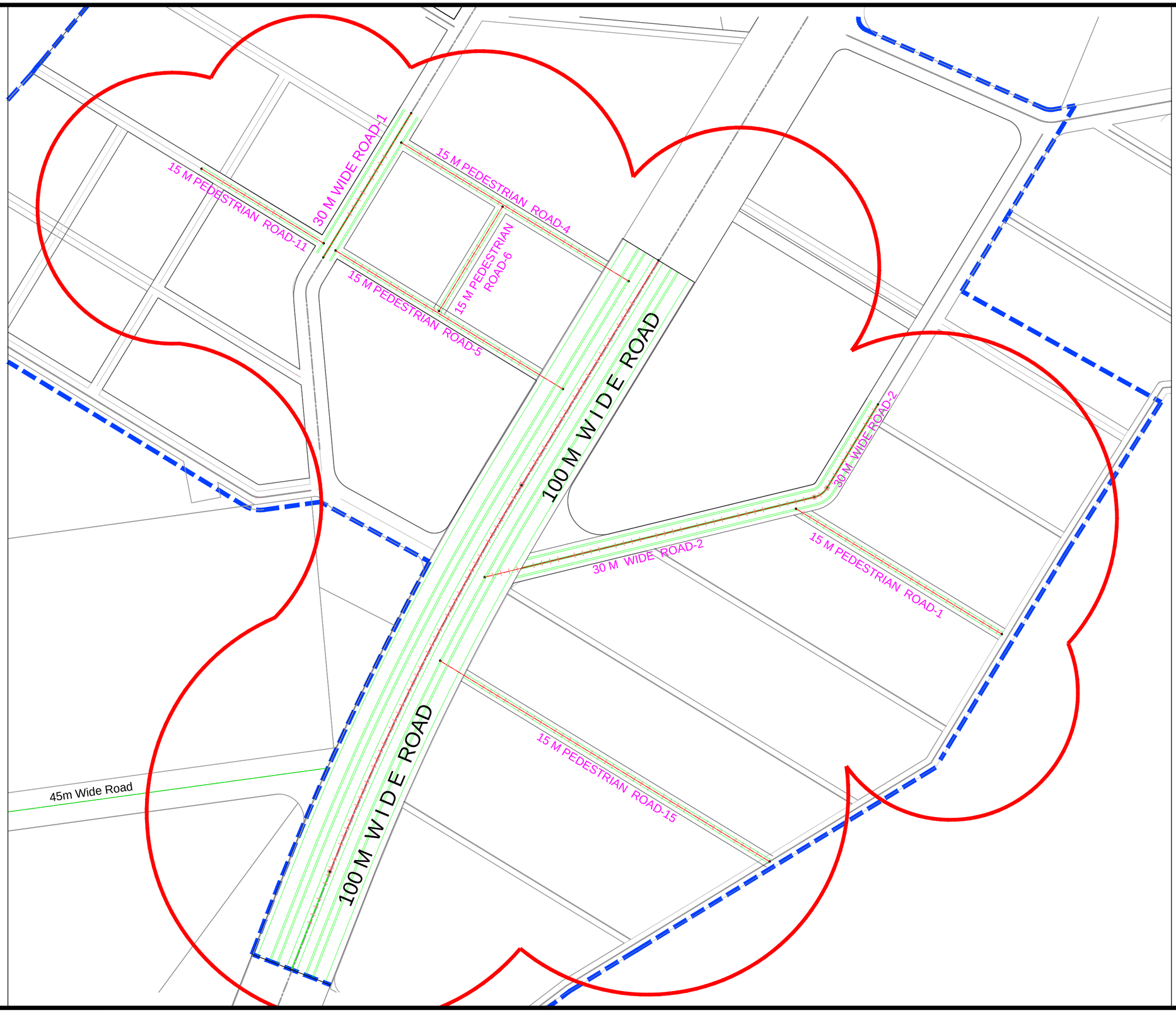
Road Lenght Details	
ROW	Lenght
100 M	910 m
30 M	630 m
15 M	1136 m

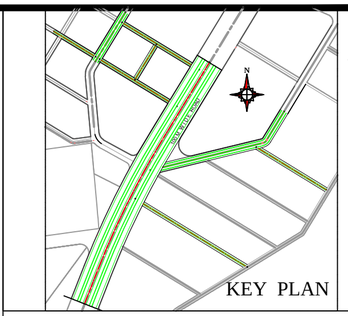
ROADS

LIST OF DRAWINGS

S.NO.	TITLE OF DRAWING	DRAWING No.
1	LIST OF DRAWINGS	EC - STZ - PH(I) - LIST-00
2	LOCATION PLAN OF ROADS	EC - STZ - PH(I) - LPRD - 01
3	TYPICAL X- SECTION 100M WIDE ROAD	EC - STZ - PH(I) - TXS-100M - 000
4	TYPICAL X- SECTION 30M WIDE ROAD	EC - STZ - PH(I) - TXS - 30M - 000
5	TYPICAL X- SECTION 15M WIDE ROAD	EC - STZ - PH(I) - TXS - 15M - 000
6	PLAN & PROFILE 100M WIDE ROAD	EC - STZ - PH(I) - MB1 - PP - 01
7	PLAN & PROFILE 30M WIDE ROAD#1	EC - STZ - PH(I) - ST 1 - PP - 01
8	PLAN & PROFILE 30M WIDE ROAD#2	EC - STZ - PH(I) - ST 2 - PP - 02
9	PLAN & PROFILE 15M WIDE ROAD - 1	EC - STZ - PH(I) - RD 1 - PP - 01
10	PLAN & PROFILE 15M WIDE ROAD - 4	EC - STZ - PH(I) - RD 4 - PP - 01
11	PLAN & PROFILE 15M WIDE ROAD - 5	EC - STZ - PH(I) - RD 5 - PP - 01
12	PLAN & PROFILE 15M WIDE ROAD - 6	EC - STZ - PH(I) - RD 6 - PP - 01
13	PLAN & PROFILE 15M WIDE ROAD - 11	EC - STZ - PH(I) - RD11 - PP - 01
14	PLAN & PROFILE 15M WIDE ROAD - 15	EC - STZ - PH(I) - RD15 - PP - 01

CGD*JUN,2026





REVISION	DATE	DESCRIPTION	NAME
00	JUN,2026	ISSUED FOR TENDER	

PROJECT:
EDUCATION CITY PROJECT

CLIENT:
PROJECT
IMPLEMENTATION UNIT

NAME OF WORK:
EDUCATION CITY
SPECIAL TECHNOLOGY ZONE PHASE-(I)

DRAWING STATUS:
TENDER DRAWINGS

DISCIPLINE:
ROADS & TRANSPORTATION

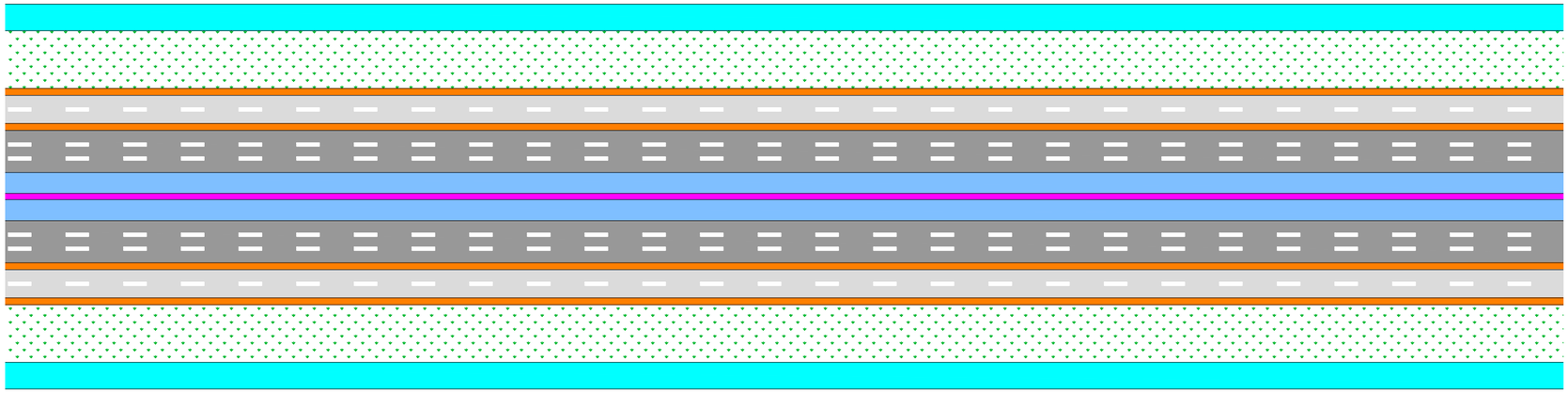
DRAWING TITLE:
LOCATION PLAN OF ROADS

CONSULTANT:
CGD CONSULTING
ARCHITECTURE-ENGINEERING-PLANNING-MANAGEMENT
Plot # 7-C,5th Zulfiqar Commercial Street,
Phase VIII-A, DHA,Karachi - Pakisten

Designed By:	Checked By:	Date:	
M.F.R.	A.W.F	JUN,2026	
Drawn By : A.A.	Scale: N.T.S.	Job No:	Sheet 01

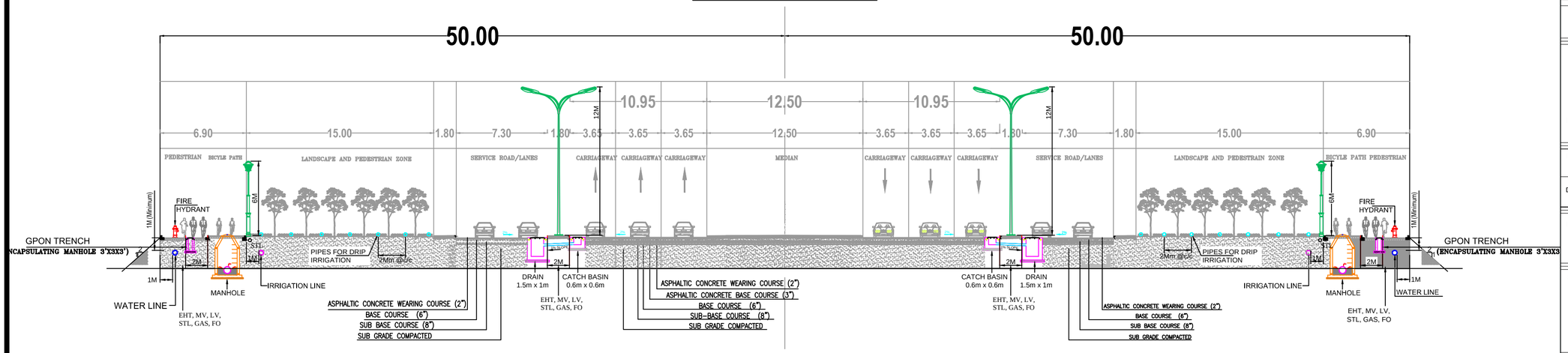
DRAWING No: EC-STZ-PH(I)-RDLP-01 | Revision 00

100M WIDE

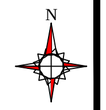


INNER RING ROAD

100M WIDE ROAD



KEY PLAN:



REVISION	DATE	DESCRIPTION	NAME

PROJECT:
EDUCATION CITY PROJECT

CLIENT:
PROJECT IMPLEMENTATION UNIT

DRAWING STATUS:

DISCIPLINE: ROADS & TRANSPORTATION

DRAWING STATUS: CONSTRUCTION DRAWING

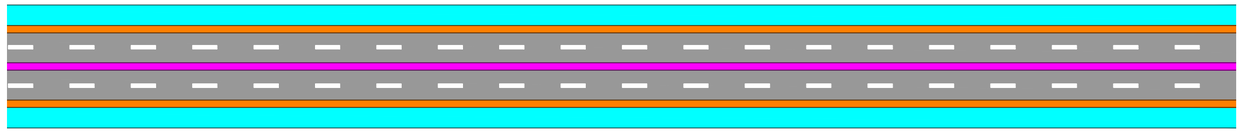
DRAWING TITLE:
CROSS-SECTION
100M WIDE ROAD

CONSULTANT:
CGD CONSULTING
ARCHITECTURE-ENGINEERING-PLANNING-MANAGEMENT
21-C Sth Zamzama Lane Phase V
D H A Karachi - Pakistan

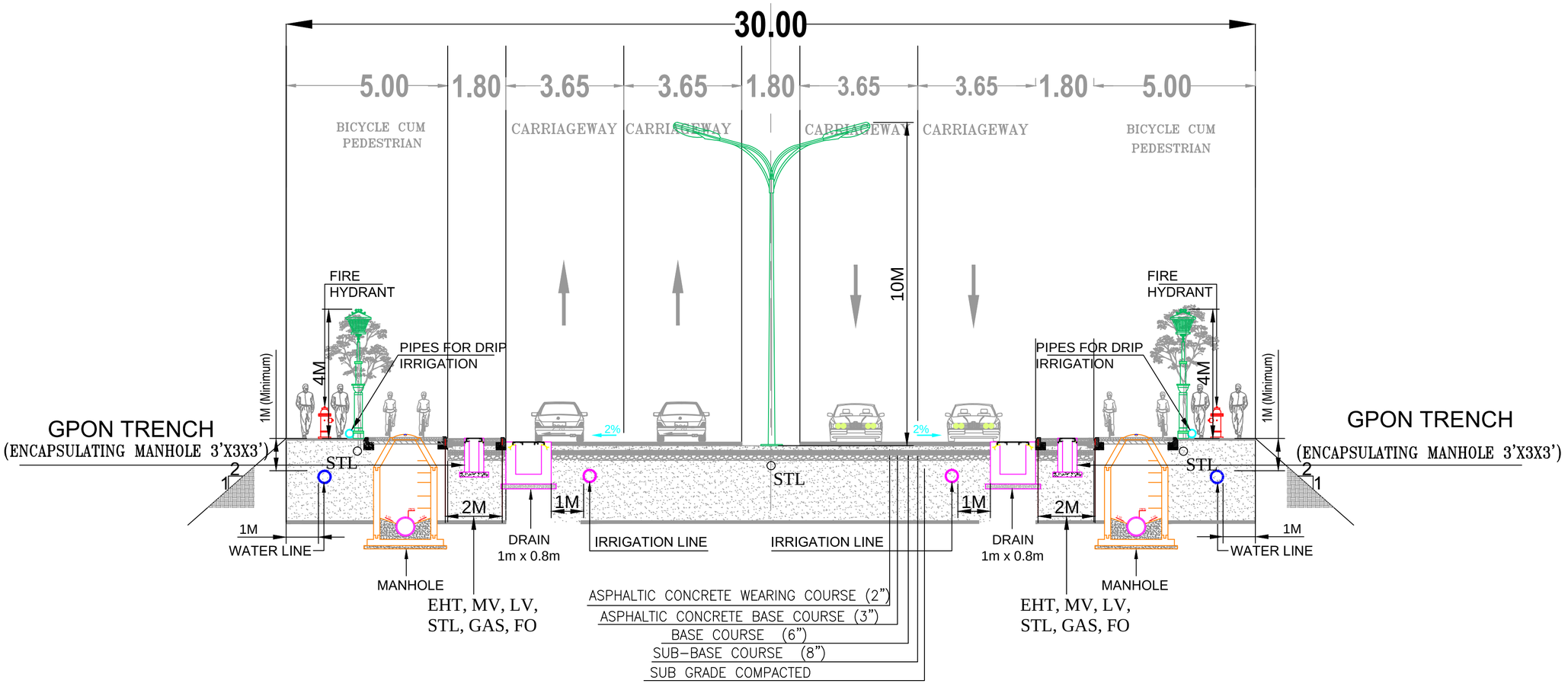
Designed By:	Checked By:	Date: JUN-2026	
Drawn By :	Scale:	Job No:	Sheet : 01

DRAWING No: EC - STZ - PH(I) - TXS-100M - 01
Revision 00

30M WIDE



30M WIDE ROAD



KEY PLAN:

PROJECT:
EDUCATION CITY PROJECT

CLIENT:
PROJECT IMPLEMENTATION UNIT

DISCIPLINE: ROADS & TRANSPORTATION

DRAWING STATUS: TENDER DRAWING

DRAWING TITLE:
STZ EXT CROSS-SECTION
30M WIDE ROAD

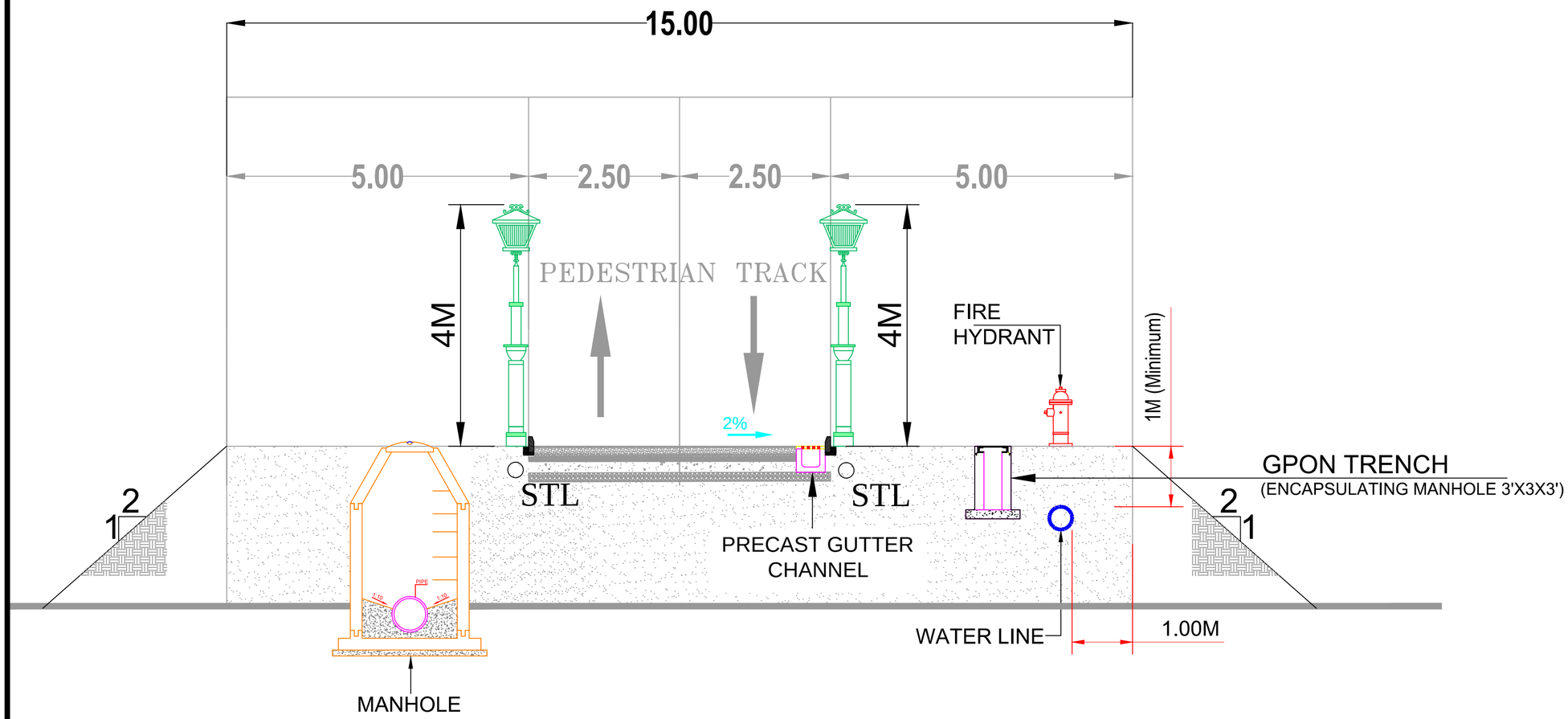
CONSULTANT:
CGD CONSULTING
ARCHITECTURE-ENGINEERING-PLANNING-MANAGEMENT
21-C 5th Zamzama Lane Phase V
D H A Karachi - Pakistan

Designed By:	Checked By:	Date: JUN-2026	
Drawn By :	Scale:	Job No:	Sheet: 2

DRAWING No: EC - STZ - PH(I) - TXS-30M - 02

Revision 00

15M WIDE PEDESTRIAN



KEY PLAN:

PROJECT:
EDUCATION CITY PROJECT

CLIENT:
PROJECT IMPLEMENTATION UNIT

DISCIPLINE:
ROADS & TRANSPORTATION

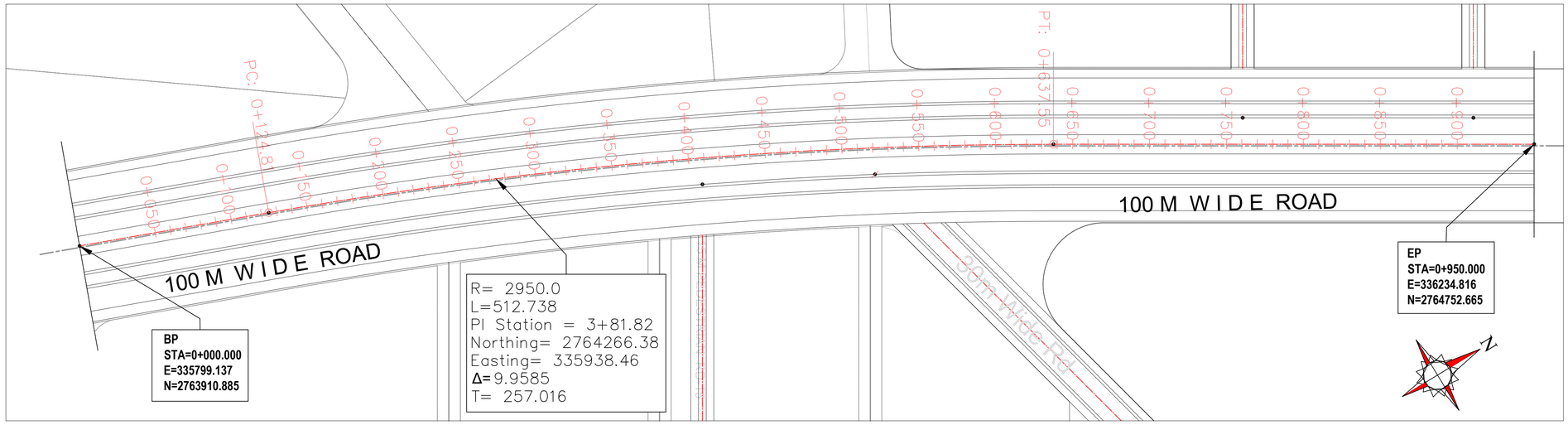
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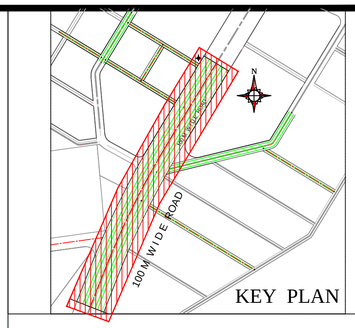
DRAWING TITLE:
STZ EXT CROSS-SECTION
15M WIDE PEDESTRIAN

CONSULTANT:
CGD CONSULTING
ARCHITECTURE-ENGINEERING-PLANNING-MANAGEMENT
21-C 5th Zamzama Lane Phase V
D H A Karachi - Pakistan

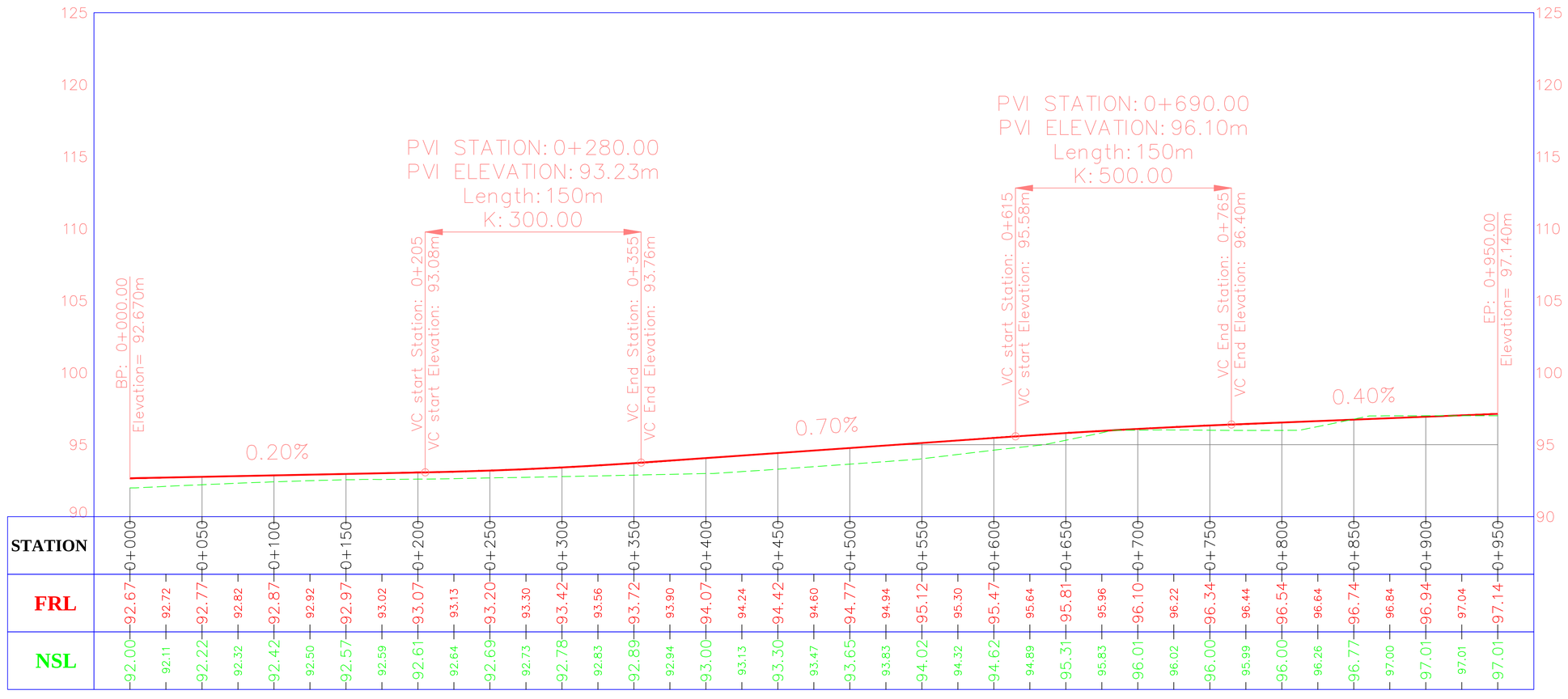
Designed By:	Checked By:	Date: JUN.2026	
Drawn By :	Scale:	Job No:	Sheet 03

DRAWING No:	Revision
EC - STZ - PH(I) - TXS-15M -03	00





PLAN & PROFILE 100M WIDE ROAD



STATION	0+000	0+050	0+100	0+150	0+200	0+250	0+300	0+350	0+400	0+450	0+500	0+550	0+600	0+650	0+700	0+750	0+800	0+850	0+900	0+950
FRL	92.67	92.72	92.77	92.82	92.87	92.92	92.97	93.02	93.07	93.13	93.20	93.30	93.42	93.56	93.72	93.90	94.07	94.24	94.42	94.60
NSL	92.00	92.11	92.22	92.32	92.42	92.50	92.57	92.59	92.61	92.64	92.69	92.73	92.78	92.83	92.89	92.94	93.00	93.13	93.30	93.47

STATION	0+500	0+550	0+600	0+650	0+700	0+750	0+800	0+850	0+900	0+950
FRL	94.77	94.94	95.12	95.30	95.47	95.64	95.81	95.96	96.10	96.22
NSL	93.65	93.83	94.02	94.32	94.62	94.89	95.31	95.83	96.01	96.02

STATION	0+000	0+050	0+100	0+150	0+200	0+250	0+300	0+350	0+400	0+450	0+500	0+550	0+600	0+650	0+700	0+750	0+800	0+850	0+900	0+950
FRL	92.67	92.72	92.77	92.82	92.87	92.92	92.97	93.02	93.07	93.13	93.20	93.30	93.42	93.56	93.72	93.90	94.07	94.24	94.42	94.60
NSL	92.00	92.11	92.22	92.32	92.42	92.50	92.57	92.59	92.61	92.64	92.69	92.73	92.78	92.83	92.89	92.94	93.00	93.13	93.30	93.47

STATION	0+500	0+550	0+600	0+650	0+700	0+750	0+800	0+850	0+900	0+950
FRL	94.77	94.94	95.12	95.30	95.47	95.64	95.81	95.96	96.10	96.22
NSL	93.65	93.83	94.02	94.32	94.62	94.89	95.31	95.83	96.01	96.02

REVISION	DATE	DESCRIPTION	NAME
00	JUN.2026	ISSUED FOR TENDER	

PROJECT:
EDUCATION CITY PROJECT

CLIENT:
PROJECT IMPLEMENTATION UNIT

NAME OF WORK:
EDUCATION CITY
SPECIAL TECHNOLOGY ZONE PHASE-(I)

DRAWING STATUS:
TENDER DRAWINGS

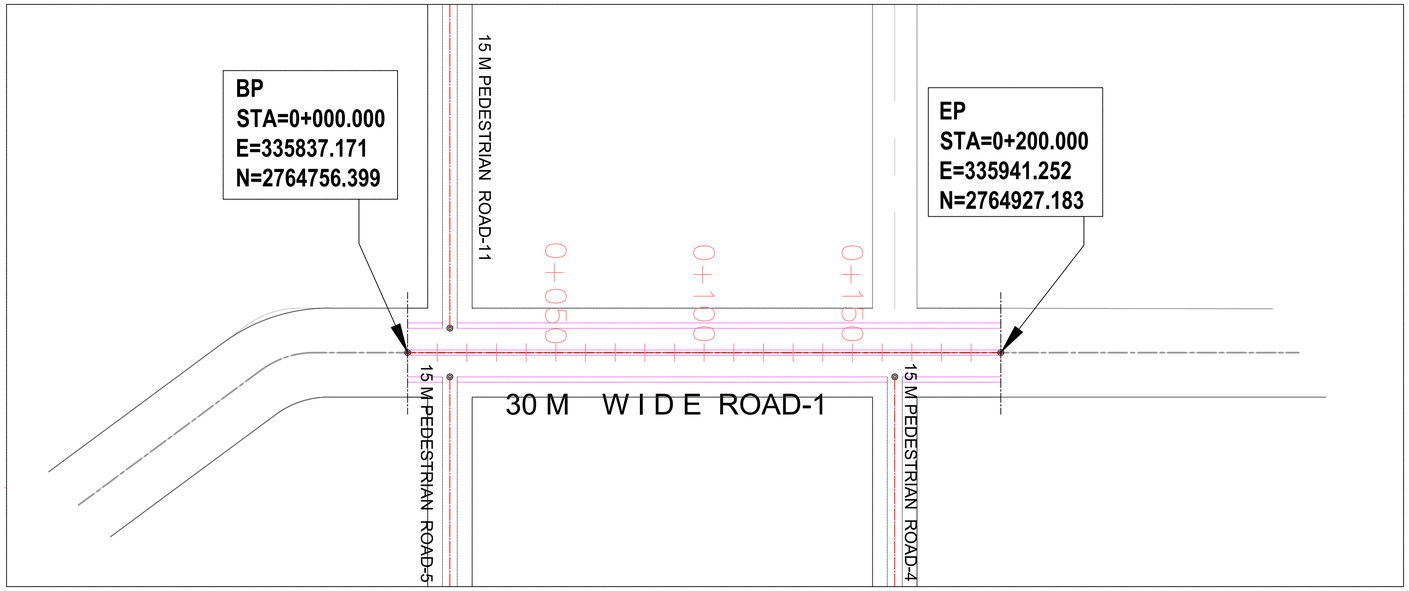
DISCIPLINE:
ROADS & TRANSPORTATION

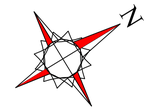
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PLAN & PROFILE 100m WIDE ROAD
CH: 0+000.0 TO 0+950.0

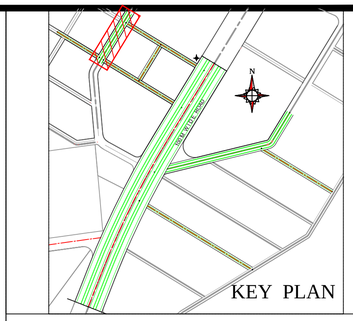
CONSULTANT:
CGD CONSULTING
ARCHITECTURE-ENGINEERING-PLANNING-MANAGEMENT
Plot # 7-C,5th Zulfiqar Commercial Street,
Phase VIII-A, DHA,Karachi - Pakisten

Designed By:	Checked By:	Date:	
M.F.R	A.W.F	JUN.2026	
Drawn By : A.A.	Scale: N.T.S.	Job No:	Sheet 01

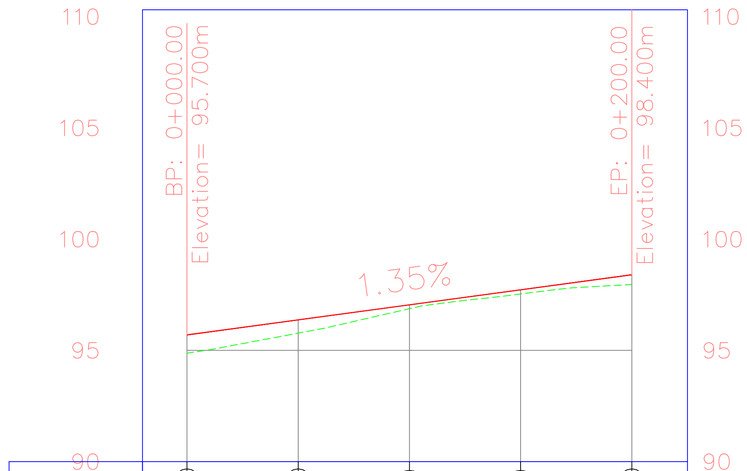
DRAWING No: EC-STZ-PH(I)-MB1-PP-01 | Revision 00







PLAN & PROFILE 30M WIDE Road - 1



REVISION	DATE	DESCRIPTION	NAME
00	JUN,2026	ISSUED FOR TENDER	

PROJECT:
EDUCATION CITY PROJECT

CLIENT:
PROJECT
IMPLEMENTATION UNIT

NAME OF WORK:
EDUCATION CITY
SPECIAL TECHNOLOGY ZONE PHASE-(I)

DRAWING STATUS:
TENDER DRAWINGS

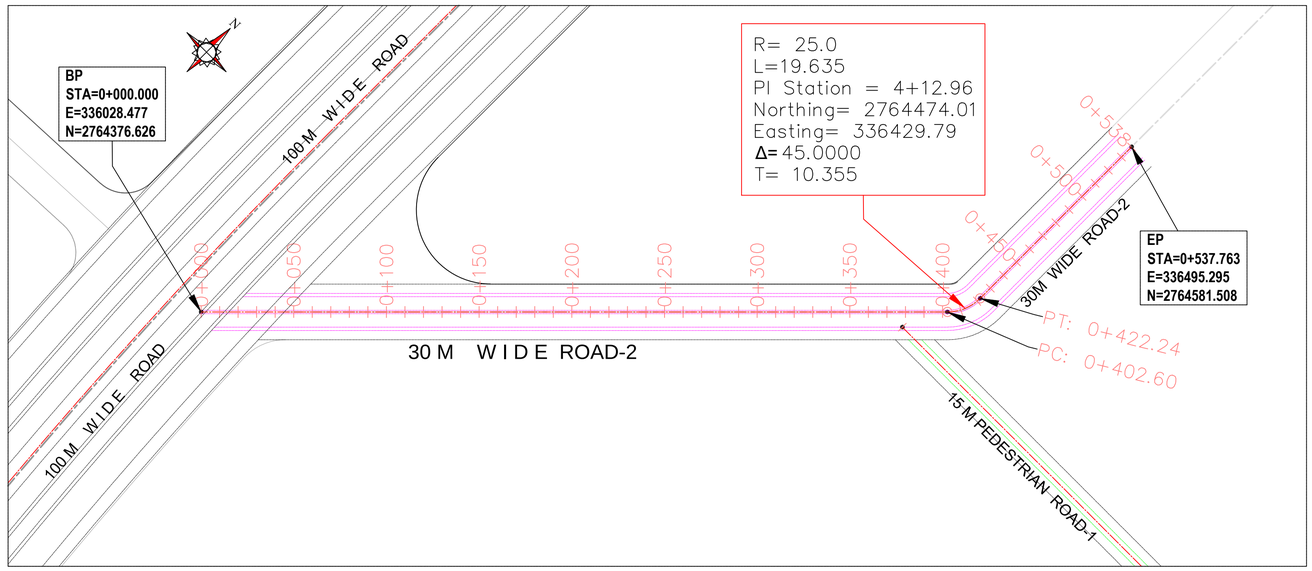
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ROADS & TRANSPORTATION

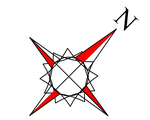
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PLAN & PROFILE 30m WIDE ROAD#1
CH : 0+000.0 TO 0+200.0

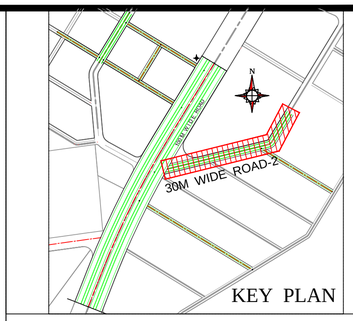
CONSULTANT:
CGD CONSULTING
ARCHITECTURE-ENGINEERING-PLANNING-MANAGEMENT
Plot # 7-C,5th Zulfiqar Commercial Street,
Phase VIII-A, DHA,Karachi - Pakisten

Designed By:	Checked By:	Date:	
M.F.R.	A.W.F	JUN.2026	
Drawn By : A.A.	Scale: N.T.S.	Job No:	Sheet 01

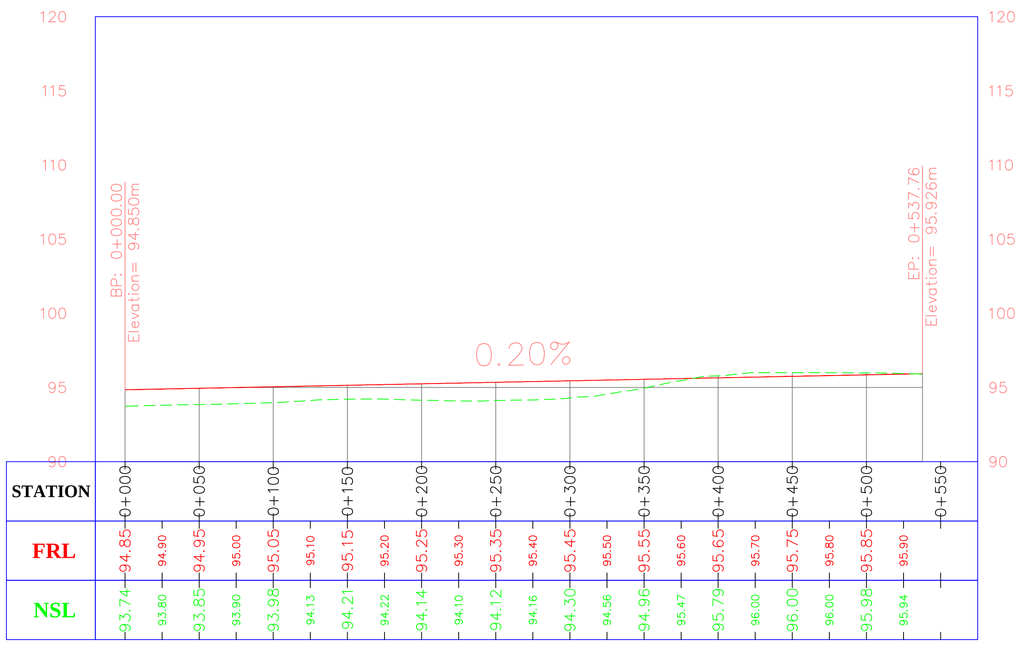
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PLAN & PROFILE 30M WIDE Road - 2



REVISION	DATE	DESCRIPTION	NAME
00	JUN,2026	ISSUED FOR TENDER	

PROJECT:
EDUCATION CITY PROJECT

CLIENT:
PROJECT IMPLEMENTATION UNIT

NAME OF WORK:
EDUCATION CITY
SPECIAL TECHNOLOGY ZONE PHASE-(I)

DRAWING STATUS:
TENDER DRAWINGS

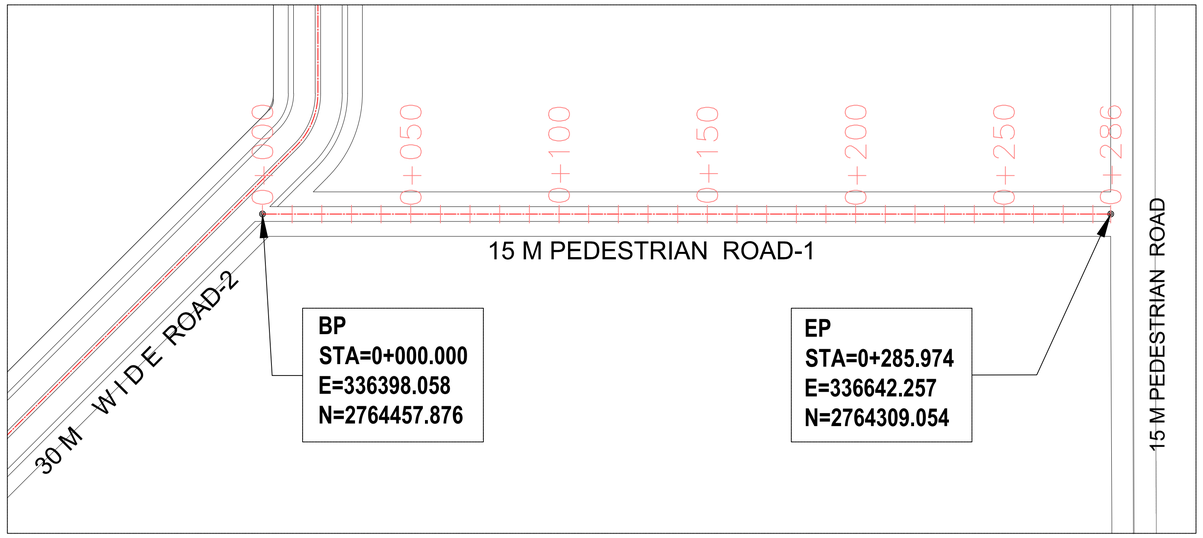
DISCIPLINE:
ROADS & TRANSPORTATION

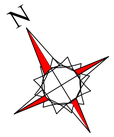
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PLAN & PROFILE 30m WIDE ROAD#2
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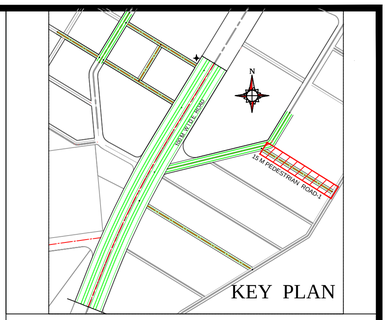
CONSULTANT:
CGD CONSULTING
ARCHITECTURE-ENGINEERING-PLANNING-MANAGEMENT
Plot # 7-C,5th Zulfiqar Commercial Street,
Phase VIII-A, DHA,Karachi - Pakisten

Designed By:	Checked By:	Date:	
M.F.R.	A.W.F	JUN.2026	
Drawn By : A.A.	Scale: N.T.S.	Job No:	Sheet 02

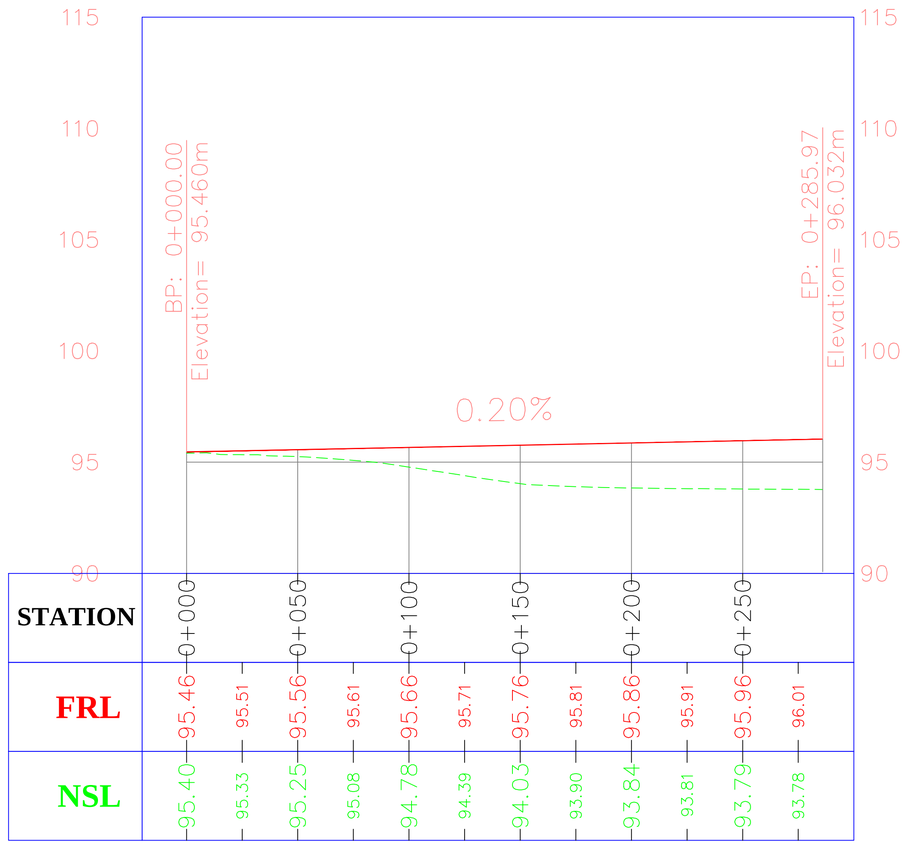
DRAWING No: EC-STZ-PH(I)-ST2-PP-02 | Revision 00







PLAN & PROFILE 15M WIDE ROAD- 1



STATION	0+000	0+050	0+100	0+150	0+200	0+250	
FRL	95.46	95.51	95.56	95.61	95.66	95.71	95.76	95.81	95.86	95.91	95.96	96.01
NSL	95.40	95.33	95.25	95.08	94.78	94.39	94.03	93.90	93.84	93.81	93.79	93.78

REVISION	DATE	DESCRIPTION	NAME
00	JUN,2026	ISSUED FOR TENDER	

PROJECT:
EDUCATION CITY PROJECT

CLIENT:
PROJECT IMPLEMENTATION UNIT

NAME OF WORK:
EDUCATION CITY
SPECIAL TECHNOLOGY ZONE PHASE-(I)

DRAWING STATUS:
TENDER DRAWINGS

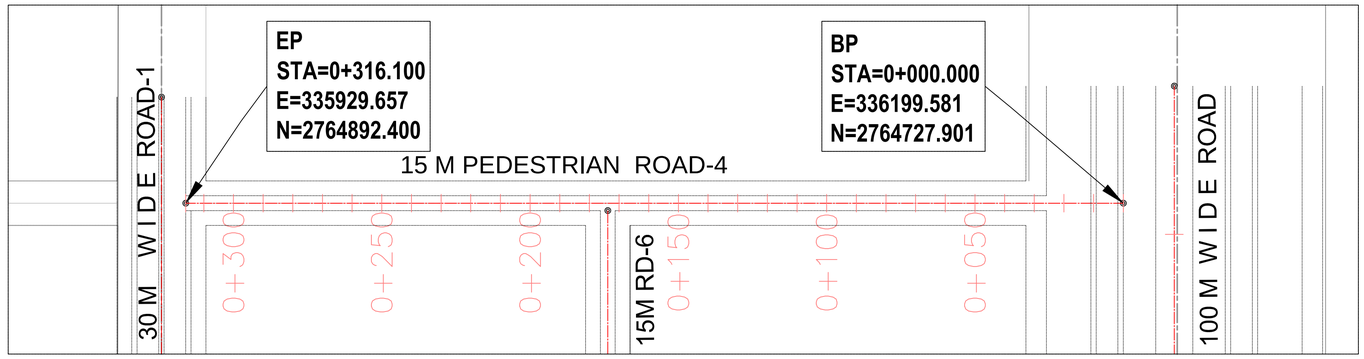
DISCIPLINE:
ROADS & TRANSPORTATION

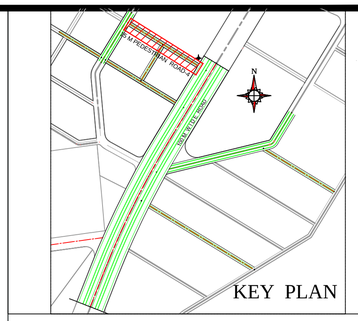
DRAWING TITLE:
PLAN & PROFILE 15m WIDE ROAD#1
CH : 0+000.0 TO 0+285.974

CONSULTANT:
CGD CONSULTING
ARCHITECTURE-ENGINEERING-PLANNING-MANAGEMENT
Plot # 7-C,5th Zulfiqar Commercial Street,
Phase VIII-A, DHA,Karachi - Pakisten

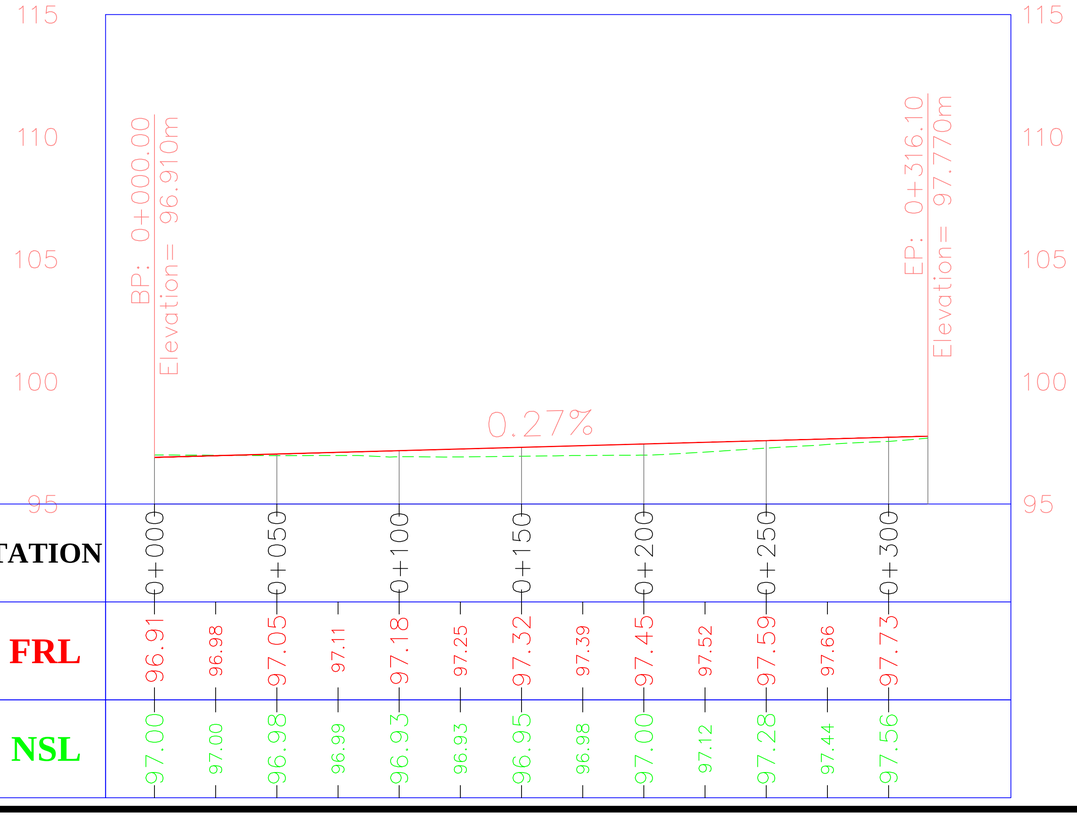
Designed By:	Checked By:	Date:	
M.F.R.	A.W.F	JUN,2026	
Drawn By : A.A.	Scale: N.T.S.	Job No:	Sheet 01

DRAWING No: EC-STZ-PH(I)-RD1-PP-01 | Revision 00





PLAN & PROFILE 15M WIDE ROAD - 4



STATION	0+000		0+050		0+100		0+150		0+200		0+250		0+300
FRL	96.91	96.98	97.05	97.11	97.18	97.25	97.32	97.39	97.45	97.52	97.59	97.66	97.73
NSL	97.00	97.00	96.98	96.99	96.93	96.93	96.95	96.98	97.00	97.12	97.28	97.44	97.56

REVISION	DATE	DESCRIPTION	NAME
00	JUN,2026	ISSUED FOR TENDER	

PROJECT:
EDUCATION CITY PROJECT

CLIENT:
PROJECT IMPLEMENTATION UNIT

NAME OF WORK:
EDUCATION CITY
SPECIAL TECHNOLOGY ZONE PHASE-(I)

DRAWING STATUS:
TENDER DRAWINGS

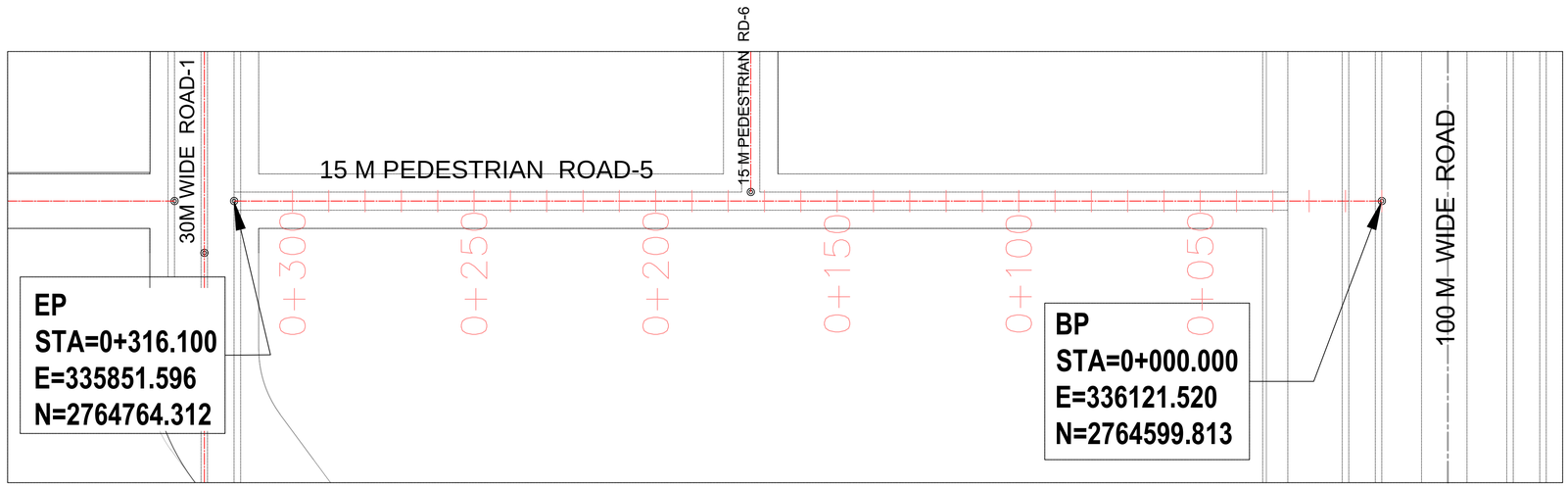
DISCIPLINE:
ROADS & TRANSPORTATION

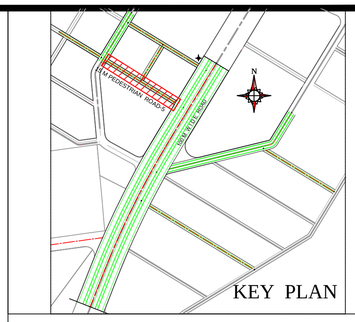
DRAWING TITLE:
PLAN & PROFILE 15m WIDE ROAD#4
CH : 0+000.0 TO 0+316.10

CONSULTANT:
CGD CONSULTING
ARCHITECTURE-ENGINEERING-PLANNING-MANAGEMENT
Plot # 7-C,5th Zulfiqar Commercial Street,
Phase VIII-A, DHA,Karachi - Pakistan

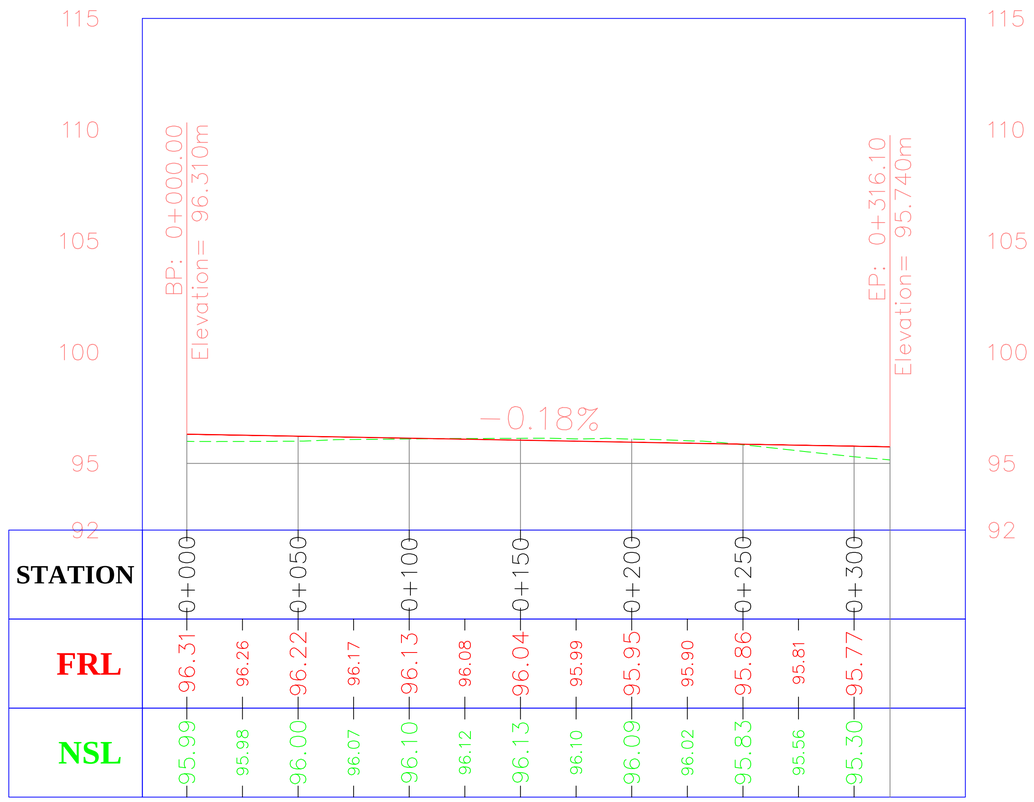
Designed By:	Checked By:	Date:	
M.F.R.	A.W.F	JUN.2026	
Drawn By : A.A.	Scale: N.T.S.	Job No:	Sheet 01

DRAWING No: EC-STZ-PH(I)-RD4-PP-01 | Revision 00





PLAN & PROFILE 15M WIDE ROAD - 5



REVISION	DATE	DESCRIPTION	NAME
00	JUN,2026	ISSUED FOR TENDER	

PROJECT:
EDUCATION CITY PROJECT

CLIENT:
PROJECT
IMPLEMENTATION UNIT

NAME OF WORK:
EDUCATION CITY
SPECIAL TECHNOLOGY ZONE PHASE-(I)

DRAWING STATUS:
TENDER DRAWINGS

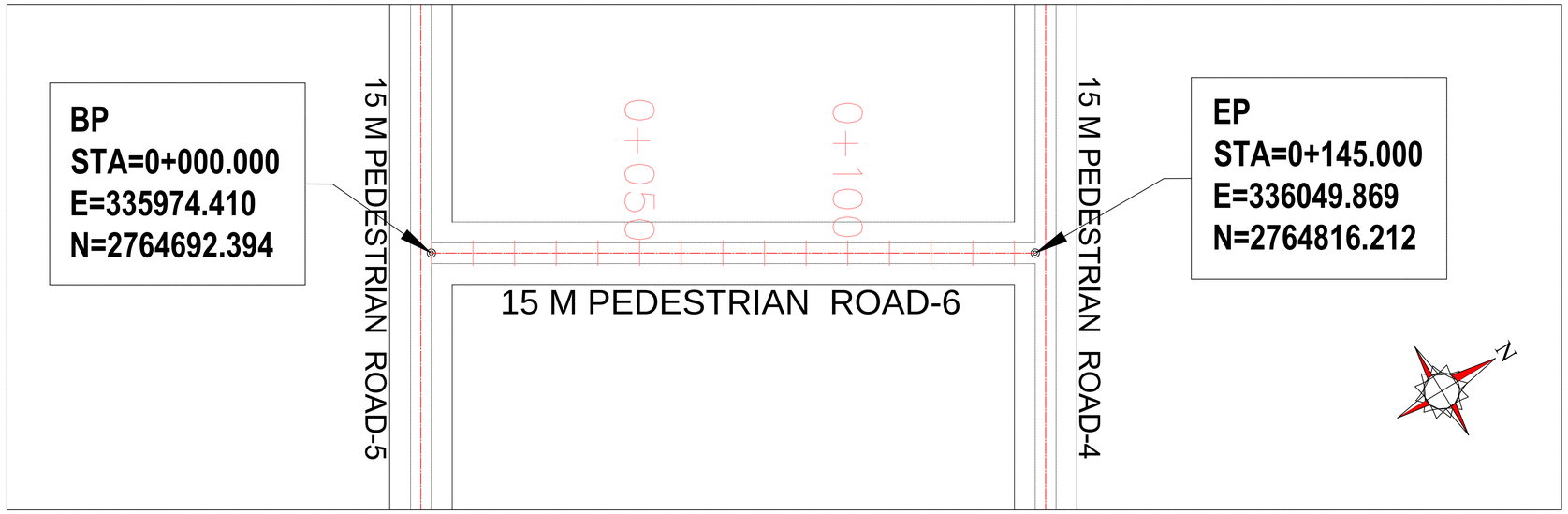
DISCIPLINE:
ROADS & TRANSPORTATION

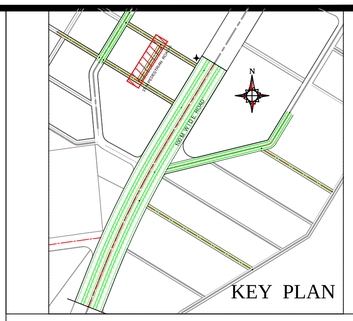
DRAWING TITLE:
PLAN & PROFILE 15m WIDE ROAD#5
CH : 0+000.0 TO 0+316.10

CONSULTANT:
CGD CONSULTING
ARCHITECTURE-ENGINEERING-PLANNING-MANAGEMENT
Plot # 7-C,5th Zulfiqar Commercial Street,
Phase VIII-A, DHA,Karachi - Pakisten

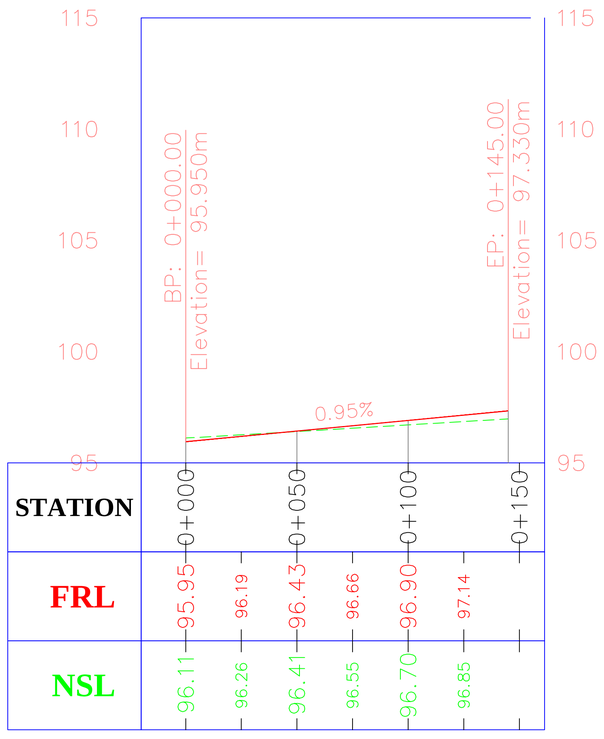
Designed By:	Checked By:	Date:	
M.F.R.	A.W.F	JUN.2026	
Drawn By : A.A.	Scale: N.T.S.	Job No:	Sheet 01

DRAWING No: EC-STZ-PH(I)-RD5-PP-01 | Revision 00





PLAN & PROFILE Road - 6



REVISION	DATE	DESCRIPTION	NAME
00	JUN,2026	ISSUED FOR TENDER	

PROJECT:
EDUCATION CITY PROJECT

CLIENT:
PROJECT
IMPLEMENTATION UNIT

NAME OF WORK:
EDUCATION CITY
SPECIAL TECHNOLOGY ZONE PHASE-(I)

DRAWING STATUS:
TENDER DRAWINGS

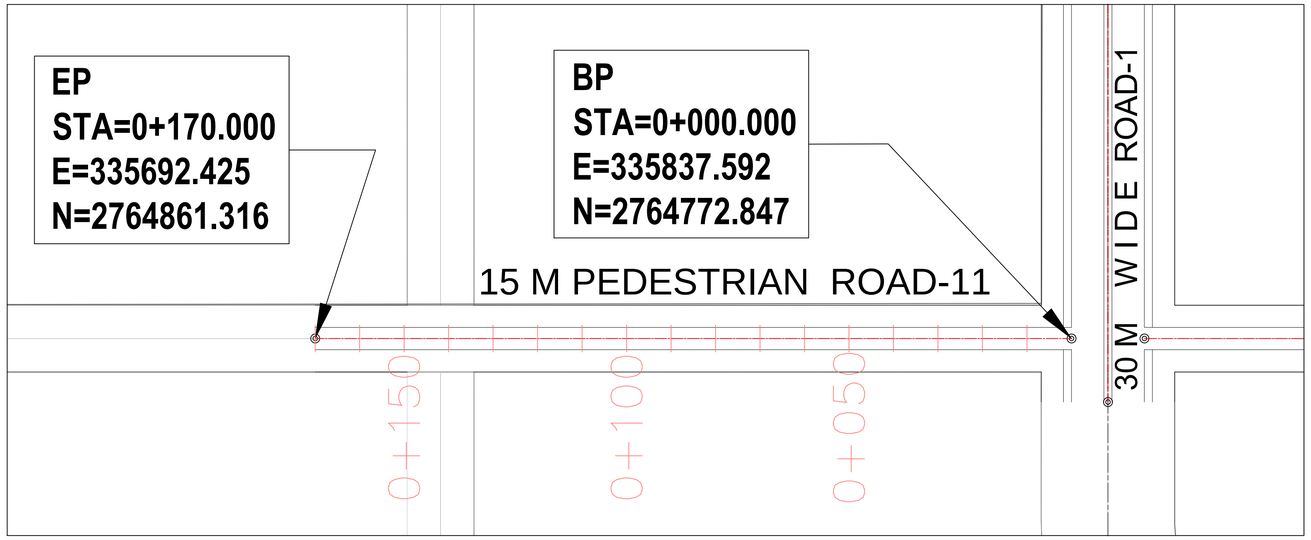
DISCIPLINE:
ROADS & TRANSPORTATION

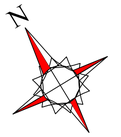
DRAWING TITLE:
PLAN & PROFILE 15m WIDE ROAD#6
CH : 0+000.0 TO 0+145.0

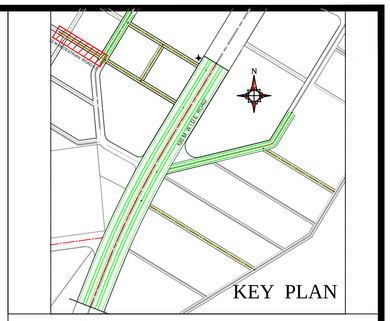
CONSULTANT:
CGD CONSULTING
ARCHITECTURE-ENGINEERING-PLANNING-MANAGEMENT
Plot # 7-C,5th Zulfiqar Commercial Street,
Phase VIII-A, DHA,Karachi - Pakisten

Designed By:	Checked By:	Date:	
M.F.R.	A.W.F	JUN,2026	
Drawn By : A.A.	Scale: N.T.S.	Job No:	Sheet 01

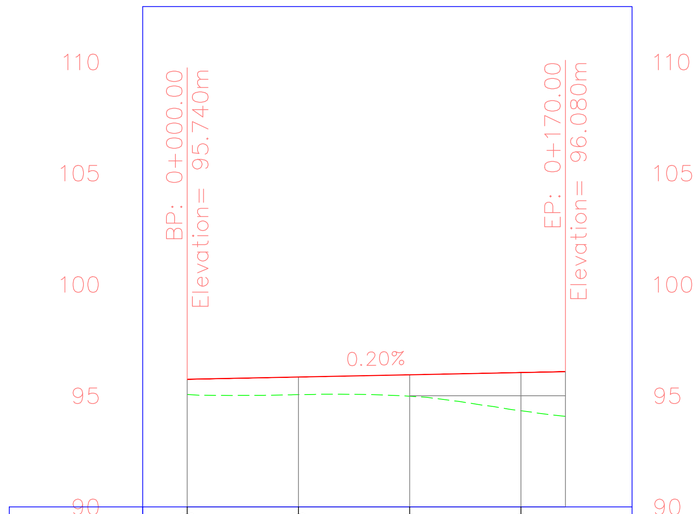
DRAWING No: EC-STZ-PH(I)-RD6-PP-01 | Revision 00







PLAN & PROFILE 15M WIDE ROAD - 11



STATION	0+000	0+050	0+100	0+150
FRL	95.74	95.84	95.94	96.04
	95.79	95.89	95.99	
NSL	95.06	95.05	94.98	94.33
	95.02	95.06	94.70	

REVISION	DATE	DESCRIPTION	NAME
00	JUN.2026	ISSUED FOR TENDER	

PROJECT:
EDUCATION CITY PROJECT

CLIENT:
PROJECT IMPLEMENTATION UNIT

NAME OF WORK:
EDUCATION CITY
SPECIAL TECHNOLOGY ZONE PHASE-(I)

DRAWING STATUS:
TENDER DRAWINGS

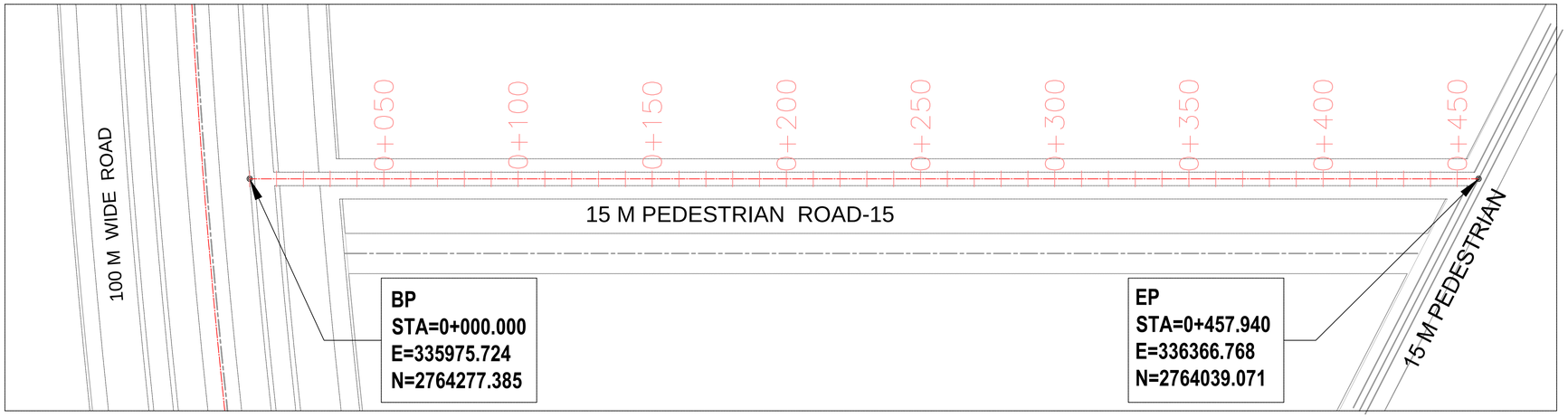
DISCIPLINE:
ROADS & TRANSPORTATION

DRAWING TITLE:
PLAN & PROFILE 15m WIDE ROAD#11
CH : 0+000.0 TO 0+170.0

CONSULTANT:
CGD CONSULTING
ARCHITECTURE-ENGINEERING-PLANNING-MANAGEMENT
Plot # 7-C,5th Zulfiqar Commercial Street, Phase VIII-A, DHA,Karachi - Pakisten

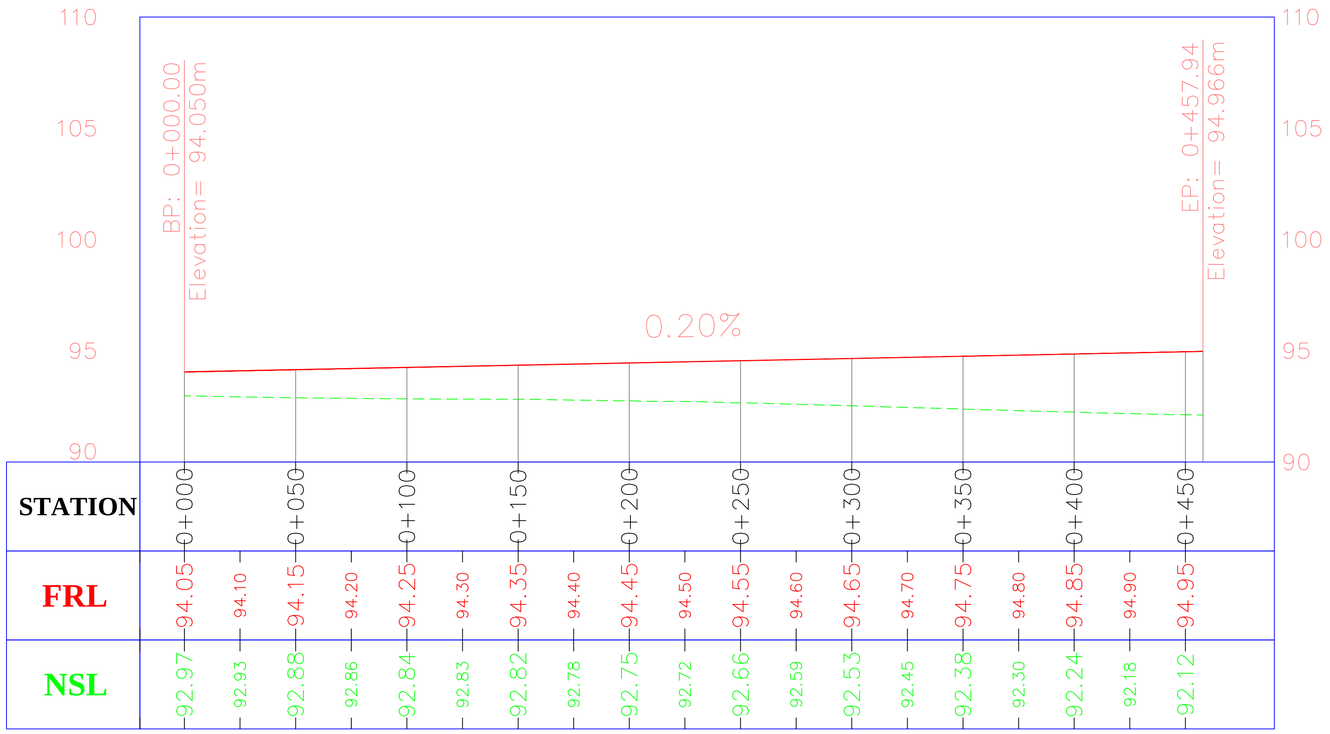
Designed By:	Checked By:	Date:	
M.F.R.	A.W.F	JUN.2026	
Drawn By : A.A.	Scale: N.T.S.	Job No:	Sheet 01

DRAWING No: EC-STZ-PH(I)-RD11-PP-01 | Revision 00





PLAN & PROFILE 15M WIDE ROAD - 15



STATION	0+000	0+050	0+100	0+150	0+200	0+250	0+300	0+350	0+400	0+450
FRL	94.05	94.15	94.25	94.35	94.45	94.55	94.65	94.75	94.85	94.95
NSL	92.97	92.88	92.84	92.82	92.75	92.66	92.53	92.38	92.24	92.12

REVISION	DATE	DESCRIPTION	NAME
00	JUN.2026	ISSUED FOR TENDER	

PROJECT:
EDUCATION CITY PROJECT

CLIENT:
PROJECT IMPLEMENTATION UNIT

NAME OF WORK:
EDUCATION CITY
SPECIAL TECHNOLOGY ZONE PHASE-(I)

DRAWING STATUS:
TENDER DRAWINGS

DISCIPLINE:
ROADS & TRANSPORTATION

DRAWING TITLE:
PLAN & PROFILE 15m WIDE ROAD#15
CH : 0+000.0 TO 0+457.94

CONSULTANT:
CGD CONSULTING
ARCHITECTURE-ENGINEERING-PLANNING-MANAGEMENT
Plot # 7-C,5th Zulfiqar Commercial Street,
Phase VIII-A, DHA,Karachi - Pakisten

Designed By:	Checked By:	Date:	
M.F.R.	A.W.F	JUN.2026	
Drawn By : A.A.	Scale: N.T.S.	Job No:	Sheet 01

DRAWING No: EC-STZ-PH(I)-RD15-PP-01 | Revision 00

STORM WATER DRAINAGE NETWORK

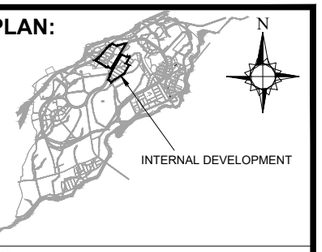
STORM WATER DRAINAGE NETWORK

LIST OF DRAWINGS

SPECIAL TECHNOLOGY ZONE (STZ) EXT.
PHASE-I (52 ACRE)

S/NO.	DESCRIPTION	DRAWING NO.
1	LIST OF DRAWINGS	EC-STZ-EXT-SWD-LD-00
2	KEY PLAN OF STORM WATER DRAINAGE NETWORK	EC-STZ-EXT-SWD-KP-01
3	LAYOUT PLAN OF STORM WATER DRAINAGE NETWORK	EC-STZ-EXT-SWD-LP-01
4	LAYOUT PLAN OF STORM WATER DRAINAGE NETWORK	EC-STZ-EXT-SWD-LP-02
5	DETAILS OF STORM WATER DRAIN & CATCH BASIN	EC-STZ-EXT-SWD-DD-01
6	TYPICAL DETAIL OF ONE CELL BOX CULVERT LENGTH 30M	EC-STZ-EXT-SWD-DD-02
7	X-SECTION OF 30M WIDE ROAD	EC-STZ-EXT-RD-XS-01
8	X-SECTION OF 15M LANE	EC-STZ-EXT-RD-XS-02
9	X-SECTION OF 100M LANE	EC-STZ-EXT-RD-XS-03

KEY PLAN:



NOTES:

LEGENDS:

REVISION	DATE	DESCRIPTION	NAME

PROJECT:
EDUCATION CITY PROJECT

CLIENT:
PROJECT IMPLEMENTATION UNIT

NAME OF WORK:
EDUCATION CITY
SPECIAL TECHNOLOGY ZONE (STZ) EXT.
PHASE-I (52 ACRE)

DRAWING STATUS:
TENDER DRAWINGS

DISCIPLINE:
INFRA STRUCTURE-WET UTILITIES

DRAWING TITLE:
LIST OF DRAWINGS
STORM WATER DRAINAGE
NETWORK

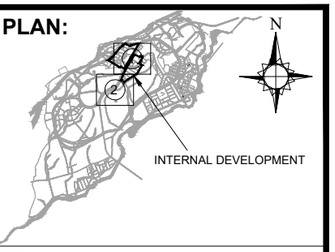
CONSULTANT:
CGD CONSULTING
ARCHITECTURE-ENGINEERING-PLANNING-MANAGEMENT
Plot # 7-C,5th Zulfiqar Commercial Street,
Phase VIII-A, DHA,Karachi - Pakisten

Designed By:	Checked By:	Date:	
A.W.F	S.A	JUN.2026	
Drawn By :	Scale:	Job No:	Sheet
N.A			A3

DRAWING No: EC-STZ-EXT-SWD-LD-00
Revision: 00



KEY PLAN:



NOTES:

1. FOR DETAILS OF STORM WATER DRAIN & CATCH BASIN REFER DWGS. # EC-STZ-EXT-SWD-DD-01.

LEGENDS:

- DRAIN SIZE (1.0m x 1.0m)
- DRAIN SIZE (0.7m x 0.7m)
- FLOW DIRECTION
- ONE CELL BOX CULVERT
- BOUNDARY (INTERNAL ROAD)

REVISION	DATE	DESCRIPTION	NAME

PROJECT:

EDUCATION CITY PROJECT

CLIENT:

PROJECT IMPLEMENTATION UNIT

NAME OF WORK:

EDUCATION CITY
SPECIAL TECHNOLOGY ZONE (STZ) EXT.
PHASE-I (52 ACRE)

DRAWING STATUS:

TENDER DRAWINGS

DISCIPLINE:

INFRA STRUCTURE-WET UTILITIES

DRAWING TITLE:

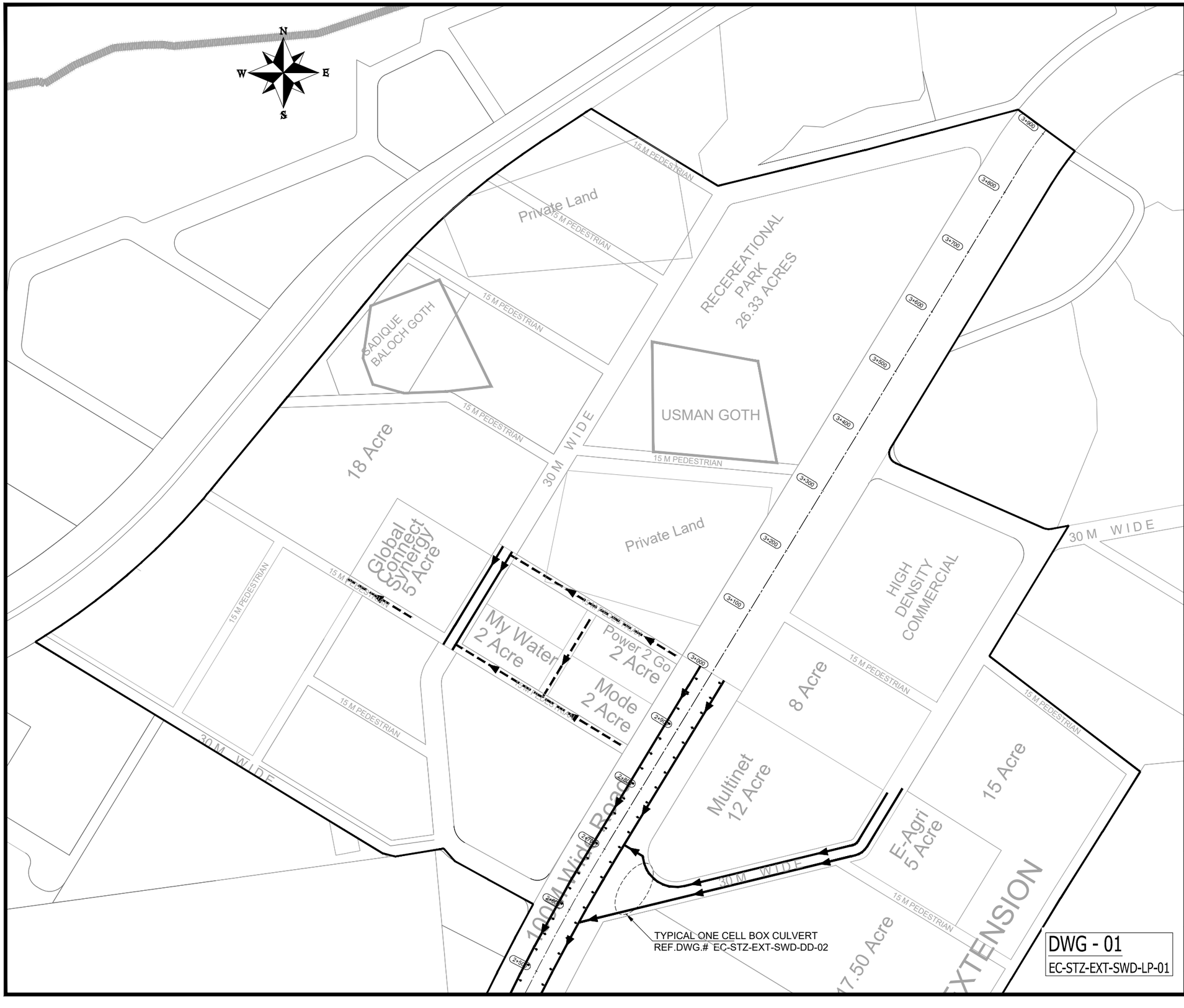
KEY PLAN
OF
STORM WATER DRAINAGE NETWORK

CONSULTANT:

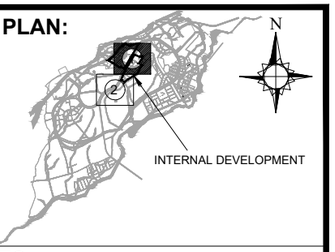
CGD CONSULTING
ARCHITECTURE-ENGINEERING-PLANNING-MANAGEMENT
Plot # 7-C,5th Zulfiqar Commercial Street,
Phase VIII-A, DHA,Karachi - Pakisten

Designed By:	Checked By:	Date:	
A.W.F	S.A	JUN.2026	
Drawn By :	Scale:	Job No:	Sheet
N.A			A3

DRAWING No:	Revision	
EC-STZ-EXT-SWD-KP-01	00	



KEY PLAN:



NOTES:

1. FOR DETAILS OF STORM WATER DRAIN & CATCH BASIN REFER DWGS. # EC-STZ-EXT-SWD-DD-01.

LEGENDS:

- DRAIN SIZE (1.0m x 1.0m)
- DRAIN SIZE (0.7m x 0.7m)
- FLOW DIRECTION
- ONE CELL BOX CULVERT
- BOUNDARY (INTERNAL ROAD)

REVISION	DATE	DESCRIPTION	NAME

PROJECT:
EDUCATION CITY PROJECT

CLIENT:
PROJECT IMPLEMENTATION UNIT

NAME OF WORK:
EDUCATION CITY
SPECIAL TECHNOLOGY ZONE (STZ) EXT.
PHASE-I (52 ACRE)

DRAWING STATUS:
TENDER DRAWINGS

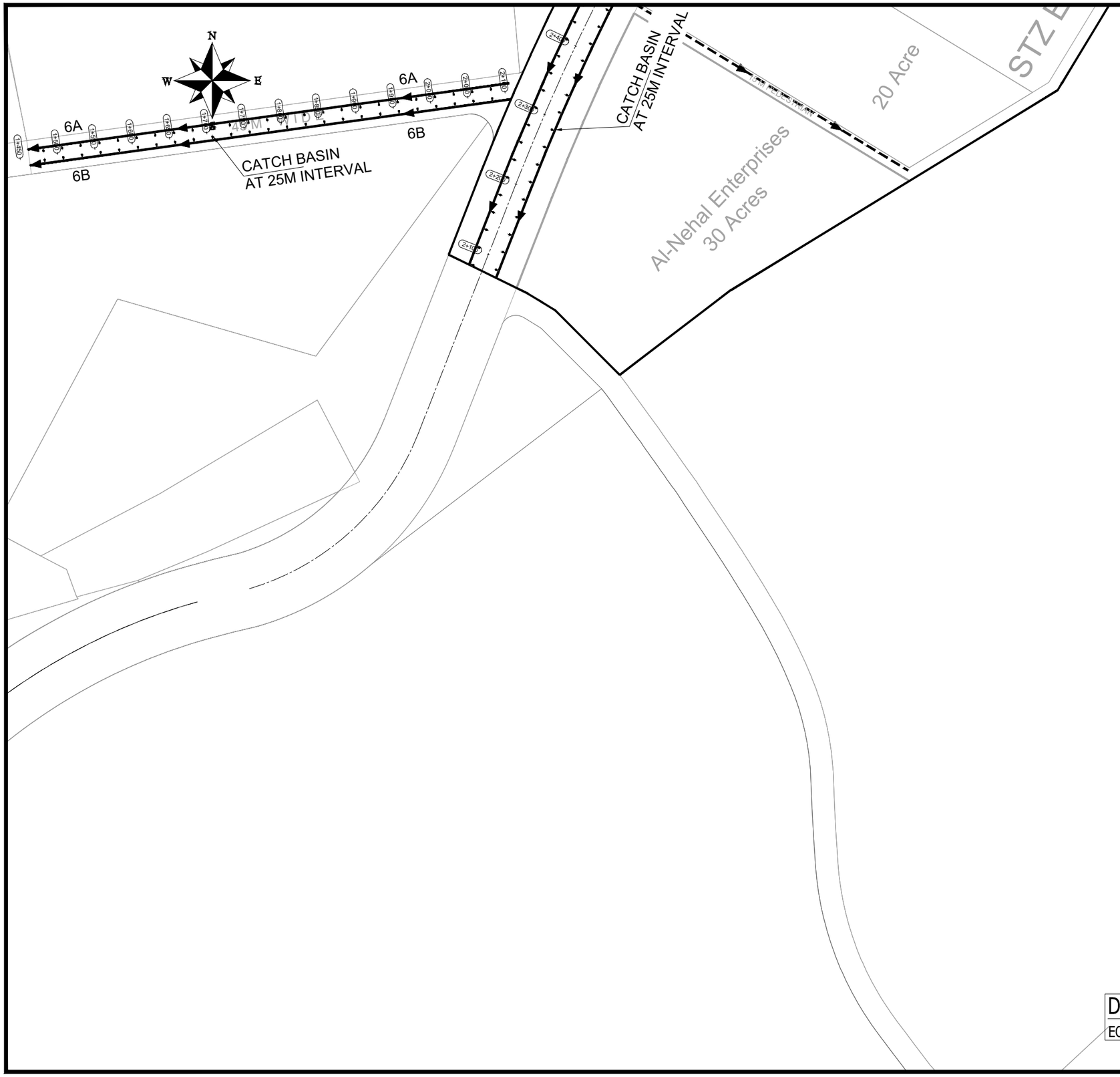
DISCIPLINE:
INFRA STRUCTURE-WET UTILITIES

DRAWING TITLE:
LAYOUT PLAN
OF
STORM WATER DRAINAGE NETWORK

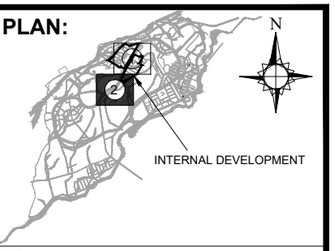
CONSULTANT:
CGD CONSULTING
ARCHITECTURE-ENGINEERING-PLANNING-MANAGEMENT
Plot # 7-C,5th Zulfiqar Commercial Street,
Phase VIII-A, DHA,Karachi - Pakisten

Designed By:	Checked By:	Date:	
A.W.F	S.A	JUN.2026	
Drawn By :	Scale:	Job No:	Sheet
N.A	1:5000		A3

DRAWING No: EC-STZ-EXT-SWD-LP-01 | Revision 00



KEY PLAN:



NOTES:

1. FOR DETAILS OF STORM WATER DRAIN & CATCH BASIN REFER DWGS. # EC-STZ-EXT-SWD-DD-01.

LEGENDS:

- DRAIN SIZE (1.0m x 1.0m)
- DRAIN SIZE (0.7m x 0.7m)
- FLOW DIRECTION
- ONE CELL BOX CULVERT
- BOUNDARY (INTERNAL ROAD)

REVISION	DATE	DESCRIPTION	NAME

PROJECT:

EDUCATION CITY PROJECT

CLIENT:

PROJECT IMPLEMENTATION UNIT

NAME OF WORK:

EDUCATION CITY
SPECIAL TECHNOLOGY ZONE (STZ) EXT.
PHASE-I (52 ACRE)

DRAWING STATUS:

TENDER DRAWINGS

DISCIPLINE:

INFRA STRUCTURE-WET UTILITIES

DRAWING TITLE:

LAYOUT PLAN
OF
STORM WATER DRAINAGE NETWORK

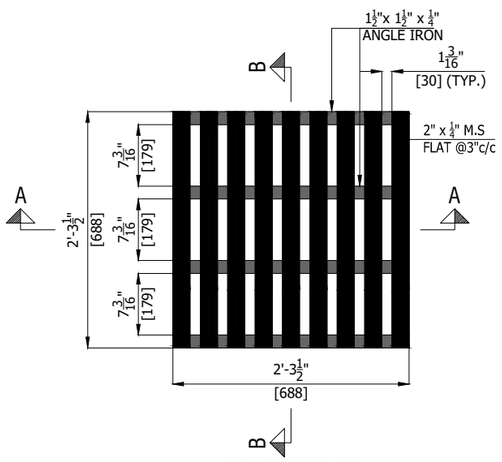
CONSULTANT:

CGD CONSULTING
ARCHITECTURE-ENGINEERING-PLANNING-MANAGEMENT
Plot # 7-C,5th Zulfiqar Commercial Street,
Phase VIII-A, DHA,Karachi - Pakisten

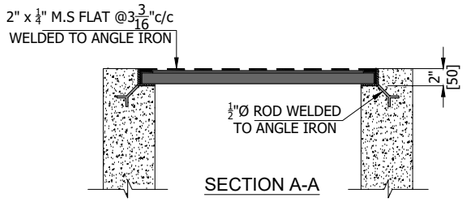
Designed By:	Checked By:	Date:	
A.W.F	S.A	JUN.2026	
Drawn By :	Scale:	Job No:	Sheet
N.A	1:5000		A3

DRAWING No: EC-STZ-EXT-SWD-LP-02 | Revision: 00

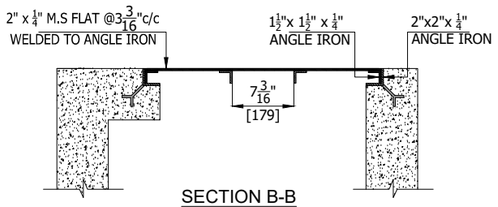
DWG - 02
EC-STZ-EXT-SWD-LP-02



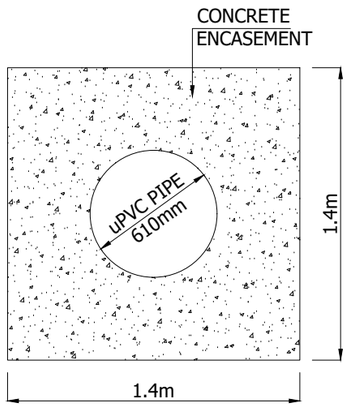
GRATING PLAN



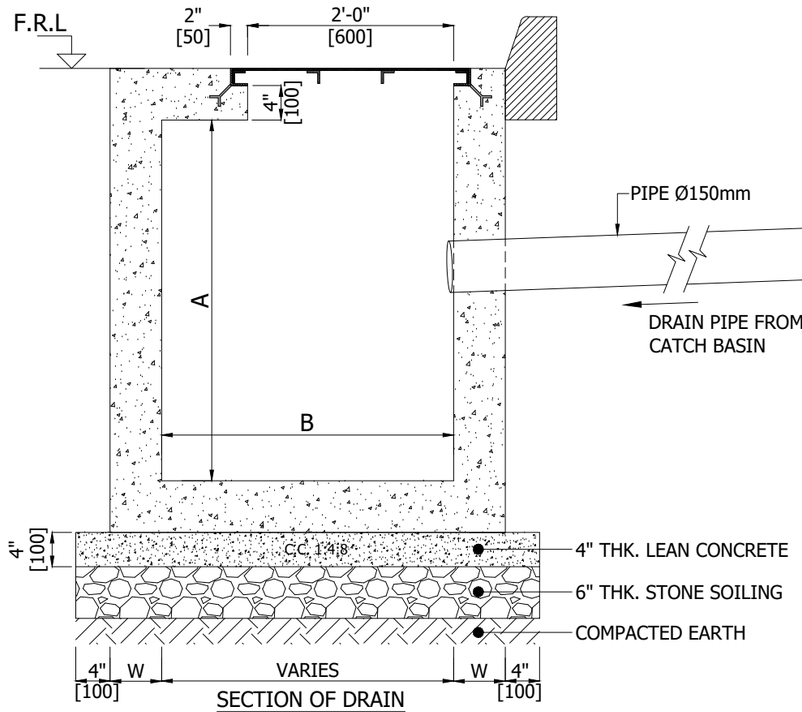
SECTION A-A



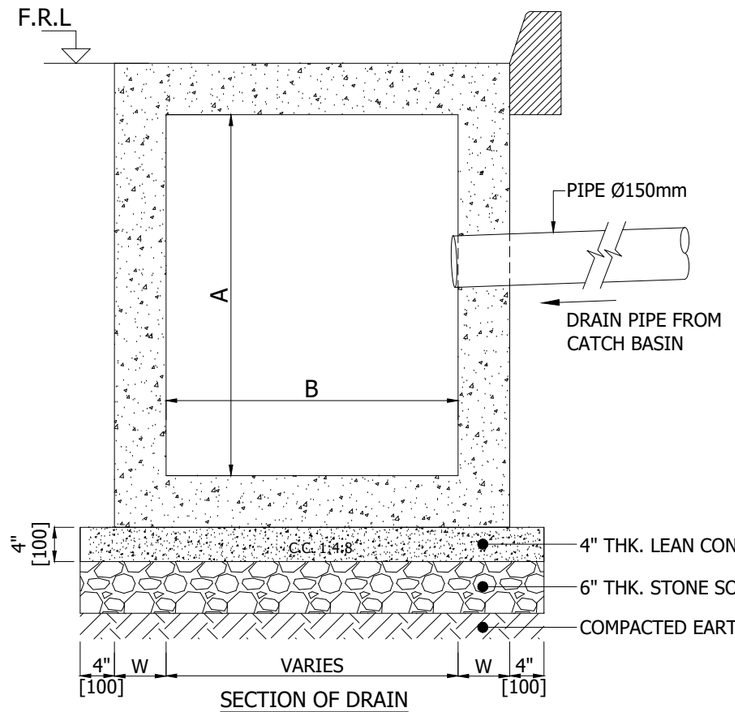
SECTION B-B



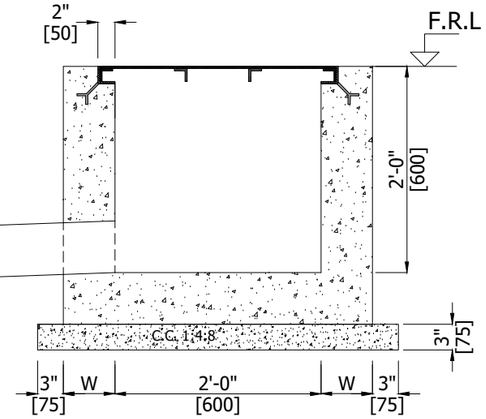
X-SECTION OF DRAINAGE uPVC PIPE Ø610mm
WITH CONCRETE ENCASEMENT
(AT ROAD CROSSING)



SECTION OF DRAIN
WITH GRATING



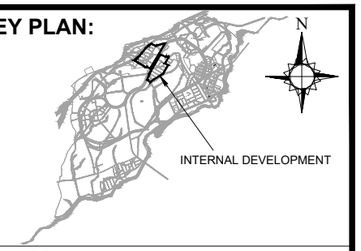
SECTION OF DRAIN
WITHOUT GRATING



SECTION OF CATCH BASIN
WITH GRATING

TYPE OF DRAINS SIZE	
INTERNAL DEPTH (A)m	INTERNAL WIDTH (B)m
1.50m	1.50m
1.00m	1.00m
0.7m	0.7m
0.6m	0.6m
0.5m	0.5m

KEY PLAN:



NOTES:

1- FOR LAYOUT PLAN REFER DWG. # EC-STZ-EXT-SWD-KP-01 TO LP-02.
2 - GRATE INLET FOR DRAINAGE IS USED WHERE DRAINS ARE LOCATED BELOW THE ROAD .
3 - KERB INLET FOR DRAINAGE IS USED WHERE DRAINS ARE LOCATED BELOW THE SIDE WALK .
4 - DRAINAGE uPVC PIPE Ø610mm (CLASS-B WITH CONCRETE ENCASEMENT (AT ROAD CROSSING).
5- FOR DIMENSION OF WALL THICKNESS SEE ARCHITECTURE DRAWINGS.

LEGENDS:

REVISION	DATE	DESCRIPTION	NAME

PROJECT:
EDUCATION CITY PROJECT

CLIENT:
PROJECT IMPLEMENTATION UNIT

NAME OF WORK:
EDUCATION CITY
SPECIAL TECHNOLOGY ZONE (STZ) EXT.
PHASE-I (52 ACRE)

DRAWING STATUS:
TENDER DRAWINGS

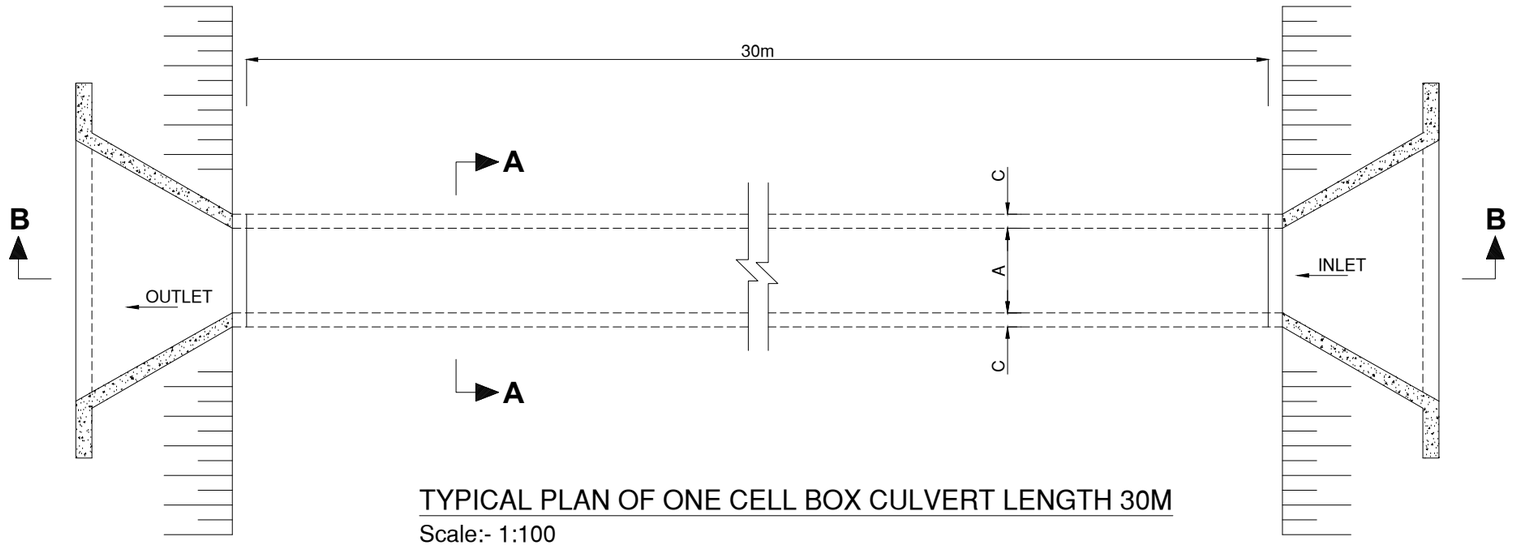
DISCIPLINE:
INFRA STRUCTURE-WET UTILITIES

DRAWING TITLE:
DETAILS OF STORM WATER
DRAIN & CATCH BASIN

CONSULTANT:
CGD CONSULTING
ARCHITECTURE-ENGINEERING-PLANNING-MANAGEMENT
Plot # 7-C,5th Zulfiqar Commercial Street,
Phase VIII-A, DHA,Karachi - Pakisten

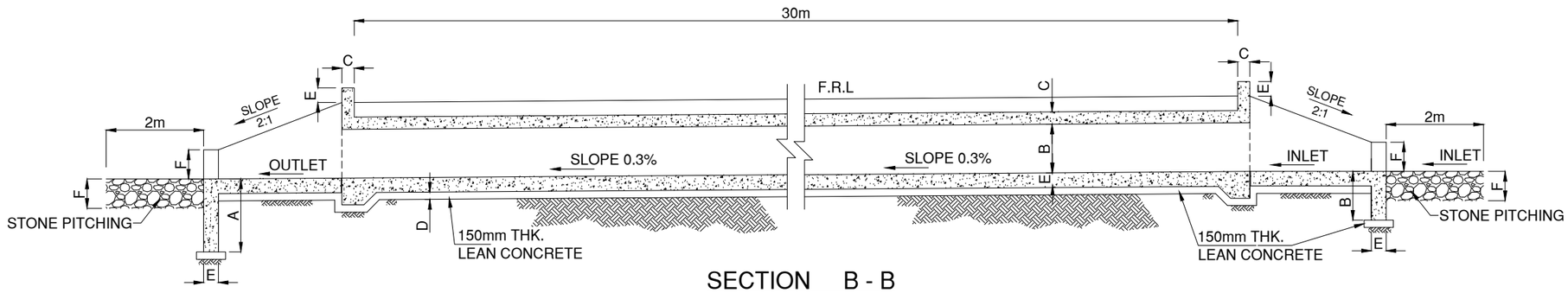
Designed By:	Checked By:	Date:	
A.W.F	S.A	JUN.2026	
Drawn By :	Scale:	Job No:	Sheet
N.A			A3

DRAWING No: EC-STZ-EXT-SWD-DD-01
Revision: 00



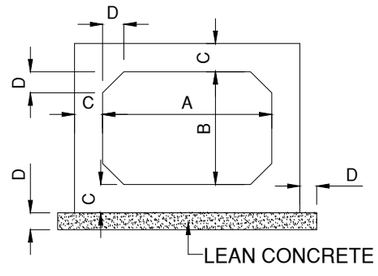
TYPICAL PLAN OF ONE CELL BOX CULVERT LENGTH 30M

Scale:- 1:100



SECTION B - B

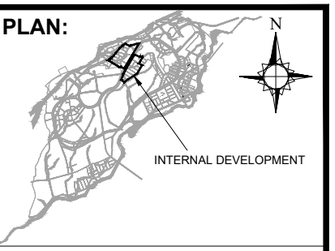
ONE CELL BOX CULVERT SIZE					
A	B	C	D	E	F
1500mm	1000mm	300mm	150mm	300mm	600mm



TYPICAL SECTION A-A OF ONE CELL BOX CULVERT

Scale:- 1:50

KEY PLAN:



NOTES:

1- FOR LAYOUT PLAN REFER
DWG. # EC-STZ-EXT-SWD-KP-01, LP-01 TO LP-02.

LEGENDS:

REVISION	DATE	DESCRIPTION	NAME

PROJECT:
EDUCATION CITY PROJECT

CLIENT:
PROJECT IMPLEMENTATION UNIT

NAME OF WORK:
EDUCATION CITY
SPECIAL TECHNOLOGY ZONE (STZ) EXT.
PHASE-I (52 ACRE)

DRAWING STATUS:
TENDER DRAWINGS

DISCIPLINE:
INFRA STRUCTURE-WET UTILITIES

DRAWING TITLE:
TYPICAL DETAIL OF ONE CELL
BOX CULVERT LENGTH 30M

CONSULTANT:
CGD CONSULTING
ARCHITECTURE-ENGINEERING-PLANNING-MANAGEMENT
Plot # 7-C,5th Zulfiqar Commercial Street,
Phase VIII-A, DHA,Karachi - Pakisten

Designed By:	Checked By:	Date:	
A.W.F	S.A	JUN.2026	
Drawn By :	Scale:	Job No:	Sheet
N.A	AS SHOWN		A3

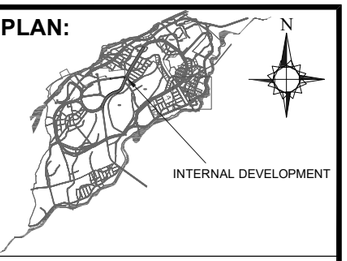
DRAWING No:	Revision
EC-STZ-EXT-SWD-DD-02	00

STRUCTURE

STRUCTURE DRAWINGS REGISTER

DRG.NO.	DRG. TITLE	SCALE
EC-STZ-EXT-STR-LD-01	LIST OF DRAWINGS	AS SHOWN
EC-STZ-EXT-STR-GN-01	GENERAL NOTES	AS SHOWN
EC-STZ-EXT-STR-GN-02	GENERAL NOTES	AS SHOWN
IRRIGATION RESERVOIR		
EC-STZ-EXT-STR-IR-ST-01	PLAN, SECTIONS & DETAILS OF IRRIGATION RESERVOIR	AS SHOWN
EC-STZ-EXT-STR-IRTW-ST-01	PLAN & DETAILS OF TUBE WELL ROOM IRRIGATION RESERVOIR	AS SHOWN
WATER RESERVOIR & PUMP ROOM		
EC-STZ-EXT-STR-WR-ST-01	FOUNDATION & TOP SLAB PLAN OF WATER RESERVOIR	AS SHOWN
EC-STZ-EXT-STR-WR-ST-02	SECTIONS & DETAILS OF WATER RESERVOIR	AS SHOWN
EC-STZ-EXT-STR-WR-ST-03	PLANS & SECTIONS OF PUMP ROOM OF WATER RESERVOIR	AS SHOWN
TUBE WELL		
EC-STZ-EXT-STR-WRTW-ST-01	PLAN & DETAILS OF TUBE WELL ROOM WATER RESERVOIR	AS SHOWN
STROM WATER DRAIN		
EC-STZ-EXT-STR-SWD-ST-01	SECTIONS & DETAILS OF STROM WATER DRAIN	AS SHOWN
MANHOLE		
EC-STZ-EXT-STR-MH-ST-01	DETAIL OF MANHOLE TYPE-A & B SEWERAGE SYSTEM	AS SHOWN
4 CELL BOX CULVERT		
EC-STZ-EXT-STR-CUL4-ST-01	PLAN & SECTION OF 4 CELL BOX CULVERT	AS SHOWN
EC-STZ-EXT-STR-CUL4-ST-02	SECTIONS & DETAILS OF 4 CELL BOX CULVERT (CONCRETE)	AS SHOWN
EC-STZ-EXT-STR-CUL4-ST-03	SECTIONS & DETAILS OF 4 CELL BOX CULVERT (REINFORCEMENT)	AS SHOWN
1 CELL 15M BOX CULVERT		
EC-STZ-EXT-STR-CUL15M-ST-01	PLAN & SECTION OF 1 CELL 15M BOX CULVERT	AS SHOWN
EC-STZ-EXT-STR-CUL15M-ST-02	SECTIONS & DETAILS OF 1 CELL 15M BOX CULVERT (CONCRETE)	AS SHOWN
EC-STZ-EXT-STR-CUL15M-ST-03	SECTIONS & DETAILS OF 1 CELL 15M BOX CULVERT (REINFORCEMENT)	AS SHOWN
1 CELL 30M BOX CULVERT		
EC-STZ-EXT-STR-CUL30M-ST-01	PLAN & SECTION OF 1 CELL 30M BOX CULVERT	AS SHOWN
EC-STZ-EXT-STR-CUL30M-ST-02	SECTIONS & DETAILS OF 1 CELL 30M BOX CULVERT (CONCRETE)	AS SHOWN
EC-STZ-EXT-STR-CUL30M-ST-03	SECTIONS & DETAILS OF 1 CELL 30M BOX CULVERT (REINFORCEMENT)	AS SHOWN
POLE FOUNDATION		
EC-STZ-EXT-STR-LP-ST-01	PLAN & SECTION OF LIGHT POLE FOUNDATION	AS SHOWN

KEY PLAN:



NOTES:

LEGENDS:

REVISION	DATE	DESCRIPTION	NAME

PROJECT:
EDUCATION CITY PROJECT

CLIENT:
PROJECT IMPLEMENTATION UNIT

NAME OF WORK:
EDUCATION CITY
SPECIAL TECHNOLOGY ZONE (STZ) EXT.
(INTERNAL DEVELOPMENT)

DRAWING STATUS:
TENDER DRAWINGS

DISCIPLINE:
STRUCTURE

DRAWING TITLE:
LIST OF DRAWINGS

CONSULTANT:
CGD CONSULTING
ARCHITECTURE-ENGINEERING-PLANNING-MANAGEMENT
Plot # 7-C,5th Zulfiqar Commercial Street,
Phase VIII-A, DHA,Karachi - Pakisten

Designed By:	Checked By:	Date:	
F.A	T.S	DEC-2025	
Drawn By :	Scale:	Job No:	Sheet
Z.A			A3

DRAWING No:	Revision
EC-STZ-EXT-STR-LD-01	00

GENERAL

1 STRUCTURAL DRAWINGS SHALL BE READ IN CONJUNCTION WITH ALL OTHER DISCIPLINE DRAWINGS, DOCUMENTS, SPECIFICATIONS ETC. AS MAY BE ISSUED DURING THE COURSE OF THE CONTRACT. ALL DISCREPANCIES SHALL BE REFERRED TO THE DESIGN CONSULTANT FOR DECISION BEFORE PROCEEDING.

2 FOR MAIN SETTING OUT LINES AND LEVELS REFER TO ARCHITECTURAL DRAWINGS.

3 THE CONTRACTOR SHALL BE RESPONSIBLE FOR ENSURING THE SAFETY OF CONSTRUCTION AT ALL TIMES AND SHALL ENSURE THAT NO PART OF INTERMEDIATE COMPLETED CONSTRUCTION IS HAZARDOUS (FOR EXAMPLE; SIDES OF EXCAVATION, STARTER BARS ETC.)

4 THE CONTRACTOR SHALL PROVIDE TEMPORARY BRACING AND SHORING AGAINST LATERAL FORCES AND ALL CONSTRUCTION LOADS THROUGHOUT THE CONSTRUCTION PROCESS.

5 CONTRACTOR CAN PROPOSE HIS ALTERNATE DESIGN FOR ANY ELEMENT IN THE FORM OF PRECAST, CAST IN SITU OR STRUCTURAL STEEL. HOWEVER THE DESIGN SHALL BE SUBMITTED TO DESIGN CONSULTANT FOR REVIEW AND APPROVAL.

6 THE DESIGN CONSULTANT'S REVIEW PROCESS FOR ALL SUBMITTALS, DRAWINGS, METHOD STATEMENTS AND DOCUMENTS IS ONLY COMPLETE ONCE A STATUS OF 'NO OBJECTION' IS REACHED. THE SUBMITTAL SHALL BE REVIEWED BY THE DESIGN CONSULTANT FOR COMPLIANCE WITH THE DESIGN INTENT, HOWEVER THIS DOES NOT RELIEVE THE CONTRACTOR FROM HIS CONTRACTUAL RESPONSIBILITIES.

7 FOR ALL BUILDINGS WORK INFORMATION (OPENINGS IN STRUCTURAL ELEMENTS):- LIGHTING POINTS, GULLIES, CAST-IN PIPES, SLEEVES, ELECTRICAL TRENCHES, MANHOLES ETC, REFER TO MEP DRAWINGS. THE CONTRACTOR SHALL PREPARE COORDINATED SERVICES DRAWINGS IDENTIFYING STRUCTURAL, MEP AND ARCHITECTURAL ELEMENTS/DETAILS FOR CONSULTANT'S REVIEW BEFORE COMMENCEMENT OF CONSTRUCTION IN THE AREA CONCERNED.

8 ALL DESIGN, WORKMANSHIP AND MATERIAL SHALL BE IN ACCORDANCE WITH THE CURRENT ACI, UBC-97, PBC-2007 AND AISC STANDARDS AND PROJECT DESIGN CRITERIA UNLESS NOTED OTHERWISE. EQUIVALENT BRITISH STANDARDS MAY BE ACCEPTABLE SUBJECT TO APPROVAL OF THE DESIGN CONSULTANT.

9 WHERE ANY ITEM OR MATERIAL IS SPECIFIED BY A GENERIC DESCRIPTION FOLLOWED BY AND IN CONJUCTION WITH A NAMED PRODUCT, THE CONTRACTOR CAN SUBSTITUTE AN APPROVED ALTERNATE PRODUCT WHICH HAS SIMILAR CHARACTERSTICS OR PERFORMANCE TO THE NAMED PRODUCT WHICH MATCHES.

10 ALL JOINT FILLERS SHALL BE "FLEXEL" BY FOSROC OR EQUIVALENT APPROVED. JOINT SEALANT SHALL BE "THIOFLEX 600" BY FOSROC OR EQUIVALENT APPROVED. ALL APPLICATIONS ARE TO BE CARRIED OUT STRICTLY IN ACCORDANCE WITH THE MANUFACTURERS INSTRUCTIONS.

11 WATER STOPPERS / BARS OF APPROVED MANUFACTURER AND/OR SIZE SHALL BE PROVIDED IN ALL CONTROL AND CONSTRUCTION JOINTS, EXPOSED TO EARTH.

12 FOR CONCRETE IN CONTACT WITH SOIL, EXTERNAL FACES OF THE SUBSTRUCTURES SUCH AS BASEMENT WALLS ETC. SHALL HAVE APPROVED BITUMEN EMULSION PROTECTIVE COATING OR EQUIVALENT APPROVED.

13 ALL BACKFILL MATERIAL SHALL BE GRANULAR IN NATURE THAT IS SAND-GRAVEL MIX AND COMPACTED IN MAXIMUM OF 9" THICK LAYERS BACK FILLING AGAINST BASEMENT/RETAINING WALLS SHALL BE DONE AFTER GROUND FLOOR SLAB IS CASTED AND CURED. IF APPLICABLE BACK FILL AGAINST BOTH SIDES OF WALLS EQUALLY UNTIL THE LOWER ELEVATION IS ATTAINED.

CONCRETE

1 ALL R.C. WORK SHALL BE INTERNALLY VIBRATED THRU ELECTRO MECHANICAL VIBRATOR.

2 CLEAR CONCRETE COVER TO PRIMARY REINFORCEMENT SHALL BE AS FOLLOWS :

ELEMENT	COVER
FOUNDATION	2" (40mm)
COLUMN/BEAMS	1 1/2" (40mm)
RCC WALL	1 1/2" (40mm)
SLAB	3/4" (20mm)
WATER RETAINING / EARTH STRUCTURES:	
(a) SLAB	2" (50mm)
(b) WALLS	2" (50mm)
(c) BEAMS	2" (50mm)

3 ALL R.C.C. WORK SHALL BE CONTINUOUSLY MOIST CURED FOR 14 DAYS.

4 UNLESS NOTED OR AUTHORISED OTHERWISE, FORM WORK FOR R.C.C. WORK SHALL NOT BE REMOVED EARLIER THAN THE TIME INDICATED BELOW:

ELEMENT	TIME
COLUMNS / BEAM SIDES	48 HRS AFTER POURING
BEAM BOTTOM	28 DAYS AFTER POURING
SLAB	21 DAYS AFTER POURING

5 CONCRETE STRENGTH:
a- UNLESS SPECIFIED MINIMUM CONCRETE CYLINDRICAL STRENGTH AT 28 DAYS FOR ALL STRUCTURAL MEMBERS SHALL BE fc'=3.0 Ksi (21 MPa).

6 MINIMUM CYLINDRICAL STRENGTH FOR PLAIN CONCRETE MUST BE AS FOLLOW:
a- LEAN CONCRETE / 1:4:8 = 1000 psi
b- SITU / 1:3:6 = 1500 psi

7 CONCRETE MIX, TO BE DESIGNED ON THE BASIS OF ACI 211 OR EQUIVALENT, TRIAL STRENGTH RESULTS TO BE SUBMITTED BY THE CONTRACTOR FOR REVIEW & APPROVAL BEFORE CONCRETING.

8 CONCRETE MIX FOR ALL MEMBERS SHALL BE DESIGNED USING PREFERABLY RIVER RUN SAND, ROUNDED OR CRUSHED GRAVEL & PORTLAND CEMENT.

9 GRADING REQUIREMENTS FOR COARSE AGGREGATE (ASTM C-33):
a- COLUMNS/BEAMS/SLABS....3/4" (20mm) TO NO. 4, SIZE NO. 67 OF ASTM.
b- FAIR FACED CONCRETE.....3/8" (10mm) TO NO. 8, SIZE NO. 8 OF ASTM.

10 ORDINARY PORTLAND CEMENT TO BE USED IN ALL RCC WORKS. CONFORMANCE OF CEMENT TO ASTM C-150, TYPE-I OR BS 12 IS NECESSARY.

11 FINENESS MODULUS OF SAND SHALL BE WITHIN 2.6 & 3.0.

12 ALL CONCRETE SIZES AND LEVELS ARE STRUCTURAL UNLESS OTHERWISE NOTED.

13 SIZES OF CONCRETE ELEMENTS DO NOT INCLUDE THICKNESS OF APPLIED FINISHES.

14 BEAM SIZES SHOWN ARE TO BE READ (WIDTHxDEPTH) AND INCLUDE SLAB THICKNESS WHERE SLAB IS PLACED INTEGRALLY WITH THE BEAM.

15 CONSTRUCTION JOINTS OR POUR BREAKS WHERE NOT SHOWN ON PLANS OR DETAILS SHALL BE LOCATED AND FORMED TO THE APPROVAL OF THE ENGINEER.

16 A BOND BREAKING MATERIAL IS TO BE PLACED BETWEEN SURFACES IN CONTACT AT PERMANENT JOINTS UNLESS NOTED OTHERWISE.

17 NO PENETRATIONS, RECESSES OR CHASES OTHER THAN THOSE SHOWN ON THE STRUCTURAL DRAWINGS SHALL BE MADE IN CONCRETE MEMBERS WITHOUT PRIOR APPROVAL OF THE ENGINEER.

18 ALL CONCRETE SHALL BE TESTED IN ACCORDANCE WITH ASTM STANDARDS C31, C39, C172 & SPECIFICATIONS AND THE MINIMUM CYLINDER STRENGTH OF CONCRETE AT 28 DAYS SHALL BE AS FOLLOWS. TESTING OF CLASS B & LEAN CONCRETE SHALL BE PERFORMED IF SO DIRECTED BY THE ENGINEER. WITHOUT ANY FINANCIAL IMPLICATION TO WARDS THE EMPLOYER.

19 ALL OPENINGS FOR PIPING AND CONVEYANCE SHALL BE FORMED IN POSITION BEFORE CASTING CONCRETE.

20 BLOCKWORK MUST NOT BE BUILT ON CONCRETE SLABS OR BEAMS UNTIL FORMWORK SUPPORTING SAME HAS BEEN REMOVED.

21 ALL NON LOAD-BEARING WALLS SHALL BE KEPT CLEAR OF THE UNDERSIDE OF SLABS AND BEAMS BY 3/4" (20mm), UNLESS NOTED OTHERWISE. THE GAP SHALL BE APPROPRIATELY FILLED WITH A COMPRESSIBLE FILLER AND SEALED AS PER SPECIFICATIONS. SIMILARLY, VERTICAL INTERFACES BETWEEN RC COLUMNS/WALLS AND NON LOAD-BEARING WALLS SHALL BE TREATED WITH APPROPRIATE JOINT DETAILS/SEALANTS ACCORDING TO SPECIFICATIONSAND APPROVALS.

22 GROUT TUBES/WATERSTOPS SHALL BE PROVIDED IN ALL CONSTRUCTION JOINTS OF WALLS OR SLABS EXPOSED TO THE GROUND, WEATHER OR WATER SUCH AS RETAINING WALLS, SWIMMING POOLS, OPEN AREAS AND MECHANICAL FLOORS, ETC. WHETHER SHOWN ON DRAWINGS OR NOT.

23 HEAVY DUTY POLYTHENE SHEET, 0.20MM THK SHALL BE LAID BELOW THE LEAN CONCRETE FOR ALL GROUND SLABS.

24 CEMENT CONTENT FOR RCC IN CONTACT WITH EARTH TO BE 25 lbs/cft (400kg/cum).

REINFORCEMENT

1 REINFORCEMENT UNLESS OTHERWISE INDICATED ON ANY DRAWING SHALL BE HOT ROLLED AND DEFORMED CARBON STEEL, WITH CHARACTERISTIC STRENGTH OF 60 Ksi (420 MPa), CONFORMING TO ASTM A706.

2 UNLESS OTHERWISE NOTED, ALL LAP LENGTHS IN COLUMNS, WALLS, BEAMS & SLABS SHALL BE 60 TIMES DIA OF BAR.

3 PROVIDE BAR SUPPORTS OR SPACERS TO GIVE THE FOLLOWING CONCRETE COVER TO ALL REINFORCEMENTS UNLESS NOTED ON DRAWINGS.

4 ALL REINFORCEMENT TO BE FIRMLY SUPPORTED ON APPROVED CHAIRS GENERALLY AT NOT GREATER THAN 30" (750mm) CENTERS BOTHWAYS. BARS TO BE TIED AT ALTERNATE INTERSECTIONS.

5 BARS SHOWN STAGGERED ON PLAN SHALL BE PLACED ALTERNATELY.

6 LENGTH OF REINFORCING BARS INDICATED ON THE DRAWING ARE STRAIGHT LENGTHS ONLY.

7 WELDING OF REINFORCEMENT WILL NOT BE PERMITTED WITHOUT THE APPROVAL OF THE ENGINEER.

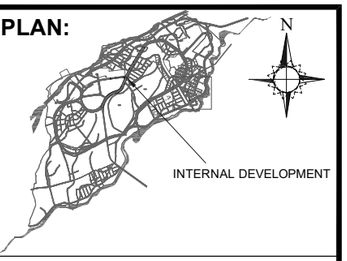
8 REINFORCEMENT MUST NOT BE CONTINUOUS THROUGH CONTRACTION/EXPANSION JOINTS.

9 THE FACE OF ALL CONCRETE AGAINST WHICH NEW CONCRETE IS TO BE CAST IS TO BE THOROUGHLY MECHANICALLY SCRABBLED, FULLY EXPOSING THE AGGREGATE.

10 FIRST SLAB BAR IS TO BE POSITIONED MAX. 4" (100mm) FROM FACE OF BEAMS, RCC WALLS AND SLAB THICKENINGS PARALLEL TO BAR. FIRST BEAM LINK TO BE PLACED MAXIMUM 2" (50mm) FROM FACE OF COLUMN OR SUPPORTING WALL UNDER.

11 ALL DETAILING SHALL BE DONE AS PER ACI STANDARDS ACI-315, ACI-318 AND ACI-350R.

KEY PLAN:



NOTES:

1 - FOR GENERAL NOTES OF BRIDGE REFER DWG.NO: EC-PKG-1-A(i)-BR-GN-01 & GN-02

LEGENDS:

REVISION	DATE	DESCRIPTION	NAME

PROJECT:
EDUCATION CITY PROJECT

CLIENT:
PROJECT IMPLEMENTATION UNIT

NAME OF WORK:
EDUCATION CITY
SPECIAL TECHNOLOGY ZONE (STZ) EXT.
(INTERNAL DEVELOPMENT)

DRAWING STATUS:
TENDER DRAWINGS

DISCIPLINE:
STRUCTURE

DRAWING TITLE:
GENERAL NOTES

CONSULTANT:
CGD CONSULTING
ARCHITECTURE-ENGINEERING-PLANNING-MANAGEMENT
Plot # 7-C,5th Zulfiqar Commercial Street, Phase VIII-A, DHA,Karachi - Pakisten

Designed By:	Checked By:	Date:	
F.A	T.S	DEC-2025	
Drawn By :	Scale:	Job No:	Sheet
Z.A			A3

DRAWING No: EC-STZ-EXT-STR-GN-01 | Revision: 00

STRUCTURAL STEEL

1 THE DESIGN OF STRUCTURAL STEEL WORK IS IN ACCORDANCE WITH AMERICAN INSTITUTE OF STEEL CONSTRUCTION (AISC).

2 CONTRACTOR IS RESPONSIBLE TO PREPARE AND SUMMIT SHOP DRAWING WITH CONNECTION DETAIL ETC. FOR ENGINEERS APPROVAL.

3 MINIMUM GROUT STRENGTH SHALL BE 4000psi.

4 ALL STRUCTURAL STEEL ERECTION SHALL START FROM LOWER MOST LEVEL AND PROCEED UPWARDS.

5 WEDGING OF ALL COLUMNS (TUBES/CHANNELS/ANGLES/WIDE FLANGE) SHALL BE DONE AFTER JACKING OF BEAM / SLAB TO THESE COLUMNS USING 5TON JACK.

6 REMOVE JACK AFTER INSTALLATION OF WEDGES / GROUT OVER COLUMNS.

7 ALL STRUCTURAL STEEL OTHER THAN METAL DECK SHALL CONFORM TO ASTM A36 (36 Ksi) & A992 (50 Ksi) AS SPECIFIED ON RELEVANT DRAWINGS.

8 THERE SHALL BE NO FIELD CUTTING OF STRUCTURAL STEEL MEMBERS FOR THE WORK OF OTHER TRADES WITHOUT PRIOR REVIEW BY THE CONSULTANT.

9 ALL BOLTS,NUTS AND WASHERS SHALL CONFORM TO ASTM A325, A490 OR AS PER SPECIFICATION.

10 ALL ANCHOR RODS AND BOLTS SHALL COMFORM TO ASTM F1554.

11 THE MINIMUM NUMBER OF BOLTS PER CONNECTION SHALL BE TWO (2) 3/4" DIAMETER A325 BOLTS.

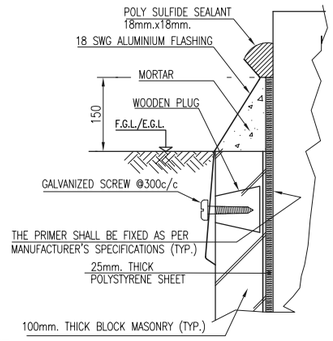
12 ALL WELDING ELECTRODES SHALL BE E 70XX AND CONFORM TO AWS 2D.1.

13 ALL WELD SIZES SHALL COMPLY WITH AISC SPECIFICATION AND SHALL NOT BE LESS THAN 1/4" (6 mm) UNLESS NOTED OTHERWISE.

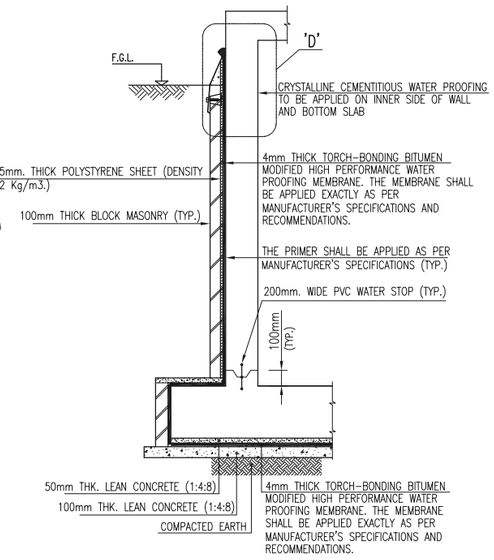
14 ALL WELDS SHALL BE VISUALLY INSPECTED 100% PER AWS D1.1. WELD SIZE AND CONFIGURATION MEASUREMENTS SHALL BE PERFORMED FOR A MINIMUM OF 15% OF ALL WELDS ON A RANDOM BASIS. IF REQUIRED WELDING CAN BE CALLED UPON FOR TESTING THROUGH APPROVED METHODS LIKE ULTRASONIC AND RADIOGRAPHIC METHODS ETC.

15 100% OF ALL BOLTED CONNECTIONS SHALL BE VISUALLY INSPECTED, AND THEN TESTED WITH A CALIBRATED TORQUE WRENCH TO VERIFY A MINIMUM OF 25% OF BOLTS IN EACH CONNECTION (2 BOLTS PER CONNECTION MINIMUM)

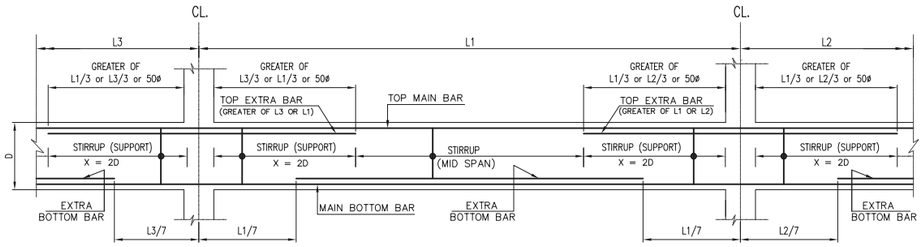
16 IN GENERAL CONTRACTOR TO SUBMIT DETAILED FABRICATION DRAWINGS FOR ENGINEER'S APPROVAL, ESPECIALLY THE CONNECTIONS WHICH ARE SHOWN INDICATIVE.



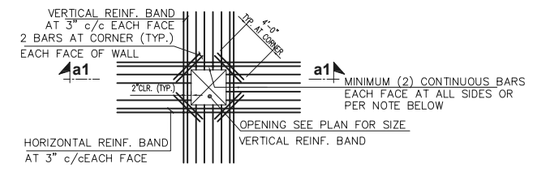
DETAIL 'D'



TYPICAL DETAIL OF WATER PROOFING



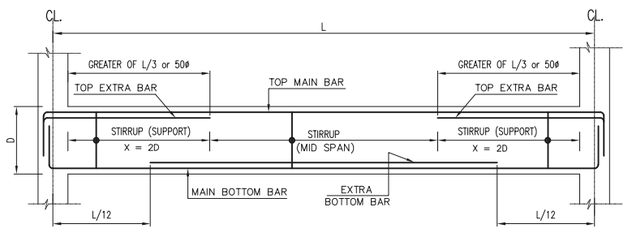
TYPICAL REINFORCEMENT OF CONTINUOUS BEAM



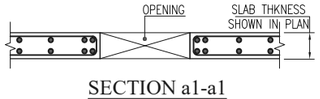
NOTE: AT OPENING WHERE REINFORCING IS INTERRUPTED ADD 1/2 OF INTERRUPTED VERTICAL BARS (FULL HEIGHT) ON EACH SIDE OF OPENING IN PLACE OF THE (2) MINIMUM BARS INDICATED. ADD 1/2 OF INTERRUPTED HORIZONTAL REINFORCING (FULL LENGTH) TO TOP AND BOTTOM OF OPENING.

TYP. OPENING DETAIL

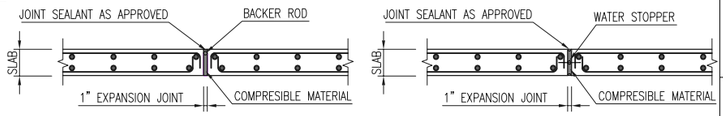
(TYP. REINF. DETAIL IN SLAB AROUND OPENING)



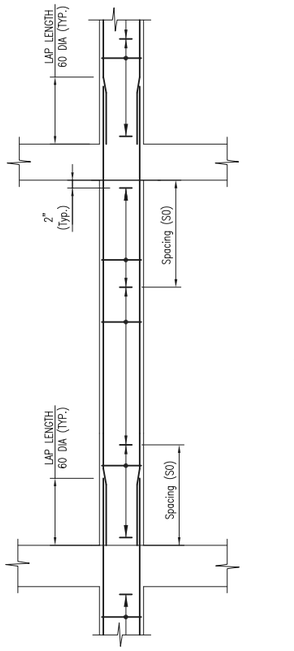
TYPICAL REINFORCEMENT OF SINGLE SPAN BEAM



SECTION a1-a1

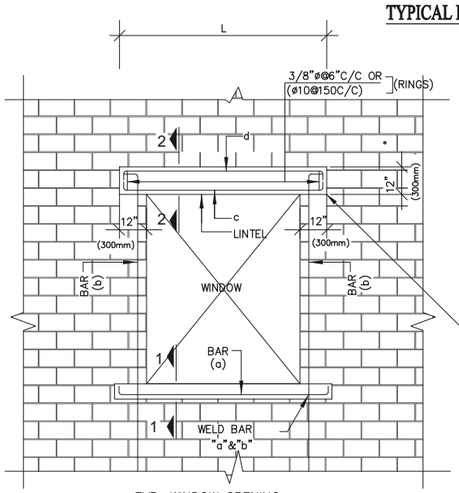


TYPICAL DETAIL OF EXPANSION JOINT

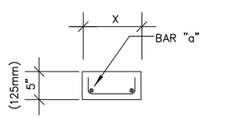


UNLESS OTHERWISE MANTIONED
* COLUMNS RINGS ARE SPECIFIED AS 3/8"ø @ S (Lo).
* WHEREVER COLUMN RINGS ARE SPECIFIED AS 3/8"ø @ S", USE RINGS THRUOUT AT SPACING OF S.

TYPICAL COLUMN DETAIL

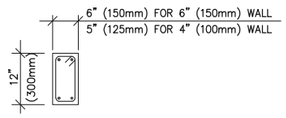


TYP. WINDOW OPENING WITH LINTEL



2-3/8"ø FOR X=8" (2ø10 FOR X=200mm)
3-3/8"ø FOR X>=8" (3ø10 FOR X≥200mm)
1/4"ø@5"C/C TIES (ø8mm@125C/C TIES)

SECTION 1-1
FOR WINDOW ONLY

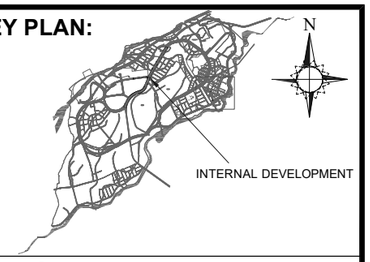


(2+2)-3/8"ø [OR (2+2)ø10] T/B UP TO 4' (1200mm) SPAN
2-3/8"ø (OR 2ø10) TOP, 2-1/2"ø (OR 2ø12) BOTT. 4' (1200mm) TO 8' (2400mm) SPAN
3/8"ø@6"C/C TIES (OR ø10@150C/C) (TYP.)

SECTION 2-2

BAR	L=3' (900mm)	L=3'-6' (900mm-1800mm)	L=6'-10' (1800mm-3000mm)
c	2-3/8"ø (2ø10)	2-1/2"ø (2ø12)	2-5/8"ø (2ø16)
d	2-3/8"ø (2ø10)	2-3/8"ø (2ø10)	2-1/2"ø (2ø12)

KEY PLAN:



NOTES:

1 - FOR GENERAL NOTES OF BRIDGE REFER DWG.NO: EC-PKG-1-A(i)-BR-GN-01 & GN-02

LEGENDS:

REVISION	DATE	DESCRIPTION	NAME

PROJECT:
EDUCATION CITY PROJECT

CLIENT:
PROJECT IMPLEMENTATION UNIT

NAME OF WORK:
EDUCATION CITY
SPECIAL TECHNOLOGY ZONE (STZ) EXT.
(INTERNAL DEVELOPMENT)

DRAWING STATUS:
TENDER DRAWINGS

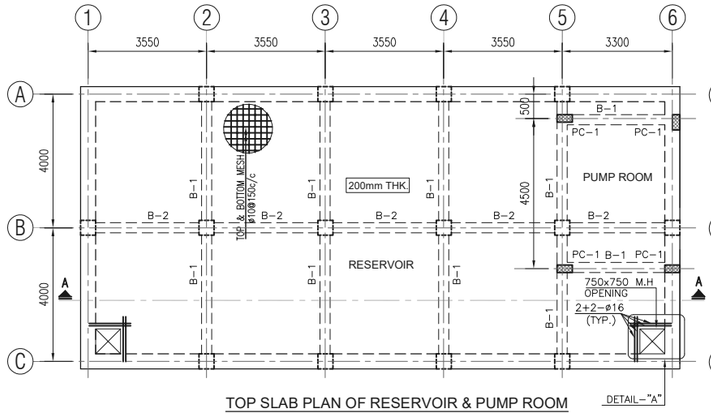
DISCIPLINE:
STRUCTURE

DRAWING TITLE:
GENERAL NOTES

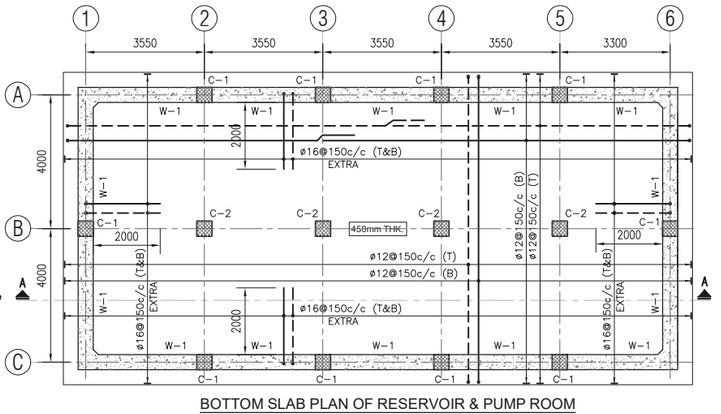
CONSULTANT:
CGD CONSULTING
ARCHITECTURE-ENGINEERING-PLANNING-MANAGEMENT
Plot # 7-C,5th Zulfiqar Commercial Street, Phase VIII-A, DHA,Karachi - Pakistan

Designed By:	Checked By:	Date:	
F.A	T.S	DEC-2025	
Drawn By :	Scale:	Job No:	Sheet
Z.A			A3

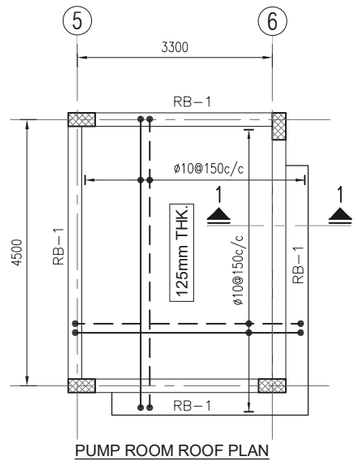
DRAWING No: EC-STZ-EXT-STR-GN-02 | Revision 00



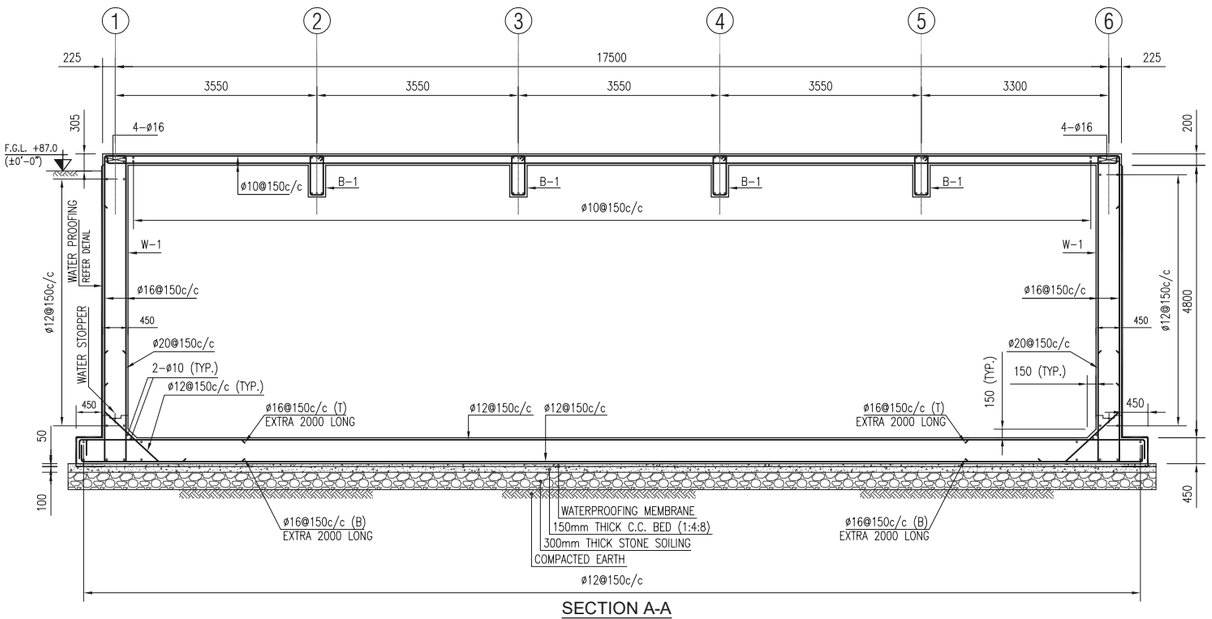
TOP SLAB PLAN OF RESERVOIR & PUMP ROOM



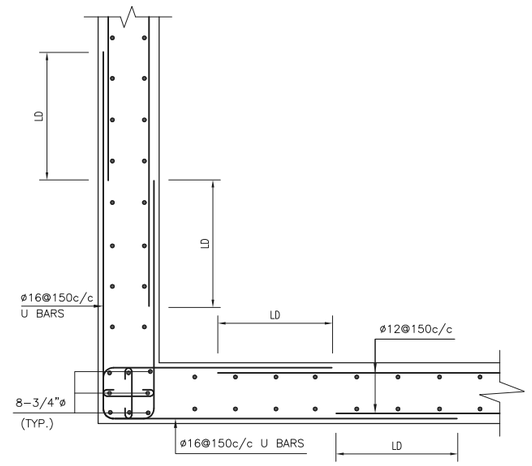
BOTTOM SLAB PLAN OF RESERVOIR & PUMP ROOM



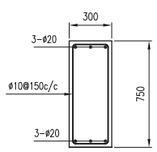
PUMP ROOM ROOF PLAN



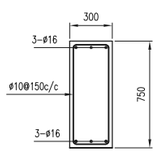
SECTION A-A



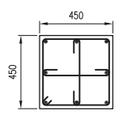
TYPICAL R.C.C WALL CORNER DETAIL



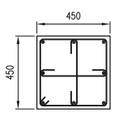
SECTION OF B-1



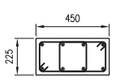
SECTION OF B-2



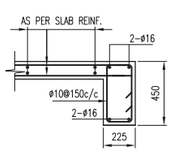
C-1
VERTICAL : 8-Ø20
RINGS : Ø10@150c/c



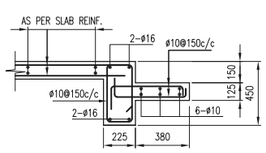
C-2
VERTICAL : 8-Ø16
RINGS : Ø16@150c/c



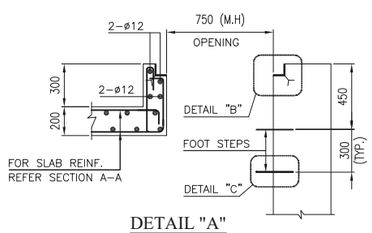
PC-1
VERTICAL : 8-Ø12
RINGS : Ø10@150c/c



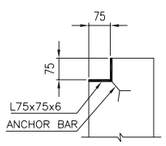
SECTION OF RB-1



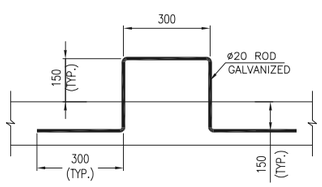
SECTION 1-1



DETAIL "A"

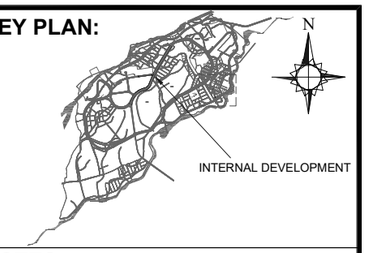


DETAIL "B"



DETAIL "C"

KEY PLAN:



NOTES:

1 - FOR GENERAL NOTES REFER DWG.NO: EC-PKG-1-A(i)-GN-01 & GN-02

2 - READ THIS DRAWING IN CONJUNCTION WITH ARCHITECTURAL, ELECTRICAL AND PLUMBING DRAWINGS.

3- MINIMUM COMPRESSIVE CYLINDRICAL STRENGTH OF CONCRETE AFTER 28 DAYS (FC') SHALL NOT BE LESS THAN 4000 Psi.

4 - FOR LOCATION OF RESERVOIR REFER DWG.NO: EC-PH-1-PKG-1-A(2) IR-DD-05.

LEGENDS:

REVISION	DATE	DESCRIPTION	NAME

PROJECT:
EDUCATION CITY PROJECT

CLIENT:
PROJECT IMPLEMENTATION UNIT

NAME OF WORK:
EDUCATION CITY
SPECIAL TECHNOLOGY ZONE (STZ) EXT.
(INTERNAL DEVELOPMENT)

DRAWING STATUS:
TENDER DRAWINGS

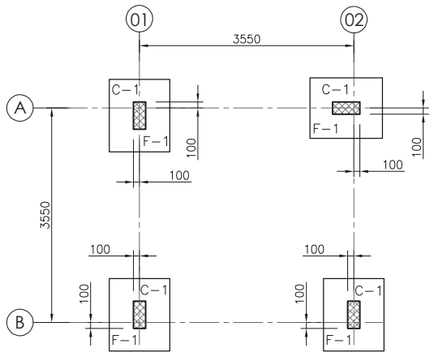
DISCIPLINE:
STRUCTURE

DRAWING TITLE:
PLAN, SECTIONS & DETAILS OF IRRIGATION RESERVOIR

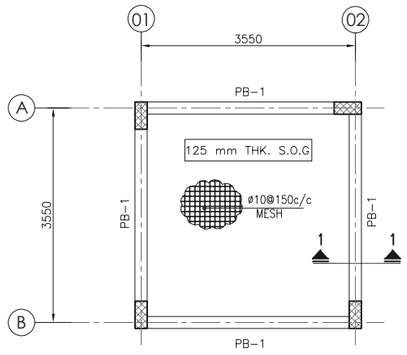
CONSULTANT:
CGD CONSULTING
ARCHITECTURE-ENGINEERING-PLANNING-MANAGEMENT
Plot # 7-C,5th Zulfiqar Commercial Street,
Phase VIII-A, DHA,Karachi - Pakisten

Designed By:	Checked By:	Date:	
F.A	T.S	DEC-2025	
Drawn By: Z.A	Scale:	Job No:	Sheet A3

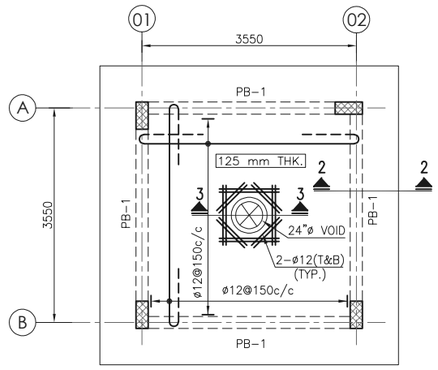
DRAWING No: EC-STZ-EXT-STR-IR-ST-01 | Revision 00



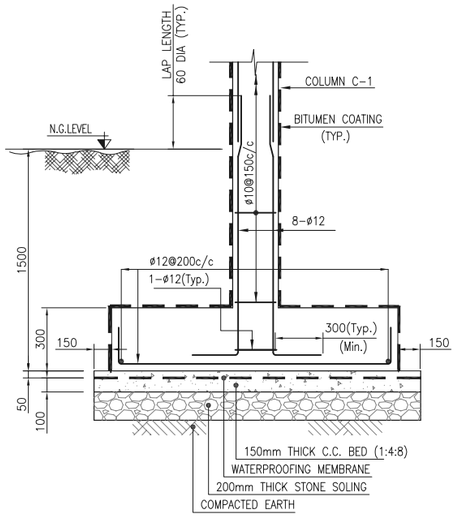
FOUNDATION & COLUMN LAYOUT PLAN



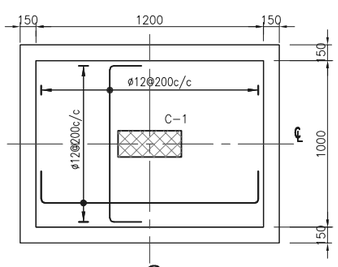
PLINTH BEAM PLAN (LEV.+0.375)



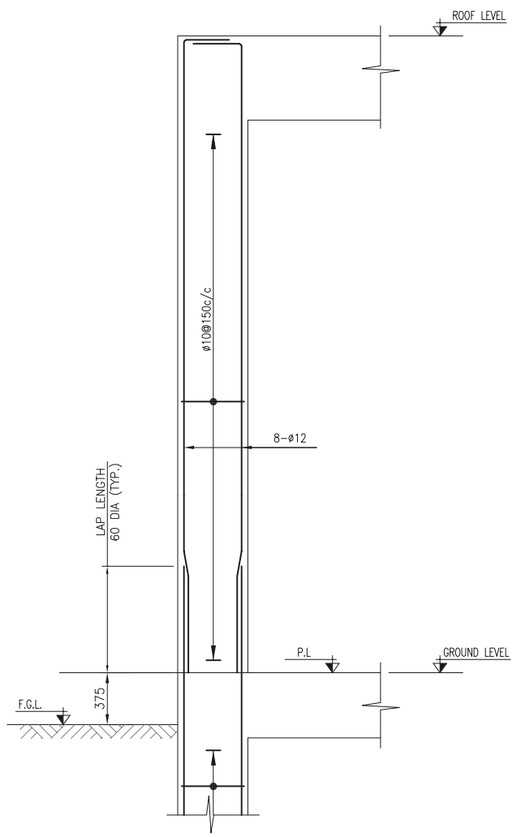
ROOF PLAN



SECTION OF FOOTING (F-1)

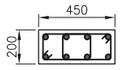


PLAN OF FOOTING (F-1)



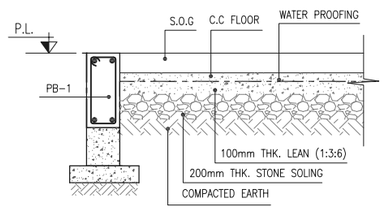
UNLESS OTHERWISE MANTIONED
* COLUMNS RINGS ARE SPECIFIED AS 3/8"ø @ S (Lo).
* WHEREVER COLUMN RINGS ARE SPECIFIED AS 3/8"ø @ S", USE RINGS THRUOUT AT SPACING OF S.

TYPICAL COLUMN DETAIL

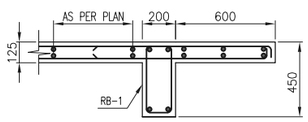


VERTICAL : 8- Ø12
RINGS : Ø10@150c/c

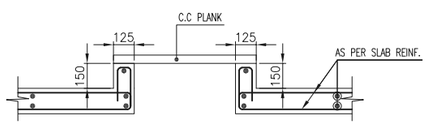
SECTION OF C-1



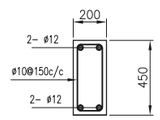
SECTION 1-1



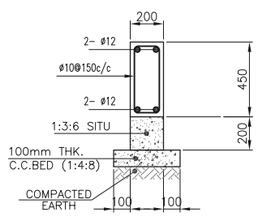
SECTION 2-2



SECTION 3-3

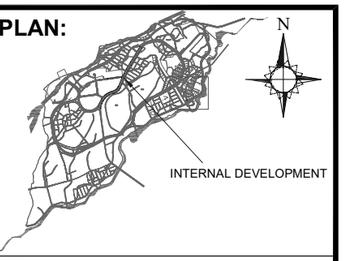


SECTION OF RB-1



SECTION OF PB-1

KEY PLAN:



NOTES:

1 - FOR GENERAL NOTES REFER DWG.NO: EC-PKG-1-A(i)-GN-01 & GN-02
2 - READ THIS DRAWING IN CONJUNCTION WITH ARCHITECTURAL, ELECTRICAL AND PLUMBING DRAWINGS.

LEGENDS:

REVISION	DATE	DESCRIPTION	NAME

PROJECT:
EDUCATION CITY PROJECT

CLIENT:
PROJECT IMPLEMENTATION UNIT

NAME OF WORK:
EDUCATION CITY
SPECIAL TECHNOLOGY ZONE (STZ) EXT.
(INTERNAL DEVELOPMENT)

DRAWING STATUS:
TENDER DRAWINGS

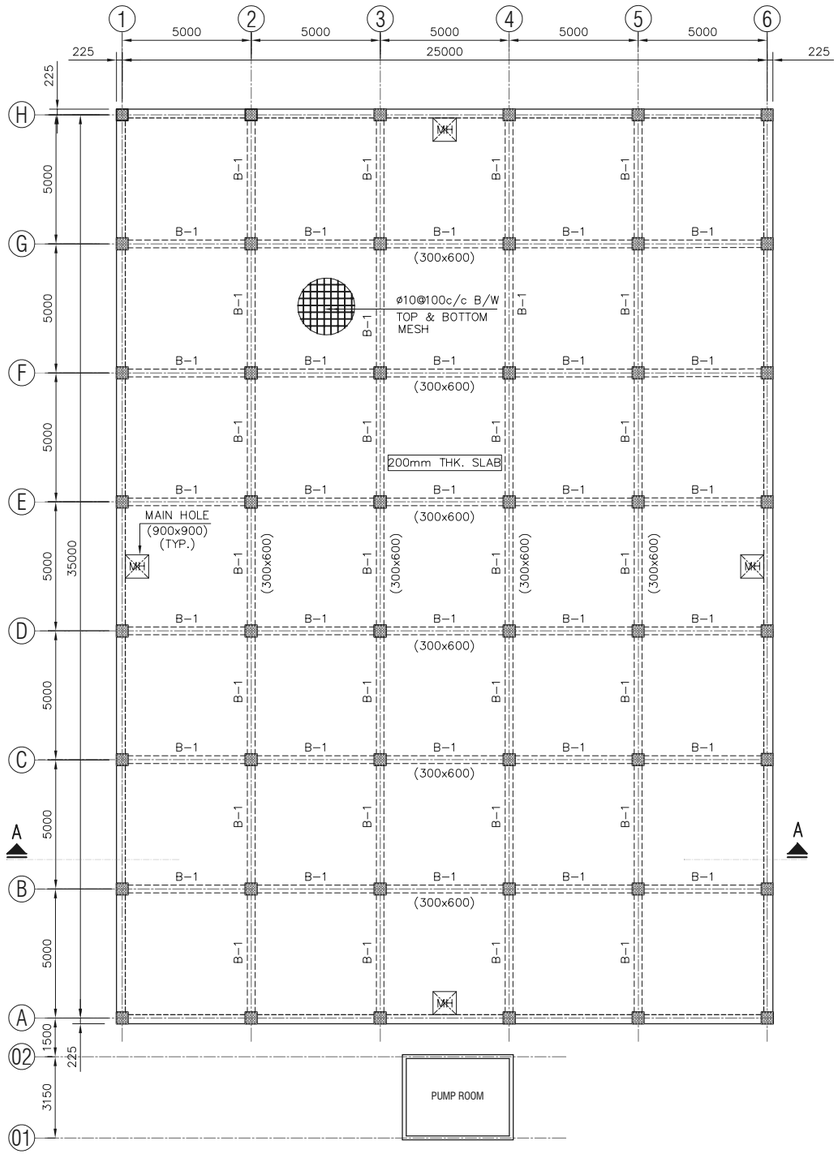
DISCIPLINE:
STRUCTURE

DRAWING TITLE:
PLAN & DETAILS OF TUBE WELL ROOM
(IRRIGATION RESERVOIR)

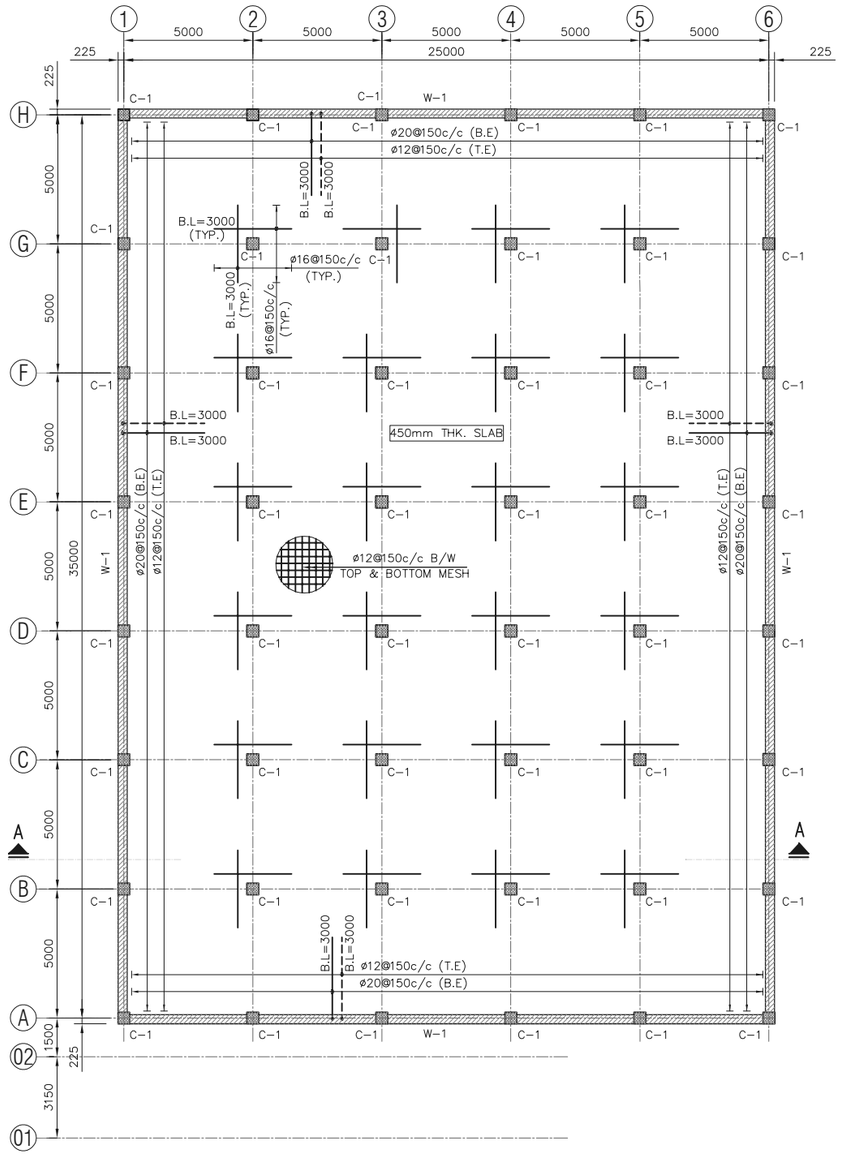
CONSULTANT:
CGD CONSULTING
ARCHITECTURE-ENGINEERING-PLANNING-MANAGEMENT
Plot # 7-C,5th Zulfiqar Commercial Street, Phase VIII-A, DHA,Karachi - Pakisten

Designed By:	Checked By:	Date:	
F.A	T.S	DEC-2025	
Drawn By :	Scale:	Job No:	Sheet
Z.A			A3

DRAWING No: EC-STZ-EXT-STR-IRTW-ST-01 | Revision 00

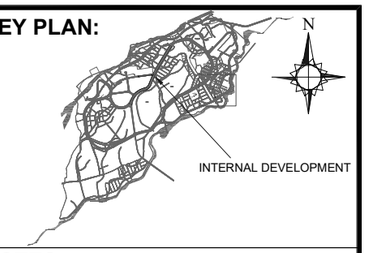


TOP SLAB PLAN



FOUNDATION PLAN

KEY PLAN:



NOTES:

1 - FOR GENERAL NOTES REFER DWG.NO: EC-STZ-EXT-STR-GN-01 & GN-02.

2 - READ THIS DRAWING IN CONJUNCTION WITH ALL OTHER DISCIPLINE DRAWINGS.

3- MINIMUM COMPRESSIVE CYLINDRICAL STRENGTH OF CONCRETE AFTER 28 DAYS (FC') SHALL NOT BE LESS THAN 4000 PSI EQUIVALENT TO CONCRETE A3 CLASS.

4 - B.L STANDS FOR BAR LENGTH.

5 - B.E STANDS FOR BOTTOM EXTRA BARS.

6 - T.E STANDS FOR TOP EXTRA BARS.

LEGENDS:

REVISION	DATE	DESCRIPTION	NAME

PROJECT:
EDUCATION CITY PROJECT

CLIENT:
PROJECT IMPLEMENTATION UNIT

NAME OF WORK:
EDUCATION CITY
SPECIAL TECHNOLOGY ZONE (STZ) EXT.
(INTERNAL DEVELOPMENT)

DRAWING STATUS:
TENDER DRAWINGS

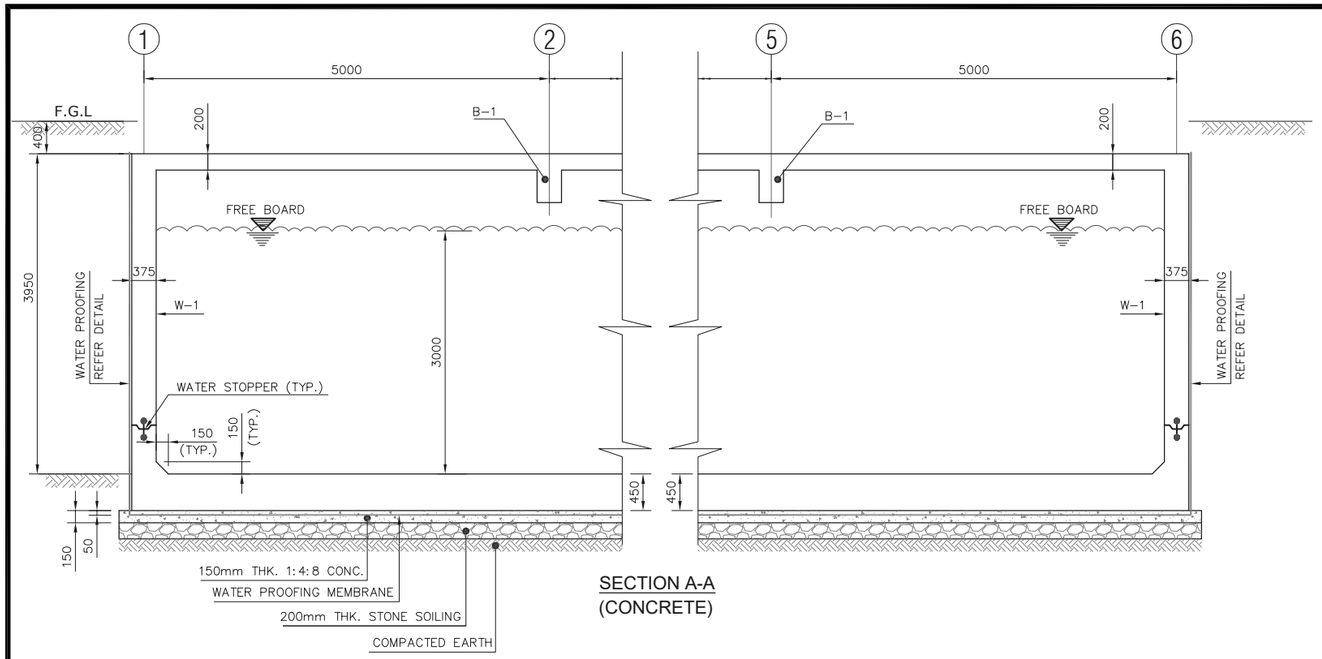
DISCIPLINE:
STRUCTURE

DRAWING TITLE:
FOUNDATION & TOP SLAB PLAN
OF
WATER RESERVOIR

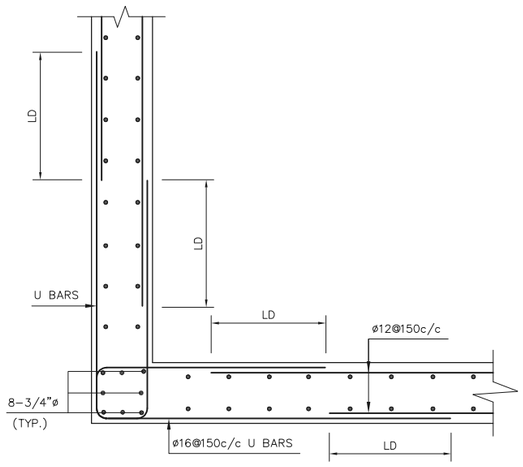
CONSULTANT:
CGD CONSULTING
ARCHITECTURE-ENGINEERING-PLANNING-MANAGEMENT
Plot # 7-C,5th Zulfiqar Commercial Street,
Phase VIII-A, DHA,Karachi - Pakisten

Designed By:	Checked By:	Date:	
F.A	T.S	DEC-2025	
Drawn By:	Scale:	Job No:	Sheet
Z.A	N.T.S		A3

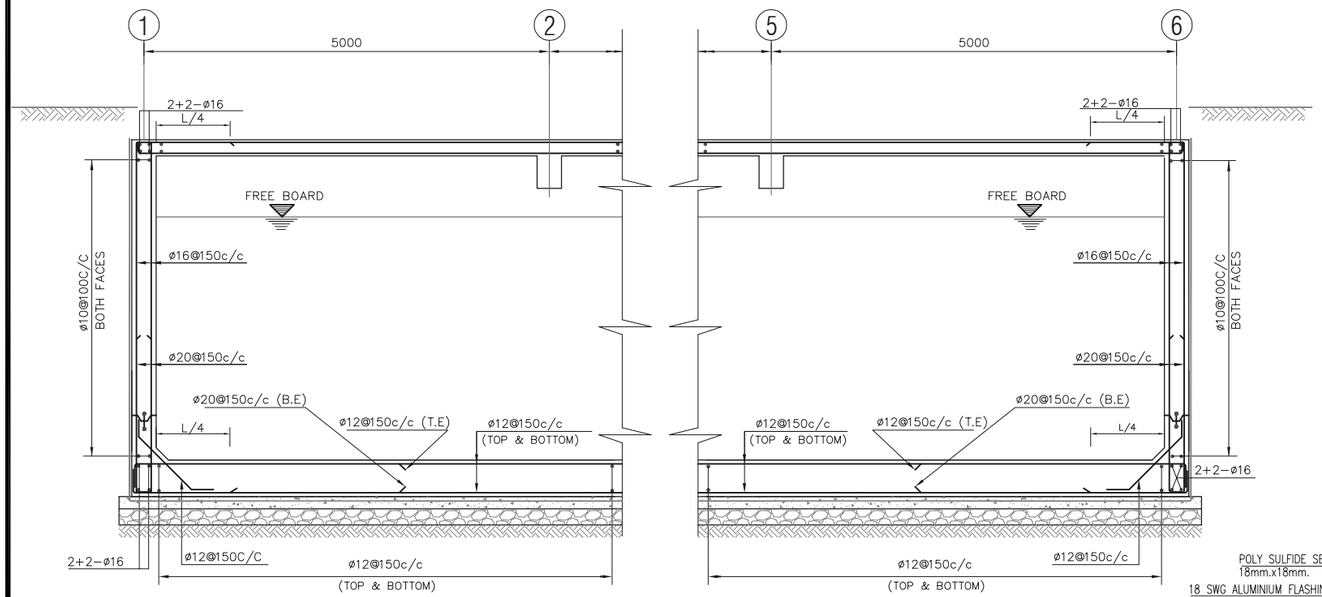
DRAWING No: EC-STZ-EXT-STR-WR1-ST-01
Revision: 00



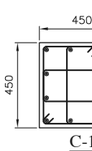
SECTION A-A
(CONCRETE)



TYPICAL R.C.C WALL
CORNER DETAIL

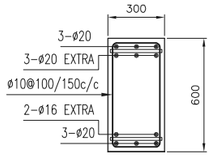


SECTION A-A
(REINFORCEMENT)

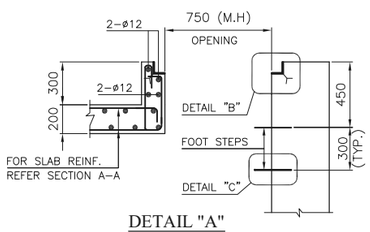


C-1

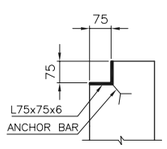
VERTICAL : 12-Ø16
RINGS : Ø10@150c/c



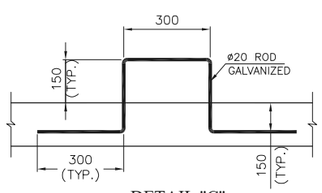
SECTION OF B-1



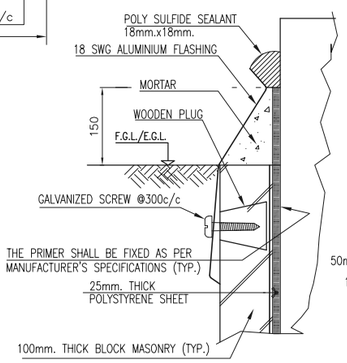
DETAIL "A"



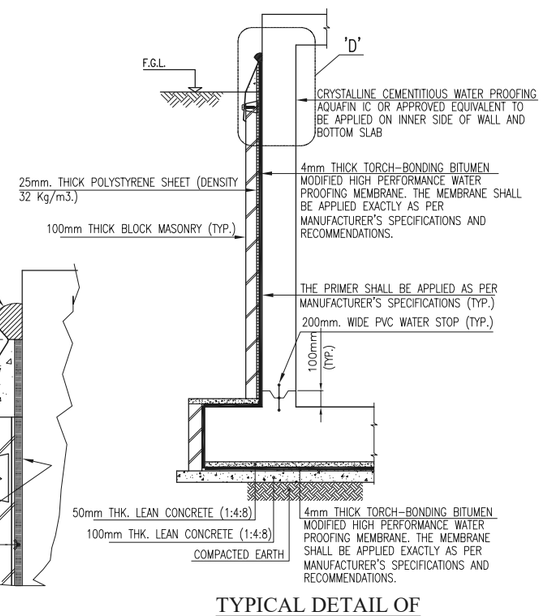
DETAIL "B"



DETAIL "C"

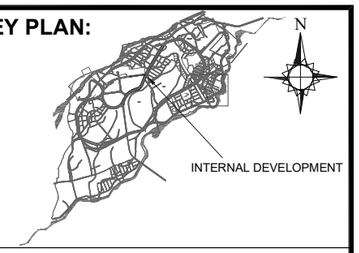


DETAIL 'D'



TYPICAL DETAIL OF
WATER PROOFING

KEY PLAN:



NOTES:

1 - FOR GENERAL NOTES REFER DWG.NO: EC-STZ-EXT-STR-GN-01 & GN-02.

2 - READ THIS DRAWING IN CONJUNCTION WITH ALL OTHER DISCIPLINE DRAWINGS.

3- MINIMUM COMPRESSIVE CYLINDRICAL STRENGTH OF CONCRETE AFTER 28 DAYS (FC') SHALL NOT BE LESS THAN 4000 PSI EQUIVALENT TO CONCRETE A3 CLASS.

LEGENDS:

REVISION	DATE	DESCRIPTION	NAME

PROJECT:
EDUCATION CITY PROJECT

CLIENT:
PROJECT IMPLEMENTATION UNIT

NAME OF WORK:
EDUCATION CITY
SPECIAL TECHNOLOGY ZONE (STZ) EXT.
(INTERNAL DEVELOPMENT)

DRAWING STATUS:
TENDER DRAWINGS

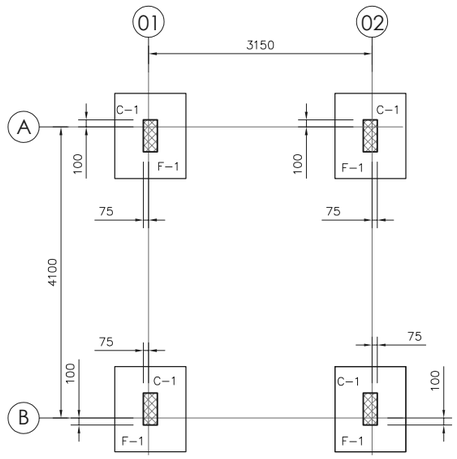
DISCIPLINE:
STRUCTURE

DRAWING TITLE:
SECTIONS & DETAILS
OF
WATER RESERVOIR

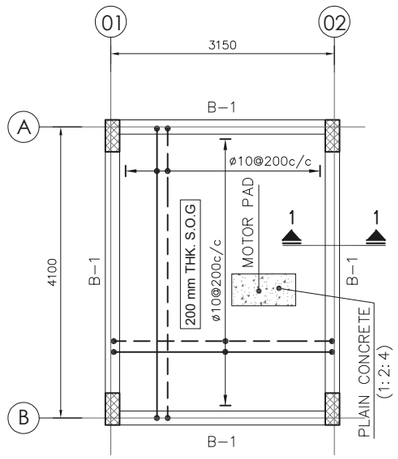
CONSULTANT:
CGD CONSULTING
ARCHITECTURE-ENGINEERING-PLANNING-MANAGEMENT
Plot # 7-C,5th Zulfiqar Commercial Street,
Phase VIII-A, DHA,Karachi - Pakistan

Designed By:	Checked By:	Date:	
F.A	T.S	DEC-2025	
Drawn By :	Scale:	Job No:	Sheet
Z.A	N.T.S		A3

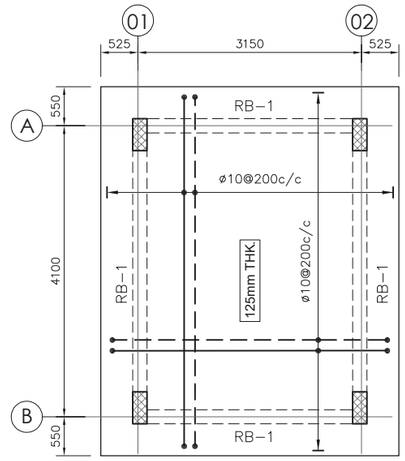
DRAWING No: EC-STZ-EXT-STR-WR1-ST-02
Revision: 00



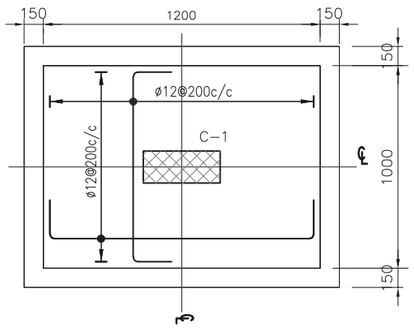
FOUNDATION & COLUMN LAYOUT PLAN



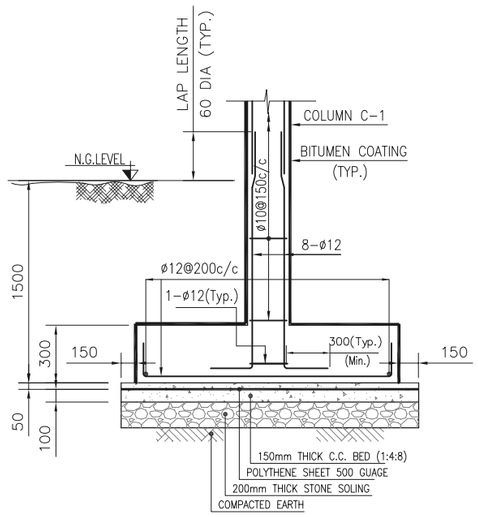
PUMP ROOM BOTTOM PLAN



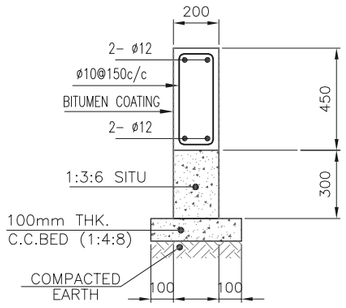
PUMP ROOM ROOF PLAN



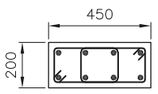
PLAN OF FOOTING (F-1)



SECTION OF FOOTING (F-1)

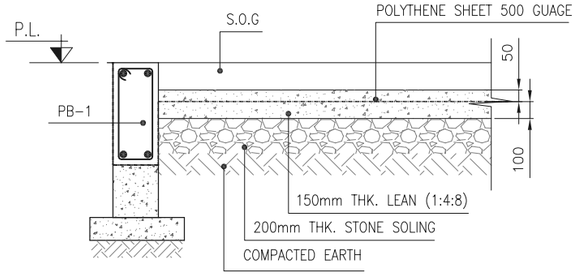


SECTION OF PB-1

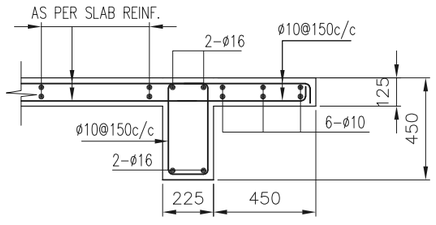


VERTICAL : 8- Ø12
RINGS : Ø10@150c/c

SECTION OF C-1

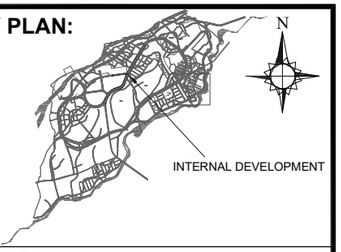


SECTION 1-1



SECTION OF RB-1

KEY PLAN:



NOTES:

1 - FOR GENERAL NOTES REFER DWG.NO: EC-STZ-EXT-STR-GN-01 & GN-02.

2 - READ THIS DRAWING IN CONJUNCTION WITH ALL OTHER DISCIPLINE DRAWINGS.

LEGENDS:

REVISION	DATE	DESCRIPTION	NAME

PROJECT:
EDUCATION CITY PROJECT

CLIENT:
PROJECT IMPLEMENTATION UNIT

NAME OF WORK:
EDUCATION CITY
SPECIAL TECHNOLOGY ZONE (STZ) EXT.
(INTERNAL DEVELOPMENT)

DRAWING STATUS: TENDER DRAWINGS

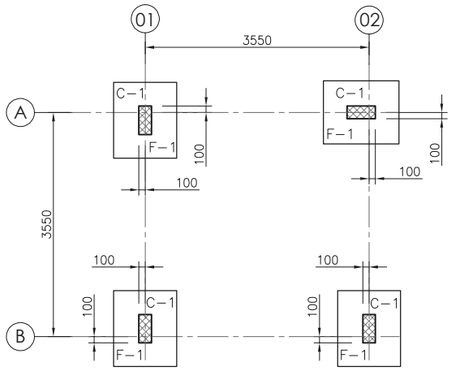
DISCIPLINE: STRUCTURE

DRAWING TITLE:
PLANS & SECTIONS OF
PUMP ROOM OF
WATER RESERVOIR

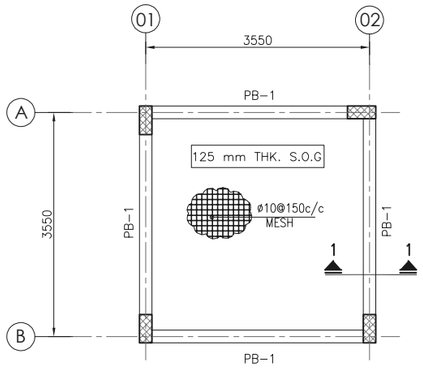
CONSULTANT:
CGD CONSULTING
ARCHITECTURE-ENGINEERING-PLANNING-MANAGEMENT
Plot # 7-C,5th Zulfiqar Commercial Street,
Phase VIII-A, DHA,Karachi - Pakisten

Designed By:	Checked By:	Date:	
F.A	T.S	DEC-2025	
Drawn By :	Scale:	Job No:	Sheet
Z.A	N.T.S		A3

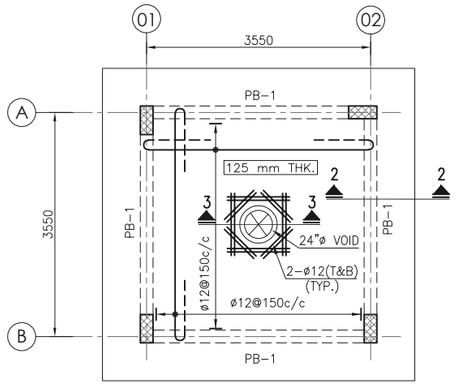
DRAWING No: EC-STZ-EXT-STR-WR1-ST-03 | Revision 00



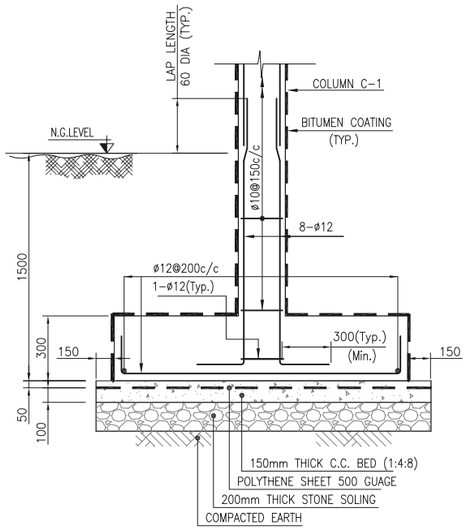
FOUNDATION & COLUMN LAYOUT PLAN



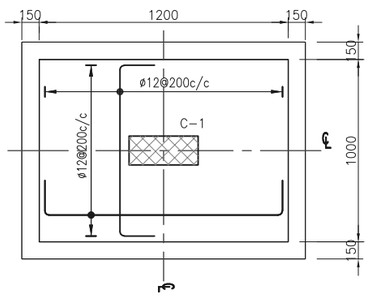
PLINTH BEAM PLAN (LEV.+0.375)



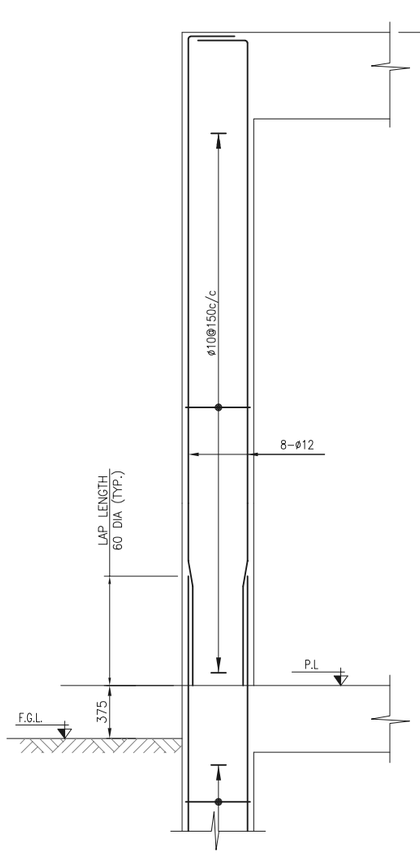
ROOF PLAN



SECTION OF FOOTING (F-1)

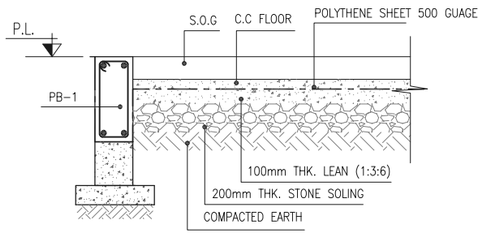


PLAN OF FOOTING (F-1)

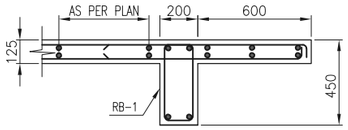


UNLESS OTHERWISE MANTIONED
* COLUMNS RINGS ARE SPECIFIED AS 3/8"ø @ S (Lo).
* WHEREVER COLUMN RINGS ARE SPECIFIED AS 3/8"ø @ S", USE RINGS THRUOUT AT SPACING OF S.

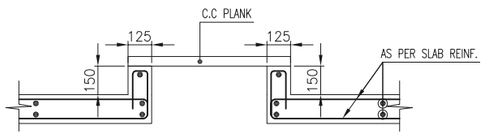
TYPICAL COLUMN DETAIL



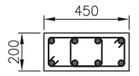
SECTION 1-1



SECTION 2-2

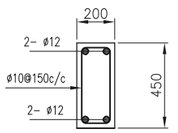


SECTION 3-3

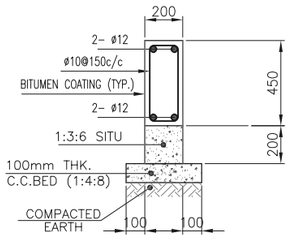


VERTICAL : 8- Ø12
RINGS : Ø10@150c/c

SECTION OF C-1

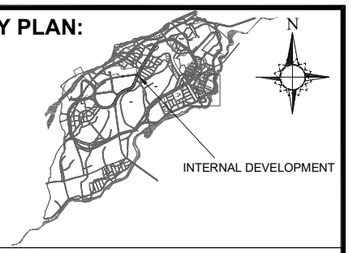


SECTION OF RB-1



SECTION OF PB-1

KEY PLAN:



NOTES:

1 - FOR GENERAL NOTES REFER DWG.NO: EC-STZ-EXT-STR-GN-01 & GN-02.

2 - READ THIS DRAWING IN CONJUNCTION WITH ALL OTHER DISCIPLINE DRAWINGS.

3- REINFORCED CONCRETE FOR MANHOLE SHOULD HAVE MINIMUM 28 DAYS CYLINDER STRENGTH OF 3000 PSI EQUIVALENT TO CONCRETE A1 CLASS. (AS PER NHA SPECIFICATIONS)

4 - FOR LOCATION OF RESERVOIR REFER DWG.NO: EC-STZ-PH-(I)-TW-KP-01

LEGENDS:

REVISION	DATE	DESCRIPTION	NAME

PROJECT:
EDUCATION CITY PROJECT

CLIENT:
PROJECT IMPLEMENTATION UNIT

NAME OF WORK:
EDUCATION CITY
SPECIAL TECHNOLOGY ZONE (STZ) EXT.
(INTERNAL DEVELOPMENT)

DRAWING STATUS:
TENDER DRAWINGS

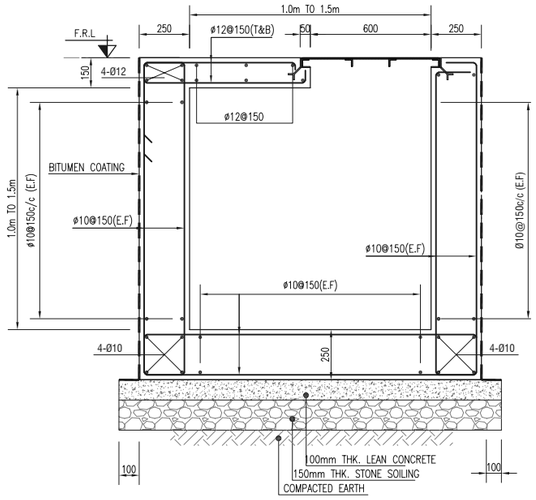
DISCIPLINE:
STRUCTURE

DRAWING TITLE:
PLAN & DETAILS OF TUBE WELL ROOM
(WATER RESERVOIR)

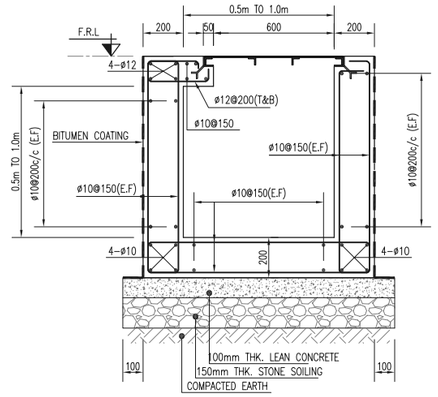
CONSULTANT:
CGD CONSULTING
ARCHITECTURE-ENGINEERING-PLANNING-MANAGEMENT
Plot # 7-C,5th Zulfiqar Commercial Street,
Phase VIII-A, DHA,Karachi - Pakisten

Designed By:	Checked By:	Date:	
F.A	T.S	DEC-2025	
Drawn By:	Scale:	Job No:	Sheet
Z.A			A3

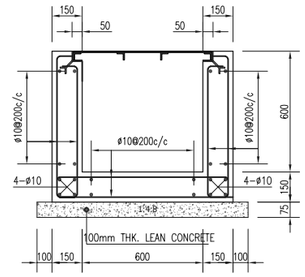
DRAWING No: EC-STZ-EXT-STR-WRTW-ST-01 | Revision 00



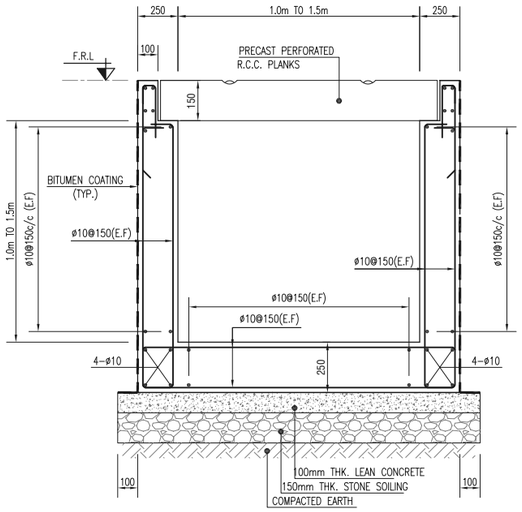
SECTION 1-1 OF STROM WATER DRAIN
(AT GRATING)



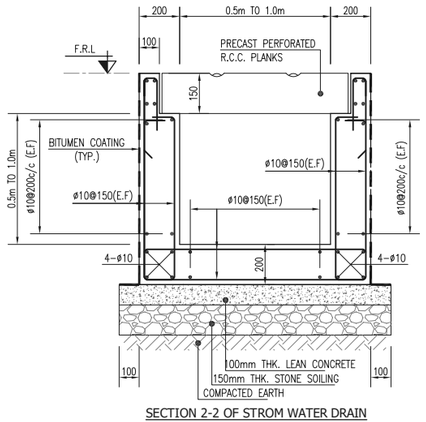
SECTION 2-2 OF STROM WATER DRAIN
(AT GRATING)



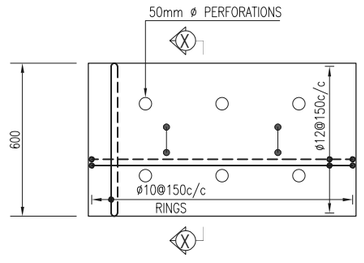
SECTION OF CATCH BASIN



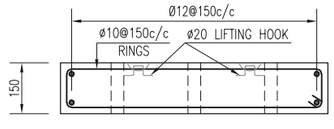
SECTION 1-1 OF STROM WATER DRAIN



SECTION 2-2 OF STROM WATER DRAIN

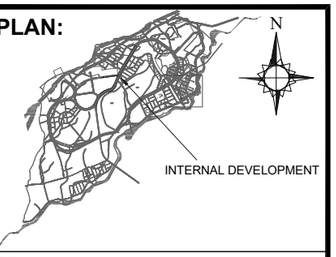


TYP. DETAIL OF R.C.C. PLANK
WITH PERFORATIONS



SECTION X-X

KEY PLAN:



NOTES:

1- READ THIS DRAWING IN CONJUNCTION WITH ARCHITECTURAL, ELECTRICAL AND PLUMBING DRAWINGS.

2- FOR LAYOUT OF STORM WATER DRAIN & CATCH BASIN REFER INFRASTRUCTURE- WEIGHT UTILITY DRAWINGS.

3- MINIMUM COMPRESSIVE CYLINDRICAL STRENGTH OF CONCRETE AFTER 28 DAYS (FC') SHALL NOT BE LESS THAN 4000 Psi.

4- PROVIDE THE EXPANSION JOINT AT EVERY 30 M.

LEGENDS:

REVISION	DATE	DESCRIPTION	NAME

PROJECT:
EDUCATION CITY PROJECT

CLIENT:
PROJECT
IMPLEMENTATION UNIT

NAME OF WORK:
EDUCATION CITY
SPECIAL TECHNOLOGY ZONE (STZ) EXT.
(INTERNAL DEVELOPMENT)

DRAWING STATUS:
TENDER DRAWINGS

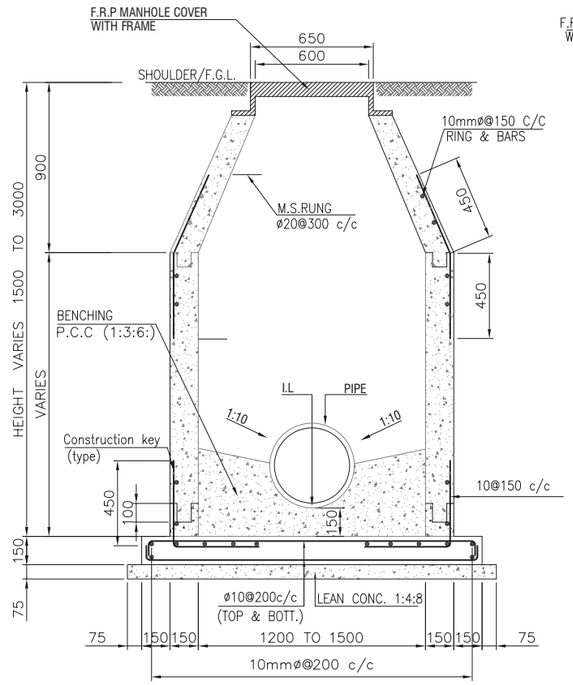
DISCIPLINE:
STRUCTURE

DRAWING TITLE:
SECTIONS & DETAILS OF STROM WATER DRAIN

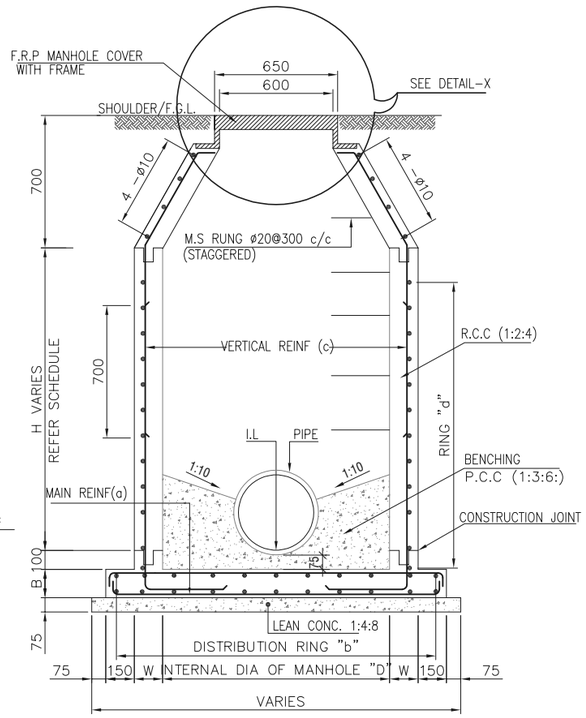
CONSULTANT:
CGD CONSULTING
ARCHITECTURE-ENGINEERING-PLANNING-MANAGEMENT
Plot # 7-C,5th Zulfiqar Commercial Street,
Phase VIII-A, DHA,Karachi - Pakistan

Designed By:	Checked By:	Date:	
F.A	T.S	DEC-2025	
Drawn By :	Scale:	Job No:	Sheet
Z.A			A3

DRAWING No: EC-STZ-EXT-STR-SWD-ST-01 | Revision 00



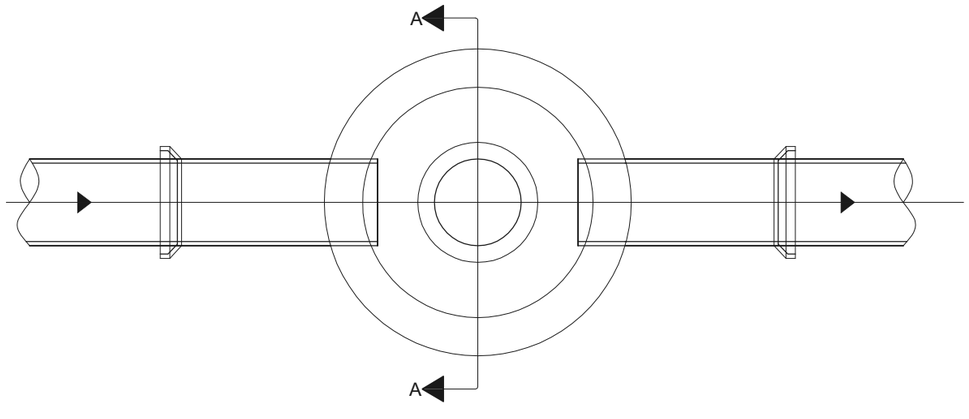
SECTION A-A
TYPE -A



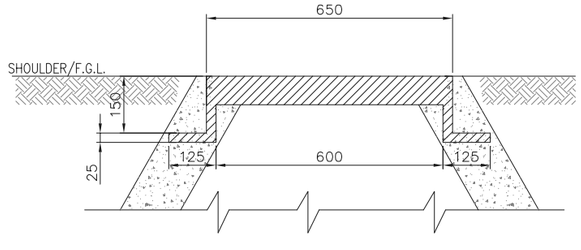
SECTION A-A
TYPE -B

SCHEDULE OF MANHOLE-TYPE-B

Sr .No	DEPTH OF MAIN HOLE "H"	INTERNAL DIA OF MAIN HOLE "D"	THICKNESS OF WALL "W"	BASE SLAB "B"	WALL REINFORCEMENT		BASE REINFORCEMENT	
					VERTICAL REINF.(c)	RING REINF.(d)	MAIN REINF.(a)	MAIN REINF.(b)
1	3000<H≤6000	1200	150	150	ø10@250c/c	ø10@250c/c	ø10@250c/c	ø10@250c/c
2	6000<H≤6500	1200	200	200	ø10@250c/c	ø10@250c/c	ø10@250c/c	ø10@250c/c
3	6500<H≤7000	1200	200	200	ø10@250c/c	ø10@250c/c	ø10@250c/c	ø10@250c/c
4	7000<H≤7500	1200	200	200	ø10@250c/c	ø10@250c/c	ø10@250c/c	ø10@250c/c
5	7500<H≤8000	1200	200	200	ø10@250c/c	ø10@250c/c	ø10@250c/c	ø10@250c/c
6	8000<H≤8500	1200	200	200	ø10@250c/c	ø10@250c/c	ø10@250c/c	ø10@250c/c
7	8500<H≤9000	1200	200	200	ø10@250c/c	ø10@250c/c	ø10@250c/c	ø10@250c/c
8	9000<H≤9500	1200	200	200	ø10@250c/c	ø10@250c/c	ø10@250c/c	ø10@250c/c
9	9500<H≤10000	1200	200	200	ø10@250c/c	ø10@250c/c	ø10@250c/c	ø10@250c/c
10	3000<H≤6000	1500	150	150	ø10@250c/c	ø10@250c/c	ø10@250c/c	ø10@250c/c
11	6000<H≤6500	1500	200	200	ø10@250c/c	ø10@250c/c	ø10@250c/c	ø10@250c/c
12	6500<H≤7000	1500	200	200	ø10@250c/c	ø10@250c/c	ø10@250c/c	ø10@250c/c
13	7000<H≤7500	1500	200	200	ø10@250c/c	ø10@250c/c	ø10@250c/c	ø10@250c/c
14	7500<H≤8000	1500	200	200	ø10@250c/c	ø10@200c/c	ø10@250c/c	ø10@250c/c
15	8000<H≤8500	1500	200	200	ø10@250c/c	ø10@200c/c	ø10@200c/c	ø10@200c/c
16	8500<H≤9000	1500	200	200	ø10@250c/c	ø10@175c/c	ø10@200c/c	ø10@200c/c
17	9000<H≤9500	1500	200	200	ø10@250c/c	ø10@175c/c	ø10@200c/c	ø10@200c/c
18	9500<H≤10000	1500	200	200	ø10@250c/c	ø10@150c/c	ø10@200c/c	ø10@200c/c
19	3000<H≤4000	2000	150	150	ø10@250c/c	ø10@200c/c	ø10@200c/c	ø10@200c/c
20	4000<H≤5000	2000	200	200	ø10@250c/c	ø10@200c/c	ø10@200c/c	ø10@200c/c
21	5000<H≤6000	2000	250	250	ø10@250c/c	ø10@150c/c	ø10@150c/c	ø10@150c/c
22	6000<H≤7000	2000	250	250	ø10@250c/c	ø10@150c/c	ø10@150c/c	ø10@150c/c
23	7000<H≤8000	2000	300	300	ø10@200c/c	ø12@200c/c	ø12@200c/c	ø12@200c/c
24	8000<H≤9000	2000	300	300	ø10@150c/c	ø12@150c/c	ø12@200c/c	ø12@200c/c
25	9000<H≤10000	2000	375	375	ø10@150c/c	ø12@150c/c	ø12@150c/c	ø12@150c/c
26	10000<H≤11000	2000	375	375	ø10@150c/c	ø12@125c/c	ø12@150c/c	ø12@150c/c
27	11000<H≤12000	2000	400	400	ø10@150c/c	ø12@125c/c	ø16@200c/c	ø16@200c/c

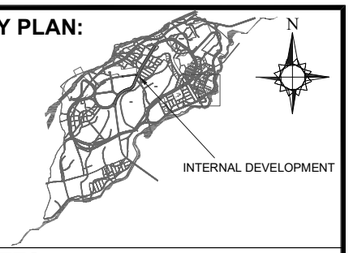


PLAN MANHOLE



F.R.P MANHOLE COVER
DETAIL-X

KEY PLAN:



NOTES:

1 - READ THIS DRAWING IN CONJUNCTION WITH ARCHITECTURAL, ELECTRICAL AND PLUMBING DRAWINGS.

2- DEPTH OF MANHOLE TO BE CONSIDERED FROM INVERT LEVEL TO ROAD FINISHED LEVEL.

3- FOR LAYOUT OF MAINHOLE REFER INFRASTRUCTURE- WEIGHT UTILITY DRAWINGS.

4- MINIMUM COMPRESSIVE CYLINDRICAL STRENGTH OF CONCRETE AFTER 28 DAYS (FC') SHALL NOT BE LESS THAN 3000 Psi.

LEGENDS:

REVISION	DATE	DESCRIPTION	NAME

PROJECT:
EDUCATION CITY PROJECT

CLIENT:
PROJECT IMPLEMENTATION UNIT

NAME OF WORK:
EDUCATION CITY
SPECIAL TECHNOLOGY ZONE (STZ) EXT.
(INTERNAL DEVELOPMENT)

DRAWING STATUS: TENDER DRAWINGS

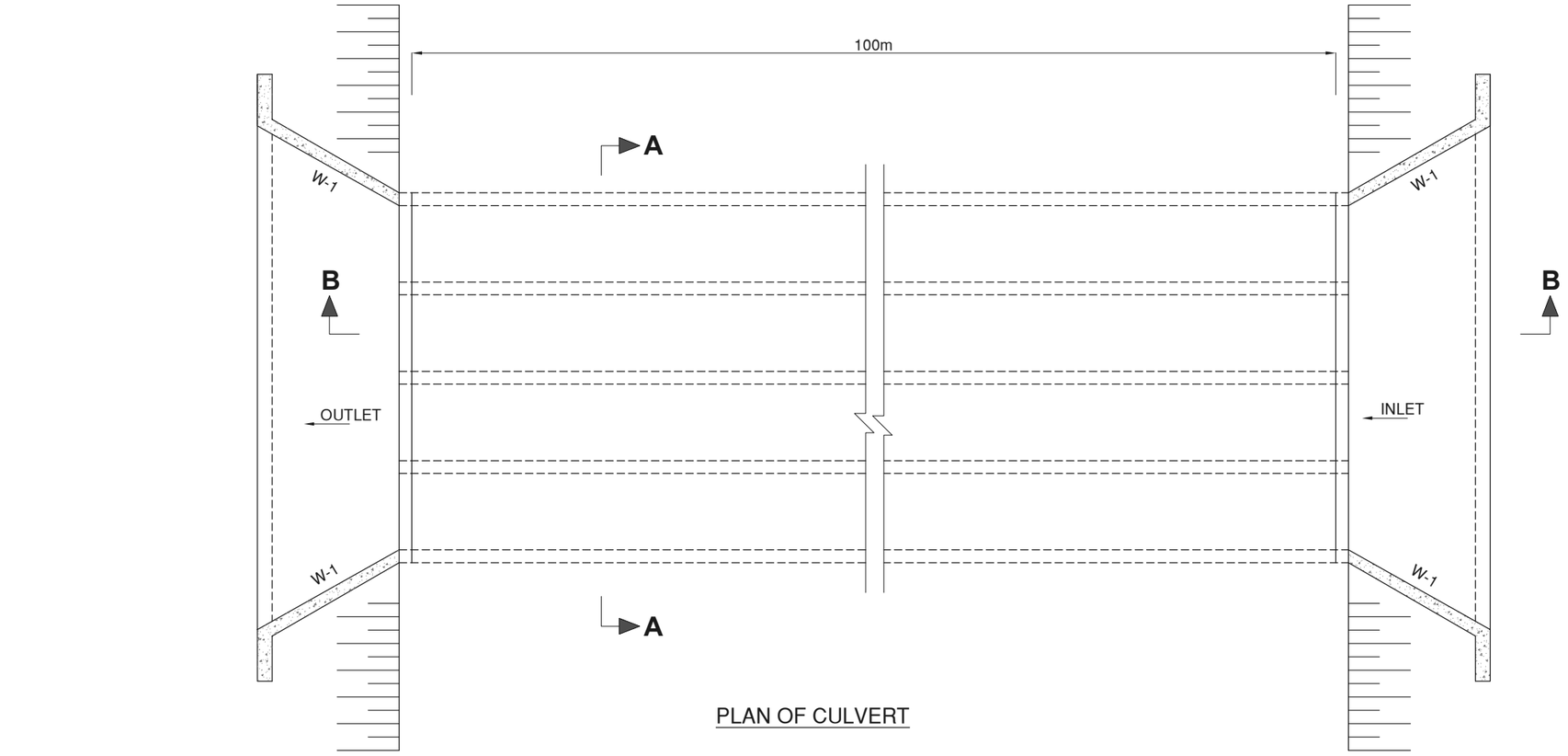
DISCIPLINE: STRUCTURE

DRAWING TITLE:
DETAIL OF MANHOLE
TYPE-A & B
SEWERAGE SYSTEM

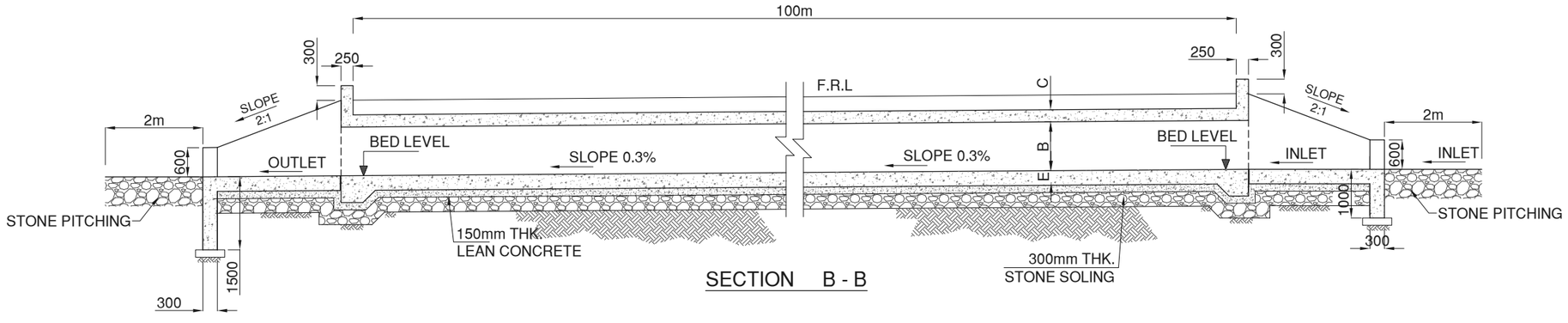
CONSULTANT:
CGD CONSULTING
ARCHITECTURE-ENGINEERING-PLANNING-MANAGEMENT
Plot # 7-C,5th Zulfiqar Commercial Street,
Phase VIII-A, DHA,Karachi - Pakisten

Designed By:	Checked By:	Date:	
F.A	T.S	DEC-2025	
Drawn By :	Scale:	Job No:	Sheet
Z.A			A3

DRAWING No: EC-STZ-EXT-STR-MH-ST-01
Revision: 00

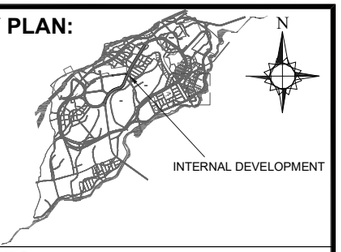


PLAN OF CULVERT



SECTION B - B

KEY PLAN:



NOTES:

1- READ THIS DRAWING IN CONJUNCTION WITH ARCHITECTURAL, ELECTRICAL AND PLUMBING DRAWINGS.

2- MINIMUM COMPRESSIVE CYLINDRICAL STRENGTH OF CONCRETE AFTER 28 DAYS (FC') SHALL NOT BE LESS THAN 4000 Psi.

LEGENDS:

REVISION	DATE	DESCRIPTION	NAME

PROJECT:
EDUCATION CITY PROJECT

CLIENT:
PROJECT IMPLEMENTATION UNIT

NAME OF WORK:
EDUCATION CITY
SPECIAL TECHNOLOGY ZONE (STZ) EXT.
(INTERNAL DEVELOPMENT)

DRAWING STATUS: TENDER DRAWINGS

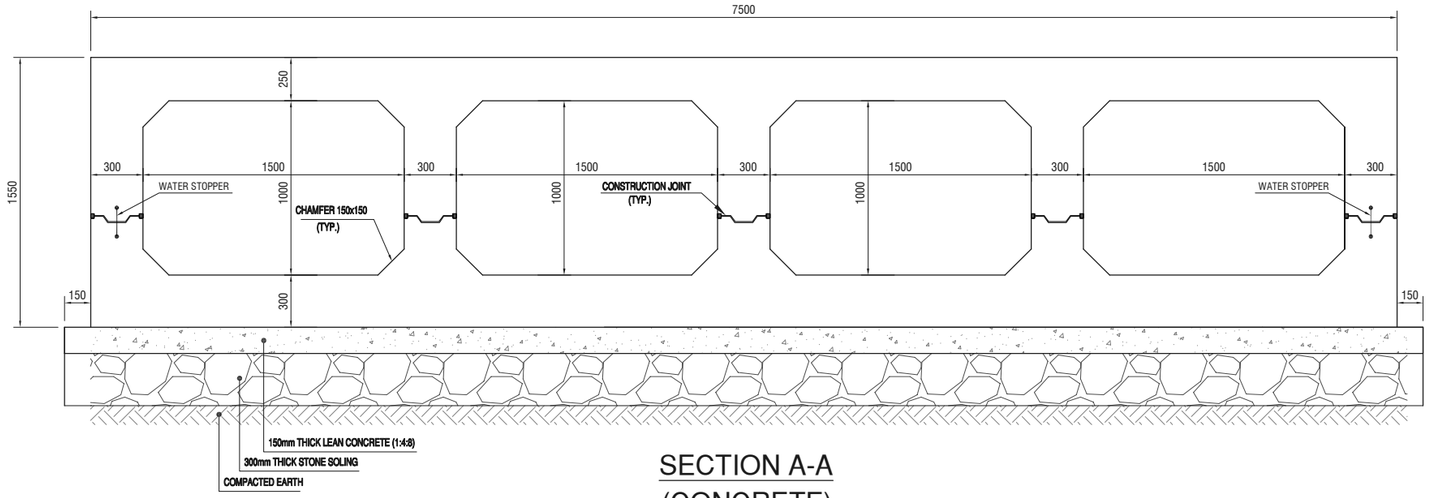
DISCIPLINE: STRUCTURE

DRAWING TITLE:
PLAN & SECTION OF 4 CELL
BOX CULVERT

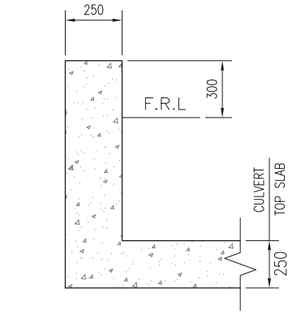
CONSULTANT:
CGD CONSULTING
ARCHITECTURE-ENGINEERING-PLANNING-MANAGEMENT
Plot # 7-C,5th Zulfiqar Commercial Street,
Phase VIII-A, DHA,Karachi - Pakistan

Designed By:	Checked By:	Date:	
F.A	T.S	DEC-2025	
Drawn By :	Scale:	Job No:	Sheet
Z.A			A3

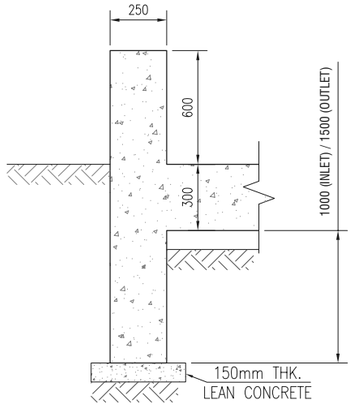
DRAWING No: EC-STZ-EXT-STR-CUL4-ST-01 | Revision 00



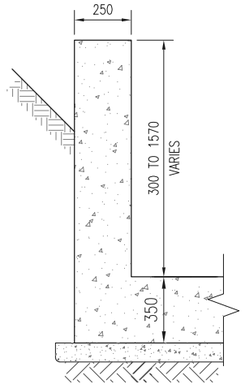
SECTION A-A
(CONCRETE)



TYPICAL SECTION OF BEAM B1

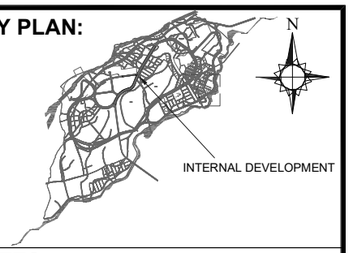


TYPICAL SECTION OF WING WALL W2



TYPICAL SECTION OF WING WALL W1

KEY PLAN:



NOTES:

1- READ THIS DRAWING IN CONJUNCTION WITH ARCHITECTURAL, ELECTRICAL AND PLUMBING DRAWINGS.

2- MINIMUM COMPRESSIVE CYLINDRICAL STRENGTH OF CONCRETE AFTER 28 DAYS (FC') SHALL NOT BE LESS THAN 4000 Psi.

LEGENDS:

REVISION	DATE	DESCRIPTION	NAME

PROJECT:
EDUCATION CITY PROJECT

CLIENT:
PROJECT IMPLEMENTATION UNIT

NAME OF WORK:
EDUCATION CITY
SPECIAL TECHNOLOGY ZONE (STZ) EXT.
(INTERNAL DEVELOPMENT)

DRAWING STATUS:
TENDER DRAWINGS

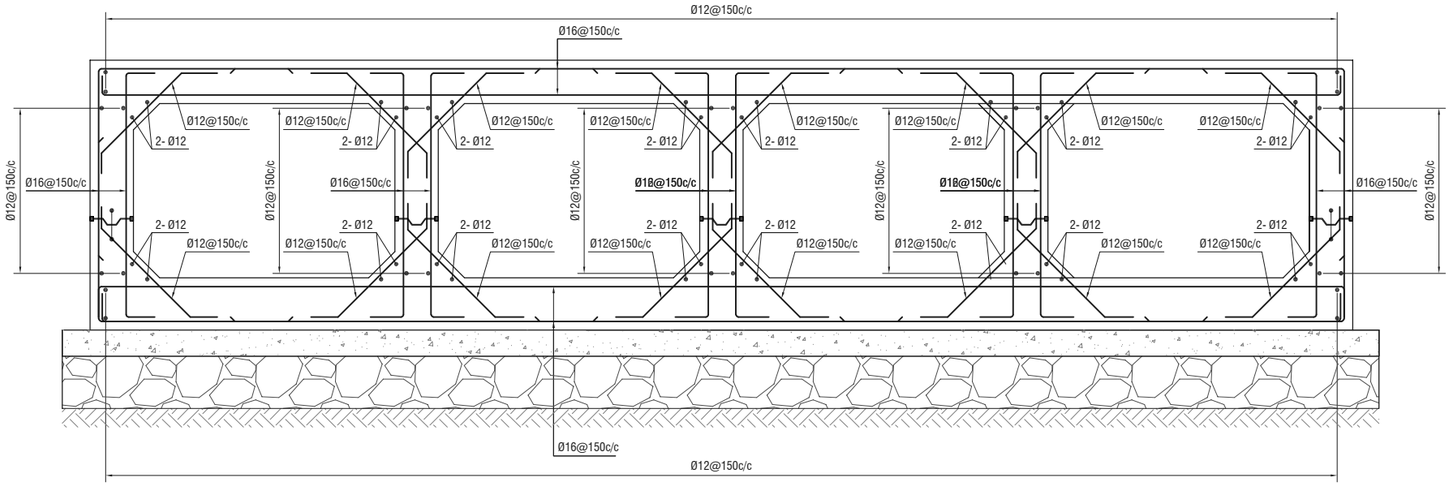
DISCIPLINE:
STRUCTURE

DRAWING TITLE:
SECTIONS & DETAILS OF 4 CELL BOX CULVERT
(CONCRETE)

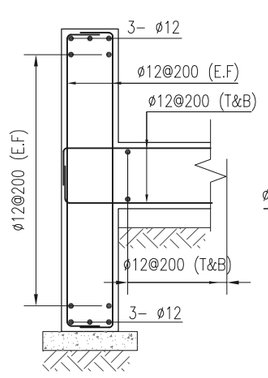
CONSULTANT:
CGD CONSULTING
ARCHITECTURE-ENGINEERING-PLANNING-MANAGEMENT
Plot # 7-C,5th Zulfiqar Commercial Street,
Phase VIII-A, DHA,Karachi - Pakisten

Designed By:	Checked By:	Date:	
F.A	T.S	DEC-2025	
Drawn By :	Scale:	Job No:	Sheet
Z.A			A3

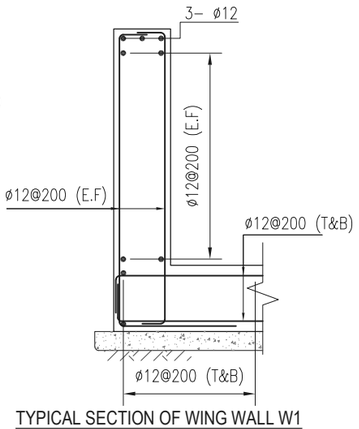
DRAWING No: EC-STZ-EXT-STR-CUL4-ST-02 | Revision 00



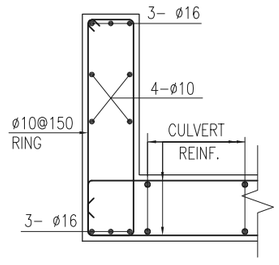
SECTION A-A
(REINFORCEMENT)



TYPICAL SECTION OF WING WALL W2

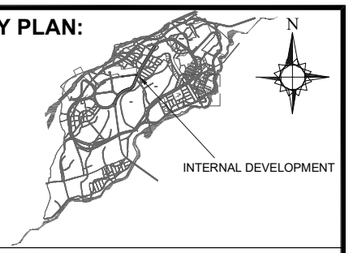


TYPICAL SECTION OF WING WALL W1



TYPICAL SECTION OF BEAM B1

KEY PLAN:



NOTES:

1- READ THIS DRAWING IN CONJUNCTION WITH ARCHITECTURAL, ELECTRICAL AND PLUMBING DRAWINGS.

LEGENDS:

REVISION	DATE	DESCRIPTION	NAME

PROJECT:
EDUCATION CITY PROJECT

CLIENT:
PROJECT IMPLEMENTATION UNIT

NAME OF WORK:
EDUCATION CITY
SPECIAL TECHNOLOGY ZONE (STZ) EXT.
(INTERNAL DEVELOPMENT)

DRAWING STATUS: TENDER DRAWINGS

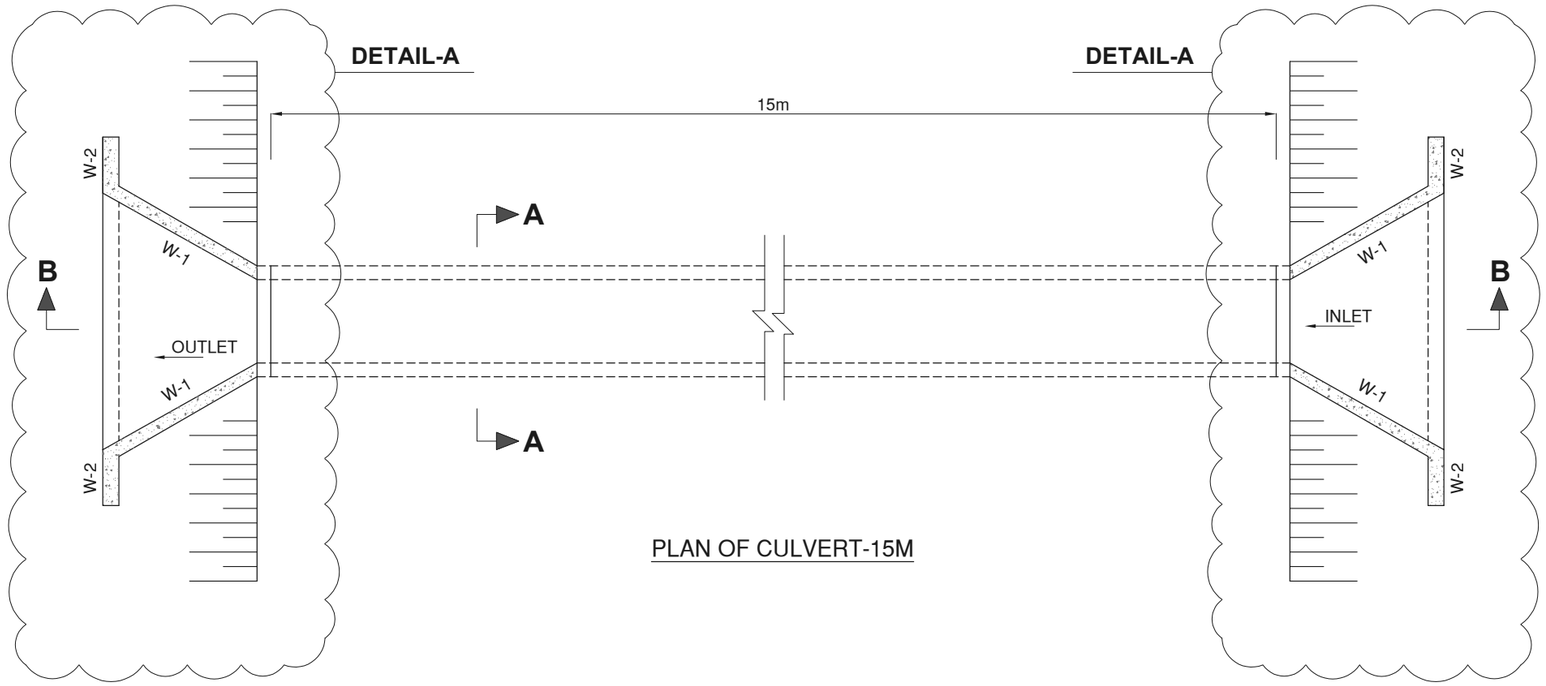
DISCIPLINE: STRUCTURE

DRAWING TITLE:
SECTIONS & DETAILS OF 4 CELL BOX CULVERT
(REINFORCEMENT)

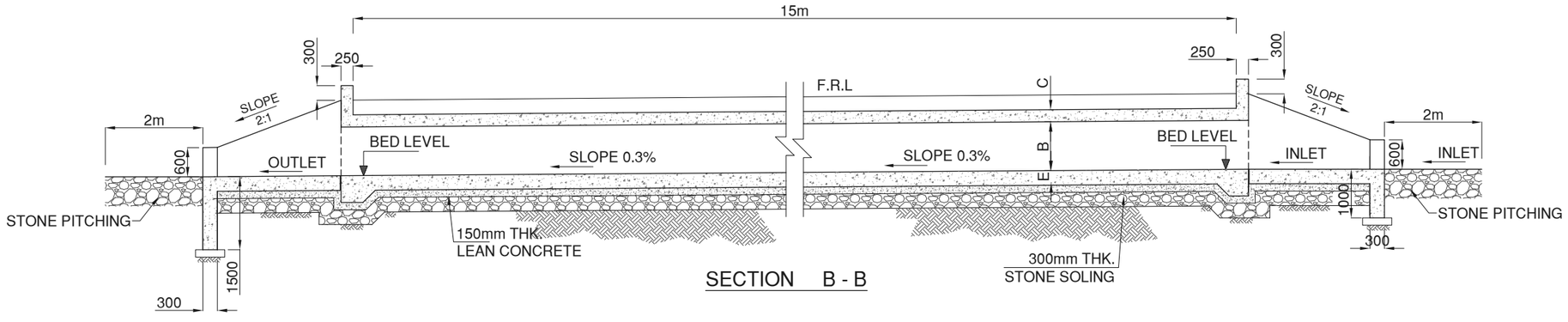
CONSULTANT:
CGD CONSULTING
ARCHITECTURE-ENGINEERING-PLANNING-MANAGEMENT
Plot # 7-C,5th Zulfiqar Commercial Street,
Phase VIII-A, DHA,Karachi - Pakisten

Designed By:	Checked By:	Date:	
F.A	T.S	DEC-2025	
Drawn By :	Scale:	Job No:	Sheet
Z.A			A3

DRAWING No: EC-STZ-EXT-STR-CUL4-ST-03 | Revision: 00

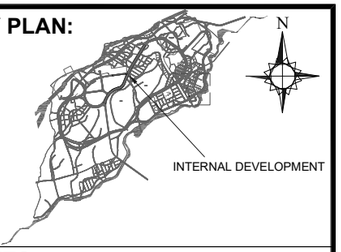


PLAN OF CULVERT-15M



SECTION B - B

KEY PLAN:



NOTES:

1- READ THIS DRAWING IN CONJUNCTION WITH ARCHITECTURAL, ELECTRICAL AND PLUMBING DRAWINGS.

2- MINIMUM COMPRESSIVE CYLINDRICAL STRENGTH OF CONCRETE AFTER 28 DAYS (FC') SHALL NOT BE LESS THAN 4000 Psi.

LEGENDS:

REVISION	DATE	DESCRIPTION	NAME

PROJECT:
EDUCATION CITY PROJECT

CLIENT:
PROJECT IMPLEMENTATION UNIT

NAME OF WORK:
EDUCATION CITY
SPECIAL TECHNOLOGY ZONE (STZ) EXT.
(INTERNAL DEVELOPMENT)

DRAWING STATUS: TENDER DRAWINGS

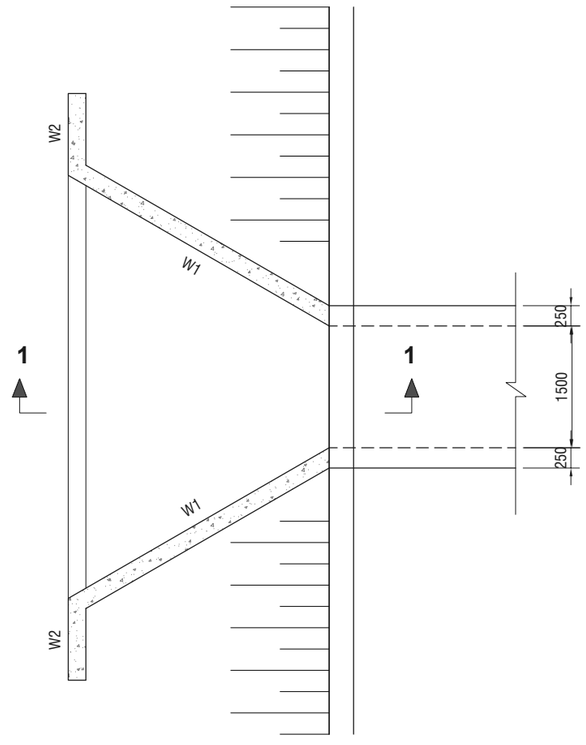
DISCIPLINE: STRUCTURE

DRAWING TITLE:
PLAN & SECTION OF 1 CELL
15M BOX CULVERT

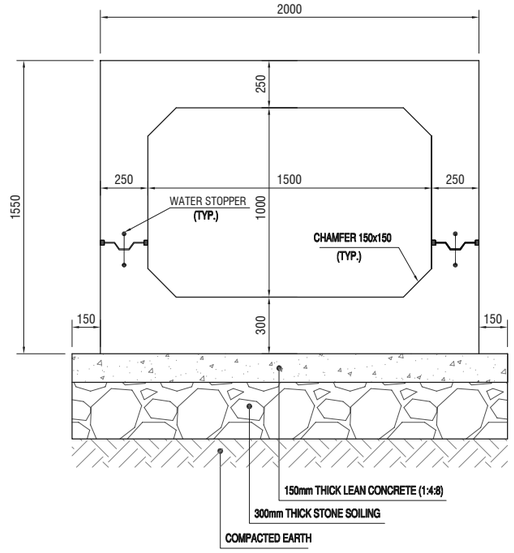
CONSULTANT:
CGD CONSULTING
ARCHITECTURE-ENGINEERING-PLANNING-MANAGEMENT
Plot # 7-C,5th Zulfiqar Commercial Street,
Phase VIII-A, DHA,Karachi - Pakistan

Designed By:	Checked By:	Date:	
F.A	T.S	DEC-2025	
Drawn By :	Scale:	Job No:	Sheet
Z.A			A3

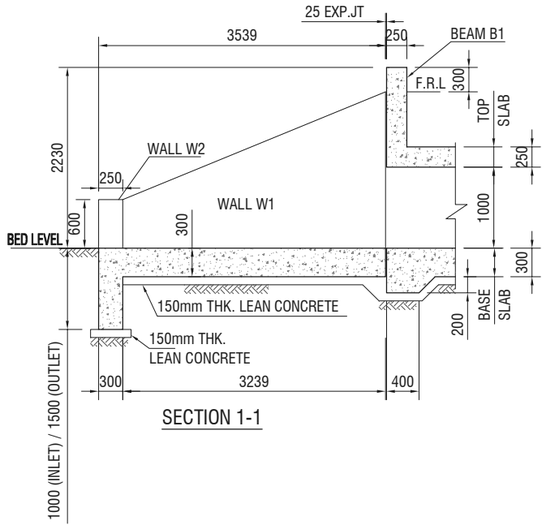
DRAWING No: EC-STZ-EXT-STR-CUL15M-ST-01 | Revision 00



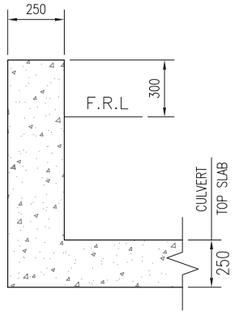
DETAIL-A



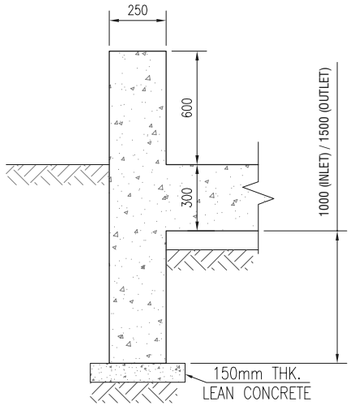
SECTION A-A
(CONCRETE)



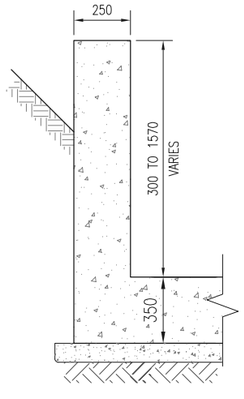
SECTION 1-1



TYPICAL SECTION OF BEAM B1

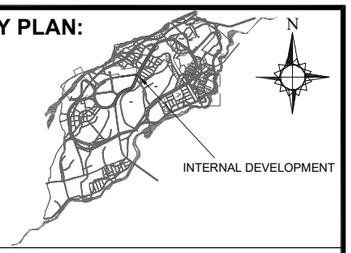


TYPICAL SECTION OF WING WALL W2



TYPICAL SECTION OF WING WALL W1

KEY PLAN:



NOTES:

1- READ THIS DRAWING IN CONJUNCTION WITH ARCHITECTURAL, ELECTRICAL AND PLUMBING DRAWINGS.

2- MINIMUM COMPRESSIVE CYLINDRICAL STRENGTH OF CONCRETE AFTER 28 DAYS (FC') SHALL NOT BE LESS THAN 4000 Psi.

LEGENDS:

REVISION	DATE	DESCRIPTION	NAME

PROJECT:
EDUCATION CITY PROJECT

CLIENT:
PROJECT IMPLEMENTATION UNIT

NAME OF WORK:
EDUCATION CITY
SPECIAL TECHNOLOGY ZONE (STZ) EXT.
(INTERNAL DEVELOPMENT)

DRAWING STATUS:
TENDER DRAWINGS

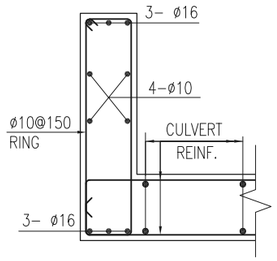
DISCIPLINE:
STRUCTURE

DRAWING TITLE:
SECTIONS & DETAILS OF 1 CELL 15M BOX CULVERT
(CONCRETE)

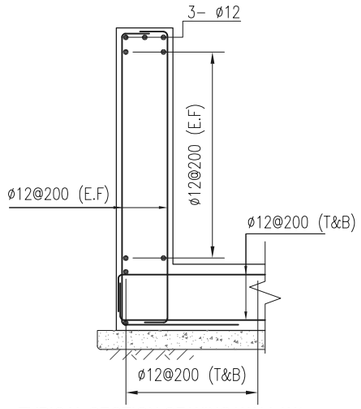
CONSULTANT:
CGD CONSULTING
ARCHITECTURE-ENGINEERING-PLANNING-MANAGEMENT
Plot # 7-C,5th Zulfiqar Commercial Street,
Phase VIII-A, DHA,Karachi - Pakisten

Designed By:	Checked By:	Date:	
F.A	T.S	DEC-2025	
Drawn By :	Scale:	Job No:	Sheet
Z.A			A3

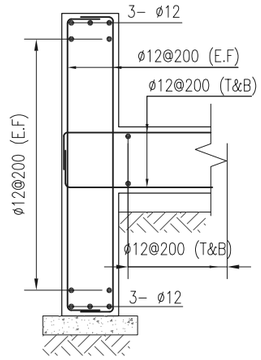
DRAWING No: EC-STZ-EXT-STR-CUL15M-ST-02 | Revision 00



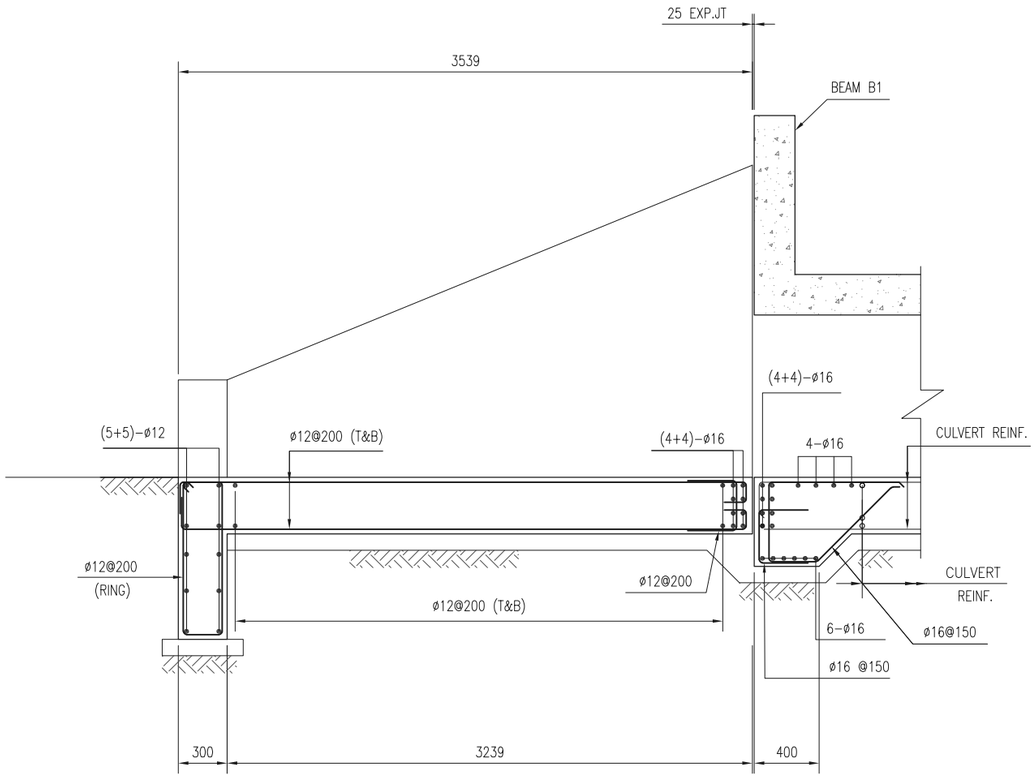
TYPICAL SECTION OF BEAM B1



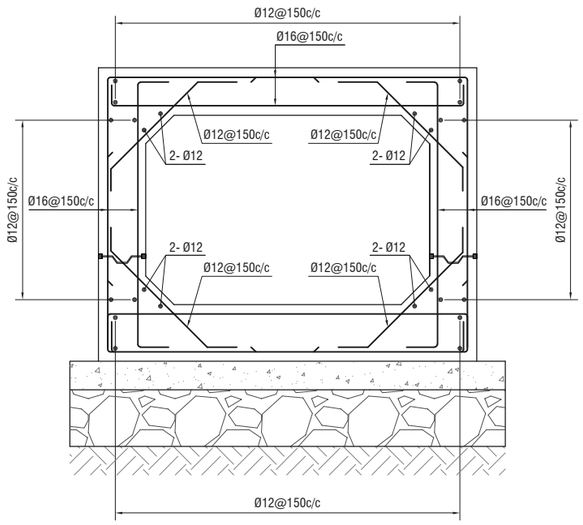
TYPICAL SECTION OF WING WALL W1



TYPICAL SECTION OF WING WALL W2

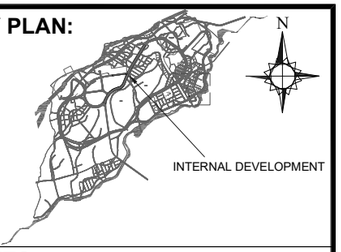


SECTION 1-1



SECTION A-A
(REINFORCEMENT)

KEY PLAN:



NOTES:

1- READ THIS DRAWING IN CONJUNCTION WITH ARCHITECTURAL, ELECTRICAL AND PLUMBING DRAWINGS.

LEGENDS:

REVISION	DATE	DESCRIPTION	NAME

PROJECT:
EDUCATION CITY PROJECT

CLIENT:
PROJECT IMPLEMENTATION UNIT

NAME OF WORK:
EDUCATION CITY
SPECIAL TECHNOLOGY ZONE (STZ) EXT.
(INTERNAL DEVELOPMENT)

DRAWING STATUS:
TENDER DRAWINGS

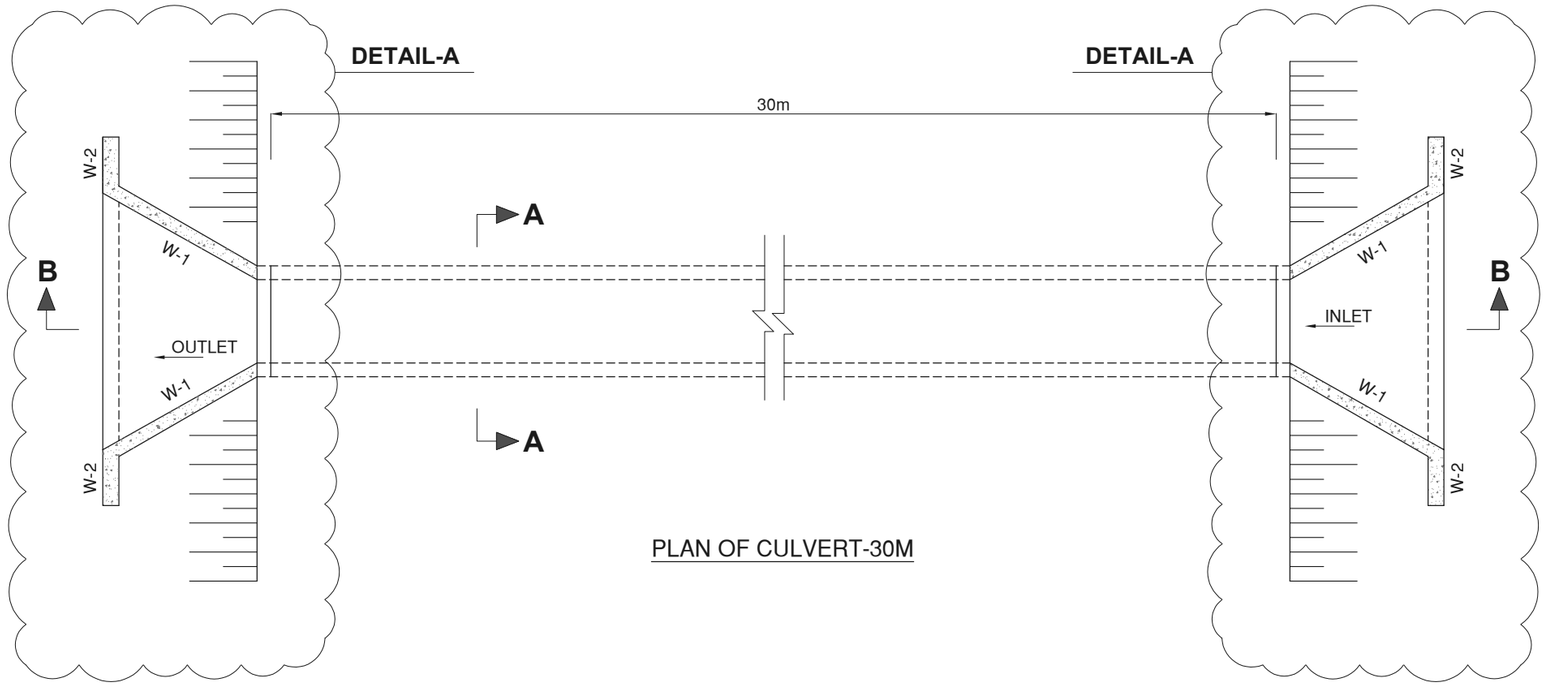
DISCIPLINE:
STRUCTURE

DRAWING TITLE:
SECTIONS & DETAILS OF 1 CELL 15M BOX CULVERT
(REINFORCEMENT)

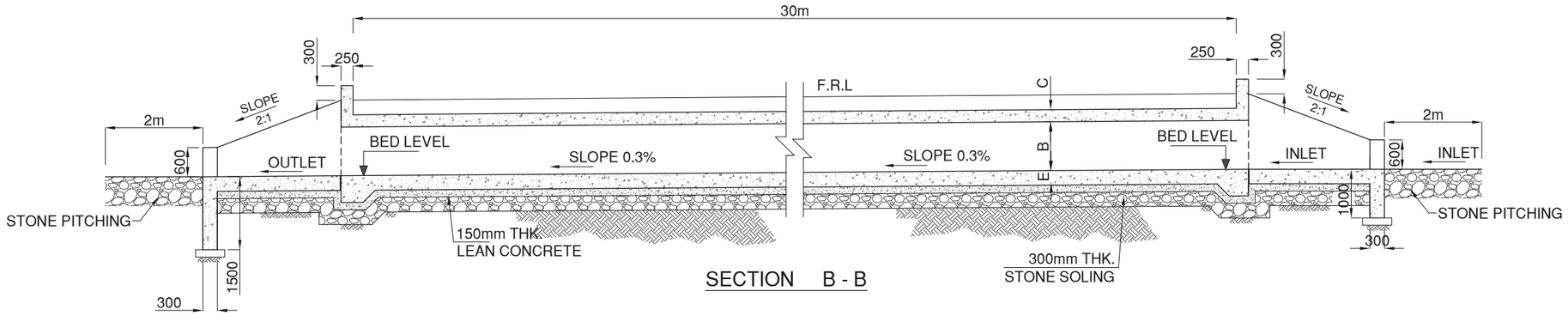
CONSULTANT:
CGD CONSULTING
ARCHITECTURE-ENGINEERING-PLANNING-MANAGEMENT
Plot # 7-C,5th Zulfiqar Commercial Street,
Phase VIII-A, DHA,Karachi - Pakisten

Designed By:	Checked By:	Date:	
F.A	T.S	DEC-2025	
Drawn By :	Scale:	Job No:	Sheet
Z.A			A3

DRAWING No: EC-STZ-EXT-STR-CUL15M-ST-03 | Revision 00

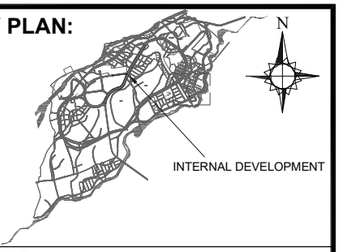


PLAN OF CULVERT-30M



SECTION B - B

KEY PLAN:



NOTES:

1- READ THIS DRAWING IN CONJUNCTION WITH ARCHITECTURAL, ELECTRICAL AND PLUMBING DRAWINGS.

2- MINIMUM COMPRESSIVE CYLINDRICAL STRENGTH OF CONCRETE AFTER 28 DAYS (FC') SHALL NOT BE LESS THAN 4000 Psi.

LEGENDS:

REVISION	DATE	DESCRIPTION	NAME

PROJECT:
EDUCATION CITY PROJECT

CLIENT:
PROJECT IMPLEMENTATION UNIT

NAME OF WORK:
EDUCATION CITY
SPECIAL TECHNOLOGY ZONE (STZ) EXT.
(INTERNAL DEVELOPMENT)

DRAWING STATUS: TENDER DRAWINGS

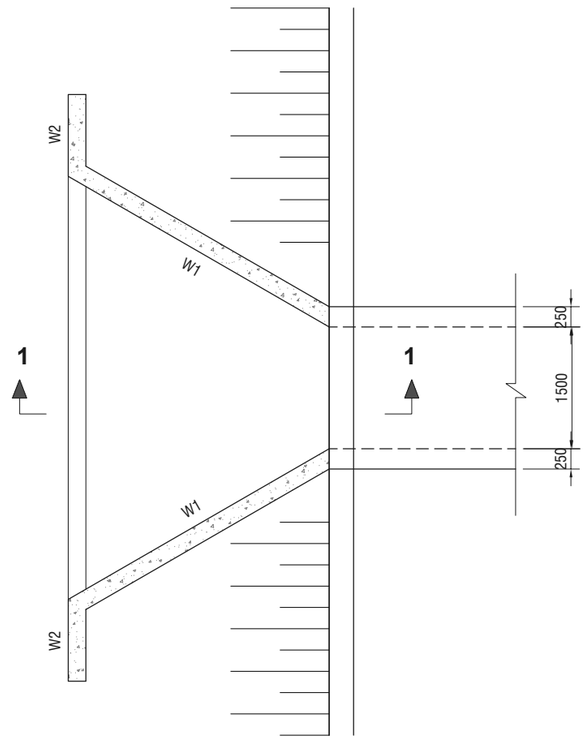
DISCIPLINE: STRUCTURE

DRAWING TITLE:
PLAN & SECTION OF 1 CELL
30M BOX CULVERT

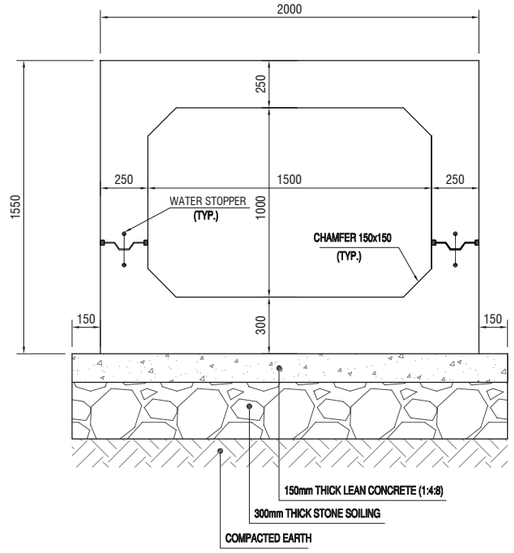
CONSULTANT:
CGD CONSULTING
ARCHITECTURE-ENGINEERING-PLANNING-MANAGEMENT
Plot # 7-C,5th Zulfiqar Commercial Street,
Phase VIII-A, DHA,Karachi - Pakistan

Designed By:	Checked By:	Date:	
F.A	T.S	DEC-2025	
Drawn By :	Scale:	Job No:	Sheet
Z.A			A3

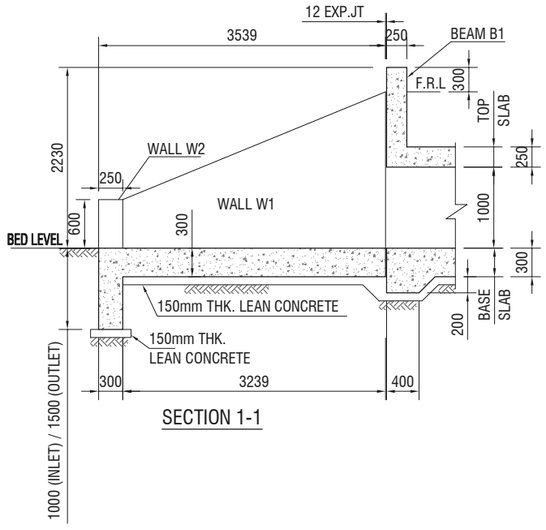
DRAWING No: EC-STZ-EXT-STR-CUL30M-ST-01 | Revision 00



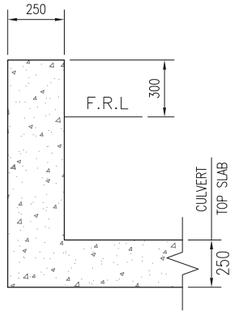
DETAIL-A



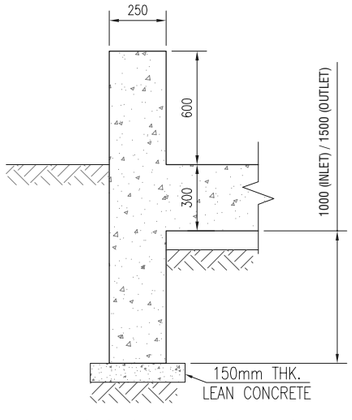
SECTION A-A
(CONCRETE)



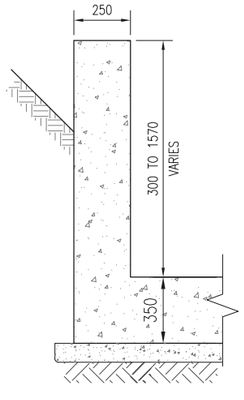
SECTION 1-1



TYPICAL SECTION OF BEAM B1

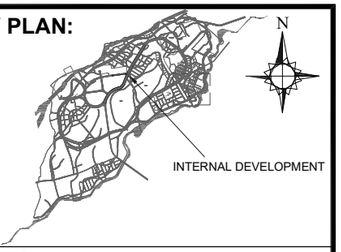


TYPICAL SECTION OF WING WALL W2



TYPICAL SECTION OF WING WALL W1

KEY PLAN:



NOTES:

1- READ THIS DRAWING IN CONJUNCTION WITH ARCHITECTURAL, ELECTRICAL AND PLUMBING DRAWINGS.

2- MINIMUM COMPRESSIVE CYLINDRICAL STRENGTH OF CONCRETE AFTER 28 DAYS (FC') SHALL NOT BE LESS THAN 4000 Psi.

LEGENDS:

REVISION	DATE	DESCRIPTION	NAME

PROJECT:
EDUCATION CITY PROJECT

CLIENT:
PROJECT IMPLEMENTATION UNIT

NAME OF WORK:
EDUCATION CITY
SPECIAL TECHNOLOGY ZONE (STZ) EXT.
(INTERNAL DEVELOPMENT)

DRAWING STATUS: TENDER DRAWINGS

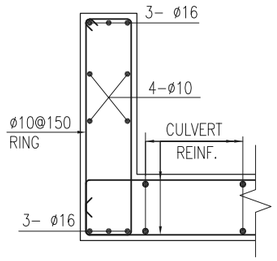
DISCIPLINE: STRUCTURE

DRAWING TITLE:
SECTIONS & DETAILS OF 1 CELL 30M BOX CULVERT
(CONCRETE)

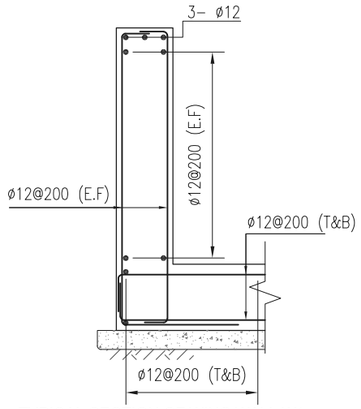
CONSULTANT:
CGD CONSULTING
ARCHITECTURE-ENGINEERING-PLANNING-MANAGEMENT
Plot # 7-C,5th Zulfiqar Commercial Street,
Phase VIII-A, DHA,Karachi - Pakisten

Designed By:	Checked By:	Date:	
F.A	T.S	DEC-2025	
Drawn By :	Scale:	Job No:	Sheet
Z.A			A3

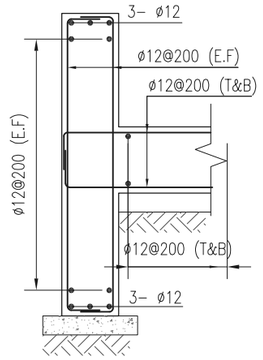
DRAWING No: EC-STZ-EXT-STR-CUL30M-ST-02 | Revision 00



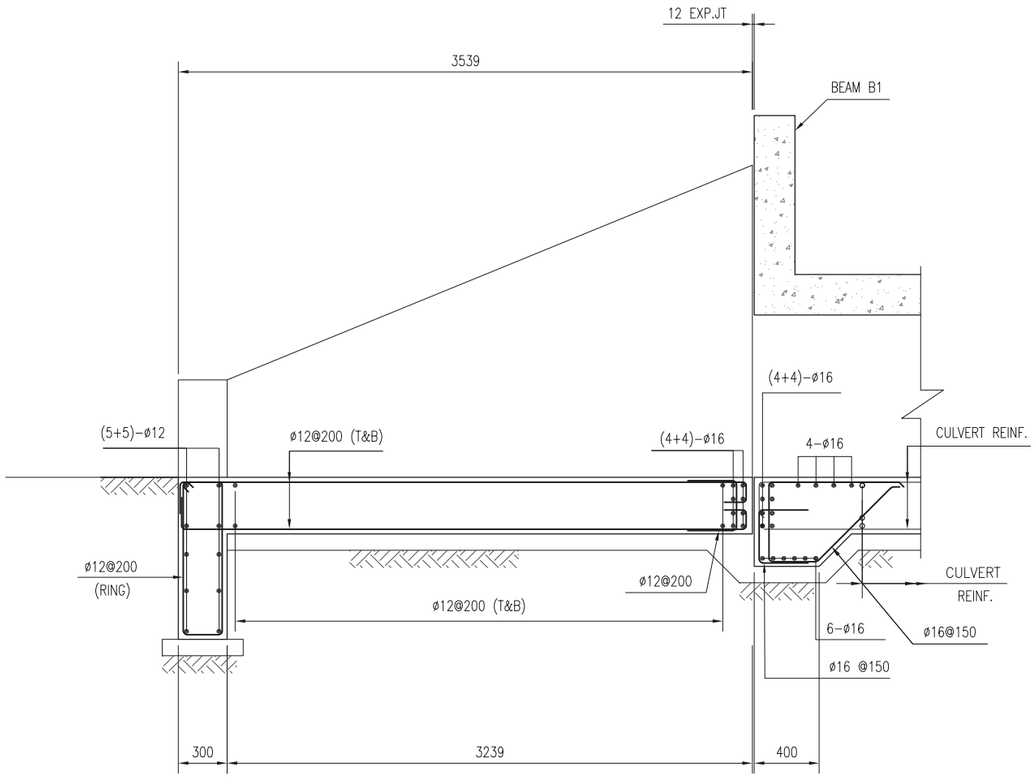
TYPICAL SECTION OF BEAM B1



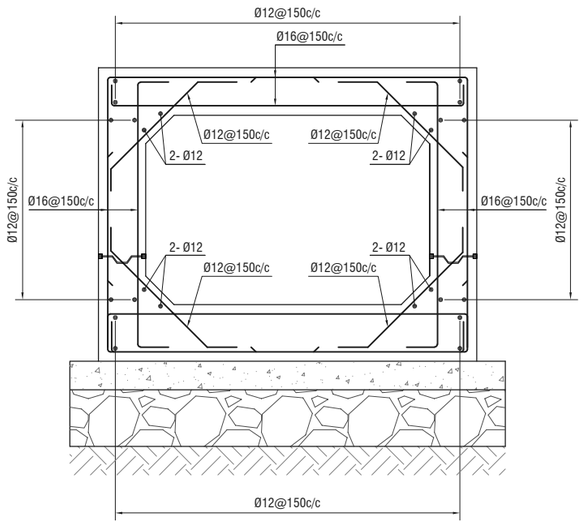
TYPICAL SECTION OF WING WALL W1



TYPICAL SECTION OF WING WALL W2

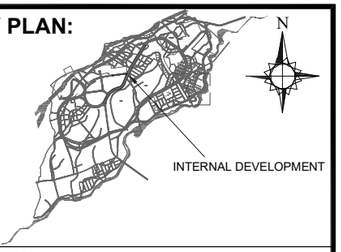


SECTION 1-1



SECTION A-A
(REINFORCEMENT)

KEY PLAN:



NOTES:

1- READ THIS DRAWING IN CONJUNCTION WITH ARCHITECTURAL, ELECTRICAL AND PLUMBING DRAWINGS.

LEGENDS:

REVISION	DATE	DESCRIPTION	NAME

PROJECT:
EDUCATION CITY PROJECT

CLIENT:
PROJECT IMPLEMENTATION UNIT

NAME OF WORK:
EDUCATION CITY
SPECIAL TECHNOLOGY ZONE (STZ) EXT.
(INTERNAL DEVELOPMENT)

DRAWING STATUS:
TENDER DRAWINGS

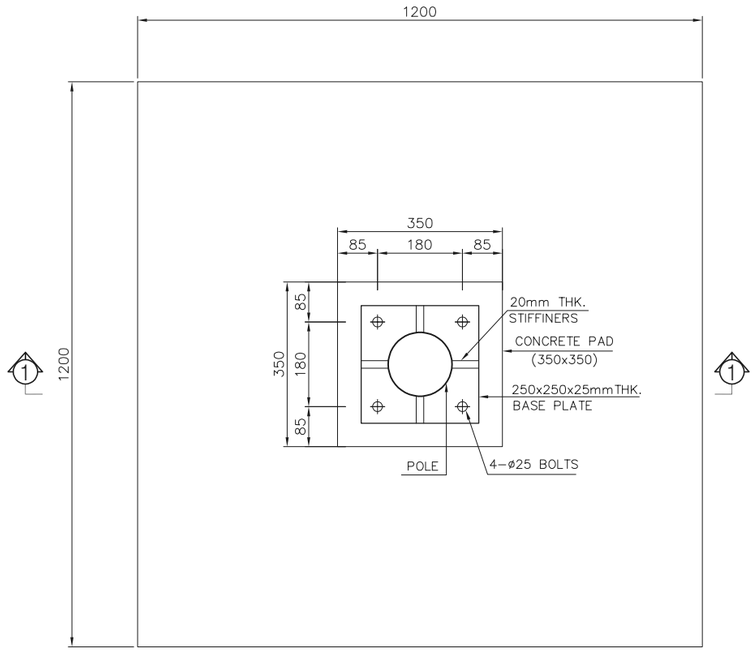
DISCIPLINE:
STRUCTURE

DRAWING TITLE:
SECTIONS & DETAILS OF 1 CELL 30M BOX CULVERT
(REINFORCEMENT)

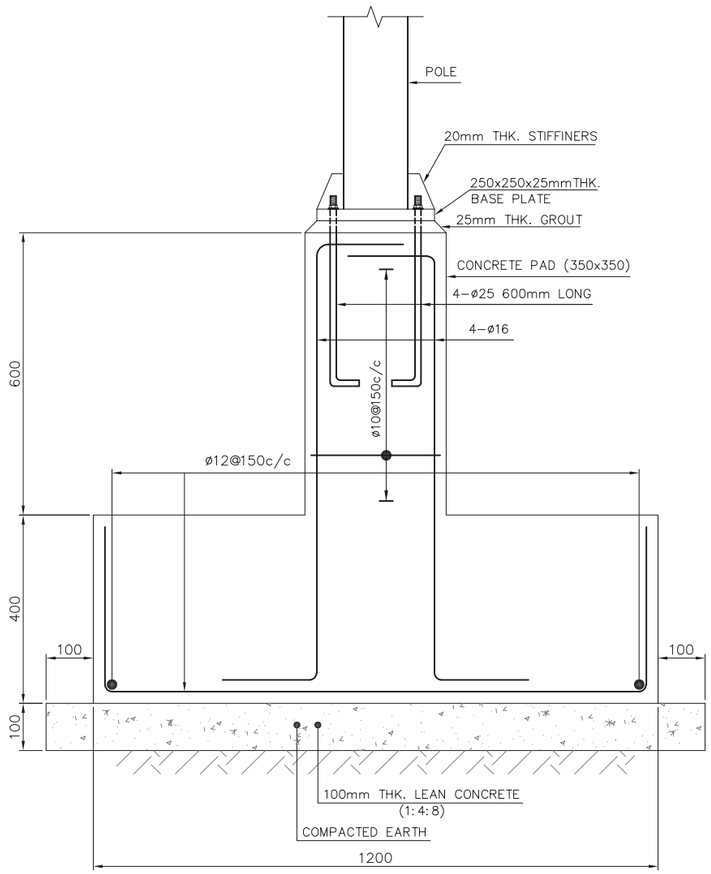
CONSULTANT:
CGD CONSULTING
ARCHITECTURE-ENGINEERING-PLANNING-MANAGEMENT
Plot # 7-C,5th Zulfiqar Commercial Street,
Phase VIII-A, DHA,Karachi - Pakisten

Designed By:	Checked By:	Date:	
F.A	T.S	DEC-2025	
Drawn By :	Scale:	Job No:	Sheet
Z.A			A3

DRAWING No: EC-STZ-EXT-STR-CUL30M-ST-03 | Revision 00

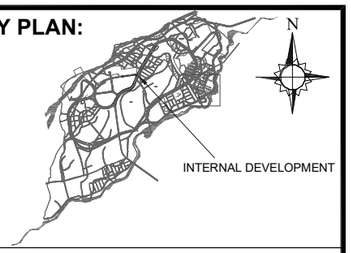


FOUNDATION PLAN OF LIGHT POLE



SECTION A-A

KEY PLAN:



NOTES:

1 - FOR GENERAL NOTES REFER DWG.NO:
EC-PKG-1-A(i)-GN-01 & EC-PKG-1-A(i)-GN-02.

LEGENDS:

REVISION	DATE	DESCRIPTION	NAME

PROJECT:
EDUCATION CITY PROJECT

CLIENT:
PROJECT IMPLEMENTATION UNIT

NAME OF WORK:
EDUCATION CITY
SPECIAL TECHNOLOGY ZONE (STZ) EXT.
(INTERNAL DEVELOPMENT)

DRAWING STATUS: TENDER DRAWINGS

DISCIPLINE: STRUCTURE

DRAWING TITLE:
PLAN & SECTION OF LIGHT POLE FOUNDATION

CONSULTANT:
CGD CONSULTING
ARCHITECTURE-ENGINEERING-PLANNING-MANAGEMENT
Plot # 7-C,5th Zulfiqar Commercial Street,
Phase VIII-A, DHA,Karachi - Pakisten

Designed By:	Checked By:	Date:	
F.A	T.S	DEC-2025	
Drawn By: Z.A	Scale:	Job No:	Sheet A3

DRAWING No: EC-PKG-1-A(i)-LP-ST-01 | Revision 00

BILL OF QUANTITIES

GRAND SUMMARY

Client / Owner : **Project Implementation Unit**

Name of Project : Infrastructure Development of Education City Project

Name of Work : Special Technology Zone Package 1 Road and Infra Works

CIVIL & INFRASTRUCTURE (AS PER NHA SPECIFICATION)		
S.No	**Name of Work**	**Total Amount Rs.**
1	Road Work	
2	Strom Water Drain	
6	Culvert	
9	Horticulture work	
	Total Amount Rs.	
	Grand Total Cost (A) In Millions	

STZ EXT INTERNAL ROADS

Consultant: CGD CONSULTING.

Special Technology Zone Package 1 Road and Infra Works

Item No.	Description	Unit	BOQ		
			Quantity	Rate (PKR)	Amount (PKR)
A)	AS PER NHA SPECIFICATION				
i)	Earth Work				
1	Clearing & Grubbing (NHA 101)	Sq.m	132,475		
2	Removal Of Trees 150 - 300 mm Girth (NHA 102a)	Each	60		
3	Removal Of Trees 301 - 600 mm Girth. (NHA 102b)	Each	60		
4	Removal Of Trees 601 mm Or Over Girth. (NHA 102c)	Each	40		
5	Stripping (NHA 103)	Cu.m	100		
6	Compaction Of Natural Ground (NHA 104)	Sq.m	132,475		
8	Formation of Embankment from Roadway Excavation in Common Material. (NHA 108a)	Cu.m	42,744		
9	Formation of Embankment from Roadway Excavation in Hard Rock / Medium Rock / Soft Rock Material. (NHA 108bi, bii, biii).	Cu.m	5,000		
11	GRANULAR SUBBASE (201)	Cu.m	9,536		
12	AGGREGATE BASE COURSE (WITH GRADER) 202ii	Cu.m	7,434		
12	CUT-BACK ASPHALT FOR BITUMINOUS PRIME COAT (302a)	SM	40,643		
13	ASPHALTIC BASE COURSE PLANT MIX (CLASS "B") (203b)	CM	3,048		
14	CUT-BACK ASPHALT FOR BITUMINOUS TACK COAT (303a	SM	40,643		
15	ASPHALTIC CONCRETE FOR WEARING COURSE (CLASS "B") (305b)	CM	2,032		
	Sub Total Amount PKR.				-

Item No.	Description	Unit	BOQ		
			Quantity	Rate (PKR)	Amount (PKR)
iv)	**Ancillary Works**				
1	Precast Curb in Concrete class A-1 of size 300 x 300 x 150mm including Bedding & haunching complete in all respects.	Rm.	38185.00		
2	Pavement Marking In Reflective TP Paint of 15 cm Width. (NHA 608h2)	Rm.	3955.00		
3	Pavement Marking In Reflective TP Paint of 20 cm Width. (NHA 608i2).	Rm.	3955.00		
4	Pavement Marking In Reflective TP Paint for 4m arrows. (NHA 608j2)	Each	1000.00		
5	Providing & fixing cement paving blocks flooring having size of 197 x 97 x 80 (mm) of city / quddra / cobble shape with pigmented, having strength b/w 5000 psi to 8500 psi i/c filling the joints with hill sand over a bed of 2" thick hill sand or stone dust and laying and compacting in specified manner/ pattern and design etc complete.(Pigmented) (PSI 5000 to 8500e / Tameer Works or Equivalent manufacturer	sm	37297.96		
	Sub Total Amount PKR.				-
	Total Amount PKR.				-

Sr. No.	Particulars	Qty.	Unit	Rate (Rs.)	Amount (Rs.)
HORTICULTURE WORKS					
	Non-Schedule Items				
1	Supplying and stacking approved garden soil (sweet earth) free from salts, pebbles and grass roots etc including all leads and lifts.Complete with all respects as per drawings, details & approved by Architect.	6142.50	Cum		
2	Supplying, stacking and spreading cow dung manure / Slaughter House manure and mixing the same up to any depth in the already laid sweet earth including breaking clods, dressing fine for Trees in pits and sprinkling water, raking and rolling complete.Complete with all respects as per drawings, details & approved by Architect.	2047.50	Cum		
3	Providing and Planting Ground covers and 3" depth dung manure as approved by the Architect including sweet earth filling up to 9"depth as shown on the drawings Complete with all respects as per drawings, details & approved by Architect.	1137.36	Sqm		
4	Supplying and stacking live (Dacca) grass in slabs with earth intact including all lead and lifts.as shown on the drawingsComplete with all respects as per drawings, details & approved by Architect.	27300.00	Sqm		
5	Providing and laying matte randum stone in lawn spaces etc. Complete with all respects as per drawings, details & approved by Architect.	1620.00	SM		
6	Plantation Providing and fixing Planting following Trees / Shurbs / Palm with making Pits and filling Sweet earth, manure complete with all respects as per drawings, details & approved by Architect.(Pots Size Tree Heights & Plantation Heights approved by Architect.)				
	Trees 4m Height				
i)	NEEM Grith 3" x Height - 4m Pot size 18"~24"	102.00	Each		
ii)	GUL MOHER Grith 3" x Ht - 4m Pot size 24"	102.00	Each		
iii)	DALBERGIA SISSOO Grth 3" xHt 4m Pot size 24"	102.00	Each		
iv)	TABEBUIA Grith - 3" x Height - 4m	102.00	Each		
v)	ACALIA NILOTIC - 3" x Height - 4m	102.00	Each		
vi)	TERMINALIA ARJUNE Grith - 3"x Ht - 4m Pot size 24"	102.00	Each		
vii)	SUMBUL CICEGI	102.00	Each		
viii)	KANGI PALM Height - 4m Pot size 24"	102.00	Each		
ix)	Flowers/Shrubs (Any approved Variety) 1m Height	953.20	Sqm		
Total Non-Schedule Items Amount Rs.					-

Item No.	Description	Unit	Estimate		
			Quantity	Rate (PKR)	Amount (PKR)
A)	**AS PER NHA SPECIFICATION**				
i)	**STRUCTURE (STROM WATER DRAIN)**				
1	Excavation In Common Material (NHA 107).	Cu.m	13973.40		
3	Backfilling of excavated soil in foundations, trenches and other structure in compacted layers not exceeding 150 mm thick as per compaction requirement of following thickness, complete in all respect as per drawings, specification or as directed by the Engineer.. (NHA 107e)	Cu.m	5696.60		
4	Concrete Class A1 (Under Ground) (NHA 401a1i)	Cu.m	2023.00		
5	Providing and fixing Precast RCC Gutter Channel of size 450 mm (W) × 300 mm (D), manufactured from M30 grade concrete with Fe500 reinforcement, including UV-stabilized FRP grating cover (load class A15–B125) fixed with stainless steel fasteners, laid to proper line and level over PCC (M10) bed, joints sealed with cement mortar (1:3), i/c excavation & proper refilling, compaction etc complete in all respects as per drawing, specification, and direction of Engineer-in-Charge.	Cu.m	1505.00		
6	Lean Concrete. (NHA 401f)	Cu.m	14535.80		
7	Steel Reinforcement (NHA 404b)	Ton	560.64		
8	PVC Water stops 6" size (12 mm thick). (NHA 406di)	Rm	4000.00		

Item No.	Description	Unit	Estimate		
			Quantity	Rate (PKR)	Amount (PKR)
9	Fabrication of heavy steel work with angles, tees, flat iron, round iron and sheet iron for making trusses, girders, tands etc. including cutting, tanks etc. including cutting, drilling rivetting, handling assembling and fixing but including erection in position complete in all respects as per drawing details and Engineer Incharge.	Kgs.	5000.00		
10	Providing and applying one coat of hot-applied bitumen coating on concrete surfaces at the rate of 0.75 kg/sqm, including thorough surface cleaning, and blinding with clean, dry sand at the rate of 0.012 cum / sqm, complete in all respects.	Sq.m	15746.50		
11	Providing and laying stone soling from approved quarry including hand packing & filling voids with stone metals over a consolidated & compacted layer of moist earth including ramming & compacting with power roller etc., complete in all respects as per drawing, standard , specifications and as directed by the Engineer.	Cu.m	1581.30		
12	Providing & fixing 0.25mm polythene sheet 1000 gauge High Density of 32 kg./Sq.m. to all exposed structural concrete surfaces.	Sq.m	6000.00		
13	Providing and laying uPVC 150mm pipe catch basin to main drain crossing complete in all respects.	Rm	2000.00		
				Total Estimated Amount Rs	-

Item No.	Description	Unit	BOQ		
			Quantity	Rate (PKR)	Amount (PKR)
B)	**NON SCHEDULE (BOX CULVERTS)**				
1	Providing and laying stone soling from approved quarry including hand packing & filling voids with stone metals over a consolidated & compacted layer of moist earth including ramming & compacting with power roller etc., complete in all respects as per drawing, standard , specifications and as directed by the Engineer.	Cu.m	86.84		
107a	Excavation In Common Material	Cu.m	946.44		
107d	Granular Back Fill	Cu.m	82.82		
107e	Backfilling of excavated soil in foundations, trenches and other structure in compacted layers not exceeding 150 mm thick as per compaction requirement of following thickness, complete in all respect as per drawings, specification or as directed by the Engineer.. (NHA 107e)	Cu.m	207.04		
401a 1i	Concrete Class A1 (Under Ground)	Cu.m	14.04		
401a 1ii	Concrete Class A1 (On Ground)	Cu.m	414.80		
401a 1iii	Concrete Class A1 (Elevated)	Cu.m	63.40		
401f	Lean Concrete	Cu.m	140.00		
404b	Steel Reinforcement	Ton	71.36		
406a	Premoulded Joint Filter 12mm Thick with Bittumatic Joint Seal	Sq.m	12.60		
406di	PVC Water stops 6" size (12 mm thick).	Rm	141.68		
509d	Grouted Riprap Class -A	Cu.m	80.24		

Item No.	Description	Unit	BOQ		
			Quantity	Rate (PKR)	Amount (PKR)
510	Dismentalling of structures & Obestructions	Cu.m	115.52		
2	Providing and applying one coat of hot-applied bitumen coating on concrete surfaces at the rate of 0.75 kg/sqm, including thorough surface cleaning, and blinding with clean, dry sand at the rate of 0.012 cum/sqm, complete in all respects.	Sq.m	827.20		
				Total Estimated Amount Rs	**-**