NED UNIVERSITY OF ENGINEERING & TECHNOLOGY
PROCUREMENT CELL

Phone # 99261261– 68, (Ext. 2471 & 2501) Fax # 99261255, e-mail: dp@neduet.edu.pk

"Say No to Corruption"

Director Procurement

No. DP/ D&USF-139112/6963/
December 03, 2020

Notice Inviting Tender

NED University of Engineering & Technology invites sealed bids on Single Stage One Envelope procedure from Reputable and Well Experienced Firms/Companies to carry out following works:

S#	Tender / Number	Tender Schedule – Date and Time				Estimated Cost (Rs in Million)	Tender Fee Rs	Time of Completion
		Issue / Sale		Submission	Opening			
		From	To					
1.	**Construction of New Road from Fitness Centre to newly developed Football Ground and Rehabilitation of existing road from overhead water tank to Fitness Centre, Tender no. PC/NED/Sports/Road /6963//2020**	17.12.2020	04.01.2021	05.01.2021 10:30 A.M.	05.01.2021 11:00 A.M.	10.38	3,000/-	Two Months

Eligibility Criteria

1. Valid Registration of the firm with tax authorities (Federal Board of Revenue, Sindh Revenue Board) with proof of company in Active Tax Payer list, Professional Tax paid & copy of CNIC along with company registration
2. Valid Registration with Pakistan Engineering Council in relevant category C-5 & above having relevant civil works codes. CE01 (i) Road and pavement, drainage and retaining structures
3. List of Similar Project against which the contractor bid for (Roads) executed in last 05 years, atleast 01 project completed with similar Cost of work with Documentary Proof (Work Order, Completion Certificate)
4. Details of equipment's, machineries and transport owned by firm/contractor with Documented proofs;
5. Audit Report/ Bank Statement of the firm last 03 years showing the required yearly turnover above 50M.
6. Income tax returns filed for the last 03 years. Documentary Proof attached
7. Bid Security of the required amount in the shape of pay order.
8. Affidavit upon original stamp paper that the firm has never been black listed, not involved in any Litigation with any Government, Semi-Government & Autonomous Body

Terms & Conditions

a) Under the following conditions, bid shall be rejected.
   i. Black listed firm / companies.
   ii. Bid received after specified time and date.
   iii. Incomplete, conditional, electronic and telegraphic bids / tender.
   iv. Bids not accompanied by bid security of required amount and form.

b) **Bid validity period:** (90) days from the date of opening of tender.

c) **Bid Security:** 2% of bid cost in the form of Deposit at Call or Pay Order or Demand Draft or a Bank Guarantee issued by a scheduled bank in Pakistan or from a foreign bank duly counter guaranteed by scheduled bank in Pakistan in favor of Director Finance NEDUET, Karachi.

Tender Fee in shape of Payorder / bank draft should be in favor of Director Finance, NEDUET. Bidding documents can be obtained and shall be submitted in the office of ADP – II in the University as per above schedule. Bidders are requested to give their Best and Final Price as "No Negotiations" is permitted. Bidding Documents containing detailed terms and conditions are available at Websites www.neduet.edu.pk and www.ppms.spprasindh.gov.pk. In case of public holiday or any holiday or non-working day due to Force Majeure, the next official working day shall be deemed to be date for issuance, submission and opening of tenders. NEDUET shall not be responsible for any cost or expenses incurred by bidders. Procuring Agency reserves the right to reject all or any bids subject to the relevant provisions of Sindh Public Procurement Rules 2010 (Amended up to date).

Director Procurement
03/12/2020

NED UNIVERSITY OF ENGINEERING AND TECHNOLOGY, KARACHI

CONSTRUCTION OF NEW ROAD FROM FITNESS CENTRE TO NEWLY DEVELOPED FOOTBALL GROUND AND REHABILITATION OF EXISTING ROAD FROM OVERHEAD WATER TANK TO FITNESS CENTRE

TENDER DOCUMENTS VOLUME-I

CONDITIONS OF CONTRACT

PC/NED/Road/Sports/6963/2020

DEVELOPMENT & UPGRADATION OF SPORTS FACILITIES

OFFICE A-202, SECOND FLOOR, BLOSSOM TRADE CENTER, OPPOSITE NED UNIVERSITY PLOT # SB-26, BLOCK-01, GULISTAN-E-JAUHAR, KARACHI
021-34177576, www.nexuscon.pk,
mail@nexuscon.pk,nexusconsultingcompany@gmail.com

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INVITATION FOR BIDS

DAWN SATURDAY DECEMBER 12, 2020

NED UNIVERSITY OF ENGINEERING & TECHNOLOGY

PROCUREMENT CELL

Phone # 99261261- 68, (Ext. 2471 & 2501) Fax # 99261255, e-mail: dp@neduet.edu.pk

DIRECTOR PROCUREMENT "Say No to Corruption" No. DP/D&USF-139112/6963 / December 03, 2020

NOTICE INVITING TENDER

NED University of Engineering & Technology invites sealed bids on Single Stage One Envelope procedure from Reputable and Well Experienced Firms/Companies to carry out following works:

S. #	Tender / Number	Tender Schedule - Date and Time				Estimated Cost (Rs. in Million)	Tender Fee Rs.	Time of Completion
		Issue / Sale		Submission	Opening			
		From	To					
1	Construction of New Road from Fitness Centre to newly developed Football Ground and Rehabilitation of existing road from overhead water tank to Fitness Centre. Tender no. PC/NED/Sports/Road /6963//2020	17-12-2020	04-01-2021	05-01-2021 10:30 A.M.	05-01-2021 11:00 A.M.	10.38	3,000/-	Two Months

Eligibility Criteria

1. Valid Registration of the firm with tax authorities (Federal Board of Revenue, Sindh Revenue Board) with proof of company in Active Tax Payer list, Professional Tax paid & copy of CNIC along with company registration.
2. Valid Registration with Pakistan Engineering Council in relevant category **C-5 & above** having relevant civil works codes, **CE01** (i) Road and pavement, drainage and retaining structures.
3. List of Similar Project against which the contractor bid for (Roads) executed in last 05 years, atleast 01 project completed with similar Cost of work with Documentary Proof (Work Order, Completion Certificate).
4. Details of equipments, machineries and transport owned by firm/contractor with Documented proofs;
5. Audit Report/ Bank Statement of the firm last 03 years showing the required yearly turnover above 50M.
6. Income tax returns filed for the last 03 years, Documentary Proof attached.
7. Bid Security of the required amount in the shape of pay order.
8. Affidavit upon original stamp paper that the firm has never been black listed, not involved in any Litigation with any Government, Semi-Government & Autonomous Body.

Terms & Conditions

(a) Under the following conditions bid shell be rejected:
   i. Black listed firms/ companies.
   ii. Bid received after specified time and date.
   iii. Incomplete, Conditional, electronic and telegraphic bids/tenders.
   iv. Bids not accompanied by bid security of required amount and form.

(b) **Bid validity Period:** (90) days from the date of opening of tender.

(c) **Bid Security:** 2% of bid cost in the form of Deposit at Call or Pay Order or Demand Draft or a Bank Guarantee issued by a scheduled bank in Pakistan or from a foreign bank duly counter guaranteed by scheduled bank in Pakistan in favor of Director Finance NEDUET, Karachi.

Tender Fee in shape of Payorder / Bank draft should be in favor of Director Finance, NEDUET. Bidding documents can be obtained and shall be submitted in the office of ADP - II in the University as per above schedule. Bidders are requested to give their Best and Final Price as "No Negotiations" is permitted. Bidding Documents containing detailed terms and conditions are available at Websites www.neduet.edu.pk and www.ppms.spprasindh.gov.pk. In case of public holiday or any holiday or non-working day due to Force Majeure, the next official working day shall be deemed to be date for issuance, submission and opening of tenders. NEDUET shall not be responsible for any cost or expenses incurred by bidders. Procuring Agency reserves the right to reject all or any bids subject to the relevant provisions of Sindh Public Procurement Rules 2010 (Amended up to date).

INF/KRY/3648/2020 **DIRECTOR PROCUREMENT**

INSTRUCTIONS TO BIDDERS & BIDDING DATA

Notes on the Instructions to Bidders

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

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

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INSTRUCTIONS TO BIDDERS

Clause No. Description Page No.

INSTRUCTIONS TO BIDDERS

A. GENERAL

IB.1 Scope of Bid & Source of Funds

1.1 Scope of Bid

The Procuring Agency as defined in the Bidding Data (hereinafter called the Office of NED University of Engineering & Technology, University Road, Karachi- 75270") wishes to receive Bids for the Works summarized in the Bidding Data (hereinafter referred to as the Works **Construction Of New Road From Fitness Centre to Newly Developed Football Ground And Rehabilitation Of Existing Road From Overhead Water Tank To Fitness Centre**

Bidders must quote for the complete scope of work. Any Bid covering partial scope of work will be rejected as non-responsive.

1.2 Source of Funds

The Procuring Agency has arranged funds from its own sources or *Donor agency,* towards the cost of the project/scheme.

IB.2 Eligible Bidders

2.1 Bidding is open to all firms and persons meeting the following requirements:

a) Duly licensed by the Pakistan Engineering Council (PEC) in the appropriate category for value of works and Prequalified by the Department.

b) Duly pre-qualified with the procuring agency

c) If prequalification has not undertaken, the procuring agency may ask information and documents not limited to following: **(refer NIT Eligibility Criteria)**

(i) Company profile;
(ii) Works of similar nature and size for each performed in last *3* years;
(iii) Construction equipment's;
(iv) Qualification and experience of technical personnel and key site management;
(v) Financial statement of last 3 years
(vi) Information regarding litigations and abandoned works if any.

IB.3 Cost of Bidding

3.1 The bidder shall bear all costs associated with the preparation and submission of its bid and the Office of NED University of Engineering & Technology, University Road, Karachi- 75270" will in no case be responsible or liable for those costs, regardless of the conduct or outcome of the bidding process (SPP Rules 24 & 25).

B. BIDDING DOCUMENTS

IB.4 Contents of Bidding Documents

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

1. Instructions to Bidders & Bidding Data
2. Form of Bid, Qualification Information & Schedules to Bid Schedules to Bid comprise the following:

   (i) Schedule A: Schedule of Prices/ Bill of Quantities (BOQ).
   (ii) Schedule B: Specific Works Data
   (iii) Schedule C: Works to be Performed by Subcontractors
   (iv) Schedule D: Proposed Programme of Works
   (v) Schedule E: Method of Performing Works
   (vi) Schedule F: Integrity Pact (works costing Rs 10 million and above)

3. Conditions of Contract & Contract Data

4. Standard Forms
   (i) Form of Bid Section
   (ii) Form of Performance Security;
   (iii) Form of Contract Agreement;
   (iv) Form of Bank Guarantee for Advance Payment.

5. Specification Drawings, if any

IB.5 Clarification of Bidding Documents

5.1 A prospective bidder requiring any clarification(s) in respect of the Bidding Documents may notify the Office of NED University of Engineering & Technology, University Road, Karachi- 75270"address indicated in the Bidding Data.

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

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

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

6.2 Any addendum thus issued shall be part of the Bidding Documents pursuant to Sub-Clause 6.1 hereof, and shall be communicated in writing to all purchasers of the Bidding Documents. Prospective bidders shall acknowledge receipt of each addendum in writing to the Procuring Agency.

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

C. PREPARATION OF BIDS

IB.7 Language of Bid

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

IB.8 Documents Comprising the Bid

8.1 The Bid submitted by the bidder shall comprise the following:

a) Offer /Covering Letter
b) Form of Bid duly filled, signed and sealed, in accordance with IB.14.3.
c) Schedules (A to F) to Bid duly filled and initialled, in accordance with the instructions contained therein & in accordance with IB.14.3.
d) Bid Security furnished in accordance with IB.13.
e) Power of Attorney in accordance with IB 14.5.
f) Documentary evidence in accordance with IB.2(c) & IB.11
g) Documentary evidence in accordance with IB.12.

IB.9 Sufficiency of Bid

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

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

IB.10 Bid Prices, Currency of Bid and Payment

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

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

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

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

IB.11 Documents Establishing Bidder’s Eligibility and Qualifications

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

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

IB.12 Documents Establishing Works’ Conformity to Bidding Documents

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

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

IB.13 Bid Security

13.1 Each bidder shall furnish, as part of his bid, at the option of the bidder, a Bid Security as percentage of bid price/estimated cost or in the amount stipulated in Bidding Data in Pak. Rupees in the form of *Deposit at Call/ Payee’s Order or a Bank Guarantee* issued by a Scheduled Bank in Pakistan in favour of the NED University of Engineering & Technology,

University Road, Karachi- 75270" valid for a period up to Ninety (90) days beyond the bid submission date as per SPP Rule 37 the Bid Security shall be 2% (Two Percentage).

13.2 Any bid not accompanied by an acceptable Bid Security shall be rejected by the Office of NED University of Engineering & Technology, University Road, Karachi- 75270" as non-responsive.

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

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

13.5 The Bid Security may be forfeited:

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

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

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

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

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

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

14.5 Each bidder shall prepare Original and number of copies specified in the Bidding Data of the documents comprising the bid as described in IB.8 and clearly mark them

"ORIGINAL" and **"COPY** "as appropriate. In the event of discrepancy between them, the original shall prevail.

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

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

D. SUBMISSION OF BID

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

15.1 Bids must be received by the Office of Director Procurement, NED University of Engineering & Technology, University Road, Karachi- 75270",, Karachi at the address provided in Bidding Data not later than the time and date stipulated therein.

15.2 The inner and outer envelopes shall

a) Be addressed to the Office of Director Procurement, NED University of Engineering & Technology, University Road, Karachi- 75270",, Karachi at the address provided in the Bidding Data;
b) Bear the name and identification number of the Contract as defined in the Bidding and Contract Data; and
c) Provide a warning not to open before the specified time and date for Bid opening as defined in the Bidding Data.
d) In addition to the identification required in 15.2, the inner envelopes shall indicate the name and address of the Bidder to enable the Bid to be returned unopened in case it is declared late
e) If the outer envelope is not sealed and marked as above, the Procuring Agency will assume no responsibility for the misplacement or premature opening of the Bid.

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

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

15.5 Any bidder may modify or withdraw his bid after bid submission provided that the modification or written notice of withdrawal is received by the Procuring Agency prior to the deadline for submission of bids.

15.6 Withdrawal of a bid during the interval between the deadline for submission of bids and the

expiration of the period of bid validity specified in the Form of Bid may result in forfeiture of the Bid Security pursuant to IB.13.5 (a).

E. BID OPENING AND EVALUATION

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

16.1 The Office of Director Procurement, NED University of Engineering & Technology, University Road, Karachi- 75270" will open the bids, in the presence of bidders 'representatives who choose to attend, at the time, date and in the place specified in the Bidding Data.

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

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

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

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

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

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

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

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

16.6 Any minor informality or non-conformity or irregularity in a Bid which does not constitute a material deviation **(major deviation)** may be waived by Office of NED University of

Engineering & Technology, University Road, Karachi- 75270",

Provided such waiver does not prejudice or affect the relative ranking of any other bidders.

(A). Major (material) Deviations include:

Bid has been not properly signed;

(i) is not accompanied by the bid security of required amount and manner;
(ii) stipulating price adjustment when fixed price bids were called for;
(iii) failing to respond to specifications;
(iv) failing to comply with Mile-stones/Critical dates provided in Bidding Documents;
(v) sub-contracting contrary to the Conditions of Contract specified in Bidding Documents;
(vi) refusing to bear important responsibilities and liabilities allocated in the Bidding Documents, such as performance guarantees and insurance coverage;
(vii) taking exception to critical provisions such as applicable law, taxes and duties and dispute resolution procedures;
(viii) a material deviation or reservation is one :

(a) which affect in any substantial way the scope, quality or performance of the works;
(b) adoption/rectification whereof would affect unfairly the competitive position of other bidders presenting substantially responsive bids.

(B) Minor Deviations

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

16.7 The Office of NED University of Engineering & Technology, University Road, Karachi-75270" will evaluate and compare only the bids previously determined to be substantially responsive pursuant to IB.16.4 to 16.6 as per requirements given hereunder. Bids will be evaluated for complete scope of works. The prices will be compared on the basis of the Evaluated Bid Price pursuant to IB.16.8 herein below.

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

16.8 Evaluated Bid Price

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

below to determine the Evaluated Bid Price:

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

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

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

IB.17 Process to be Confidential

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

17.2 Any effort by a bidder to influence Office of NED University of Engineering & Technology, University Road, Karachi- 75270" in the Bid evaluation, Bid comparison or Contract Award decisions may result in the rejection of his Bid. Whereas any bidder feeling aggrieved, may lodge a written complaint to Complaint Redressal Committee as per terms and conditions mentioned in SPP Rules 31 & 32. However, mere fact of lodging a complaint shall not warrant suspension of procurement process.

17.3 Bidders may be excluded if involved in **"Corrupt and Fraudulent Practices"** means either one or any combination of the practices given below SPP Rule 2(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, non-competitive levels for any wrongful gain;

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

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

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

of inspection and audit rights provided for under the Rules.

F. AWARD OF CONTRACT

IB.18. Post Qualification

18.1 The Office of NED University of Engineering & Technology, University Road, Karachi-75270",, Karachi, at any stage of the bid evaluation, having credible reasons for or *prima facie* evidence of any defect in contractor's capacities, may require the contractors to provide information concerning their professional, technical, financial, legal or managerial competence whether already pre-qualified or not:

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

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

IB.19 Award Criteria & Office of NED University of Engineering & Technology, University Road, Karachi- 75270"'s Right

19.1 Subject to IB.19.2, the Office of NED University of Engineering & Technology, University Road, Karachi- 75270"will award the Contract to the bidder whose bid has been determined to be substantially responsive to the Bidding Documents and who has offered the lowest evaluated Bid Price, provided that such bidder has been determined to be qualified to satisfactory perform the Contract in accordance with the provisions of the IB.18.

19.2 Notwithstanding IB.19.1, the Procuring Agency reserves the right to accept or reject any bid, and to annul the bidding process and reject all bids, at any time prior to award of Contract, without thereby incurring any liability to the affected bidders or any obligation to inform the affected bidders of the grounds for the Procuring Agency's action except that the grounds for its rejection of all bids shall upon request be communicated, to any bidder who submitted a bid, without justification of the grounds. Notice of the rejection of all the bids shall be given promptly to all the bidders (SPP Rule 25).

IB.20 Notification of Award & Signing of Contract Agreement

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

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

20.3 The formal Agreement between the Office of NED University of Engineering & Technology, University Road, Karachi- 75270"and the successful bidder duly stamped at rate of 0.35% of bid price(updated from time to time) stated in Letter of Acceptance shall be executed within seven (07) days of the receipt of Form of Contract Agreement by the successful bidder from the Procuring Agency.

IB.21 Performance Security

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

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

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

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

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

BIDDING DATA

Instructions to Bidders Clause Reference

1.1 **Name of Procuring Agency**

Office of NED University of Engineering & Technology, University Road, Karachi- 75270",

Brief Description of Works

5.1 (a) Procuring Agency's address:

Director Procurement,
Office of NED University of Engineering & Technology, University Road, Karachi- 75270"
Phone: (9221)9926-1261-68 EXT: 2291 Fax No. (9221) 9926-1255

10.3 Bid shall be quoted entirely in Pak. Rupees. The payment shall be made in Pak. Rupees.

11.2 The bidder has the financial, technical and constructional capability necessary to perform the Contract as mentioned below (*as per published NIT)*

Eligibility criteria

- **i.** Valid Registration of the firm with tax authorities (Federal Board of Revenue, Sindh Revenue Board) with proof of company in Active Tax Payer list, Professional Tax paid & copy of CNIC along with company registration
- **ii.** Valid Registration with Pakistan Engineering Council in relevant category C-5 & above having relevant civil works codes. **CE01 (i)** Road and pavement, drainage and retaining structures
- **iii.** List of Similar Project against which the contractor bid for (Roads) executed in last 05 years, atleast 01 project completed with similar Cost of work with Documentary Proof (Work Order, Completion Certificate)
- **iv.** Details of equipment's, machineries and transport owned by firm/contractor with Documented proofs;
- **v** Audit Report/ Bank Statement of the firm last 03 years showing the required yearly turnover above 50M.
- **vi** Income tax returns filed for the last 03 years, Documentary Proof attached
- **vii.** Bid Security of the required amount in the shape of pay order.
- **viii.** Affidavit upon **original stamp paper** that the firm has never been black listed, not involved in any Litigation with any Government, Semi-Government & Autonomous Body

Terms & Conditions.

(a) Under the following conditions, bid can be rejected:

i. Bidders are advised that before filling the Bidding Document all Papers of Bidding Documents should carefully be rechecked. If any Page(s)/Paper(s) of Bidding Documents are missing, that can be downloaded from the Official Website of the University and SPPRA, and also can be obtained from the Office of the ADP-2 in Procurement Cell, NEDUET, Karachi. Bid(s) with incomplete Bidding Document will straightaway be rejected.
ii. Incomplete, Conditional, Electronic and Telegraphic Bids/Tenders
iii. Bids not accompanied by Bid Security of required amount & Form
iv. Bids received after specified Date & time
v. Black Listed Firms/ Companies

(a) A detailed description of the Works, essential technical and performance characteristics.

(b) Complete set of technical information, description data, literature and drawings as required in accordance with Schedule B to Bid, Specific Works Data. This will include but not be limited to a sufficient number of drawings, photographs, catalogues, illustrations and such other information as is necessary to illustrate clearly the significant characteristics such as general construction dimensions and other relevant information about the works to be performed.

13.1 **Amount of Bid Security**

(2%) of the bid amount in the shape of Payorder or Demand Draft in Favour of Director Finance, NED University of Engineering & Technology Karachi

14.1 **Period of Bid Validity**

(9O Days)

14.4 **Number of Copies of the Bid to be submitted:**

One original plus One copy

14.6 **(a) Address for the Purpose of Bid Submission**

Office of NED University of Engineering & Technology, University Road, Karachi- 75270"
Phone: (9221)9926-1261-68 EXT: 2291 FaxNo. (9221) 9926-1255

15.1 **Deadline for Submission of Bids**

As notified in "Invitation to Bids"

16.1 **Venue, Time, and Date of Bid Opening**

As notified in "Invitation to Bids"

16.4 **Responsiveness of Bids**

(i) Bid is valid till required period,
(ii) *Bid prices are firm during currency of contract/Price adjustment;
(iii) Completion period offered is within specified limits,
(iv) Bidder is eligible to Bid and possesses the requisite experience, capability and qualification.
(v) Bid does not deviate from basic technical requirements and
(vi) Bids are generally in order, etc.

FORM OF BID AND SCHEDULES TO BID

(LETTER OF OFFER)

Bid Reference No. _____

(Name of Works)

To:

Gentlemen,

1. Having examined the Bidding Documents including Instructions to Bidders, Bidding Data, Conditions of Contract, Contract Data, Specifications, Drawings, if any, Schedule of Prices and Addenda Nos. _____ for the execution of the above-named works, we, the undersigned, being a company doing business under the name of and address _____ _____ and being duly incorporated under the laws of Pakistan hereby offer to execute and complete such works and remedy any defects therein in conformity with the said Documents including Addenda thereto for the Total Bid Price of Rs_____(Rupees_____) or such other sum as may be ascertained in accordance with the said Documents.

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

3. As security for due performance of the undertakings and obligations of this Bid, we submit herewith a Bid Security in the amount of _____ _____ drawn in your favour or made payable to you and valid for a period of Ninety (90) days beyond the period of validity of Bid.

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

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

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

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

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

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

Dated this _____day of _____, 20 Signature _____ in the

capacity of _____duly authorized to sign bid for and on behalf of

(Name of Bidder in Block Capitals) (Seal)

Address:
_____
_____
_____

Witness:

(Signature)_____

Name:_____
Address: _____

[SCHEDULES TO BID INCLUDE THE FOLLOWING:

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

SCHEDULE – A TO BID
SCHEDULE OF PRICES

Sr. No.

1 Preamble to Schedule of Prices……..

2 Schedule of Prices…….

*(a) Summary of Bid Prices

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

SCHEDULE -A TO BID

PREAMBLE TO SCHEDULE OF PRICES

1. General

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

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

2. Description

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

3. Units & Abbreviations

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

4. Rates and Prices

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

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

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

4.4 The whole cost of complying with the provisions of the Contract shall be included in the items provided in the Schedule of Prices, and where

no items are provided, the cost shall be deemed to be distributed among the rates and prices entered for the related items of the Works and no separate payment will be made for those items.

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

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

*(b) The Contractor shall be responsible to make complete arrangements for the transportation of the Plant to the Site.
*(*Office of NED University of Engineering & Technology, University Road, Karachi-75270")

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

2 **Bid Prices**

5.1 Break-up of Bid Prices the various elements of Bid Prices shall be quoted as detailed by the Procuring Agency in the format of Schedule of Prices. The bidder shall recognize such elements of the costs which he expects to incur the performance of the Works and shall include all such costs in the rates and amounts entered in the Schedule of Prices.

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

6. Provisional Sums and Day work

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

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

SCHEDULE -A TO BID SCHEDULE OF PRICES – SUMMARY OF BID PRICES (Sample)

	Description	Total Amount (Rs)
	A) Building Work Follow Volume-II, Schedule of Price (BOQ)	
	Total Bid Price (The amount to be entered in Para 1 of the Form of Bid) (In words). _____	

SCHEDULE -A TO BID

SCHEDULE OF PRICES

Item No.	Description	Quantity	Unit Rate(Rs)	Total Amount (Rs)
.	Follow Volume-II, Schedule of Prices BOQ			
Total (*to be carried to Summary of Bid Price*) *Add/ Deduct the percentage quoted above/below on the prices of items based on Composite Schedule of Rates.*				

VOLUME-I

SCHEDULE -B TO BID

"SPECIFIC WORKS DATA"

SCHEDULE – C TO BID WORKS TO BE PERFORMED BY SUBCONTRACTORS*

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

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

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

2. The truthfulness and accuracy of the statement as to the experience of Sub-Contractors is guaranteed by the bidder. The Procuring Agency‘s judgment shall be final as to the evaluation of the experience of Sub-Contractors submitted by the bidder.

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

SCHEDULE – D TO BID

PROPOSED PROGRAMME OF WORKS

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

SCHEDULE – E TO BID

METHOD OF PERFORMING WORKS

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

- The sequence and methods in which he proposes to carry out the Works, including the number of shifts per day and hours per shift, he expects to work.

- A list of all major items of construction and plant erection, tools and vehicles proposed to be used in delivering/carrying out the works at site.

- The procedure for installation of equipment and transportation of equipment and materials to the site.

- Organization chart indicating head office & field office personnel involved in management, supervision and engineering of the Works to be done under the Contract.

SCHEDULE – F TO BID

(INTEGRITY PACT)

DECLARATION OF FEES, COMMISSION AND BROKERAGE ETC PAYABLE BY CONTRACTORS

(FOR CONTRACTS WORTH RS. 10.00 MILLION OR MORE)

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

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

……
[Procuring Agency] [Contractor]

CONDITIONS OF CONTRACT

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CONDITIONS OF CONTRACT

1. GENERAL PROVISIONS

1.1 Definitions

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

The Contract

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

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

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

Persons

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

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

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

Dates, Times and Periods

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

1.1.8 "Day"means a calendar day

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

Money and Payments

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

Other Definitions

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

1.1.12 "Country" means the Islamic Republic of Pakistan.

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

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

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

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

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

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

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

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

1.2 **Interpretation**

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

1.3 **Priority of Documents**

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

1.4 **Law**

The Law of the contract is the relevant law of Islamic republic of Pakistan.

1.5 **Communications**

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

1.6 **Statutory Obligations**

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

2. THE PROCURING AGENCY

2.1 **Provision of Site**

The Procuring Agency shall provide the Site and right of access thereto at the times stated in the Contract Data. **Site Investigation Reports** are those that were included in the bidding documents and are factual and interpretative reports about the surface and sub-surface conditions at the Site.

2.2 **Permits etc.**

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

2.3 **Engineer's/Procuring Agency's Instructions**

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

2.4 **Approvals**

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

3. ENGINEER'S/PROCURING AGENCY'S REPRESENTATIVES

3.1 **Authorized Person**

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

3.2 **Engineer's / Procuring Agency's Representative**

The name and address of Engineer‘s/Procuring Agency‘s Representative is given in Contract

Data. However the Contractor shall be notified by the Engineer/Procuring Agency, the delegated duties and authority before the Commencement of works.

5. DESIGN BY CONTRACTOR (NOT APPLICABLE)

5.1 **Contractor's Design (not applicable)**

The Contractor shall carry out design to the extent specified, as referred to in the Contract Data. The Contractor shall promptly submit to the Engineer/Procuring Agency all designs prepared by him, within fourteen (14) days of receipt the Engineer/Procuring Agency shall notify any comments or, if the design submitted is not in accordance with the Contract, shall reject it stating the reasons. The contractors shall not construct any element of the works designed by him within fourteen (14) days after the design has been submitted to the Engineer/Procuring Agency or which has been rejected. Design that has been rejected shall be promptly amended and resubmitted. The Contractor shall resubmit all designs commented on taking these comments into account as necessary.

5.2 **Responsibility for Design (not applicable)**

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

6. PROCURING AGENCY'S RISKS

6.1 **The Procuring Agency's Risks**

The Procuring Agency's Risks are:

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

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

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

d) ionising radiations, or contamination by radio-activity from any nuclear fuel, or from any nuclear waste from the combustion of nuclear fuel, radio-active toxic explosive, or other hazardous properties of any explosive nuclear assembly or nuclear component of such an assembly, except to the extent to which the Contractor/Sub-Contractors may be responsible for the use of any radio-active material**;**

e) Pressure waves caused by aircraft or other aerial devices travelling at sonic or supersonic speeds**;**

f) use or occupation by the Procuring Agency of any part of the Works, except as may be specified in the Contract**;**

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

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

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

7. TIME FOR COMPLETION

7.1 Execution of the Works

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

7.2 Programme

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

7.3 Extension of Time

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

7.4 Late Completion

If the Contractor fails to complete the Works within the Time for Completion, the Contractor‘s

only liability to the Procuring Agency for such failure shall be to pay the amount as **liquidity damages** stated in the Contract Data for each day for which he fails to complete the Works.

8. **TAKING-OVER**

8.1 **Completion**

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

8.2 Taking our Notice

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

9. REMEDYING DEFECTS

9.1 **Remedying Defects**

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

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

9.2 **Uncovering and Testing**

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

10. VARIATIONS AND CLAIMS

10.1 **Right to Vary**

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

10.2 **Valuation of Variations**

Variations shall be valued as follows:

a) at a lump sum price agreed between the Parties, or

b) where appropriate, at rates in the Contract, or

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

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

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

10.3 **Changes in the Quantities.**

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

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

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

10.4 **Early Warning**

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

To the extent of the Contractor‘s failure to notify, which results to the Engineer/Procuring Agency being unable to keep all relevant records or not taking steps to minimize any delay, disruption, or Cost,

or the value of any Variation, the Contractor‘s entitlement to extension of the Time for Completion or additional payment shall be reduced/rejected.

10.5 **Valuation of Claims**

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

10.6 **Variation and Claim Procedure**

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

11. CONTRACT PRICE AND PAYMENT

11.1 (a) **Terms of Payments**

The amount due to the Contractor under any Interim Payment Certificate issued by the Engineer pursuant to this Clause, or to any other terms of the Contract, shall , subject to Clause 11.3, be paid by the Procuring Agency to the Contractor within 30 days after such Interim Payment Certificate has been jointly verified by Procuring Agency, Engineer and Contractor, or, in the case of the Final Certificate referred to in Sub Clause 11.5, within 60days after such Final Payment Certificate has been jointly verified by Procuring Agency, Engineer and Contractor;

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

(b) **Valuation of the Works**
The Works shall be valued as provided for in the Contract Data, subject to Clause 10.

11.2 **Monthly Statements**
The Contractor shall be entitled to be paid at monthly intervals:

a) the value of the Works executed less to the cumulative amount paid previously; and
b) value of secured advance on the materials and valuation of variations (if any).

The Contractor shall submit each month to the Engineer/Procuring Agency a statement showing the

amounts to which he considers himself entitled.

11.3 **Interim Payments**

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

11.4 **Retention**

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

11.5 **Final Payment**

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

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

11.6 **Currency**

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

12. DEFAULT

12.1 **Defaults by Contractor**

If the Contractor abandons the Works, refuses or fails to comply with a valid instruction of the Engineer/Procuring Agency or fails to proceed expeditiously and without delay, or is, despite a written complaint, in breach of the Contract, the Procuring Agency may give notice referring to this Sub-Clause and stating the default. If the Contractor has not taken all practicable steps to remedy the default within fourteen (14) days after receipt of the Procuring Agency‘s notice, the Procuring Agency may by a second notice given within a further twenty one (21) days, terminate the Contract. The Contractor

shall then demobilize from the Site leaving behind any Contractor‘s Equipment which the Procuring Agency instructs, in the second notice, to be used for the completion of the Works at the risk and cost of the Contractor.

12.2 **Defaults by Procuring Agency**

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

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

12.3 **Insolvency**

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

12.4 **Payment upon Termination**

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

b) any sums to which the Procuring Agency is entitled,

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

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

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

13. RISKS AND RESPONSIBILITIES

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

After termination, the Contractor shall be entitled to payment of the unpaid balance of the value of the works executed and of the Materials and Plant reasonably delivered to the site, adjusted by the following: Subject to Sub-Clause 9.1, the Contractor shall take full responsibility for the care of the work from the commencement date until the date of the Procuring Agency 's / Engineer's insurance for certificate of compilation under Sub-Clause 8.2. Responsibility shall then pass to the Procuring Agency. If any loss or damage happens to the Works during the above period, the Contractor shall rectify such loss or damage so that the Works conform with the Contract. Unless the loss or damage happens as a result of any of the procuring Agency Risks, the Contractor shall indemnify the Procuring Agency, or his agents against all claims loss, damage and expense arising out of the Works

13.2 **Force Majeure**

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

If the event continues for a period of eighty four (84) days, either Party may then give notice of termination which shall take effect twenty eight (28) days after the giving of the notice.

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

a) any sums to which the Contractor is entitled under Sub-Clause 10.4,
b) the cost of his demobilization, and
c) less any sums to which the Procuring Agency is entitled.

The net balance due shall be paid or repaid within thirty five (35) days of the notice of termination.

14. INSURANCE

14.1 **Arrangements**

The Contractor shall, prior to commencing the Works, effect insurances of the types, in the amounts

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

14.2 **Default**

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

15. **RESOLUTION OF DISPUTES**

15.1 **Engineer's Decision**

If a dispute of any kind whatsoever arises between the Procuring Agency and the Contractor in connection with the works, the matter in dispute shall, in the first place, be referred in writing to the Engineer, with a copy to the other party. Such reference shall state that it is made pursuant to this Clause. No later than the twenty eight (28) days after the day on which he received such reference, the Engineer shall give notice of his decision to the Procuring Agency and the Contractor.

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

15.2 **Notice of Dissatisfaction**

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

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

15.3 **Arbitration**

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

16 INTEGRITY PACT

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

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

(b) terminate the Contract;

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

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

CONTRACT DATA

Sub-Clauses of Conditions
of Contract

1.1.3 (Office of NED University of Engineering & Technology, University Road, Karachi-75270"Drawings, if any

1.1.4 **The Procuring Agency** means
NED University of Engineering & Technology, Karachi-75270 Phone: (9221) 9926-1261-8EXT:

2291 FAX no.: (9221)9926-1255

1.1.5 **The Contractor** means execute the work

1.1.7 **Commencement Date** means the date of issue of Engineer's Notice to Commence which shall be issued within Seven (07) days of the signing of the Contract Agreement.

1.1.9 **Time for Completion 02 months**

1.1.20 **Engineer** M/s Nexus Consulting (consultant) , A-202, Blossom Trade Center, SB#26, Gulistan-e-Jauhar, Block-01, Main University Road, Karachi,

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

(a) The Contract Agreement
(b) Letter of Acceptance.
(c) The completed Form of Bid

(d) Contract Data
(e) Conditions of Contract
(f) The completed Schedules to Bid including Schedule of Prices
(g) The Drawings,
(h) The Specifications
(i) _____
(j) _____

2.1 **Provision of Site:**
3.1 **Authorized person: Director Procurement**
3.2 **Name and address of** NED University of Engineering&Technology,Karachi-75270 Phone: (9221)

9926-1261-8EXT: 2291 FAX no.: (9221)9926-1255

4.4 **Performance Security:**
Amount: 5% of the tender /bid amount in shape of pay order or bank guarantee
Validity: The above amount will cover Contract Period and DLP Period

5.1 **Requirements for Contractor's design**

(Not applicable):

7.2 **Programme:**
Time for submission: Within Seven (07) days of the Commencement Date.

Form of programme: *(Bar Chart*)

7.4 Amount payable due to failure to complete shall be 0.1% per day up to a maximum of (10%) of sum stated in the Letter of Acceptance/Award.

7.5 **Early Completion**

(Not applicable)

9.1 **Period for remedying defects/ defect liability period (DLP)**
DLP period will be 06 months from date of completion or from the date of Taking Over Certificate issued by the Procuring Agency.

_____

_____

11.1 **Terms of Payments**

a) Mobilization Advance

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

(i) On submission by the Contractor of a Mobilization Advance Guaranty By the full amount of the Advance in the specified form from a Scheduled Bank in Pakistan to the Procuring Agency;
(ii) Contractor will pay interest on the mobilization advance at the rate of 10% per annum on the advance; and.
(iii) This Advance including the interest shall be recovered in 5 equal instalments from the

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

OR

2) **Secured Advance on Materials**

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

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

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

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

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

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

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

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

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

(ix) Secured Advance may be permitted only against materials/quantities anticipated to be consumed / utilized on the work within a period of 3 months from the date of issue of secured advance and definitely not for full quantities of materials for the entire work/contract

(b) Recovery of Secured Advance:

(i) Secured Advance paid to the Contractor under the above provisions shall be effected from the monthly payments on actual consumption basis, but not later than period specified in the

rules not more than three months (even if unutilized); other conditions.

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

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

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

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

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

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

11.3 **Percentage of retention*:** 5%of the amount of Interim Payment Certificate
11.6 **Currency of payment:** Pak. Rupees

14.1 **Insurances:**

Type of cover

Third Party-injury to persons and damage to property
Rs.500,000 per occurrence with number of occurrence sun limited.

1. **Arbitration**** Place of Arbitration:Karachi.

STANDARD FORMS

FORM OF BID SECURITY

(Bank Guarantee)

Guarantee No._____ Executed on _____ **(**Letter by the Guarantor to the Procuring Agency)

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

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

Bid Reference No._____ Date of Bid _____

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

THE CONDITION OF THIS OBLIGATION IS SUCH, that whereas the Principal has submitted the accompanying Bid numbered and dated as above for _____ (Particulars of Bid) to the said Procuring Agency; and

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

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

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

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

(c) failure of the successful bidder to

(i) furnish the required Performance Security, in accordance with Sub-Clause IB-21.1 of Instructions to Bidders, or

(ii) sign the proposed Contract Agreement, in accordance with Sub-Clauses IB-20.2 & 20.3 of Instructions to Bidders,

The entire some be paid immediately to the said Procuring Agency for delayed completion and not as penalty for the successful bidder's failure to perform.

NOW THEREFORE, if the successful bidder shall, within the period specified therefore, on the prescribed form presented to him for signature enter into a formal Contract Agreement with the said Procuring Agency in accordance with his Bid as accepted and furnish within fourteen (14) days of receipt of Letter of Acceptance, a Performance Security with good and sufficient surety , as may be required, upon the form prescribed by the said Procuring Agency for the faithful performance and proper fulfilment of the said Contract or in the event of non-withdrawal of the said Bid within the time specified then this obligation shall be void and of no effect, but otherwise to remain in full force and effect.

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

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

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

_____
Guarantor

(Bank)
Witness:

1. Signature _____

1._____

2. Name _____

_____

3. Title _____

Corporate Secretary (Seal)

2. _____

_____

(Name, Title & Address)

Corporate Guarantor (Seal)

FORM OF PERFORMANCE SECURITY

(Bank Guarantee)

Guarantee No._____

Executed on _____

Expiry Date _____

(Letter by the Guarantor to the Procuring Agency)

Name of Guarantor (Scheduled Bank in Pakistan) with address:_____ 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 the said Documents that may hereafter be made, notice of which modifications to the Guarantor being hereby waived, then, this obligation to be void; otherwise to remain in full force and virtue till all requirements of Clause 9, Remedying Defects, of Conditions of Contract are fulfilled.

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

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

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

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

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

Guarantor (Bank) Witness:

_____
Guarantor

(Bank)
Witness: 1. Signature _____

1._____ 2. Name _____

_____ 3. Title _____

Corporate Secretary (Seal)

2. _____

_____ _____

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

FORM OF CONTRACT AGREEMENT

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

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

NOW this Agreement witnesseth as follows:

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

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

(a) The Letter of Acceptance;

(b) The completed Form of Bid along with Schedules to Bid;

(c) Conditions of Contract & Contract Data;

(d) The priced Schedule of Prices/Bill of quantities (BoQ);

(e) The Specifications; and

(f) The Drawings

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

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

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

Signature of the Contactor	Signed of the Procuring Agency
_____	_____
(Seal)	(Seal)
Signed, Sealed and Delivered in the presence of:	
Witness:	Witness:
_____	_____
(Name, Title and Address)	(Name, Title and Address)

MOBILIZATION ADVANCE GUARANTEE

Guarantee No._____

Executed on_____

(Letter by the Guarantor to the Procuring Agency)

WHEREAS the _____ (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 Rs._____ Rupees _____) 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 advance payment for the performance of his obligations under the said Contract.

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

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

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

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

This Guarantee shall expire not later than _____

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

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

Guarantor (Scheduled Bank)

_____

Guarantor (Scheduled Bank)

Witness: 1. Signature _____

1._____ 2. Name _____

_____ 3. Title _____

Corporate Secretary (Seal)

2. _____

_____ _____

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

INDENTURE FOR SECURED ADVANCE

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

This INDENTURE made the .... day of ..... -----..... ----------.....-20-----"-BETWEEN (hereinafter called "the Contractor" which expression shall where the context so admits or implied be deemed to include his heirs, executors, administrators and assigns) of the one part and THE GOVERNOR OF SINDH (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 (E). 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) ThatthesaidsumofRupees.....-..... ----------..... ----------(RF. ----------) so advanced by the Government to the Contractor as aforesaid and all or any further sum or sums which may be advanced aforesaid shall be employed by the contractor in or towards expending the execution of the said works and for no other purpose whatsoever.

(2) That the materials detailed in the said Running Account Bill (B) which have been

Fin R Form No. 17-A

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

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

Fin. R. Form No. 17-A

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

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

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

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

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

to repay and the same respectively to it accordingly.

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

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

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

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

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

(10) That in the event of any conflict between the provisions of these presents and the said agreement the provisions of these presents shall prevail and in the event of any dispute or difference arising over the construction or effect of these presents the settlement of which has not been hereinbefore expressly provided for the same shall be referred to the Procuring Agency ..... Circle whose……. decision shall be final and the provisions of the Indian Arbitration Act for the time being in force so far as they are applicable shall apply to any such reference.

In witness where of the* _____on behalf of the Governor of Sindh and the said..... —..... -..... --have hereunto set their respective hands and seals the day and first above written.

Signed, sealed and delivered by* In the
presence of

_____
Seal

1st witness 2nd
witness

Signed, sealed and delivered by* In the
presence of

Seal
1st Witness 2nd witness

SPECIFICATION

[Note for Preparing the Specifications]

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

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

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

Sample Clause: Equivalency of Standards and Codes

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

DRAWING

NED UNIVERSITY OF ENGINEERING & TECHNOLOGY, KARACHI

CONSTRUCTION OF NEW ROAD FROM FITNESS CENTRE TO NEWLY DEVELOPED FOOTBALL GROUND AND REHABILITATION OF EXISTING ROAD FROM OVERHEAD WATER TANK TO FITNESS CENTRE

TENDER DOCUMENTS VOLUME-II
BILL OF QUANTITIES

PC/NED/Road/Sports/6963/2020

DEVELOPMENT & UPGRADATION OF SPORTS FACILITIES

OFFICE A-202, SECOND FLOOR, BLOSSOM TRADE CENTER, OPPOSITE NED UNIVERSITY PLOT # SB-26, BLOCK-01, GULISTAN-E-JAUHAR, KARACHI
021-34177576, www.nexuscon.pk,
mail@nexuscon.pk,nexusconsultingcompany@gmail.com

NED UNIVERSITY OF ENGINEERING & TECHNOLOGY

CONSTRUCTION OF NEW ROAD FROM FITNESS CENTER TO NEWLY DEVELOPED FOOTBALL GROUND AND REHABILITATION OF EXISTING ROAD FROM OVERHEAD WATER TANK TO FITNESS CENTER

Summary of BOQs

Sr.No.	Description	Amount
A	Schedule Items PREMIUM (Below_____Above_____)	2,631,488.00
	Sub Total	
B	Non-Schedule Items	
	Total	

Contractor:_____

Name:_____

Signature:_____

Consultant

Nexus Consulting

ENGINEERING - ENVIRONMENTAL
& PROJECT MANAGEMENT SERVICES

Note:
Rates quoted in the bids must include of all taxes (income tax and SRB)

NED UNIVERSITY OF ENGINEERING & TECHNOLOGY

CONSTRUCTION OF NEW ROAD FROM FITNESS CENTER TO NEWLY DEVELOPED FOOTBALL GROUND AND REHABILITATION OF EXISTING ROAD FROM OVERHEAD WATER TANK TO FITNESS CENTER

ABSTRACT OF COST

BOQs CIVIL WORKS
Schedule Rates

Sr.No.	Description	Unit	Qty	Rate	Amount
	Footpath & Storm Water Drain Work				
1	Cement Concrete plain including finishing and curing, complete (including screening and washing at stone aggregate without shuttering ratio 1:4:8 **(Sr-5i/P-15)**				
	For New road	%Cft	3,484.28	11,288.75	393,332
	For existing road	%Cft	1,151.00	11,288.75	129,934
2	Cement Concrete plain including finishing and curing, complete (including screening and washing at stone aggregate without shuttering ratio 1:2:4 **(Sr-5f/P-15)**				
	repair of Green Belt of existing road	%Cft	280.00	14,429.25	40,402
3	Erection and removal of centering for RCC or plain cement concrete works of Partal wood , vertical (CSR, SR. 19bii/18)				
	repair of Green Belt of existing road	%Sft	1,120.00	3,127.41	35,027
4	Cement Plaster 1:4 up to 12' height 3/4" thcik (CSR, SR.11d/52				
	repair of Green Belt of existing road	%Sft	1,680.00	3,015.76	50,665
5	Providing and laying 2" thick topping cement concrete (1:2:4) including surface finishing and dividing into panel (CSR. SR.16c/42)				
	For New Road	%Sft	1,968.56	3,275.50	64,480
6	Providing & fixing cement paving blocks flooring having size of 197x97x60 (mm) of city /quddra/ cobble shape with natural colours, having strength b/w 5000 psi to 8500 psi I/cfilling the joints with hill sand and laying in specified manner / pattern and designed etc. complete **(Sr.No.71/49)**				
	For New Road	Sft	5,000.00	199.77	998,850
	For existing road	Sft	2,302.00	199.77	459,871
	Road Work				

Sr.No.	Description	Unit	Qty	Rate	Amount
7	Clearing and grabbing the site by cutting uprooting and removing all rubbish and shrubs including disposal to out side limit) designated places **Highway works (Sr.1/P-1)**	%Sft	21,288.62	97.07	20,665
8	Compaction of natural ground upto a depth of 20cm (8" inch) below the natural ground level compacted upto 90% density modified AASHTO **Highway works (Sr.2/P-1)**	%Sft	21,288.62	177.56	37,800
9	**Cat Eyes/Road Studs** supplying and fixing of reflective road studs double face flush surface type				
	For New road	Each	145.69	596.00	86,830
	For existing road	Each	118.50	596.00	70,626
10	**Thermo Plastic Paint** Pavement marking reflective tharmo plastic paint for lines of 6 inch width.CSR Highway Misc Sr.13/15)				
	For New road	P.Rft	3,424.50	41.24	141,226
	For existing road	P.Rft	2,468.00	41.24	101,780
	Total Schedule items				**2,631,488**

NED UNIVERSITY OF ENGINEERING & TECHNOLOGY

CONSTRUCTION OF NEW ROAD FROM FITNESS CENTER TO NEWLY DEVELOPED FOOTBALL GROUND AND REHABILITATION OF EXISTING ROAD FROM OVERHEAD WATER TANK TO FITNESS CENTER

ABSTRACT OF COST

BOQs CIVIL WORKS
Non-Schedule Rates

Sr.No.	Description	Unit	Qty	Rate	Amount
	Footpath and Road Work				
1	Excavation for road pavement, footpath etc. in all kind of soil general ordinary soil, Murom silts etc, through manually or mechanical up to any depth, lift and lead including dewatering if required, excavated material may be used a backfilling material or disposal of excavated material out side the university the cost of disposal of excavated material is including with cost of excavation	Cft	10,644.31		
2	Preparing Sub-base course by supplying and spreading stone metal of stone metal 1-1/2"-2" gauge of approved quality from approved quarry in required thickness to proper camber and grade including hand packing filling voids with 20 cft of pit/canal sand having plasticity index not more than 6% of suitable quality watering and compacting to achieve 98-100% density as per modified AASHTO specifications (rate includes all cost of material T&P and carriage.	Cft	10,644.31		

Sr.No.	Description	Unit	Qty	Rate	Amount
3	Preparing base course i/c supplying and spreading stone metal of approved quality properly graded to maximum size of 1-1/2 in required thickness to proper camber and graded including supplying and spreading 15 cft : screenings and plastic quarry fines filling depressions with stone metal after initial rolling including watering and compaction the same so as to achieve 100% density as per modified AASHTO Specifications. (Rate includes providing and using templates, camber plates screens, forms as directed. (Rate includes all cost of material T&P and carriage up to 3 chains).(Highway Sr.No.13A/5) One Layer 6" Thick.	Cft	10,644.31		
4	Applying priming coat or tack coat with approved binder at the required rate including cleaning the road surface thoroughly heating to the required temperature and spraying the binder with pressure as directed etc. complete	Sft	41,007.11		
5	3" (75mm) Asphaltic Base Plant Mix A-Providing and laying plant mixed asphalt concrete binder course compacted thickness 3 inches (75mm thick) as per approved job mix formula using crush aggregate from approved source. Using asphalt of grade 60/70 during laying temperature not less than 140C compacted by steel wheel & PTR roller. The procedure of laying binder course material & methodology shall fully comply with AASHTO and as directed by Engineer Incharge. Minimum bitumen content should be 3.5% binder course shall be spreading using paver machine. Rolling & Finishing to design proper grade line level and camber etc.:(Machinery with POLs cost of material carriage)	Sft	21,288.62		

Sr.No.	Description	Unit	Qty	Rate	Amount
6	2" THICK Asphalt Concrete wearing course Plant Mix B laying mechanically to proper line and grade mixed Asphalt concrete specified formula according to job mixed formula approved by the engineer incharge rolling and finishing to design proper grade line lebel and camber etc. (Machinery with POLs cost of material carriage)				
	Overlay of existing road	Sft	19,718.49		
7	Providing & fixing kerb block 3750 PSI industrial Made size 6 inches thick x 12 inches long x 18 inched high including the cost of cartage excavation, form work for hunching 1450 lean concrete 2250 psi concrete for hunching, 1:4 cement sand mortar.				
	For new Road	Rft	1,481.00		
8	Supplying and laying fine sand/khaka under the pavers up to 2" thick, spreading and leveling, complete in all respect as directed				
	For New Road	Sft	5,000.00		
	For existing road	Sft	2,302.00		
9	Providing & fixing golden stone edging at road sides, size of golden stone 12x8x6 inch including the cost of cartage excavation, form work for hunching 1450 lean concrete 2250 psi concrete for hunching, 1:4 cement sand mortar.				
	For Exiting Road	Rft	1,232.00		
10	Scarifying the existing road surface by mechanical means complete in all respect as per direction	Sft	18,987.28		
	Total Non Schedule Items				

NED UNIVERSITY OF ENGINEERING AND TECHNOLOGY, KARACHI

CONSTRUCTION OF NEW ROAD FROM FITNESS CENTRE TO NEWLY DEVELOPED FOOTBALL GROUND AND REHABILITATION OF EXISTING ROAD FROM OVERHEAD WATER TANK TO FITNESS CENTRE

TENDER DOCUMENTS VOLUME-III

Technical Specifications

PC/NED/Road/Sports/6963/2020

DEVELOPMENT & UPGRADATION OF SPORTS FACILITIES

OFFICE A-202, SECOND FLOOR, BLOSSOM TRADE CENTER, OPPOSITE NED UNIVERSITY PLOT # SB-26, BLOCK-01, GULISTAN-E-JAUHAR, KARACHI, 021-34177576, www.nexuscon.pk, mail@nexuscon.pk,nexusconsultingcompany@gmail.com

Table of Contents

1. GENERAL AND SITE FACILITIES

1.1 INTRODUCTION

These Specifications shall apply to all such works to be executed involving construction of a building and its allied works under the Contract or otherwise directed by the Engineer. In every case, the Work shall be carried out to the satisfaction of the Engineer and conform to the location, lines, dimensions, cross-sections, etc shown on the Drawings or in the Bill of Quantities (BOQ) or as indicated by the Engineer. The quality of materials, processing of materials as may be needed at the site, salient features of the construction work and quality of finished works shall comply with the requirements set forth in the succeeding Sections and Sub-sections. Where the Drawings and Specifications describe a portion of the work in only general terms and not in complete detail, it shall be understood that only the best general practices are to prevail, materials and workmanship of the best quality are to be employed and instructions of the Engineer are to be fully complied with.

Words importing the singular also mean the plural and vice versa where the context so demands. Similarly, words importing the male also mean female or neuter and vice versa where the context so requires. Words have their normal meaning under the English language unless specifically defined.

1.2 DEFINITIONS

The following words and expressions shall have the meaning hereby assigned to them, except where the context otherwise require. However, in the case of any conflict with the stipulations of the Conditions of the Contract, the expressions and meaning of the Conditions of Contract shall prevail.

'The Employer' is the N.E.D. University of Engineering & Technology (The PA) representative by its PD/Civil Engineer (Food Project) as PA's Coordinator or any other representative appointed from time to time by the authority and notified in writing to the Contractor to act as the PA's representative for the purpose of this Work.

'The Engineer' shall mean the engineer designated or any other engineer appointed from time to time by the PA and notified in writing to the Contractor to act as 'the Engineer' for the purpose of the Contract.

'The Contractor' shall mean any person or corporate body who is pre-qualified under the Project/ enlisted with the PEC and whose Tender to carry out the Work has been accepted by the Employer and the legal successors in title to such person, but not (except with the consent of the Employer) any assignee of such person.

A 'Sub-Contractor' shall mean any person or corporate body named in the Contract as a Subcontractor for a part of the Work or any person or corporate body to whom a part of the Work has been subcontracted with the consent of the Engineer and the legal successors in title to such person or corporate body, but not any assignee of any such person or corporate body.

'The Contract' is the contract between the Employer and the Contractor to execute, complete and maintain the Work.

The expression of 'Work' or 'Works' are what the Contract requires by the Contractor to construct, install and hand over to the Employer, as defined in the Tender Documents. Unless there be something either in the subject or context repugnant to such construction it shall be construed and taken to mean the works by or by virtue of Contract to be executed, whether temporary or permanent and whether original, altered, substituted or additional.

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

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

'Letter of Acceptance' means the formal acceptance by the Employer of the Tender.

1.3 SCOPE OF WORK

The Work to be carried out under the Contract shall consist of the various items as generally described in the Tender Documents as well as in the BOQ furnished in the Tender Documents.

The Work to be performed shall also include all general works preparatory to the construction of a building and all other related works. The Work shall include works of any kind necessary for the due and satisfactory construction, completion and maintenance of the works to the intent and of the Drawings, BOQ and these Specifications and further Drawings and Orders as may be issued by the Engineer from time to time. Whether specifically mentioned or not in the various Sections of this Specification, the Scope of Work shall include compliance by the Contractor with all conditions of the Contract, all materials, apparatus, plant, equipment, tools, fuel, water strutting, timbering, transport, offices, stores, workshop, staff, labor and the provision for proper and sufficient protective works, temporary fencing and lighting, etc. It shall also include safety of workers, first-aid equipment, suitable accommodation for the staff and workmen with adequate sanitary arrangements, the effecting and maintenance of all insurance, the payment of all wages, salaries, fees, royalties, duties or other charges arising from the erection of works and the regular clearance of rubbish, reinstating and clearing the site as may be required on completion of the Work, safety of the public and protection of the Work and the adjoining land.

The Contractor shall ensure that all actions are taken to have a built-in quality assurance in the planning and execution of the Work. The quality assurance shall cover all stages of works such as setting out, selection of materials, selection of construction methods, selection of equipment and plant, deployment of personnel and supervisory staff, quality control testing, etc. The work of built-in quality assurance shall be deemed to be covered in the Scope of Work.

1.4 SUBMITTAL

The submittal by the Contractor shall include construction programme, all Shop Drawings, reports, samples, test results etc. to conform with all applicable provisions of the General Conditions of the Contract and as required under the various Sections of these Specifications. The purpose of the submittal required herein is to assure that items furnished and installed are, in all matters of consequence, equivalent to the specified items and that proper records are maintained of the changes

made in the Specifications, Drawings or in materials used or any deviations made in the construction process.

The Contractor shall forward all submittal to the Engineer under a cover letter stating that the submittal has been carefully reviewed by the Contractor and that on-site conditions or dimensions where necessary and correctness have been verified and checked.

The submittal shall be reviewed by the Engineer to verify that the Contractor's obligations are fulfilled as per the turn intention of the Contract. In checking and approving submittal, the Employer does not relieve the Contractor from responsibilities for construction errors or omissions, which may occur, even though executed in accordance with the approved Shop Drawings. Any such errors or omissions, as is discovered later on, should be corrected by the Contractor irrespective of any approval by the Employer at no additional cost to the Employer. This does not apply to modifications approved as specified herein.

The Contractor shall make submittal of construction requirements at least 10 days prior to actual construction of the component to allow time for checking and re-checking, if necessary. Any works fabricated or installed by the Contractor prior to approval of the Shop Drawings or other required submittal shall be done at his own risk.

1.4.1 CONSTRUCTION PROGRAM

Within 14 days of the date of the Letter of Acceptance, the Contractor shall submit to the Engineer for his approval a Bar Chart/Gantt Chart showing the program sequence in which works have been proposed to be carried out including the procurement and delivery of equipment and materials.

The Contractor shall, whenever required by the Engineer, also provide in writing a general description of the arrangements and methods, which would be adopted for the execution of the Work.

If at any time it would appear to the Engineer that the actual progress of work does not conform to the approved program, the Contractor shall be obliged to produce for the approval of the Engineer the reasons for any changes with a revised program showing the modifications to the previously approved program necessary to complete the Work on schedule. Submission to and approval by the Engineer of such program or furnishing of such particulars shall neither relieve the Contractor from any of his duties and responsibilities under the Contract nor it shall prejudice the 'Liquidated Damages' Clause of the Contract.

1.4.2 NOTICE OF OPERATION

The Contractor shall give full and complete written notice of all the important operations, including setting out, to the Engineer sufficiently in advance (not less than 10 days) to enable the Engineer to make such arrangements as the Engineer may consider necessary for inspection and for any other purposes. The Contractor shall not start any important operation without the written approval of the Engineer.

1.4.3 AS-BUILT DRAWINGS

Before the expiry of the period of maintenance, the Contractor shall submit the full sets of As-Built Drawings of the completed works to the Employer. The sets shall comprise of all Discipline Drawings (9 copies) along with soft copies on a CD.

The As-Built Drawing shall clearly show the lines and dimensions of the permanent construction actually made based on the changes to the original design from time to time as ordered by the Engineer or proposed by the Contractor and approved by the Engineer.

The original soft copies of the Tender Drawings and Design Drawings will be provided to the contractor for producing additional copies, if the contractor requires.

1.4.4 SHOP DRAWINGS

The Contractor shall prepare the Shop Drawings at his own costs showing clearly all elements of construction that are required to assure proper shop fabrication or job ins Shop Drawings shall be clearly shown. All material quality, finishes, construction details as specifically related to the project must be shown on the Shop Drawings installation of items requiring.

1.5 TAKING OVER POSSESSION OF SITE

The Contractor shall, upon receiving the Work Order, immediately take possession of the Site and move his men and materials to prepare the Site in order to create conditions for starting the Work as per terms of the Contract, Drawings and Specifications.

1.6 MOBILIZATION

The work of mobilization shall consist of carrying out the following listed actions together with all other requirements of the Contract with regard to commencing the execution of the Work by the Contractor at his own cost.

i. Procurement, assembly, repair and make to running condition of all the contractor-owned constructional plant and equipment by the Contractor at any other site as convenient to him.
ii. Transportation of Contractor-owned constructional plant, equipment and materials from the storage site as mentioned above in (a) to the place of construction.
iii. Assembling and installation of all items of constructional plant, equipment, etc. required for the execution of the Work.
iv. Receiving all constructional plant, equipment and materials to be furnished by the Employer, if any, and collect and transport those to the Work site. All materials shall be properly stored, inventoried and protected until used in to the Work and all plant and equipment shall be tested and made ready for use.
v. Construction of a suitable Site office building or shed for storage of materials and equipment, workshop, other operational buildings and First-Aid Center attended by competent Medical Assistants.
vi. Maintenance of all temporary roads, fences and sanitary facilities, keep all areas used by the Contractor clean, neat, well-kept and in good repair and provide proper drainage to protect the area from surface run-off and flooding.

vii. Provide all the required electric power, water supply and other utility connections to temporary installations at the Site as may be necessary for the execution of the Work.

viii. Obtain all insurance policies, performance bond and payment guarantee as required under this Contract.

ix. Payment of all fees, permits, licenses, etc. as may be required covering the execution of the Contract.

1.7 MONITORING PROGRESS

The Contractor shall furnish the Engineer, without cost to the Employer, at regular monthly interval and in a form and number of copies determined by the Engineer, with the following:

i. Physical progress for the month under report and the estimated progress for the following month.

ii. Completion schedules (target and actual) based on the approved construction program.

iii. A tabulation of construction equipment listing the major items and pieces of equipment comprising the construction plant as were utilized for performance of the Work during the month under report.

iv. A tabulation of employees countersigned by the Engineer's representative, showing the supervisory staff and the number of several classes of labour employed by the Contractor in the month under report.

v. Any report which may be specifically requested by the Employer and/or by the Engineer.

1.7.1 ATTENDANCE AT SITE MEETINGS

The Contractor shall attend punctually the progress and other on-site meetings as would be requested by the Engineer.

1.7.2 ECEIVING VISITORS

The Contractor shall receive all authorized visitors of the Employer and allow them to visit the Work in the manner as would be requested by the Employer

1.8 **CONTRACTOR'S SITE FACILITIES**

The Contractor shall, at his own expenses, be responsible for the provision, maintenance, operation and subsequent removal of the following and all other necessary temporary facilities and services on Site those are required to accomplish the Work in a safe and orderly manner as per provisions of the Contract:

i. All temporary stores, warehouses and workshops.

ii. All temporary buildings for office accommodation for the Contractor's staff.

iii. Living accommodation for staff.

iv. Adequate number of toilets necessary for all persons engaged for the Work with separate arrangements for women. All sewage from toilets shall be disposed off by means of septic tank and soak pit or by some other acceptable disposal system.

v. To keep all sanitary facilities clean and their frequent disinfecting.

vi. Fencing, lighting and security.

vii. Cranes or other appropriate ways and means for off-loading plant and equipment, placing in temporary storage and moving from storage to equipment locations.
viii. Site transport for the staff.
ix. Electric power for temporary buildings and tools.
x. Provisions for adequate supply of water of acceptable quality at the Site for use in the Work.
xi. Raw water from Site Tube-wells and provisions for adequate potable water.

In addition to above, the Contractor shall also make available all other necessary temporary facilities and services on Site those are required to accomplish the Work in a safe and orderly manner as per provisions of the Contract.

The Contractor shall submit for the approval of the Engineer Detailed Plans and/or construction Drawings of the temporary buildings, warehouses, workshops and labor camps that he proposes to construct or arrange on lease/rent including the proposals for water and power supply and sewerage facilities. These requirements shall be fulfilled by the Contractor within 10 (ten) days from receipt of the Formal Work Order to commence work (Date of commencement of Work). All buildings and facilities shall be of standard and acceptable to the Engineer.

The labour camps shall be at a location approved by the Engineer and conform to all requirements of the local law. It shall be laid and constructed in accordance with a Drawing prepared by the Contractor and approved by the Engineer.

The Contractor shall be responsible for acquiring the land deemed necessary for the Work beyond the Employer's land and for his temporary buildings, warehouses, workshops, staff quarters, labour camps and any temporary access road. The Contractor shall maintain the Site and all working areas in a safe and hygienic condition and in all matters of health and sanitation shall comply with the requirements of the local Medical Officer of Health or other competent Authority.

1.9 MATERIALS, PLANT, EQUIPMENT AND TOOLS

The Contractor at his own expenses shall provide the materials, plant, equipment and tools products as shown on the Drawings or as specified in the Contract. Necessary haulage and safe storage of materials, supervision of works etc. shall be provided by the Contractor.

1.9.1 EQUAL PRODUCTS AND EQUIVALENTS

Except as specifically required otherwise, the mention of any proprietary materials by trade name is intended to establish a standard of quality, appearance, size and durability. The products of other manufacturers may be used subject to the conditions as stated below.

1.9.2 ADDITIONAL COSTS RELATED TO SUBSTITUTIONS

Any additional costs, or any losses or damages, arising from the substitution of any materials or methods from those originally specified shall be borne by the Contractor, unless such substitution was made at the written request or direction of the Employer.

1.9.3 FAILURE OF EQUAL PRODUCTS

Where products are accepted, based on representation of the Contractor, as approved equals, those shall be used subject to the same installation and performance standards as required by the original

specification. Approval of a request for substitution shall not modify the Contract requirements except as specifically noted. Subsequent failure of "approved equals" shall be considered first. For any evidence of improper installation or product inequality, the installation shall be repaired or corrected as directed by the Engineer at the full costs of the Contractor.

1.9.4 PLANT, EQUIPMENT AND TOOLS

The Contractor shall furnish all constructional plant, equipment and tools for the proper execution of the Work at his own expenses and keep those in proper working condition. The Contractor shall supply the Employer a list of major items of the constructional equipment and tools that he proposes to use in execution of the Work.

1.10 SUFFICIENCY OF MEANS EMPLOYED

The Contractor shall take upon himself the full and entire responsibilities for the sufficiency of his supervisory and other personnel, plant or equipment or tools, scaffolding, timbering and generally for all means used for the fulfillment of the Contract. In the event of any of these means proving insufficient, the Contractor shall remain fully and entirely responsible for the sufficiency of these means notwithstanding any previous approval or recommendation that might have been given by the Engineer.

1.11 PROTECTION AND SAFETY

1.11.1 GENERAL

The Contractor at all times shall take all necessary measures to the safety of life and property during construction of various parts of a building. International Safety Manuals used in Engineering Construction Project shall be adopted for protection and safety at the construction Site during the period of construction. Nothing stated herein shall be construed to nullify any rules, regulations, safety standards or statutes of the local authority, or those contained in the various Acts of the Government of Pakistan. The specific rules, regulations and Acts pertaining to the protection of the public or workmen from health and other hazards wherever specified by the local Authority etc. or by the Act/Ordinance of the Government shall take precedence over whatever are specified herein.

1.11.2 SAFETY OF WORKMEN

Helmets conforming to and shall be worn by the workmen and other personnel at all times while works are going on.

Safety goggles of accepted standard shall be used by individuals engaged in drilling, cutting, welding and all such works which cause hazard to the eye. The welders and gas cutters shall be equipped with proper protective equipment like gloves, safety boots, aprons and hand shields having filter glass of accepted standard and suitable to the eyes of a particular worker.

1.11.3 SITE PRECAUTIONS

In absence of boundary walls, construction Site shall be delineated by fences.

Warning signs shall be displayed, where necessary, to indicate hazardous areas like high voltage zone, area of no smoking etc. Hand lamps shall be of low voltage, preferably 24V. All electrically operated hand tools shall be provided with double earthing.

The temporary wells, which shall be provided by the Contractor at the construction Site as a part of the toilet facilities, shall be provided with proper covers. The toilet facilities shall be located at a corner of the Site so as to avoid any obstruction. Protection from bad weather and falling object and proper privacy shall be provided to the toilet users.

Temporary toilets shall be dismantled, all wells filled up, and the whole area made level, dressed and restored back to proper grade at the end of the project.

The Contractor at all times shall protect the excavation, trenches and building materials from rain water, groundwater, backing up of drains and from water of any origin. He shall provide all pumping arrangements for removal of surplus water, coverings and other materials as required.

All rubbish and debris shall be removed from the Site and disposed of at a safe distance as per direction of the Engineer so as not to create any obstruction to Work or give rise to health hazards.

The Contractor shall take all necessary precautions to ensure against fire during construction. The Contractor must make all necessary arrangements for providing adequate protection against fire hazards at the construction site during the period of execution of the Work.

Timber, coal, paints and similar combustible materials shall be separated from each other. A minimum of two dry chemical powder (DCP) type fire extinguishers shall be provided at both open and covered locations where combustible and inflammable materials are stored.

Inflammable liquids like petrol, thinner etc., shall be stored in conformity with the relevant regulations.

1.12 CARE OF WORKS

1.12.1 MOVEMENT OF TRANSPORT AND PLANT

The Contractor shall exercise diligence and care in the movement of all transports and plant within the Work area so as not to cause injury or damage to life or property. The Contractor shall be responsible for restoring any roadway, bridge, culvert etc. damaged by his transports and plant to the satisfaction of the Engineer or the appropriate Authority.

1.12.2 KEEPING WORKS FREE FROM ATMOSPHERIC CONDITION

The Contractor shall construct all temporary works and other works and supply and operate pumping plant and ensures all measures as may be found necessary for the construction of the Work under proper atmospheric condition.

Notwithstanding any approval by the Engineer of the arrangements made, the Contractor shall remain responsible for the sufficiency thereof and shall be liable for keeping the works safe at all-time regardless of the climatic condition at his own expenses. Any loss of production, additional overheads or additional costs of any kind that may result from inclement climatic conditions shall be at the Contractor's risk

1.12.3 MATERIALS ON AND UNDER THE SITE

All soil, turf, gravel, stone, timber, or other materials obtained in the excavations, clearing of the Site of the Work and soil stripping, shall belong to the Employer and must not be removed from the

Site without the written permission of the Engineer. Provided the Engineer directs the Contractor, he may use for the construction of the Work, any timber obtained from trees felled at the Site and any of the materials excavated under the Contract, which the Engineer may determine to be fit for such use.

1.13 SURVEY WORKS

1.13.1 PERMANENT BENCH MARK

Before commencing the work, the Contractor shall establish at his own cost, at least 2 (two) permanent Bench Marks (B.M) with permanent pillars at suitable positions as per direction of the Engineer. These B.Ms. shall be incorporated in the Drawings and used for controlling all levels of construction works.

1.13.2 REFERENCE LINE PILLARS

The Contractor shall establish permanent Reference Line Pillars (axis pillars, centre line pillars, etc.) at his own cost for all structures before starting of excavation of foundation pits/trenches as per standard practice and or as per direction of the Engineer. The Contractor shall remain responsible for safeguarding all Survey Monuments, Bench Marks, Beacons, etc. The Contractor, at his own expenses, shall make necessary arrangements to protect the B.M pillars against any disturbances, damages, including their maintenance.

The Engineer will provide the Contractor with the data necessary for setting out of the center line. All dimensions and levels shown on the Drawings or mentioned in the Documents forming part of or issued under the Contract shall be verified by the Contractor on the Site and he shall immediately inform the Engineer of any apparent error or discrepancy, if found by him in such dimensions or levels. The Contractor shall, after or in connection with these staking out of the center line, survey the terrain and shall submit to the Engineer for his approval, a profile as required by the Engineer.

Instruments and equipment for surveys shall be subject to rigorous inspection by both the Contractor and the Engineer and any items found to be defective in the opinion of the Engineer, shall be promptly replaced, repaired or adjusted as per his direction. A qualified Surveyor or Engineer shall supervise all survey works. The checking of the setting-out of works by the Engineer's staff shall not relieve the Contractor of any of his liabilities or responsibilities under the Contract

1.14 FABRICATED ITEMS INCORPORATED IN THE WORK

Whenever required by the Specifications to fabricate or manufacture and furnish equipment for incorporation in the permanent works, the Contractor shall submit to the Engineer for his approval the names of the manufacturers or fabricators the Contractor proposes to use and also his detailed Shop Drawings for approval before proceeding with the Work. All such Drawings shall be adequately and properly checked before being submitted to the Engineer for approval and shall be so designated.

Any fabricating or manufacturing undertaken during or before the approval of the Drawings, will be at the Contractor's risk. The Engineer shall have the right reserved to ask the Contractor to make any changes in the Design, which may be found necessary in the opinion of the Engineer, for the equipment or component materials to fully meet the requirements and intent of these Specifications without causing any additional costs to the Employer.

Approval of the Contractor's Drawings shall not relieve the Contractor of any part of his obligation to meet all requirements of these Specifications or of the responsibilities for the correctness of his Drawings. At the time of delivery of the equipment, the Contractor, if requested to do so, shall furnish the Engineer two complete sets of the final approved Drawings.

1.15 INSPECTION AT FABRICATOR'S WORKSHOP

1.15.1 GENERAL

All equipment furnished under these Specifications and all works performed thereon will be subject to inspection by the Engineer or his authorized representative. Inspection at the manufacturer's plant, when located only in Pakistan, may be made with the intention to determine the meeting of requirements of the Specifications in respect of use of equipment and materials. The Contractor shall notify the Engineer a minimum of 15 (fifteen) days in advance of the date and place of equipment/materials to be available for inspection. No equipment or materials shall arrive at the Site until the Engineer's inspection at the manufacturer's plant or Contractor's storage place outside the actual Site has been made, the Engineer's approval has been given, final Drawings have been furnished by the Contractor and the Contractor's responsibilities for furnishing equipment and materials meeting the requirements of the Contract Document are fully complied with. All costs of the Engineer's inspection shall be borne by the Contractor.

1.15.2 TESTS AND INSPECTION RECORD

The record shall identify the Contractor and the Supervision Consultant staff (when applicable) involved, the place, the date and time when the inspection is completed, the sections of the Work and the materials tested or inspected and its state of completion. Reference shall be made to the relevant Working Drawings and the specific aspects or properties, which were checked or measured, shall be recorded.

One copy of each record of inspection shall be submitted to the Engineer and one copy of each record of inspection shall be submitted to the Supervision Consultant (when involved). The Contractor shall maintain records of inspections and tests in an orderly fashion at the Site until the issuance of the Defects Liability Certificate for the whole of the Work, or such earlier time as the Engineer may instruct. The Engineer shall have the rights of access to them at all times After the issuance of the Defects Liability Certificate for the whole of the Work, or such earlier time as the Engineer may instruct, the Contractor shall, as instructed by the Engineer, either dispose of the records or deliver them as directed.

1.15.3 NOTICE OF WORKS OFF-SITE

The Contractor shall give adequate written notices to the Engineer on the preparation or manufacture at a place not within the Site of any pre-fabricated units or parts of units or materials to be used in the Work. Such notices shall state the place and time of the preparation or manufacture, quarrying or extraction. The notice be given sufficiently in advance as to enable the Engineer to make arrangements which he may deem necessary for inspection before the start and at any stage of the Work and not only at the time when the units or parts are completed. Off-Site works shall not commence without the prior approval of the Engineer.

Any unit or parts, prepared or manufactured without giving such prior notice to the Engineer, may be rejected, if the Engineer considers that his inspection was necessary during the time of preparation or manufacture. No inspection by the Engineer shall relieve the Contractor of any of his responsibilities, duties and liabilities under the Contract.

1.15.4 STANDARDS

Except where otherwise specified or authorized by the Engineer, all materials and workmanship shall conform to the latest edition of the relevant Standard Specifications of the ASTM.

Materials meeting other internationally accepted equivalent or higher Standards may be accepted subject to review by the Engineer. The Contractor shall submit in English language any such alternative Standards proposed by him, for approval by the Engineer.

The Contractor shall provide the Engineer 3 (three) sets of each of the Standards, Codes and References to be used in the Contract within 45 (forty-five) days of the Date of Commencement of the Work. In addition, he shall supply 3 (three) copies of any other Standards or Codes subsequently specified or alternatively proposed to be used by the Engineer, the Supervision Consultant (when involved) and the Site Laboratory. All Standards shall be in English. On completion of the Contract, all copies of Standards, Codes and References, so provided, shall become the properties of the Employer.

1.15.5 PROPRIETARY PRODUCTS

Where a proprietary or brand name or the name of a supplier or manufacturer is indicated on the Drawings or in the Specifications, this would be in respect of items, which have not otherwise being adequately described by ASTM or equivalent recognized Standards. Alternative items based on recognized national Standards of the country of origin may be accepted provided that documented proof in the English language is submitted to the Engineer for his approval sufficiently in advance and showing that the alternative proposal is equal or higher in quality and performance than the specified item.

1.15.6 MATERIALS TO BE NEW

All materials used in the permanent works shall be new. No materials, incorporated in the permanent works, shall have previously been used in the temporary works.

1.15.7 ORDERS FOR MATERIALS

Before orders are placed for any materials of any description to be used in the permanent works, the Contractor shall submit to the Engineer the names and addresses of the manufacturers or suppliers proposed. Following approval by the Engineer, the Contractor shall submit to him copies of all orders placed for such materials.

1.15.8 SAMPLES

In accordance with the provisions of the Contract, the Contractor shall, in the way as directed by the Engineer, supply samples of materials to be incorporated in the Work. The Contractor shall submit the samples required for approval in labelled boxes suitable for storage and with sufficient time for testing. Due allowance shall be kept for the fact that if samples are rejected, further samples

and testing will be required. The Engineer shall keep the approved samples with him and will compare the supply with the sample before acceptance. He shall reject any materials not conforming to the character and quality of the approved samples.

1.15.9 CERTIFICATES

All manufacturer's certificates of tests, proof sheets, mill sheets etc., showing that the materials have been tested in accordance with the requirements of the relevant ASTM or other approved Standard or this Specification, shall be supplied in English language by the Contractor to the Engineer free of charge.

1.16 TOLERANCES

Unless it has been specified in the different Sections otherwise, all works shall be constructed within the tolerances shown in the Table given below;

Type of Structure	Item	Tolerance
Concrete Structures	Tolerances from the specified position (Structure)	
	Maximum departure of plan position of structure or element	25mm
	Tolerances from the specified dimensions (Structure)	
	Maximum departure in thickness or cross-sectional dimensions of columns, beams, buttresses, wall footings etc., up to and including 500mm thick (except tunnel and shaft linings)	+6mm -3mm
	Ditto – between 500mm and 1000mm thick	+10mm
	Ditto – between 1000mm and 4000mm thick	- 5mm
	Ditto – over 4000mm thick	+10mm -8mm
	Tolerances from specified position (Surface)	
	Maximum departure of vertical, sloping or curved surfaces including joint surfaces	+25mm -10mm
	Maximum departure of horizontal or near-horizontal surfaces including joint surfaces	25mm
	Tolerance on Straightness or Departure from Specified	20mm

	Curve (Surface) General Surface Maximum deviation in horizontal or vertical directions (gradual) Maximum deviation in horizontal or vertical directions (abrupt)	 12mm in 2m 6mm
Formwork	Sectional dimension Plumb Levels (before any deflections has taken place)	±5mm ±1 in 1000 of height ±3mm
Reinforcement	Length of splice Variation of protective cover Variation in indicated position or reinforcement: ▪ Starter bars ▪ Slabs and Walls ▪ One bar diameter Dimension of bent bars: ▪ Stirrups and ties ▪ Other bars	-25mm ± 1 in 1000 of ht. ± 3mm One bar dia. 0.25 times the indicated spacing. ±5mm ±5mm ±10mm
R.C.C. Piles	Pre-cast driven pile: a) Verticality for vertical pile b) Verticality for raker pile c) Deviation from position shown on the plan for vertical and raker piles after driving. Concrete piles casting tolerances: a) Maximum departure in thickness or crosssectional dimensions. b) Deviation of pile face c) Deviation of cross-section centroid from straight line connecting the centroid of the end faces of the pile. 2. Bored and Cast-in-situ pile: a) Verticality for vertical pile b)	 1 in 50 1 in 25 1/4th of Least dimension of 75mm whichever is greater. +6mm -0.00 6mm in 3m 10mm

	Verticality for raker pile c) Deviation from position shown on the plan for vertical and raker pile shaft	1 in 75 1 in 25 Maximum 75mm in any direction
Timber Piles	Deviation of cross-sectional dimension. Deviation of cross-section centroid from straight line joining end face centroid. Level of top Pile.	-6mm 40mm + 12mm

* In addition to above, other tolerances have also been specified in the different Sections and Subsections in the relevant portion

1.17 RECORDING OF MEASUREMENT

Conditions of the Contract, Technical Specifications and Contract Drawings are to be read in conjunction with the Bill of Quantities (BOQ).

General directions and descriptions of works and materials are not necessarily be repeated nor summarized in the BOQ. References to the relevant Sections of the Contract documents shall be made before entering the Tender's rate.

The quantities given in the BOQ are only approximate and provisional and are given to provide a common basis for tendering. It does neither expressly nor by implication prescribed that the actual volume of work to be performed will exactly correspond therewith.

Any clarification regarding the BOQ and the Method of Measurement shall be adjudged by the Engineer in accordance with this Standard Specification, its Sub-sections, BOQ and other Tender Documents The works, executed fully complying the Drawings and instructions of the Engineer, will be measured for payment in accordance with the method adopted in the BOQ and the item therein set forth, notwithstanding any custom to the contrary. The net quantities of the finished works in place will always be taken except where otherwise specified.

No allowance shall be made for waste, laps, cuttings, etc. and no deduction will be made for grout nicks, joggle holes or rounded arises and sink age or for fitting iron works, etc.

1.18 PAYMENT

Full account shall be taken of all information contained in the Tender Documents and made available during the tender period as affects, inter-alia, working methods, haulage requirements and sequence of operations. Full allowance shall be made for all these provisions in the rates and sums entered against the various items in the BOQ of the Contract.

The specified payment Sections/Sub-sections of the Contract shall apply to any additional or varied works, which may be required to execute under the Contract except where specifically varied therein.

The basis of payment will be the actual quantities of works ordered and carried out, as measured by the Engineer (based on the As-Built Drawing, BOQ or otherwise as directed by the Engineer) and

valued at the rates and prices of the Tender, where applicable, or otherwise at such rates and prices as (in case of non-tendered items) the Engineer may fix within the Terms of the Contract.

No payment will be made on account of the anticipated profit for work covered by the Contract, which is not performed. No adjustment will also be made in the unit rates set out in the Bill of Quantities because of an increase or decrease in the actual quantities from the Estimated quantities indicated therein, unless otherwise stated in the Conditions of Contract.

Notwithstanding any limit, which may be implied by the wording of the individual item and or the explanations in this Section, it is to be clearly understood that the Tender price is for the works finished and completed in every respect. Full account of all requirements and obligations have to be taken, whether expressed or implied covered by all parts of the Contract. The Tender price shall, therefore, include all incidental and contingent expenses (including all taxes and VATs) and risks of every kind necessary to construct, complete and maintain the whole of the Work in accordance with the Contract. Full allowance is to be made in the Tender price for all costs involved in the following, inter- alia, which are referred to and/or specified herein:

i. All setting-out and survey works.
ii. Temporary access unless separately billed, fencing, guarding, lighting, and all temporary works including their removal on completion.
iii. Paying fees and giving notices to the Authorities.
iv. Reinstatement of the Site.
v. Safety precautions and all measures to prevent and suppress fire and other hazards.
vi. Interference to the works by persons or vehicles being legitimate users of the facilities on or in the vicinity of the Site.
vii. vii. Protection and safety of adjacent structures so far as they may be affected by the works or temporary works.
viii. viii. Supplying, maintaining and removing the Contractor's own housing for staff and labour, offices, workshop, plant yard, transport, welfare, services in connection therewith and other facilities required by the Contractor on completion of work unless separately billed.
ix. Working in the dry condition except where otherwise permitted by the Specification.
x. Supplying, inspection and testing of materials intended for use in the works including the provision and use of equipment.
xi. Maintaining public roads and footpaths.
xii. Opening quarries and borrow pits including all surveys, site investigations, removal and disposal of overburden, trimming of quarry or borrow pit faces and floors and all measures necessary to render quarries or pits safe and free for draining on completion.
xiii. Providing and transporting to Site all equipment necessary for the execution of the Work, setting to works, operating (including all fuel and consumable stores), removal from the Site all construction equipment upon completion of the Work, costs of all tests and other requirements in respect of such plant and equipment.
xiv. The requirements and all incidental costs and expenses involved to provide all necessary skilled and unskilled labors and supervision.

xv. Protection of all completed works following operations making good damages to any completed works due to any cause whatsoever, clearing all rubbish as they accumulate and leaving the Site in a tidy condition.

xvi. All costs associated with the provision and submission of Progress Reports, Records, Photographs, preparation of the necessary Shop and Working Drawings etc. except those provided in the Bill of Quantities.

xvii. Workmen's compensation and Owner's liability insurance.

xviii. Payments under the item for hiring of land (if there be any) in addition to the Employer's land for temporary works shall be made in accordance with the receipts obtained from the land owners within the limitation of quoted rate only if such provision is made in the BOQ of the Contract.

xix. Payment of royalties for fill materials obtained from privately owned land/carried earth shall remain included within the rates of the relevant items of the Contract. The volume of borrowed materials shall be calculated on the basis of pre-work and post-work measurements. Finished sections as per Drawings will be the basis for post-work measurement while the Work is complete as per Specifications.

xx. Payment shall mean gross payable amount on the rates of the BOQ including the Performance Security.

xxi. With regard to the Sub-section on 'Contractor's Site Facilities', payment will be made for hiring land for the Contractor's temporary works outside the Employer's property, only if such provisions are kept in the BOQ of the Contract.

xxii. The cost of keeping the works free from water will only be paid for, if referred to in the BOQ of the Contract Documents.

xxiii. No payment shall be made for any tests required under the Specification unless specifically referred to in the BOQ. If the Engineer requires any tests outside the BOQ, the cost of such test shall be agreed with the Engineer before execution and paid for as a supplementary item.

xxiv. No direct payment shall be made for works required under other Sub-sections. The costs for such works shall be deemed included in the related items of the BOQ.

2. CONSTRUCTION MATERIALS

2.1 FIRST CLASS MACHINE MADE BRICKS

First Class Machine Made Bricks shall be thoroughly burnt and shall have plane rectangular faces with parallel sides and sharp straight right-angled edges. They shall be of uniform color (generally deep red or copper), homogeneous in texture and free from cracks, flaws and nodules of free lime. A fractured surface shall show a uniform compact structure free from limps and grits of holes. Other requirements of the First-Class Machine-Made Bricks shall comply with the following requirements:

Minimum crushing strength	210 kg/cm2.
Maximum water absorption	10% of dry weight
Efflorescence	Nil
Dimensions (+ 5mm)	200mm x 100mm x 50mm

2.2 AGGREGATES

Aggregates shall be hard, strong, durable, dense and free from injurious amount of adherent coatings, clay, lumps, dust, soft or flaky particles, shell, mica, alkali, organic matter and other deleterious substances. The various sizes of particles of which an aggregate is composed of shall be uniformly distributed throughout the mass.

Testing of aggregates shall be in accordance with BS 812 or ASTM C-136.

Approval of a source of aggregate by the Engineer shall not be construed as constituting the approval of all materials to be taken from that source and the Contractor shall be responsible for the specified quantity and quality of all such materials used in the Work. Aggregates shall not be obtained from sources, which have not been approved by the Engineer. The Contractor shall provide means of storing aggregates at each point where concrete is made such that;

i. Aggregates shall be stored on a hard and dry patch of ground covered with a 50mm thick layer of lean concrete.
ii. Each nominal size of coarse aggregate and the fine aggregate shall be kept separated at all times.
iii. Contamination of the aggregates by the ground or other foreign materials shall be effectively prevented at all times.
iv. Each heap of aggregate shall be capable of draining freely.
v. The aggregates shall be handled so as to avoid segregation.

The Contractor shall make available to the Engineer such samples of the aggregate as he may require. Such samples shall be collected at the point of discharge of aggregate to the batching plant/mixer machine. If any such sample does not conform with the Specifications, the aggregate shall promptly be removed from the Site and the Contractor shall carry out such modifications to the supply and storage arrangements as may be necessary to secure compliance with the Specifications.

2.2.1 COARSE AGGREGATE

Coarse aggregate shall be obtained from breaking hard durable rock or gravel or Picked Jhama Bricks, which conform to the requirements of AASHTO Standard Specifications M-80. Coarse aggregate shall be clean, free from dust and other deleterious materials. The grading of the coarse aggregate shall be such that when combined with the approved fine aggregate and cement, it shall produce a workable concrete of maximum density.

Aggregate pieces shall be angular in shape and have granular or crystalline or smooth, but not glossy non-powdery surfaces.

Maximum allowable limits of deleterious substances that shall not be exceeded for coarse aggregate are shown in the following table:

Material	Mass Percent
Soft fragments	2.00
Clay Lumps	0.25
Material passing the 0.075mm sieve	0.50 for clay 1.50 for fracture dust
Thin or elongated pieces: Flakiness Index (BS 8821992) less than	50 for uncrushed 40 for crushed

The Aggregate Crushing Value shall be less than 25% or the Ten percent Fine Value shall be greater than 150 kN according to BS 882-1992. Grading for nominal size coarse aggregate shall comply with the following ASTM C-33 standard gradations:

20mm nominal size Coarse Aggregate

Sieve Size (mm)	% Passing by Weight
25	100
19	90-100
12.50	20-55
9.50	0-15
4.75	0-5

40mm nominal size Coarse Aggregate

Sieve Size (mm)	% Passing by Weight
50	100
37.5	90-100

19	20-55
9.50	0-15
4.75	0-5

Coarse aggregate subject to five cycles of the Soundness Test, specified in ASTM C88, shall not show a loss exceeding 10% when magnesium sulphate solution is used except where otherwise approved.

The flakiness and elongation indices of the predominant size fractions in each single sized coarse aggregate, determined in accordance with BS 812, shall not exceed 20% and 35% by weight respectively.

Aggregate for use in concrete which is subject to abrasion and impact shall comply with the Test requirements of BS 812 and the Specification of BS 63 Part 1 and BS 63 Part 2 and BS 882 respectively.

Coarse aggregate shall be tested for drying shrinkage characteristics in accordance with BRS Digest No. 35.

Coarse aggregate shall be stored at Site in such a manner that it is not contaminated by fine aggregate, earth or other foreign matter. Adequate precautions shall be taken to prevent segregation of the coarse aggregate while it is being transported and stacked.

2.2.2 STONE AGGREGATE

The boulders to be used as coarse aggregate in concrete shall be composed of limestone, sandstone, granite, trap rock or rock of similar nature and shall have the following properties:

Minimum compressive strength	490 kg/cm2
Specific gravity	2.4-2.7
Unit-weight	2245-2566 kg/m3
Porosity	2 – 6%
Water absorption	1.5 – 5% by weight

The boulder shall be of uniform light colour as approved and shall be free from thin lamination, adherent coatings and deleterious substances. The wear loss of coarse aggregate of all types shall not exceed 35% by weight when tested by the Los Angeles Abrasion Test.

The boulders shall be supplied in sizes that can be handled manually by one person. Stock piling shall be such as to permit ready identification of the materials and shall be approved by the Engineer. Site for stockpiles shall be clean prior to storing materials. The stockpiles shall be built up in layers not to exceed 1.22m in height and each layer shall be inspected before the next layer is started. The crushed boulder chips shall be stacked in accordance with the specified sizes in different stacks as

directed by the Engineer. Height of each stack should not exceed 33% of the minimum base dimension of the stack.

2.2.3 STORAGE OF COARSE AGGREGATE

Aggregate of different sizes or grades and from different sources of supply shall not be mixed. All aggregate shall be stored separately free from contact with earth and other deleterious matter. The coarse aggregate should be stockpiled in different stacks, according to the sieve sizes.

All precautions shall be taken during transport and stockpiling of coarse aggregate to prevent segregation. Segregated aggregate shall not be used until they have been thoroughly re-mixed and the resulting stack is of uniform and acceptable gradation.

Aggregate shall be stock-piled at least 7 (seven) days prior to their anticipated use to permit the Engineer to sample each stock-pile to determine the acceptability of the material for the intended use.

2.2.4 FINE AGGREGATE

Fine aggregates for use in the concrete and masonry work shall be non-saline clean natural sand and have a Specific Gravity not less than 2.6 and conform to the requirements of ASTM C 144. It shall be angular (gritty to touch), hard and durable, free from clay, mica and soft flaky pieces. All sands must be well washed and clean before use.

A well graded sand should be used for cement work as it adds to the density of the mortars and concretes. Sand required for brick work needs to be finer than that for stone work.

Sand which contains 90% of particles of size greater than 0.06mm and less than 0.2mm is fine sand. On the other hand, sand which contains 90% of particles of size greater than 0.6mm and less than 2mm is coarse sand.

Supply methods and stock piling of sand shall be such, as to permit ready identification of the material delivered and shall be approved by the Engineer.

2.2.5 IMPURITIES

Sand shall be clean and free from injurious amount of organic impurities. Deleterious substances shall not exceed the following percentage by weight.

Material Passing No. 200 sieve	2.0
Shale, coat, soft or flaky fragments	1.0
Sulphur Compounds	0.3
Clay Lumps (wet, on No. 4 sieve)	0.00

Fine aggregate subject to five cycles of the soundness test, specified in ASTM C88 shall not show a loss exceeding 10 mass percent when magnesium sulphate solution is used except where otherwise approved.

2.2.6 GRADING

Sand shall be well graded from coarse to fine within the limits given below or shall conform to the specified Fineness Modulus.

2.2.7 FINE AGGREGATE FOR CONCRETE

Sieve Size (mm)	% Passing by Weight
9.5	100
4	95-100
16	45-80
50	10-30
100	2-10

2.2.8 FINE AGGREGATE FOR MASONRY

Sieve Size (mm)	% Passing by Weight
4	100
8	95-100
16	70-100
30	40-75
50	10-35
100	2-15

2.2.9 SAND FILL

Sand for sand fill shall consist of hard, dense, durable materials free from injurious amounts of clay lumps, lightweight materials or other deleterious substances. Unless otherwise specified on the Drawings, sand fill with gunny bags shall have Fineness Modulus not less than 0.8. Sand fill for the Geo-textile bags shall, unless otherwise approved by the Engineer, comply with the following grading: mm

d_{90} = 0.60 to 0.30

d_{86} = 0.50 to 0.25

d_{60} = 0.40 to 0.20

d_{50} = 0.35 to 0.20

d_{10} = 0.20 to 0.05

2.3 CEMENT

Cement used in the works shall be obtained from manufacturers, approved in writing by the Engineer and shall be Ordinary Portland Cement complying with the requirements of ASTM C150 Type 1 or BS 12 or equivalent standard. Special cements shall conform to the requirements provided in writing by the Engineer.

A certificate showing the place of manufacture and the results of standard tests carried out on the bulk supply from which the cement was extracted must accompany each consignment of cement delivered to the Site.

The Engineer may make any tests, which he considers advisable or necessary to ascertain, if the cement has deteriorated in any manner during transit or storage. Any cement which, in the opinion of the Engineer, is of doubtful quality shall not be used in the Work until it has been re-tested and test result sheets, showing that it complies in all respects with the relevant standard, have been delivered to and accepted by the Engineer.

Cement that becomes lumpy or otherwise deteriorated in transit or storage shall not be used for brick masonry or concrete works. All cement, found unsuitable for use, shall be removed from the Site immediately.

The Engineer shall ask to carry out sampling, inspection and testing of all cement as may consider be necessary. Samples shall be taken as instructed from the Site store or from elsewhere on the Work or from any places where cement is used for incorporation in the Work. The compressive strength and tensile strength of standard cubes and briquettes respectively shall be not less than as follows:

Days	Compressive Strength (N/mm2)	Tensile Strength (N/mm2)
3	12.4	1.0
7	19.3	1.9
28	27.6	2.4

Initial setting time shall be not less than 45 minutes and the final setting time shall be not more than 8 hours. Cement, when tested for fineness, shall have a specific surface of not less than 160m2/kg. Cement when tested for soundness shall not have an expansion of more than 10 mm. The unit weight of cement shall be a minimum of 14.16 KN/m3.

2.3.1 WHITE CEMENT

White Cement shall be made from pure calcite lime stone and have the same physical properties as those of Portland Cement Type 1, ASTM C-150. Atypical composition of White Cement is as follows:

CaO	65%
SiO2	25.5%

Al2O3	5.9%
Fe2O3	0.6%
MgO	1.1%
SO3	0.1%

2.3.2 REJECTION OF CEMENT

The Engineer may reject any cement as the result of any tests thereof notwithstanding the manufacturer's certificate. The Engineer may also reject cement, which has deteriorated owing to inadequate protection or from other causes where the cement is not to his satisfaction. The Contractor shall remove at his cost all rejected cement from the Site without delay.

2.3.3 STORAGE OF CEMENT

Cement shall be delivered at the Site in sound and properly sealed jute/paper bags, each plainly marked with manufactures name or registered mark. Cement shall be well protected from weather by tarpaulins or other approved cover during transit. Weight of individual bag containing cement shall be 50 kg and weight of all bags shall be uniform. Weight of cement shall be legibly marked on each bag. Bags in broken or damaged condition shall be rejected.

The Contractor shall provide waterproof and well-ventilated god owns at the specified or approved location at the Site having a floor of wood or concrete raised platform at minimum 450mm above the ground so as to protect the cement against moisture from air or from any other source. Sheds shall be large enough to allow a minimum 300mm gap between the stacked cement and the god own walls to store cement in sufficient quantity to ensure continuity of work and to permit each consignment to be stacked separately therein to permit easy access for inspection. All storage facilities shall be subject to approval by the Engineer.

Immediately upon arrival at the Site, cement shall be stored in the god owns with adequate provisions to prevent absorption of moisture. The Contractor shall use the consignments in the order in which they are received. Cement delivered to the Site in drums or bags provided by the supplier or manufacturer, shall be stored in the drums or bags until used in the Work. Any cement in drums or bags, which has been opened, shall be used immediately on opening. Cement shall not be stored in a go down for more than 3 (three) months if bagged or 6 (six) months, if in bulk or a lesser period as directed by the Engineer. After this period is over, any unused cement shall be removed from the Site.

2.4 ADMIXTURE

Admixture shall be used to provide excellent acceleration of gaining strength at early age and major increase in strength at all ages by significantly reducing water demand in a concrete mix, especially suitable for pre-cast concrete and other high early strength requirements. Admixture shall conform to BS 5075 Part 3 and ASTM C 494.

2.5 REINFORCEMENT

2.5.1 HIGH STRENGTH DEFORMED ROAD

Reinforcing steel under this type comprises Grade-60 Deformed re-bars. The steel shall conform to ASTM Specification A 617M or A 615M of yield strength not less than 420 MPa (N/mm2). The structural grade shall be made from billets. The ends of the bar shall be machine sheared perpendicular to the axis of the bar. The bars shall be free from injurious defects and shall have a workman like finish.

2.5.2 CLEANING AND STORAGE

Steel reinforcement bars and structural steel shall be stored in a way to prevent distortion, corrosion, scaling and rusting. Reinforcement bars and structural steel sections shall be coated with cement wash before stacking, especially in humid areas. In the case of long time storage or storage in coastal areas, reinforcement bars and steel sections shall be stacked at least 200mm above the ground level.

Steel sections shall be stacked upon platforms, skids or any other suitable supports. Bars of different sizes and lengths and structural sections shall be stored separately to facilitate issues in required sizes and lengths without cutting from standard lengths. Ends of bars and sections of each type shall be painted with separate designated colors.

Tag line shall be used to control the load in handling reinforcing bars or structural steel when a crane is used. Heavy steel sections and bundles of reinforcing bars shall be lifted and carried with the help of slings and tackles.

All bars, prior to its use, shall be cleaned with wire brush to make them free from nail scale, loose rust, dirt, paint, oil, grease or other foreign substances.

Bars of reduced sectional area to excessive rust shall be rejected.

All reinforcing steel shall be stored properly under shed not to be contaminated by oil, grease, dirt or mud.

All stacking and storing of bars shall be the Contractor's responsibility and contingent upon his Tender.

2.5.3 PRE-STRESSING STEEL AND ANCHORAGE

Pre-stressing reinforcement shall comprise high strength seven wire strand, high strength steel wire or high strength alloy bars conforming grade and type as shown on the Drawings.

Un-coated seven-wire strand shall conform to the specifications of AASHTO M 203.

Un-coated stress-relieved steel wire shall conform to the specifications of AASHTO M 204.

Un-coated high-strength bars shall conform to the specifications of AASHTO M 275.

2.6 RUSTLESS TYING WIRE

Rustles tying wire of 18 SWG shall be obtained from approved manufacturers and shall, as regards strength, comply with the requirements specified. The Contractor shall, at his own costs, provide binding wires of required specifications.

2.7 LIME

Lime shall be stone lime of good quality high calcium lime containing calcium oxide from 95% upwards. The impurities, insoluble in acids, should not exceed 3% for the quick lime and 1% for the hydrated lime. Limes shall conform to the requirements of ASTM C 5 for quick lime and ASTM C 207 for hydrated lime.

2.7.1 STORAGE AND HANDLING OF LIME

Quicklime shall be slaked as soon as possible. If not possible, it may be stored in compact heaps having only the minimum of exposed area. The heaps shall be stored on a suitable platform under a roof protected from rain and wind. A minimum space of 300mm shall be provided all round the heaps to avoid bulging of walls.

Un-slaked lime shall be stored in a watertight place and shall be separated from combustible materials.

Hydrated lime shall be supplied either in containers or sacks, such as jute bags lined with polyethylene or high density polyethylene woven bags lined with polyethylene or craft paper bags. It shall be stored in a dry room to protect the lime from dampness and to minimize warehouse deterioration.

When dry slaked lime is to be used within a few days, it shall be stored on a covered platform and protected from rain and wind. It shall be kept in a dry airtight god own when immediate use is not required. However, it shall never be stored for more than two months.

Workmen, handling bulk lime, shall wear protective clothing, respirators and goggles. They shall be instructed for cleanliness as a preventive measure against dermatitis and shall be provided with hand cream, petroleum jelly or similar protectors.

2.8 WATER

Water shall be clean, fresh and free from organic or inorganic matter in solution or suspension in such amount that may impair the strength or durability of the concrete. Water shall be obtained from a supply, where possible. However, it may be taken from any other sources, only if approved. No water from excavation shall be used. Only water of approved quality shall be used for washing shuttering, curing of concrete and similar other purposes.

Water to be used in construction shall be stored in tanks, bottom and the sides of which shall be constructed with brick or concrete. Contact with any organic impurities shall be prevented.

The tank shall be so located as to facilitate easy storage and filling in, and supply for construction works and other purposes.

2.9 FILL

Materials for filling shall be uniform in character throughout and free from substances that by decay or otherwise may cause the formation of hollows or cavities or otherwise affect the stability of the filling.

Earth filling shall be of selected materials obtained from the excavation or carted fine sand as approved by the Engineer. No soft chalk or clay or earth with a predominating clay content shall be used. Hard core shall be selected hard clean gravel, broken brick, broken concrete, broken or crushed stone, quarry waste or similar approved materials. Concrete for filling shall be to the proportions specified.

2.10 TIMBER

2.10.1 GENERAL

All timbers for temporary or permanent works shall be of best quality, sound, straight and well-seasoned. They shall be free from sap, defects, radial cracks, cup-shakes, large/loose/dead knots, or other imperfections and shall show a clean surface with cut.

Timber shall be stored in stacks on well treated and even surfaced beams, sleepers or brick pillars so as to be at least 200mm above the ground level. Members shall be stored separately in layers according to the lengths.

A space of 25mm shall be kept between the members. The longer pieces shall be placed in the bottom layers and the shorter pieces in the top layers. At least one end of the stack shall be in true vertical alignment.

The recommended width and height of a stack are 1.5m and 2.0m respectively. Minimum distance between two stacks shall be 800mm.

The stacks of the timbers shall be protected from hot dry wind, direct sun and rain. Weights may be placed on top of the stacks to prevent wrapping of timber. Nails, metal straps, etc. attached to used timber shall be removed before stacking.

2.10.2 INSPECTION

All timbers shall be subject to inspection at Site piece by piece and shall be to the approval of the Engineer who may reject such timber as is considered by him to be under-specified. In the case of timber specified to be creosoted, the Engineer may reject such timber before or after creosoting, if specifications are not correctly followed. The Contractor shall provide all necessary labour for handling the timber during inspection free of charge.

2.11 **WROUGHT FACES AND ALLOWANCES ON JOINER'S WORK**

All joiner's works shall be wrought and finished with a clean, even and smooth face. Thickness shall be given to include 2mm for each wrought face in soft- wood and 1.5mm for hard wood.

2.12 PAINTS AND PROTECTIVE MATERIALS

2.12.1 KNOTTING

Knotting shall be uniform dispersion of lac or suitable resin (natural or synthetic) in a suitable solvent.

White lead paint shall be made from pure white lead in accordance with BS 239, mixed with fine boiled linseed oil, turpentine, dryers and pigments and strained free from skins and all extraneous matter before being pigments. If so used, the quantity shall not exceed 8% of the paint mixed ready for the brush. No other ingredient except the coloring matter will be allowed and the color shall be produced by using the least required amount of coloring matter. The proportions of the ingredients for the various coats shall be subject to the approval of the Engineer.

2.12.2 RED LEAD PAINT

Red lead paint shall be made from non-setting red lead in accordance with BS 217, thoroughly ground and well and freely mixed with approximately 15% of boiled linseed oil to give a paint with good covering power, bobby and adhesion. It shall be determined by tests to be made by the Contractor to the satisfaction of the Engineer. The Engineer may select samples of the paint for analysis after a sufficient quantity of the work about to be painted has been mixed.

2.12.3 LINSEED OIL PUTTY

Putty for stopping and glazing shall consist of whiting/chalk powder thoroughly ground with linseed oil to form a smooth paste, and shall conform BS 544.

2.12.4 VARNISHES/WOOD POLISH

The material is required to be clear and transparent and when applied shall on drying, give a glossy coating free from fun and specks. The composition of the varnish shall conform to the requirements of BS 274.

2.12.5 WHITE WASH

White wash shall be made from pure flat lime brought to the work in an un slaked condition. Water shall be added to this lime in a tub until the mixture is of the consistency of cream and shall be allowed to rest for a period of 48 hours. The mixture shall then be strained through an approved cloth strainer and 4 kg of gum boiled with 12 kg of rice and a suitable quantity of blue shall be added per cubic meter of the mixture.

2.12.6 COLOUR WASH

Color wash, where not of an approved proprietary brand, shall be made from pure selected fat lime as described above for white wash, to which shall be added and intimately mixed the necessary pigment to produce the tint specified. The pigment shall be to the approval of the Engineer.

2.12.7 OIL BOUND DISTEMPER

Oil bound distemper shall comply with BS 1053 Type-1 and shall be obtained from an approved manufacturer.

2.12.8 EMULSION PAINTS

Berger/ICI Emulsion Paints shall preferably be used but the Engineer may allow any other brands of equivalent standard subject to the production of appropriate test certificates and guarantees.

2.12.9 CREOSOTE

The Creosote is a paint used for preservation of timber. It shall be pure tar distillate of the best quality as obtained and sold under the trade name "SOLIGNUM'. The 'SOLIGNUM' shall be clear so

as not to mar the timber. Other brands equivalent to 'SOLIGNUM' may also be used, if only approved by the Engineer.

2.12.10 STORAGE AND HANDLING OF PAINT, VARNISHES, ETC

Paints, varnishes, lacquers and thinners shall be kept in properly sealed or closed containers. The containers shall be kept in a well-ventilated location, free from excessive heat, smoke, sparks or flames. The floor of the paint store shall have at least 100 mm thick loose sand on it.

Temporary electrical wiring and fittings shall not be installed in a paint store. When electrical lights, switches or electrical equipment are necessary to be stored or used in the same room, the room shall be designed in a way to reduce explosion risks.

Buckets containing sand shall be kept ready for use. A five-kilogram dry powder fire extinguisher conforming to accepted standards shall be kept at an easily accessible position close to the paint store.

2.13 PIPES

2.13.1 M.S. PIPE

M.S. Pipe shall be made from low carbon steel conforming to the requirements of ASTM A 53 and physical requirements as specified therein.

2.13.2 PVC PIPE

PVC pipe shall be of plasticized poly ring/chloride and shall conform to BS 3500: 1968/3506:1969 or equivalent. The pipes shall be laid and jointed in accordance with the manufacturer's instructions and to the Engineer's satisfaction.

2.13.3 STORAGE AND HANDLING OF PIPE

Pipes shall be stored in stacks with stoppers provided at the bottom layer to keep the pipe stack stable. The stack, particularly of smaller diameter pipes, shall be in a pyramid shape. Pipes shall not be stacked more than 1.5m height.

Each stack shall have pipes of the same type and size only. Removal of pipes shall start from the top layer and by pulling from one end. A pipe shall not be stored inside another pipe. The pipes may also be placed alternately length and crosswise.

PVC pipes shall be stored in a shaded area. The ends of pipe, particularly those especially prepared for jointing, shall be protected from abrasion. Damaged portion of a pipe shall be cut out completely.

Pipes of conducting materials shall be stacked on solid level sills and contained in a manner to prevent spreading or rolling of the pipe. For storage in large quantity, suitable packing shall be placed between the layers. During transportation, the pipes shall be so secured as to prevent dis-placement/rolling.

2.14 GUNNY BAGS

The gunny bags used in the permanent works shall be new, 50/75 kg capacity bags similar to those normally used. The Contractor shall submit sample bags to the Engineer for his approval.

3. MATERIAL TESTING

3.1 GENERAL

Notwithstanding the requirements stated in the detailed specifications for individual items, the following minimum tests shall be performed in the laboratories (NED University Laboratory or Karachi Shipyard & Engineering Works Laboratory) or as directed by the Engineer.

Contractor's Materials Engineer will be responsible for liaison and coordination with the Site laboratory, the Engineer, field sampling/testing staff and off-Site laboratories to ensure that all sampling, specified tests and inspections are carried out in a timely manner.

No inspection or approval by the Engineer shall relieve the Contractor of any of his duties and obligations under the Contract.

All test types and quantities described in the following Sub-sections are considered "Normal Testing" and anything beyond that in type and quantity is considered as "Special Testing". The Engineer may increase the frequency of testing as per requirement.

3.2 TESTS

3.2.1 BRICKS

For each consignment not exceeding 100,000 bricks, minimum 6 (six) bricks shall be tested to ascertain:

i. Dimensions and unit weight
ii. Compressive strength
iii. Water absorption
iv. Efflorescence

3.2.2 COARSE AGGREGATE

The tests mentioned below shall be carried out for each day's casting or per 15 cubic meter of concrete whichever provides the greater number of tests.

i. Gradation
ii. Unit weight
iii. Water absorption
iv. Specific gravity
v. Abrasion loss/Crushing loss

3.2.3 FINE AGGREGATE

The tests mentioned below shall be carried out for each day's casting or per 15 cubic meter of concrete whichever provides the greater number of tests.

Gradation

i. Fineness Modulus (F.M.).
ii. Specific Gravity
iii. Water absorption

iv. Surface moisture

3.2.4 CEMENT

For each consignment of a particular brand not exceeding 25 tons, at least 3 (three) samples collected random shall be tested prior to the cement be incorporated in to the works to ascertain:

i. Consistency
ii. Setting time
iii. Compressive strength
iv. Fineness

3.2.5 REINFORCEMENT

For each consignment not exceeding 10 (ten) tons or as directed, 3 (three) representative samples of each size of M.S. bar shall be tested for:

i. Cross sectional area
ii. Unit weight
iii. Measurement of deformation
iv. Yield strength
v. Tensile strength
vi. Elongation
vii. Bending

Only Test Certificates issued by NED University Laboratory or Karachi Shipyard & Engineering Works Laboratory shall be accepted by the Engineer.

3.2.6 TEST FOR WATER

Water will be tested to ensure that it remains free of oil, salt, acid, alkali, sugar, vegetable or other injurious substances

3.2.7 WORKABILITY TEST FOR CONCRETE

The Slump Test shall be carried out as frequently as required by the Engineer and not less than one per hour during placing of concrete

3.2.8 STRENGTH TEST FOR CONCRETE

The compressive strength of the concrete shall be determined by Cylinder Test. The Cylinder molds shall be 150mm in diameter and 300mm long. Each class of concrete shall be represented by at least six Cylinders. Not less than one group of six test Cylinders shall be made for each 30 cubic meter of structural concrete, but there shall be at least one group of six test Cylinders for each day's concrete work. For columns and girders, one set of test Cylinders would be made from each batch of concrete not exceeding one cubic meter. Samples from which compression test specimen are molded, shall be obtained in accordance with the Method of Sampling Fresh Concrete (ASTM C 172). The concrete samples would be collected from a point just before final placement or as directed by the Engineer. Cylinders may be collected from any batch (load) including the first. Specimens made to check the adequacy of the proportions for strength of concrete or as a basis for acceptance of concrete shall be made and cured in accordance with methods and curing, concrete compression

and flexure test specimens in the field (ASTM C 31 or equal). Strength tests shall be made in accordance with the method of test for compressive strength of molded concrete cylinders (ASTM C 39 or equal).

Six Cylinders would form a set of sample for strength determination. Three Cylinders shall be tested at seven days and three cylinders shall be tested at twenty-eight days. Every twenty-eight days Cylinders shall attain the minimum specified compressive strength. The Contractor shall perform trial mix of his own to determine the characteristic strength or mean strength that has to be attained.

The twenty-eight days' strength tests shall be used as a basis for acceptance of the concrete. Seven days' tests are made to obtain advance information on the adequacy of strength development. Age-strength relationships shall be pre-established for the materials and proportion used.

4. OFFICE SPACE AND FACILITIES FOR ENGINEER

4.1 FIELD OFFICE

In addition to the office space required for his own use, the Contractor shall provide and maintain Field Office with toilet facilities, furniture and office equipment for the use of the Engineer and his staff.

Field Office for the Engineer shall mean a building having a minimum 150 square feet net clear internal floor area exclusive of walls and partitions, staircase and toilet and have number of rooms as required by the Engineer. It shall be constructed in 250mm thick brick wall in appropriate cement mortar with C.I. sheet roofing and a protective ceiling made of hard board and timber to the satisfaction of the Engineer. The floor shall be 75mm thick lean concrete with 30mm thick mortar on the top with a neat cement finish to give a smooth look. The foundation of this building shall be sound to the satisfaction of the Engineer. The building shall have required number of doors and windows. Uninterrupted power supply facility, if necessary, shall be made available by means of arranging a stand-by generator.

Access road to the Field Office, sufficient parking accommodation and hard standing sheds for vehicles along with boundary fencing shall be constructed by the Contractor.

The Contractor shall provide, for each office, one office table and four chairs of standard, approved by the Engineer. Safety helmets in adequate numbers be always made available for use of the staff and the visitors.

Offices shall be maintained watertight and shall be provided with ventilation. All doors shall be fitted with approved locks. Windows shall be provided with separate screens and blinds and shall have interior locking devices too.

All offices, complete with furnishings, fittings, access roads and hard standings, shall be ready, for occupation by the Engineer within four weeks of the date when the Contractor first occupies the Site.

All offices shall be regularly and properly cleaned as long as they are in use.

All access roads and hard standings shall be maintained in a convenient trafficable condition throughout the Contract period.

The general location of the Field Office shall be decided by the Engineer in consideration of the Contractor's Work Plans. The Field Office shall be situated at locations that shall be free from flooding.

The Contractor shall submit for the approval of the Engineer, along with the Tender, Plans and Drawings showing the details for the building including plans and designs for foundations, access roads, sheds, etc. Plans shall also be submitted showing architectural and structural details and the proposed layout of electrical and running water supply, roads and hard standings thereto. The Engineer may require revision of the said plan prior to the approval for construction.

Prior to the occupation of the office, the Engineer may specify to the Contractor the defects in the work whereupon he may occupy the office and withhold payment for the work in this item until the Contractor remedies and makes good the said defects to the satisfaction of the Engineer.

On completion of the Contract the Field Office including furnishings shall become the property of the Employer.

4.2 OFFICE EQUIPMENT AND STATIONARY ARTICLE

The Contractor shall require to purchase and supply the following Office equipment and consumables to the Engineer:

i. Two Computer (English) of approved brand with printer, internet / Auto CAD facilities.
ii. Two Mobile Phones with monthly billing limit upto 5,000 PKR/phone.
iii. Minor items of field office equipment such as file trays, punches, staplers etc. in reasonable number/quantities as requested by the Engineer.
iv. Consumables such as papers, pens, files etc. in reasonable number/quantities as requested from time to time by the Engineer.
v. Upon completion of the Contract, the office equipment listed above shall remain the property of the Employer.

4.3 SURVEY EQUIPMENT

As per requirement of the program, survey equipment shall be provided on each contract Site for use by the staff of the Contractor and the Engineer. A tentative list of such survey equipment is given below:

Optical Square	1 no.
Spirit level (metal 1m long)	1 no.
Steel measuring tape 25m long	1 no.
Steel measuring tape 5m long	1 no.
Levelling staff 3m long	1 no.
Ranging Poles	5 nos.
Surveyor's plumb bob	1 no.
Wild T-1A Theodolite with tripod (or equivalent)	1 no.
Wild NA-2A Automatic Level with tripod (or equivalent)	1 no.
Total Station with Tripod	1no.
Traversing targets with tripods	1 no.
Magnetic Compass	1 no.

Miscellaneous tools and minor items of survey equipment such as umbrellas, hammers, knives etc. shall be made available at Site in reasonable numbers at all times for use by the staff of the Contractor and the Engineer.

Consumables such as pegs, stakes, string lines, paint, marking crayons, etc., shall be made available at Site in reasonable numbers and quantities at all times for use by the staff of the Contractor and the Engineer.

Upon completion of the Contract, the survey equipment listed above shall remain the property of the Contractor

4.4 OFFICES AND EQUIPMENT

The Contractor shall provide and maintain an inventory of all furnishings and equipment and shall replace any equipment, which is lost or irreparably damaged subject to the condition that the Engineer shall ensure his staff to take all reasonable precautions in the handling, operation and transportation of such equipment.

The Contractor shall pay all expenses in respect of water, electricity (where available), garbage cleaning etc. necessary for running the Office and maintaining conducive environment.

The Contractor shall place all necessary support staff such as office boys, cleaners, messengers, road- men, chain-men etc. in required number to the Engineer and his personnel in smooth performing of his responsibilities.

4.5 SIGNBOARDS

The Contractor shall supply, erect and maintain in good condition at least two Identification Signboards of sizes to be specified by the Engineer to be fixed one at each end of the Work at a place clearly visible to the public. The Signboards shall be mounted on steel pipe frames with the required sizes at a height 2m above the ground and shall be sufficiently strong to withstand the wind forces. The board shall be fabricated from steel angle and plates and painted with suitable colors and written in English as per direction of the Engineer.

Each board shall display:

i. The name of the Project
ii. The name of the Work
iii. The name of the Employer
iv. The name of the Consultant
v. Contract value
vi. Date of commencement of work
vii. Date of completion of work
viii. Other particulars, which will be asked by the Engineer.

4.6 PROGRESS IN PHOTOGRAPHS AND VIDEOS

Photographs and videos showing the progress of works and special photographs showing particular features or other matters of interest in connection with the Work or their surroundings shall be taken

every month by an approved qualified photographer/cameraman to the choice of the Engineer. Number of photographs/video clips will not exceed 10 (ten) per month.

Four color un-mounted prints of a size 250mm on approved photographic paper of every such photograph inscribed with its serial number, date of shooting and a short title shall be furnished to the Engineer every month.

All negatives and video clips shall be numbered, filed and retained at the Site. On completion of the Contract, those shall become the properties of the Employer and shall be handed over to the Employer by the Contractor.

6 (six) complete sets of color prints of the finished permanent Work, not exceeding 20 (twenty) photographs in number, shall be taken when and as directed by the Engineer prior to finally granting the Contractor the Certificate of Completion and shall be suitably mounted, titled and supplied to the Engineer.

4.7 MEASUREMENT AND PAYMENT

Provisions for Office space and facilities for the Engineer shall not be measured.

Payment for all the items as stated below shall be for the full period of the Contract including any extension, if allowed. At the end of contract period all items listed will be Client's Property.

Payment for all equipment, signboards, photographs, video clips, services etc. of the Field Office detailed in this Sub-section shall be made as described below, where price and payment shall be the full compensation for complying with this Section of the Specification and the Conditions of the Contract.

Payment of rates for the pay items shall be the full compensation for supplying, erecting and maintaining the Field Office for the Engineer including all furniture, fixtures and fittings, access roads, office equipment, signboards, photographs, video clips etc. all in full compliance with the requirements of this Section.

No separate payment shall be made to the Contractor for providing the requisite tools, minor items and the consumables. Compensation for these items shall be deemed to be included in the other pay items of the BOQ.

Item of Payment	Unit
Supply , erection and maintenance of Signboards	Lump sum
Providing, erection and maintenance of office for the Engineer including all office equipment and consumables	Lump sum
Providing Vehicles	Lump Sum
Providing photographs	Lump sum

5. SITE PREPARATION

5.1 SITE PREPARATION

5.1.1 DESCRIPTION

This item of work shall consist of clearing the Site, undertaking general type of earthworks, setting out, etc. as shown on the Drawings, stated in the BOQ and/or as instructed by the Engineer.

5.1.2 COMMENCEMENT

The Contractor shall give the Engineer at least 7 (seven) days written notice of his intention to commence work on any part of the Site. Works shall not be commenced until written approval has been received by the Contractor from the Engineer.

5.1.3 DRAWINGS

The works are to be carried out in accordance with the Drawings and as directed by the Engineer. It may become necessary or desirable, during the progress of the Work, to change any feature shown on the Drawings in accordance with the actual field conditions. Whenever this may occur, the Contractor shall perform the required works to the revised dimensions in accordance with the written instructions of the Engineer.

5.1.4 SETTING OUT

Prior to the commencement of the Work, the Contractor shall study the Drawings and fully understand all aspects of the Work and co-relate the same with the dimensions shown on the Structural Drawings and shall fix up the alignment, set the Bench Mark (B.M) pillars, levels, pegs etc.

The Contractor shall check all the vital measurements of the layout plan of the building and submit a report to the Engineer the deviation, if required any from the dimensions shown in the approved Drawings for the building before starting construction works. In case of any deviation of unacceptable amount, the Engineer will inform the Contractor of the remedial measures, which may be necessary under a particular situation.

Cutting or filling charts, prepared by the Engineer, will be given to the Contractor to sign as a token of his agreement

5.1.5 EARTHWORKS, GENERAL

Earthwork shall be undertaken to the lines and levels shown on the Drawings unless directed otherwise by the Engineer. In carrying out the earthworks, the Contractor shall take all necessary precautions to avoid damage to or deterioration of the earthwork materials and existing ground

5.1.6 CLEARING OF SITE

The Site shall be cleared as required to remove all stumps, roots, vegetable and other objectionable materials specifically within the areas for construction of structure, appurtenance and any other facilities indicated on the Drawings or designated by the Engineer. The cleared materials shall be deposited on the approved off-Site areas or burnt as directed by the Engineer.

5.1.7 MEASUREMENT

The works on Site preparation shall not be measured.

5.1.8 PAYMENT

No direct payment shall be made for works required under this Section. Costs for such works shall be deemed included in the related items of the BOQ.

6. EXCAVATION AND BACK-FILL FOR STRUCTURES

6.1 DESCRIPTION

6.2 MATERIALS

This item of work shall consist of excavation in any type of soil/material for the foundation of structures, disposal of excavated materials, construction and removal of cofferdams, sheeting and other temporary works in protecting the stability and safety of the excavated foundations, pumping, dewatering/bailing water from foundations, back-filling of completed structures with suitable backfill.

No separate payment shall be made for the excavation and back-fill for structures when the works will involve use of cofferdams. The costs of this temporary work shall be deemed included as part of the Tender sum.

The Work shall be carried out at the locations and according to the lines, levels, grades and dimensions shown on the Drawings, stated in the BOQ and/or as directed by the Engineer.

6.2.1 EXCAVATED MATERIAL

The Engineer shall classify all excavated materials either as suitable for fill or as waste.

Approved suitable excavated materials free from large lumps, wood or other objectionable materials shall be placed as back-fill above the level of pile except where other materials are shown on the Drawings, stated in the BOQ and/or required by the Engineer

6.2.2 ORDINARY FILL

Ordinary fill consists of earth having Liquid Limit not exceeding 50 and Plasticity Index not exceeding 20, as determined by AASHTO T89 & T90, and shall be used as back-fill material above the level of pile caps and areas except where other materials are shown on the Drawings, stated in the BOQ and/or required by the Engineer.

6.2.3 SAND

Unless otherwise stated on the Drawings or in the BOQ or ordered by the Engineer, back-fill material below the top level of pile caps shall consist of sand free from chemical contamination with not more than 10% of the material passing the No. 200 sieve (U.S. size). All other specifications should conform to what have been illustrated under the relevant Sub-section of this Specification. The sand to be used shall be approved by the Engineer prior to placing.

6.3 BLINDING CONCRETE

Blinding concrete shall be placed as backfill as shown on the Drawings, stated in the BOQ and/or ordered by the Engineer. The material shall conform to the specifications stated below:

6.3.1 CEMENT

Cement shall conform to the requirements of ASTM specification C 150 Type 1 or similar approved standard for normal Portland cement.

Cement shall be free from any hardened lumps and foreign matter. It shall have a minimum of 90% of particles by weight passing the 75-micron sieve, an initial setting time in excess of 45 minutes and a final setting time of not more than 375 minutes.

All other specifications should conform to what have been illustrated under the relevant Sub- sections of this Specification.

6.3.2 COARSE AGGREGATE

Except otherwise stated, coarse aggregate shall consist of hard, durable angular fragments of crushed stone and/or crushed natural gravel conforming all other specifications illustrated under the relevant Sub-section of this Specification.

6.3.3 FINE AGGREGATE

All specifications should conform to what have been illustrated under the relevant Sub-section of this Specification.

6.3.4 WATER

Water shall be subject to the approval of the Engineer and shall be reasonably clear, free from oil, alkali, salts, acid and organic substances and other deleterious materials or objectionable quantities of suspended materials. All other specifications shall be in accordance with the requirements illustrated under the relevant Sub-section of this Specification

6.4 CONSTRUCTION METHODS

6.4.1 EXCAVATION

The Contractor shall notify the Engineer before commencing excavation of the foundation trenches so that the cross-section, elevations and measurements of the undisturbed ground may be taken. The natural ground adjacent to the structure shall not be disturbed without taking any permission from the Engineer.

Trenches and foundation pits for structures shall be excavated to the lines, grades and elevations as shown on the Drawings or as directed by the Engineer. The elevations of the bottom of the foundations shown on the Drawings are approximate only and the Engineer may order such changes as deemed necessary to provide a secured foundation.

Where unstable soil is encountered at the bed level, it should be brought to the notice of the Engineer and all such unstable soil shall be removed as directed and replaced with suitable materials to provide adequate support for the structure.

On acceptance of the materials forming the bottom of any excavation by the Engineer subsequently becoming unacceptable to him due to exposure to weather condition or due to flooding or have become puddled, soft or loose during the work process, the Contractor shall remove such damaged, soft, or loose materials and make additional excavation as per requirement. Such additional excavation shall be held as excess excavation and the cost of the excess excavation and subsequent replacement with a suitable back-fill shall be at the expenses of the Contractor.

Any erroneous excavation or excess excavation for the conveniences of the Contractor, or over excavation performed by the Contractor for any purpose or reasons shall be at the expenses of the

Contractor. If the excavation for foundations exceeds the depths specified, the Contractor shall bring it back to the specified levels with sand, mass concrete or other approved materials conforming Standard Specifications at the Contractor's own expenses.

Excavation shall be sufficiently large to provide necessary working space, shuttering and any other Temporary Works required during construction.

Boulders, roots and any other objectionable materials encountered in excavation, shall be removed. The excavated foundation shall be cleared of all loose materials and cut to a firm surface.

When the footing is to rest on the ground and not on piles, special cares shall be taken not to disturb the bottom of the excavation and excavation to final grade shall be deferred until immediately before the footing is placed. If foundation fill material is required, it shall be placed and compacted in layers not more than 150mm thick or as directed by the Engineer. The dry density on compaction within 300mm below the top level shall not be less than 100% maximum dry density as determined in accordance with AASHTO T99 or ASTM D698.

In excavating foundation trenches, the last 150mm layer shall not be excavated until immediately before commencing the construction work except that the Engineer shall instruct otherwise. Any damages to the work due to the Contractor's operation shall be repaired at the expenses of the Contractor.

The Contractor shall be solely responsible for the safety and stability of the excavation and shall provide all protective supports, bracing, sheet piles, shoring etc. as required. Shoring should be adequate to provide enough safety to all the adjacent structures and land.

Excavated materials, classified as suitable for fill, shall be stockpiled. Waste materials and suitable fill materials in excess of requirement, shall be disposed of by the Contractor outside the limits of the Site.

The foundation material shall be cleared of all loose and displaced materials and cut to a firm surface, either leveled, stepped or serrated, as specified or shown on the Drawing or directed by the Engineer leaving a smooth solid bed to receive foundation.

No footing, bedding material or structure shall be placed on any foundation until the Engineer has inspected and approved the depth of excavation and the foundation materials.

6.4.2 POOR FOUNDATION MATERIAL

When, in the opinion of the Engineer, the bottom of any excavated foundation is of soft or otherwise unsuitable material, the Contractor shall remove the unsuitable material and fill with sand or blinding concrete at the direction of the Engineer. The sand or concrete shall be placed following the procedures specified for back-filling. Sand shall be clear, all passing a No.4 sieve (U.S. size).

When the ground between the piles is too soft to support the green concrete, the Contractor shall submit his proposal for a bottom form to the Engineer for his approval. Extra excavation and foundation-fill or concrete-fill in such case will not be paid separately.

If the bottom form is carried out by strengthening the ground in the aforementioned way, the Contractor shall, if requested, submit calculations showing that the pile cap will not be harmed during hardening due to differential settlement between the piles and the strengthened ground.

6.4.3 DISPOSAL OF EXCAVATED MATERIAL

All excavated materials, so far accepted by the Engineer as suitable, shall be utilized as back-fill or embankment-fill. The surplus materials shall be termed as waste.

Excavated materials, suitable for use as back-fill, shall be deposited by the Contractor in spoil heaps at points convenient for re-handling of the materials during the back-filling operations.

Excavated materials shall be deposited in such places and in such a manner as not to cause damage to roads, services or properties either within or outside the project area and so as to cause no impediment to the drainage of the Site or surrounding areas. The location of spoil heaps shall be subject to the approval of the Engineer.

Waste materials shall be disposed of in accordance with the instruction of the Engineer.

6.4.4 PUMPING AND BAILING

The foundation shall be kept free from water at all times during the construction period. The ground water level shall be maintained at a minimum of 0.9m below the lowest designed excavation level.

Pumping and bailing from any foundation shall be done so as to preclude the possibility of the movement of water through or alongside any concrete being placed. No pumping or bailing will be permitted during the placing of concrete and for at least 24 hours thereafter, unless it is done from a suitable sump separated from the concrete work by a watertight wall or from well points.

The Contractor shall be solely responsible and include in his rates all costs in designing the de-watering system, providing all equipment and accessories required for de-watering. The rates shall also include cost for transportation, furnishing, installation, safe operation and maintaining of the system including operators, mechanics, the supply of power, fuel, lubricants, spares, repairing, etc. throughout and the removal of the equipment at the end of the construction period under this Contract.

Excavations shall be as dry as possible prior to and during placing concrete. Placing of concrete under water will only be permitted if indicated on the Drawings or approved by the Engineer.

6.4.5 BACK-FILLING

All excavated spaces shall be back-filled around the permanent structure to original ground level. Prior to placing back-fill, all trash, metal, debris, lumber, bricks, soft materials and similar objectionable foreign materials shall be removed from the area to be back-filled. No back-fill shall be placed against any structure without the prior permission of the Engineer.

Any protective support, bracing or shoring shall be removed, as the back-filling progresses in such a manner as to prevent caving-in.

Back-fill shall be of approved materials that will produce a dense and well-compacted filling. The material shall be free from large lumps, organic or extraneous materials.

Ordinary fill placed as back-fill shall be laid and compacted. The moisture content of the fill materials, before compaction, shall be within + 5% of the Optimum Moisture Content. Each layer of materials shall be compacted uniformly using approved compaction equipment and procedures. The materials shall be compacted to achieve not less than 90% Maximum Dry Density (STD) beneath the bottom level. The dry density, after compaction within 300mm below the top level, shall not be less than 95% Maximum Dry Density as determined in accordance with AASHTO T99 or ASTM D698 and soaked CBR (4 days) should be greater than 4% at 95% Maximum Dry Density. The compacted layer shall be approved by the Engineer before the Contractor can commence a new layer.

Sand back-fill shall be placed and thoroughly compacted in layers of not more than 150mm. Sand should be clear, all passing a No. 4 U.S. Standard Sieve and conforming generally to ASTM C 144 for fine aggregate with F.M. not less than 1.2 or as required by the Engineer.

Layers of filling shall be tested as directed by the Engineer. Each compacted layer shall not be covered until the Engineer is satisfied that the specified degree of compaction has been achieved.

In placing back-fill, the materials shall be placed in, as far as possible, to approximately the same height on each side of the structure. If conditions require appreciable higher back-filling on one side, the additional materials shall not be placed until permission is given by the Engineer on being satisfied by himself that the structure has enough strength to withstand any created pressure.

In general, no structure shall be subject to the pressure of back-filling until 3 (three) days on expiry of the period designated for removal of forms. This period shall be extended if abnormal curing conditions exist Adequate provisions shall be made for drainage during placing back-fill.

6.4.6 COFFERDAM

The term "cofferdam" denotes any temporary or removable structure, constructed to hold the surrounding earth, water or both, out of the excavation whether such structure is constructed of earth, timber, steel, concrete or any combination of these. The term includes earth dikes, timber cribs, sheet piling, removable steel shells and all bracings and it shall be understood to include excavation enclosed by pumping wells and well points.

Cofferdams shall be constructed so as to control water to preclude sliding and caving-in of the walls of the excavation.

The interior dimensions of cofferdams shall be such as to give sufficient clearance for the construction and removal of any required forms and the inspection of the interior and to permit pumping.

If possible, cofferdams shall be so designed that no cross bracing shall be left in place. If this is not possible, bracing left in place shall be of structural steel. The end of such structural members that would be exposed when the structure is completed shall be boxed back at least 50mm behind the face. The resulting holes shall be completely filled with concrete.

In general, sheet-piling cofferdams shall extend well below the bottom of the footings and shall be well braced and made maximum watertight.

When conditions are encountered which, in the opinion of the Engineer, render it impossible to dewater the foundation before placing of brickwork or concrete, the Engineer may require the construction of a concrete foundation or seal. This shall be placed as directed by the Engineer. The foundation shall then be de-watered and the footing placed.

When foundation piles are to be driven inside a cofferdam and it is judged impossible to de-water the cofferdam before placing concrete, the excavation may be extended below the design level to a depth sufficient to allow for swell of the materials during pile driving operations. Any materials that rise above the design level shall be removed.

Where it is possible to de-water the cofferdam, the foundation materials shall be removed to exact grade after the foundation piles are driven.

The natural streambed adjacent to the cofferdam shall not be disturbed without the permission of the Engineer. Any excavation adjacent to the cofferdam shall be back-filled to the original ground level to the satisfaction of the Engineer.

Unless otherwise provided, cofferdams shall be removed on completion of the structure without disturbing or marring the finished work. The Engineer may order the Contractor to leave any part or the whole of the cofferdam in place and this shall not entitle the Contractor to claim for any additional payments.

The Contractor shall submit Drawings showing his proposed methods of cofferdam construction. However, the Contractor shall remain fully responsible for the adequacy of the design for strength and stability and for the safety of the people working therein.

6.5 MEASUREMENT

The volume of excavation and back-fill shall be measured in cubic meter.

The quantity of excavation for structures to be measured for payment shall include excavation for all structures. Back-filling with previously excavated materials shall not be measured or paid for separately but shall be deemed included within the rate for excavation.

Volumes to be excavated for blinding concrete shall not be measured and the price for the excavation thereof shall be included in the above measured item for excavation and back-fill.

Back-fill with concrete or sand, where directed by the Engineer, including concrete seals shall be measured separately as the volume within the plan outline and top and bottom surfaces. Concrete or sand, placed to back-fill excavation beyond the excavation required, will not be measured for payment.

If sand fill is ordered over top level of pile cap, the fill shall be the specified filling volume measured on the Drawings up to the profiles agreed upon in writing by the Engineer.

Removal of cofferdams, slides, silting or filling, if required, shall neither be measured nor paid for

6.5.1 PAYMENT

The work measured shall be paid for at the Contract unit prices per cubic meter as shown in the Bill of Quantities. The payment shall be the full compensation for all excavations and back-filling for

structures including supply of all materials, labor, equipment, tools and incidentals necessary to the successful completion of the work.

The payment shall also be the full compensation for excavation and subsequent back-filling of working space around the foundation structure for shoring and other protective supports, for construction and removal of cofferdams, for de-watering and for disposal of surplus excavated materials by hauling to any distance at approved locations.

Should it be necessary, in the opinion of the Engineer, to lower the footings to an elevation below the level shown on the Drawings, payment for the excavation and backfill for structures required below plan level down to and including an elevation 1.5m below plan level for any individual footing will be made at a unit price equal to 115% of the Contract unit price and payment for the excavation from an elevation greater than 1.5m below plan level down to and including an elevation 3m below plan level will be made at a unit price equal to 125% of the Contract unit price for "Excavation and Back-filling for Structures".

No additional extra compensation will be allowed for any required cofferdam adjustments arising from such lowering of footings.

In case where the extra depth required for any footing or footings exceeds 3m, a supplementary agreement shall be made covering the quantities recovered from depths in excess of 3m below the plan grade.

Payment for Back-filling shall be included in the pay item for "Excavation and Back fill for Structures" except for sand fill and concrete fill. These fill types shall be measured as provided above and paid for at the concerned Contract unit prices. However, no compensation shall be made for less Back-filling with excavated materials or more surplus to waste in the pay item of "Excavation and Back-filling for Structures".

All payments for the Back-filling and compaction of those areas, which were removed as structural excavation shall be included in the appropriate unit rates as shown below:

Item of Payment	Unit
Excavation and back-fill for structures	Cubic meter / Cubic feet
Concrete back-fill for structures	Cubic meter / Cubic feet
Sand back-fill for structures	Cubic meter/ Cubic feet

7. EARTH FILLING AND SAND FILLING

7.1 EARTH FILLING

7.1.1 DESCRIPTION

This work shall consist of filling any place by furnishing, placing, compacting and shaping suitable earth material of acceptable quality obtained from approved sources to make up levels to the lines, levels, grades, dimensions and cross sections in accordance with these specifications and as shown on the Drawings and/or as instructed by the Engineer.

7.1.2 MATERIALS

All fill materials shall be free from roots, sods or other deleterious materials. All fill materials shall be stockpiled outside the working areas. Materials shall be tested and approved by the Engineer. The selected fill so stockpiled, shall satisfy the following criteria:

i. Liquid limit of fraction passing 425-micron sieve shall not exceed 50% as determined by AASHTO T89.
ii. Plasticity index of fraction passing 425-micron sieve shall not exceed 20% as determined by AASHTO T90.
iii. The dry density after compaction in layers more than 300mm below top level shall not be less than 90% of the maximum dry density as determined in accordance with AASHTO T99 or ASTM D698.
iv. The dry density after compaction within 300mm below the top level (or such greater depth if shown on the plans and drawings) shall not be less than 95% maximum dry density as determined in accordance with AASHTO T99 or ASTM D698.
v. Soaked (4 day) CBR greater than 4% at 95% MDD. The moisture content at the time of compaction shall be the optimum moisture content ± 5%. Sampling to be carried out as per ASTM D 75 and D 3665.

7.1.3 CONSTRUCTION METHODS

Prior to placing any fill upon any area, all clearing and grubbing operations shall be completed following the procedures stated below.

The original ground surface should be prepared by scarifying, watering, aerating and compacting. The dry density after compaction shall not be less than 90% of MDD (STD).

Filling in swamps or water shall be carried out as indicated on the Drawings and as described in these Specifications. The Contractor shall, when ordered by the Engineer, excavate or displace swampy ground and backfill with suitable materials. Such backfill shall be river or beach sand unless otherwise directed by the Engineer.

The materials that are borrowed from canals or other waterlogged areas for use as fill material, being saturated, shall initially be stockpiled to drain the excess water before placing it in the designated areas

CLEARING

Clearing shall consist of the removal and disposal of everything above foundation level except those the Engineer directs are to be left undisturbed. The materials to be cleared shall include but not necessarily be limited to trees, stumps, logs, bush, undergrowth, grass, crops, loose vegetable matter and structures unless provided elsewhere.

All tree stumps shall completely be removed within the limits of earthwork.

Clearing shall also include the removal of existing fences, remnants of buildings, etc

GRUBBING

Grubbing shall be confined to major roots beneath the excavations. In agricultural areas where the ground has been formed into ridges of dikes, the ground shall be roughly leveled or graded to form a surface suitable for filling and to the satisfaction of the Engineer.

OWNERSHIP OF CLEARED MATERIALS

All cleared materials shall, unless otherwise provided for in the Contract, be the property of the Department.

SPREADING AND COMPACTION OF EARTH FILL

Earth carried from outside shall be placed on the land to be developed in horizontal layers and each layer shall not exceed a loose thickness that is required to obtain a compacted thickness of 150mm. The earth of each basket is to be placed near to the earth placed before it and spread systematically. The Contractor shall not be allowed to throw earth in heaps.

The materials to be compacted shall be deposited in horizontal layers on the land to be developed with a loose thickness as stated above. The clods of earth shall be broken down to a maximum size of 25mm by striking the clods with the back of a spade or by using wooden drag or ladder or by any other suitable means before the next basket of earth is thrown close to it. Distribution of materials shall be made in such a way that the compacted materials will become homogeneous and free from lenses, pockets, streaks or other imperfections. Excavating and placing operations shall be such that the materials, when compacted, will be blended sufficiently to secure the best practicable degree of compaction, impermeability and stability and for this purpose the preceding compacted layer shall be scarified before placing a new layer.

All fill materials shall generally be compacted mechanically. However, under some special circumstance and when specifically allowed under the BOQ, the fill may be allowed to be compacted manually.

If the density measurement checks fall below the specified density level, re-compacting shall be required irrespective of the field compaction trial results. The Contractor shall be carried out such works

Earth fill materials, which does not contain sufficient moisture requirement for compaction in accordance with the requirements of this Sub-section shall be reworked and watered as per direction of the Engineer. The Contractor shall carry out this work at his own expenses.

Earth fill materials containing excess moisture shall be reworked and dried prior to or during compaction. Drying of wet materials shall be performed by methods proposed by the Contractor and approved by the Engineer at the expenses of the Contractor.

Compaction of every layer shall have to be approved by the Engineer. In the event the Contractor fails to obtain the approval of the Engineer of a fill layer, the materials above the unsatisfactory

layer shall be removed and the unsatisfactory layer shall be re-compacted to satisfy the specifications at the expenses of the Contractor.

MANUALLY COMPACTED FILL

Fill shall be placed and compacted in layers for 150mm maximum compacted thickness, uniformly spread and compacted over the fill area of each layer. If for any reason, progress in compaction of the fill is interrupted for any unreasonable time, the surface area of the fill shall be scarified or ploughed before compaction continues. Each layer shall be compacted, using controlled manual compaction methods to achieve at least 85% of the Standard Proctor maximum dry density.

Compaction of every layer shall have to be approved by the Engineer. In the event the Contractor fails to obtain the approval of the Engineer of a fill layer, the materials above the unsatisfactory layer shall be removed and the unsatisfactory layer shall be re-compacted to satisfy the specifications at the expenses of the Contractor.

Under special circumstances and if directed by the Engineer, the Contractor shall excavate 5 to 10 trial pits each of size 2m long, 1m wide and 2m depth or to a depth of the improved land (whichever is less) at random spacing to test the degree of compaction. The size of voids encountered shall not exceed 5 cm in diameter and the number of voids shall be less than 10 per square meter.

PROCEDURES FOR MANUAL COMPACTION

The earth shall be compacted manually using concrete drop hammers each weighing 6 kg to 7 kg, fitted with a shaft of about 1.5m long. Ramming shall reduce the voids and shall continue until no further shrinkage of earth is possible by ramming.

Before commencing ramming, the moisture content of the soil shall be increased or decreased as per requirement by sprinkling the soil with water or by allowing natural drying of the soil as applicable so as to ensure that the materials shall have a moisture content of not less than 5% or greater than 5% dry of the optimum moisture required for the purpose of compaction. Both wetting and drying may be aided by furrowing the fill and then re-spreading when the moisture content is suitable.

If the moisture content exceeds the aforementioned tolerance, the compaction operations shall not proceed until the material is wetted or allowed to dry out, as the case may be to obtain optimum moisture content within the permitted tolerances. However, there may be an exception with a specific approval of the Engineer. No adjustment in price shall be made on account of any operations of the Contractor related to wetting or drying the materials or on account of any delays occasioned thereby.

The preceding operations shall continue layer after layer until the top of the filling is reached.

MECHANICAL COMPACTION

In the case of mechanical compaction, area of development, designated on the Drawings or by the Engineer, shall be compacted to the lines and grades shown on the Drawings or established by the Engineer. The Contractor's operations in importing materials, designated for use, shall be such as will result in an acceptable gradation of material when placed as determined by the Engineer.

Just prior to and during placement operations, the materials shall have a moisture content of not greater than 5% wet or less than 5% dry of the optimum moisture required for the purpose of compaction, as determined by Test No. 12 of BS 1337 and approved by the Engineer. The materials shall be so worked as to have uniform moisture content throughout the entire layer.

If the moisture content exceeds the aforementioned tolerance, the compaction operations shall not proceed until the materials are wetted or allowed to dry out, as the case may be to obtain the optimum moisture content within the permissible tolerances. However, there may be an exception with a specific approval of the Engineer. No adjustment in price shall be made on account of any operations of the Contractor related to wetting or drying the materials or on account of any delays occasioned thereby.

When the material has been conditioned and placed as specified or directed, it shall be compacted with appropriate motorized vibratory compaction equipment or tampers of adequate weight and size as approved by the Engineer. Each layer shall be compacted to obtain at least 98% compaction of the maximum dry density. If the test results show that the density has not met the requirement, the Contractor shall have to carry out further compaction until the required density is achieved.The insitu dry density of the compacted fill shall be determined by the Sand Replacement Method described in Test No. 15 of BS 1377 or by other similar approved tests at locations as ordered by the Engineer.

7.1.4 MEASUREMENT

Measurements for earth filling works shall be taken for payment in cubic meters on cross sections compacted and accepted in place. The volume to be measured will be the net volume of required and accepted filling, actually constructed and completed in accordance with the Specifications, to the lines, levels and cross sections required as per the Drawings or such other dimensions as directed by the Engineer. This stipulation of volume determination will be regardless of the method of excavation, filling, re-sectioning and backfilling at structures or type of materials.

The cross sections to be used shall be measured by pre-work (after clearing and stripping) and post-work field surveyed sections. Pre-work sections of the portion of the work allotted to the Contractor, computed through survey works, shall be signed by the Contractor before executing the works for retention by the Engineer.

7.1.5 PAYMENT

The unit rate paid per cubic meter for earth filling shall be in accordance with the Contract unit price, which payment shall constitute the full compensation for furnishing all materials and providing all labor, tools and equipment and works as specified. The rate shall also include costs of all other items related therewith and all incidentals, which may need to be completed to execute the work strictly in accordance with the Specifications and/or as per the directions of the Engineer.

Costs of all works and the cost of lead, lift or carriage shall be included in the unit rates for the relevant item of earth filling works of the BOQ of the Contract. Unless otherwise specified, no royalties will be paid for the purchase of earth from a private land regardless of its distance from the Site. No additional payment shall be made for purchasing a land and excavating the fill outside the rate agreed in the Contract for the item of earth filling works.

No direct or separate payment shall be made for works required under the other sub-items of this item. Costs for such works shall be deemed to have included in the related items of the BOQ.

Payment shall only be made when all works have been completed in accordance with the designed sections satisfying all specifications and accepted by the Engineer.

Item of Payment	Unit
Earth filling	Cubic meter/ Cubic feet

7.2 SAND FILLING

7.2.1 DESCRIPTION

This work shall consist of filling in foundation trenches, inside plinth or at any other places by furnishing, placing, compacting and shaping suitable sand of acceptable quality and F.M. to make up levels to the lines, levels, grades, dimensions and cross sections in accordance with these specifications and as shown on the Drawings or BOQ and/or as instructed by the Engineer

7.2.2 MATERIALS

Materials shall be of natural sand free from vegetable matters, from soft particles and from clay. F.M. of sand shall be in accordance with the stipulations of the BOQ or as per the direction of the Engineer.

All fill materials shall be stockpiled outside the working areas. Materials shall be tested and approved by the Engineer. The selected sand fill so stockpiled, shall satisfy the following criteria:

i. The fraction passing the 425-micron sieve shall have a Plasticity Index not greater than 10 (AASHTO, Soil Classification A-2-4).
ii. The material shall have a soaked CBR value not less than 8% when compacted to 98% of maximum dry density as to be determined by AASHTO T-99.

7.2.3 CONSTRUCTION METHODS

GENERAL

Prior to placing any sand fill upon any area, all clearing and grubbing operations shall be completed. Within the limits of sand filling, tree stumps shall completely be removed.

The original ground surface should be prepared by scarifying, watering, aerating and compacting.

SPREADING AND COMPACTION OF SAND FILL

Sand fill shall be placed on the desired place in horizontal layers and each layer shall not exceed a loose thickness that will be required to obtain a compacted thickness of 150mm. Sand in each basket is to be placed near to the sand placed before it and spread systematically. The Contractor shall not be allowed to throw sand in heaps.

The compacted materials should become homogeneous and free from lenses, pockets, streaks or other imperfections. Placing operations shall be such that the materials, when compacted, will be blended sufficiently to secure the best practicable degree of compaction, impermeability and stability and for this purpose the preceding compacted layer shall be scarified before placing a new layer.

All fill materials shall generally be compacted mechanically. However, under some special circumstance and when specifically allowed under the BOQ, the fill may be allowed to be compacted manually.

If the density measurement checks fall below the specified density level, re-compacting shall be required irrespective of the field compaction trial results The Contractor shall carry out such works at his own expenses.

Sand fill materials not containing sufficient moisture requirement for compaction in accordance with the requirements of this Sub-section, shall be reworked and watered as per the direction of the Engineer. The Contractor shall carry out this work at his own expenses.

Sand fill materials containing excess moisture shall be reworked and dried prior to or during compaction. Drying of wet materials shall be performed by methods proposed by the Contractor and approved by the Engineer at the expenses of the Contractor.

Compaction of every layer shall have to be approved by the Engineer. In the event the Contractor fails to obtain the approval of the Engineer of a fill layer, the materials above the unsatisfactory layer shall be removed and the unsatisfactory layer shall be re-compacted to satisfy the specifications at the expenses of the Contractor.

PROCEDURE FOR MANUAL COMPACTION

Sand shall be compacted manually by using concrete drop hammers each weighing 6 kg to 7 kg, fitted with a shaft of about 1.5m long. Ramming shall reduce the voids and shall continue until no further shrinkage of sand is possible by ramming.

Before commencing ramming, the moisture content of sand shall be increased or decreased as per requirement by sprinkling water or by allowing natural drying of sand as applicable so as to ensure that the materials shall have a moisture content of not less than 3% or greater than 3% dry of the optimum moisture required for the purpose of compaction respectively.

The compaction operations shall not proceed until the material is wetted or allowed to dry out, as may be required, to obtain optimum moisture content within the tolerances as permitted above. However, there may be an exception with a specific approval of the Engineer. No adjustment in price shall be made on account of any operations of the Contractor in wetting or drying the materials or on account of any delays occasioned thereby.

The preceding operations shall continue layer after layer until the top of the filling is reached.

MECHANICAL COMPACTION

In the case of mechanical compaction, area of filling, designated on the Drawings or by the Engineer, shall be compacted to the lines and grades shown on the Drawings or established by the Engineer. The Contractor's operations in importing materials, designated for use, shall be such as will result the desired F.M.

Just prior to and during compacting operations, the materials shall have a moisture content of not greater than 3% wet or less than 3% dry of the optimum moisture required for the purpose of compaction, as determined by Test No. 12 of BS 1337 and approved by the Engineer. The materials shall be so worked as to have uniform moisture content throughout the entire layer.

If the moisture content is less than optimum by more than 3% or is greater than optimum by more than 3%, the compaction operations shall not proceed until the material is wetted or allowed to dry out, as may be required, to bring the optimum moisture content within the tolerances. However, there may be an exception with a specific approval of the Engineer. No adjustment in price shall be made on account of any operations of the Contractor in wetting or drying the materials or on account of any delays occasioned thereby.

When the material has been conditioned and placed as specified or directed, it shall be compacted with appropriate motorized vibratory compaction equipment or tampers of adequate weight and size as approved by the Engineer. Each layer shall be compacted to obtain at least 98% compaction of

the maximum dry density (STD). If the test results show that the density has not met the requirement, the Contractor shall have to carry out further compaction until the required density is achieved.

7.2.4 MEASUREMENT

Measurement shall be taken for payment on the compacted volume of completed and accepted works in cubic meter. The cross sections to be used will be the areas bound by the original ground (existing) shaped or leveled, the sides and the bottom of the foundation or the floor.

7.2.5 PAYMENT

Payment for sand filling shall be made at the Contract unit price per cubic meter measured as provided above which price shall constitute the full compensation for furnishing all materials with their storage, placing, leveling and shaping, wetting or drying, compacting the fill materials and providing all equipment, tools and all incidentals necessary to complete the work true to the Specifications and/or as per the directions of the Engineer.

Payment shall only be made when all works have been completed in accordance with the designed sections satisfying all Specifications and accepted by the Engineer.

Item of Payment	Unit
Sand filling	Cubic meter / Cubic feet

8. CEMENT CONCRETE BLOCK MASONRY

8.1 SCOPE

The work covered by this section of the Specifications consists of furnishing all labour, tools scaffolding, hoisting equipment and masonry materials of every kind; and in performing all operations in connection with procurement, transportation and delivery, erection and building in of all work classified as masonry work and/or included as such herein, i.e., concrete masonry units; masonry mortars; and all related items and appurtenances, including all items supplied by other trades and customarily built-in and/or installed under mason work or required to complete mason work, in strict accordance with the requirements of the Drawings and Schedules, as specified herein, and subject to the Terms and Conditions of the CONTRACT Documents.

8.2 CODES AND STANDARDS

Unless otherwise specified or shown, the following codes and standards shall apply:

ASTM C31	Making and curing concrete test specimen in the field.
ASTM C39	Compressive Strength of cylindrical concrete specimen.
ASTM C90	Hollow load bearing concrete masonry units.
ASTM C144	Aggregate for masonry mortar
ASTM C270	Mortar for unit masonry
ASTM C404	Aggregate for masonry grout
ASTM E119	Fire tests of building construction and materials
UBC UL-618	Concrete masonry units, fire resistance index
ACI 531	Building code requirements for concrete masonry structure

8.3 SUBMITTALS

i. Samples: Submit three samples of each type of block required, and the full range of exposed texture to be used in the completed works. The review will be for texture only.

ii. Test Reports: Reports for compressive strengths of masonry units, grout and mortar

8.4 SUCTION RATE

The CONTRACTOR shall, at his own cost, satisfy the ENGINEER that the suction rate of the block when determined in accordance with Appendix `A' of BS 3921 does not exceed 20g/cm.sq/min., or that the CONTRACTOR is able to adjust it so that it does not exceed this value on SITE.

8.5 SOLUBLE SALT CONTENT

For exposed block work, the contents by weight percent of soluble sulfate, calcium, magnesium, potassium and sodium radicals, shall not exceed 0.30, 0.10, 0.03 and 0.03 percent respectively, when ascertained in accordance with BS 3921 at the cost of the CONTRACTOR.

8.6 PRODUCTS

8.6.1 MATERIALS FOR BLOCKS

Cement, aggregate and water for concrete blocks shall conform to the requirements as specified in the section for Plain and Reinforced Concrete

8.6.2 CONCRETE BLOCK MAKING

i. The blocks shall be machine molded. The block making machines shall be of the standard approved by the ENGINEER. They shall be operated according to the instructions laid down by the manufacturers.

ii. The blocks shall be continuously water cured by sprinkling for a minimum of 10 days and covered between sprinkling operations with 4 mils thick polyethylene sheeting. After 10 days' water-curing period the blocks shall be air dried. Under no circumstances will blocks be used in the work until they are completely dry. During curing period no surface of the block will be allowed to dry.

iii. Cured concrete blocks shall be stored off the ground, stacked on level platforms, which allow air circulation under stacked units. Units shall be covered and protected against wetting.

iv. Care shall be exercised in the handling of all concrete blocks. No damaged blocks shall be used in the work.

v. The blocks cast on different dates shall be stacked separately and must be labeled showing the date on which they are cast

8.6.3 PROPERTIES OF BLOCKS

i. Block sizes, unless otherwise indicated on drawings, shall be 16" by 8" by 4", 6", & 8" thickness (Approximately 400 by 200 by 100, 150 & 200 mm). Physical requirements shall comply with relevant ASTM or equivalent approved standards.

ii. For non-load bearing wall the cement, sand and coarse aggregate shall be volume batched in the minimum ratio of one-part cement, three parts sand and six parts coarse aggregate and shall be mixed in a concrete mixer.

iii. For load bearing Hollow/Solid block wall the mix unless otherwise stated shall be proportioned to meet the following strength requirements:

- Solid Load Bearing Concrete Masonry Units shall have a 28 days' compressive strength of not less than 1500 psi (106 kg/cm. sq.) average of 3 units tested or 1200 psi (85 kg/cm. sq.) per individual unit tested.
- Hollow Load Bearing Concrete Masonry Units shall comply with ASTM C90, grade N-1 (moisture controlled), and shall have a 28-days compressive strength of 1350 psi (96 kg/cm. sq.) average of 3 units tested and 800 psi (57 kg/cm. sq.) on individual unit tested. The compressive strengths shall be verified by tests in accordance with UBC section 2404, para 2
- The CONTRACTOR shall provide test results proving the average minimum crushing strength of the blocks prior to the commencement of the construction. Further test results shall be provided as required by the ENGINEER, to ensure that all batches of blocks have the minimum specified crushing strength.

- The test shall be carried out by an authority 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, and the CONTRACTOR shall make any necessary arrangements.
- Hollow concrete block units wherever specified shall have cores with cross sectional area at least equal to the percent of gross area of block given below:

8 in. (200 mm)	38 percent
6 in. (150 mm.)	30 percent
4 in. (100 mm)	No requirement

- Minimum shell wall thickness be 1-1/4 in. (32 mm).
- Permissible tolerance in size of block shall be 1/8 in (3 mm) each way.
- Special shapes for lintels, corners, jambs, sash, cleanouts, control joints and headers, bonding and other particular needs shall be provided where required.

8.6.4 MORTAR CONSTITUENTS

i. Cement: Cement shall conform to ASTM C-150, type II low alkali non-staining without air entrainment

ii. Sand (Aggregate): Sand and its grading shall comply with the requirements of ASTM C-144, 100% passing the U.S. equivalent No. 16 sieve. Sand that has been in contact with seawater shall not be used unless it has been thoroughly washed to the satisfaction of the ENGINEER.

iii. Water: Water shall conform to the specifications set forth in Section of Plain and Reinforced Concrete.

iv. Lime: Hydrate lime shall conform to ASTM C-207 type S. If it is not available, use quick lime according to ASTM C-5.

8.6.5 MORTAR PROPORTIONS AND MIXING

i. Cement, Lime and Sand shall be mixed in proportion, by volume, as follows:

Type (1) 1:1:6 (Cement: Lime: Sand)

Type (2) Alternatively use 1:4 (Cement: sand) mix subject to the prior approval of the ENGINEER.

ii. Mix only as much mortar in a mortar mixer as can be used in one hour for Type-1 and 30 minutes for Type-II after water has been first mixed into the batch.

iii. Do not re-temper the mortar.

iv. Where cement lime mortar is used, sand and lime shall be mixed first and cement to be added later on.

v. Compressive strength of mortar specimen tested in accordance with ASTM C39 shall not be less than 2500 psi (210 Kg/cm sq.)

8.6.6 REINFORCING AND ANCHORS

i. All masonry walls shall be reinforced. At least one vertical and one horizontal reinforcing member shall be provided for every 16 sq.ft of wall elevation or as per structural drawings.

ii. Block masonry anchors and ties required to connect masonry with structural member unless shown otherwise on drawings, shall be 3/8″ dia. (10-mm dia) bars every 4-5th course, anchored 6" in each jointing element.

iii. Additional details of anchors, if any, are shown on drawings.

iv. Alternate compatible anchoring system may be used subject to the approval of the ENGINEER. v. All reinforcing steel shall conform to ASTM A 615 grade 40 deformed bars as specified in section 3310 plain and reinforced concrete.

8.6.7 ERECTION / WORKMANSHIP

Blocks shall be laid true to line, level and laid in accurately spaced courses in stretcher bond with vertical joints of each course located at center of units in alternate courses below. Each course shall be properly bonded at corners and intersections of walls. Courses of block shall be kept plumb throughout, and corners reveals shall be true and in plumb.

Standard width of mortar joints for both horizontal and vertical joints shall be 1/2" (12.5 mm) maximum. Mortar joints in walls shall have full mortar coverage on vertical and horizontal faces between the blocks. Mortar joints on wall including struck joints, shall be thoroughly compacted and pressed tight against the edges of the blocks with proper tools. Block terminating against soffits of beam or slab construction shall be wedged tight with wedges and the joint shall be packed solidly with mortar between the top of the block and the bottom of slab or beam. Expansion joints shall be kept free from mortar or other debris.

Unless otherwise shown on the drawings or specified by the ENGINEER, the spaces around door frames and other material or built in items shall be solidly filled with mortar. Spaces around the door and window holdfasts shall be filled in with 3 ksi concrete. Work required to be built in with masonry including door frame anchors, wall plugs, dovetail anchors and accessories shall be built in as the erection progresses.

The block work shall be carried up in uniform manner and no portion shall be carried more than 3. ft (1 meter) above the adjoining one at any time. All masonry shall be kept strictly true and square and the whole properly bonded together and leveled round each floor.

Sleeves, chases and holes etc. shall be built in as construction proceeds. Chasing of completed walls or the formation of holes shall only be carried out with the approval of the ENGINEER.

Walls of blocks indicated as being non-load bearing shall not be constructed on the in-situ concrete floor slab unit until the floor shuttering is struck and the concrete has obtained sufficient strength to support their weight. Toothing into load bearing walls shall not be permitted.

8.6.8 CURING

Masonry wall shall be cured by keeping it moist with water for at least 10 days after its construction. ENGINEER may direct additional curing if required.

8.6.9 SCAFFOLDING

CONTRACTOR shall provide safe scaffolding of adequate strength for use of workmen at all levels and heights at his own expense. Scaffolding which is unsafe in the opinion of the ENGINEER shall

not be used until it has been strengthened and made safe for use of workmen. Cost of scaffolding etc., shall be included by the CONTRACTOR in the unit rate for masonry items.

Damage to masonry from scaffolding or from any other object shall be repaired by the CONTRACTOR at his own cost.

8.6.10 TOLERANCES

All block work shall be erected plumb and true to line and level with the maximum variation in any story height or any length of wall being 1/8" (3 mm) in 10 feet (3 meter). The maximum tolerance in the length, height or width of any single masonry unit shall be +/- 1/8" (3 mm).

8.6.11 MEASUREMENT & PAYMENT

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 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; making curing etc.
iii. All fixtures and all costs in connection therewith for precast works.
iv. Fitting and fixing materials and goods in position.
v. Use of plant and scaffolding.
vi. Cutting and patching work required for installation of built-in-work.
vii. Waste of materials.
viii. Square cutting.
ix. Establishment charges, overhead charges and profit.
x. All other expenses, charges and taxes specified in Conditions of Contract

Works shall be measured net as fixed in position as per Drawings and instructions of the ENGINEER. Each measurement shall be taken to the nearest 1/2" (12.5 mm). This rule shall not apply to any dimensions stated in descriptions.

Masonry work will be paid for according to the actual net area of masonry work in square feet (Sq. m.) for the required thickness or the actual net volume of masonry work in cubic feet (C.M.) as described in the Bill of Quantities. All the openings left in the masonry walls will be deducted.

Providing and fixing all joint reinforcing bars, reinforcing bar anchors and dovetail anchors shall be deemed to be included in the unit rate for masonry work.

Due to different thickness of the slab in different areas or rooms or for any other reason whatsoever, if the chiseling of the 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 remaining height shall be made good with (f'c = 3000 psi) concrete. This concrete shall neither be measured nor be paid under item of concrete but will be paid for under the item of masonry of the walls. In case where lintel heights are such that the CONTRACTOR has to chisel the masonry or provide cast-in-place concrete to make up the height of the course, no payment will be made for chiseling, but where such cast-in-place concrete is provided, payment for the same will be made at the unit rate for masonry.

9. CONCRETE WORK

9.1 CONCRETE FOR STRUCTURES

9.1.1 DESCRIPTION

This work shall consist of construction of all Portland Cement Concrete in structures, with or without reinforcement, which shall involve furnishing, placing, finishing and curing of concrete. All items of concrete work shall include elements of structures constructed by cast-in-place and pre-cast methods using either plain or reinforced concrete or any combination thereof and shall conform to the specifications and requirements of the different Sub-sections of this item of work. All structures shall be built in a workman like manner to the lines, grades and dimensions shown on the Drawings or as directed by the Engineer.

All concrete works shall be carried out in accordance with BS 8110 or ASTM C-685 and as specified by the Engineer.

All sampling and testing of constituent materials shall be carried out in accordance with the provisions of the appropriate British or American Standard and all sampling and testing of fresh and hardened concrete shall be carried out in accordance with the provisions of BS 1881 "Method of Testing Concrete" or similar under ASTM C 39.

9.1.2 MATERIALS

GENERAL

Concrete shall be manufactured with the essential ingredients of Portland cement, fine aggregate, coarse aggregate and water as specified and shall be well mixed and brought to the proper consistency. Type and source of ingredients used in concrete shall conform to the approved samples and shall not be varied. The requirement for concrete, its constituent materials, methods and procedures shall conform to any of the Standard Specifications of ASTM, or BS or any other equivalent standard unless otherwise specified herein or directed by the Engineer.

Materials shall conform to the requirements specified below and in the relevant Section titled 'Construction Materials' of this Specification.

CEMENT

Cement used in the works shall be Ordinary Portland Cement complying with the requirements of ASTM C 150 Type 1 or BS 12 or equivalent standard. Special cements shall conform to the requirements provided by the Engineer.

USE OF CEMENT

Cement of different manufacturers and with different brands or types shall be kept separately and shall not be used in the same mix.

Consignment of cement shall be used in the order of delivery.

Only one brand, grade or kind of cement shall be used in a given structure, except upon the written permission of the Engineer.

COARSE AGGREGATE

Coarse aggregate for all types of Concrete with the exception of blinding concrete shall conform to the requirements of ASTM C 33.

Coarse aggregate shall be hard, durable, clean, free from dust and other deleterious materials. The grading of the coarse aggregate shall be such that when combined with the approved fine aggregate and cement, it shall produce workable concrete of maximum density

NOMINAL SIZE OF COARSE AGGREGATE

Different sizes of coarse aggregates should be mixed in proportions, which would be determined during trial mixes. The course aggregate to be used in the concrete mix shall be dry mixed from different sizes in specified/selected proportion one day before casting.

Nominal size of the coarse aggregate shall not be larger than one-fifth of the narrowest dimension between sides of forms or one-third the depth of slabs or three-fourth the minimum clear spacing between individual reinforcing bars or bundle of bars.

FINE AGGREGATE

Fine aggregates shall be non-saline clean natural sand and have a specific gravity not less than 2.6, a Fineness Modulus not less than what will be specified for a particular type of concrete. It shall conform to the requirements of ASTM C-33 or equivalent standard.

WATER

All sources of water for use in concrete shall be subject to the approval of the Engineer. Water shall be reasonably clean, free from injurious quantities of oil, alkali, salts and organic materials or other substances that may be deleterious to concrete or reinforcement and shall not contain any visibly solid material. Water whose concentration of chloride ion is in excess of 3,000 ppm (parts per million) shall not be used for the production of concrete. If requested by the Engineer, water shall be tested by comparing with water of known satisfactory quality. Such comparison shall be made by means of standard cement tests for soundness, time of setting and mortar strength. Any indications of un-soundness, change in time of setting of plus or minus 30 minutes or more, or reduction of more than 10 percent in mortar strength shall be sufficient cause for rejection of the water under test.

ADMIXTURES

Suitable admixtures may be used in concrete mixes with the prior acceptance of the Engineer. The type and source of admixture, and the amount added and method of use shall be to the acceptance of the Engineer, who shall be provided with the following data:

i. The manufacturer's recommended dosage and detrimental effects of underdosage and over-dosage.
ii. The chemical name of the main active ingredients in the admixture.
iii. Whether or not the admixture contains chloride and, if so, the chloride content of the admixture expressed in percentage of equivalent anhydrous calcium chloride by weight of admixture.
iv. Whether or not the admixture leads to the entraining of air when used at the manufacturers recommended dosage.
v. Evidence of previous satisfactory performance of concrete containing the additive.

Admixtures containing chloride other than impurities from admixture ingredients shall not be used in concrete containing embedded aluminium, or in concrete cast against permanent galvanized metal forms.

In admixtures for use in reinforced concrete, the chloride ion content shall not exceed one percent by weight of the admixture. If more than one admixture is used, the admixtures shall be compatible

with each other and shall be incorporated into the concrete mix in correct sequence so that the desired effects of all admixtures are obtained.

Fly ash or other pozzolans used as admixtures shall conform to 'Specification for Fly Ash and Raw or Calcined Natural Pozzolan for use as a Mineral Admixture in Portland Cement Concrete (ASTM C 618)'. All air entraining admixtures shall conform to 'Specification for Air Entraining Admixtures for Concrete (ASTM C 260)'.

Air entraining and chemical admixtures shall be incorporated into the concrete mix in a water solution. The water so included shall be considered to be a portion of the allowed mixing water. Admixtures shall be incorporated through a dispensing system sufficiently accurate to deliver within + 5% of the approved dosage rate.

All admixtures shall be used strictly in accordance with the manufacturer's instructions. A 'Literature of Compliance' of the admixture shall be furnished to the Engineer for each shipment of admixture used in the work. The said literature shall be based upon laboratory test results from an approved testing facility and shall authenticate that the admixture meets all requisite specifications.

9.1.3 TESTING OF MATERIALS

GENERAL

All tests shall be performed at Site and/or in the PEC Laboratories. Testing outside the scope of Site or PEC Laboratories shall be carried out at a recognized laboratory that will be designated by the Engineer. The test results shall be authenticated by the Head of the Laboratory.

CEMENT

Hydraulic cement shall be sampled and tested in accordance with the standard methods referred to in AASHTO M 85.

Cement may be sampled either at the factory or at the Site of the Work as provided in the Specifications.

The Contractor shall notify the Engineer of dates of delivery so that there will be sufficient time for sampling the cement, either at the factory or upon delivery. If this is not done or if additional tests are necessary, the Contractor may be required to re-handle the cement in the store for the purpose of obtaining the required samples.

Sampling shall normally be instructed by the Engineer for every stored 200 cubic meter of concrete production with the concerned cement type or if the source of cement has been changed.

AGGREGATE

Tests to assess the suitability of the aggregates proposed for use in concrete to be placed in the permanent works shall be as follows:

i. Grading
ii. Magnesium sulphate soundness
iii. Specific gravity and water absorption
iv. Clay, silt and dust content
v. Organic impurities
vi. Sulphate and chloride content
vii. Elongation and flakiness
viii. Potential alkali reactivity
ix. Los Angeles Abrasion Test

x. Aggregate drying shrinkage.

These tests are to be carried out in accordance with the appropriate ASTM Standards and the results shall comply with the limits given therein or as otherwise stated in this Specification. Grading shall be carried out at least at a weekly interval when concrete is being produced on a regular basis or before the start of production when irregular.

The Contractor shall supply samples of the aggregate materials proposed to be used for testing of Elongation and Flakiness Index, Los Angeles Abrasion Value (coarse aggregate) and Fineness Modulus (fine aggregate) and grading and other tests as required by the Engineer.

From the aggregate materials proposed by the Contractor, samples shall be selected according to ASTM D 75 and D 3665 in the presence of the Engineer. The samples shall be brought to the Site laboratory and tested for proving their conformance with the relevant Section of BS or ACI Codes.

The quality control of the aggregate shall be as directed by the Engineer. Grading shall normally be checked daily.

Moisture content of the aggregate shall be determined daily and at any time when a change in the moisture content is expected.

If the Contractor proposes to change the source of supply of aggregates, samples from the new source shall similarly be supplied and tested.

Grading of mixed coarse aggregate shall be checked at Site.

WATER

The water used in mixing or curing concrete shall be tested by methods described in AASHTO Test Method T 260.

In sampling water for testing, care shall be taken that the containers are clean and that samples are representative.

When comparative tests are made with a water of known satisfactory quality, any indication of unsoundness, marked change in time of setting, or a reduction of more than 10 percent in mortar strength, shall be sufficient cause for rejection of the water under test.

Water shall be tested before commencement of work or any time required by the Engineer, or if the source is changed.

ADMIXTURES

The Contractor shall submit to the Engineer specifications and samples of any admixtures or additives that he proposes to use at least 28 days before the commencement of construction or manufacture of the particular structure on which he intends to use the admixture.

Any tests the Engineer may require on concrete mixes on account of the Contractor's proposal to use additives shall be carried out at the expenses of the Contractor.

9.1.4 COMPOSITION OF CONCRETE

CONCRETE CLASSES

The class of concrete and properties applicable to the concrete in various parts of structures shall be as specified in the following table.

Each mix shall be designed to ensure optimum workability, prevent segregation and produce a dense, durable concrete by adjusting the fine and coarse aggregate proportions following procedures as stated under the Sub-section of 'Design of Concrete Mix' of this Specification.

Concrete Class	28 day Cylinder strength in lbs/in^2 (minimum)	Coarse Aggregate Type	Mix Ratio (by volume) (only indicative)
A-1	4000	Crushed Stone	1:1:2
A-2	3000	Crushed Stone	1:1.5:3
A-3	2500	Crushed Stone	1:2:4

The various classes of concrete shall be placed at locations as would be specified on the Drawings (if so) or elsewhere as directed by the Engineer.

Strength requirement is the only determining factor for acceptance of any above stated class of concrete. The mix ratio only shows the minimum cement requirement and it shall not put the Engineer under any obligation to accept concrete unless the requisite strength is established. If required, the cement content has to be increased to attain the desired strength without any additional costs to be paid to the Contractor.

Strength of each and every cylinder tested should conform the aforementioned specified value. Trial mixes for every class of concrete with representative material from the Site, shall be prepared by the Contractor in the laboratory in accordance with the approved procedures. The nominal strength in these tests shall exceed the specified minimum strength by 10%.

If required, suitable admixtures as approved by the Engineer would have to be added to the concrete mix to attain the desired strength without any additional costs to be paid to the Contractor. The effect of the admixture shall be carefully observed by trial mix and tests before its use.

As the work progresses, the Engineer reserves the right to change the proportions from time to time, if conditions warrant so in the interest of satisfactory output. Any such changes will be made at no additional compensation to the Contractor.

9.1.5 REGULATION OF WATER CONTENT

The amount of water used in the concrete for volume batching shall be regulated to adjust for any variation of the moisture content or grading of the aggregates as they enter the mixer as follows:

The batched volume of damp fine aggregate shall be corrected to the equivalent volume of dry aggregate. The volume of moisture in the aggregates shall be deducted from the free water to be added to the mix. To expedite correction to fine aggregate, a "bulking curve" showing the relation between moisture content and increase over dry volume shall be prepared in advance by tests on the fine aggregate used. The Engineer may direct the use of a slump less than that specified whenever concrete of such lesser slump can be consolidated into place by means of vibration specified herein. Addition of water to overcome stiffening of the concrete before placing will not be permitted. Concrete shall have uniform consistency from batch to batch. Aggregate shall not be batched for concrete when free water is dripping from the aggregate.

Concrete mix proportions shall be such that the concrete is of adequate workability and can properly be compacted. Suggested ranges of values of workability of concrete for some placing conditions are given in the following Table.

Degree of Workability	Placing Conditions	Nominal maximum aggregate (mm)	Compac-ting factor	Slump mm
Very Low	Small sections (i.e. pre-cast or > 300mm thick) subjected to intensive vibration and large sections to normal vibration	20 40	0.78 0.78	0-10 0-25
Low	Simple reinforced sections with vibration and large sections without vibration	20 40	0.85 0.85	10-25 25-50
Medium	Simple reinforced sections without vibration and heavily reinforced sections with vibration	20 40	0.92 0.92	25-50 50-100
High	Heavily reinforced sections without vibration	20 40	0.95 0.95	50-125 100-175

When the consistency of the concrete is found to exceed the nominal slump, the mixture of subsequent batches shall be adjusted to reduce the slump to a value within the nominal range. Batches of concrete with a slump exceeding the maximum specified shall not be used in the work.

If concrete of adequate workability cannot be obtained by the use of the minimum cement content as would be allowed, the cement and water content shall be increased without exceeding the specified water/cement ratio, or an approved admixture shall be used.

9.1.6 DURABILITY OF CONCRETE

SPECIAL EXPOSURES

For concrete intended to have low permeability when exposed to water, the water cement ratio shall not exceed 0.50.

For corrosion protection of reinforced concrete exposed to brackish water, sea water or spray from these sources, the water cement ratio shall not exceed 0.40.

If minimum requirement of concrete cover as given under the Section on 'Reinforcing Steel' is increased by 12mm, water cement ratio may be increased to 0.45.

The requirement of water cement ratio on Normal Weight Aggregate Concrete, if exposed to Sulphate containing solutions, shall be calculated using the weight of cement meeting the requirements of ASTM C 150 or C 595 plus the weight of fly ash or pozzolan satisfying ASTM C 618 and/or slag satisfying ASTM C 989.

SULPHATE EXPOSURES

Concrete to be exposed to sulphate containing solutions or soils shall conform to the requirements of the Table given below or be made with a cement that provides sulphate resistance with the maximum water cement ratio provided in the Table.

Calcium chloride shall not be used as an admixture in concrete exposed to severe or very severe sulphate containing solutions, as defined in Table given below.

Requirements for Normal Weight Aggregate Concrete Exposed to Sulphate Containing Solutions

Sulphate exposure	Water Soluble Sulphate (SO4) in soil (percent by weight)	Sulphate (SO4) in water (ppm)	Cement Type[1]	Maximum Water Cement Ratio, by weight
Negligible	0.00-0.10	0-150		
Moderate[2]	0.10-0.20	150-100	II, IP(MS), IS(MS), P(MS), I(PM) (MS) I(SM) (MS)	0.50
Severe	0.20-2.00	1500-10,000	V	0.45
Very Severe	Over 2.00	Over 10,000	V plus pozzolan[3]	0.45

Note:

1. For types of cement see ASTM C150 and C595.
2. Sea water
3. Pozzolan that has been determined by test or service record to improve Sulphate resistance when used in concrete containing Type V cement.

CORROSION OF REINFORCEMENT

For corrosion protection, maximum water soluble Chloride ion concentrations in hardened concrete at ages from 28 to 42 days contributed from the ingredients including water, aggregates, cementitious materials, and admixtures, shall not exceed the limits specified in the Table given below. When

testing is performed to determine water soluble Chloride ion content, test procedures shall conform to AASHTO T 260, "Methods of Sampling and Testing for Total Chloride Ion in Concrete and Concrete Raw Materials".

Type of Member	Maximum water soluble Chloride ion (C1) in Concrete, percent by weight of cement
Reinforced concrete exposed to chloride in service	0.15
Reinforced concrete that will be dry or protected from moisture in service	1.00
Other reinforced concrete construction	0.30

When reinforced concrete will be exposed to brackish water, sea water, or spray from these sources, the above requirements for water cement ratio, or concrete strength and minimum cover requirements (shown under the relevant Sub-section of the Section on 'Reinforcing Steel') shall be satisfied.

9.1.7 DESIGN OF CONCRETE MIX

When designing the concrete mix, the following conditions shall be considered:

STRENGTH

The class of the concerned concrete is to be as shown on the Drawings (if shown). The class is the specified cylinder strength of 28 days and shall be determined as indicated above in the Table under the Sub-section on 'Concrete Classes' of this Section.

WATER/CEMENT RATIO

The ratio of free water to cement when using saturated surface dry aggregate shall be as low as possible and not to exceed 0.50 by weight for all concrete.

For concrete in pile caps in contact with the ground, the water cement ratio shall not exceed 0.45.

CEMENT TYPE AND MINIMUM CONTENT

Type-1 Cement shall be used for all classes for "Concrete".

MINIMUM FILLER CONTENT

Filler is defined as fine concrete aggregates including cement with a grain diameter less than 0.25mm. It shall not be less than (except mass concrete) 435 Kg per cubic meter Concrete for maximum 20mm size Coarse Aggregate. The same for maximum 40mm size Coarse Aggregate shall not be less than 350 kg per cubic meter of Concrete.

COARSE AGGREGATE

The maximum size of the coarse aggregate shall be either 40mm or 20mm and the grading and quality shall be as indicated in the portion of 'Coarse Aggregate' under the Sub-section on 'Construction Materials' of this Specification or as specified on the Drawings or as directed by the Engineer.

FINE AGGREGATE

The grading and quality is to be as indicated in the portion of Sub-section on 'Fine Aggregate' under the Section on 'Construction Materials' of this Specification or as specified on the Drawings or as directed by the Engineer.

WORKABILITY

The concrete shall be of suitable workability to obtain full compaction. Slumps measured, as described in ASTM C-143 shall be in accordance with the values shown unless otherwise required or approved by the Engineer.

The designed concrete mix shall be approved by the Engineer to meet the requirements for each structural component.

Prior to the commencement of concrete operations, the Contractor shall design a mix for the concrete and prepare and test concrete samples of this mix under laboratory conditions. Preliminary mixes shall be repeated and adjusted as necessary to produce a concrete mix meeting the requirements stated under the Sub-section on "Composition of Concrete" of this Specification. The details of the mix and test results shall be submitted to the Engineer for his approval.

Following the Engineer's approval of the mix design, the Contractor shall prepare a trial mix in the presence of the Engineer. The trial mix shall be batched, mixed and handled using the same methods and plant, the Contractor proposes to use. The mix shall comprise not less than half a cubic meter of concrete. The proportions of cement, aggregates and water shall be carefully determined by weight in accordance with the Contractor's approved mix design and sieve analysis shall be made for the fine and coarse aggregates.

Twelve concrete cylinder samples shall be made from the trial mix in the presence of the Engineer. The concrete cylinders shall be made, cured, stored and tested in accordance with BS 1881 or ASTM C-39. Six cylinders shall be tested at 7 days and six cylinders shall be tested at 28 days. If the strength of any of the cylinders tested at 28 days is recorded below the characteristic strength, the Contractor shall redesign the mix, make further preliminary mixes for the Engineer's approval. He shall then undertake additional trial mixes and test the resultant samples until a satisfactory mix is obtained and approved by the Engineer.

From the same mix as that from which the test specimens are made, the workability of the concrete shall be determined by the slump test in accordance with ASTM C-143. The remainder of the mix shall be cast in a mould and compacted. After 24 hours, the sides of the mould shall be struck off and the surface examined in order to satisfy the Engineer that an acceptable surface can be obtained with the mix.

When a proposed mix has been approved, no variation shall be made in the mix proportions, or in the type, size, grading zone or source of any of the constituents without the consent of the Engineer. He may require further trial mixes to be made before any such variation is approved.

Until the Engineer approves the results of trial mixes for a particular class of concrete, no concrete of the relevant class shall be placed in the works.

During production, the Engineer may require additional trial mixes before a substantial change is made in the materials or in the proportions of the materials to be used. However, it will not need to be carried out when adjustments are made to the mix proportions during production in order to minimize the variability of strength and to approach more closely the target mean strength.

Trial mixes for mass concrete are not requested provided the Contractor is able to submit test results from mixes carried out before which prove that the demanded quality of the mass concrete is according to the Specifications.

When the Contractor intends to purchase factory-made pre-cast concrete units, trial mixes may be dispensed with provided that evidence is given to satisfy the Engineer that the factory regularly produces concrete, which complies with the Specifications. The evidence shall include details of mix proportions, water-cement ratios, slump tests and strengths obtained at 28 days.

Selection of the trial mix is the ultimate responsibility of the Contractor regardless of its approval accorded by the Engineer

9.1.8 PROPORTIONING OF MIX

Proportions of materials for concrete shall be such that:

xi. Workability and consistency are achieved for proper placement into forms and around reinforcement, without segregation or excessive bleeding.

xii. Resistance to special exposures to meet the durability requirements are provided, and

xiii. Conformance with strength test requirements is ensured. The approved mix shall be proportioned by weight or, except cement by volume, if volume batching is approved by the Engineer. Allowance shall be made for the moisture content of the aggregates.

Fine and coarse aggregates and water may only be measured by volume in boxes or containers approved by the Engineer. Cement shall be added to Concrete Mixer by whole number of bags only.

9.1.9 CONCRETE IN BLINDING LAYERS

The blinding concrete/lean concrete (Mix 1:3:6) shall be mixed in proportion by volume wherever specified on the Drawings. Ordinary Portland Cement and well-graded aggregate of maximum nominal size, not exceeding 40mm, shall be used unless otherwise specified.

9.1.10 BATCHING

GENERAL

The Contractor shall provide and maintain suitable measuring equipment and devices of good order required to determine and control accurately the relative amount of various materials entering the mix.

All measurements shall be by weight/volume and shall be accurate within a tolerance of 1% for each batch. Besides, the deviation from the average amount of filler from ten samples of different batches of fresh concrete should not be more than 6%.

Satisfactory methods of handling materials shall be employed.

A batching plant shall be used for measuring materials but alternative methods proposed by the Contractor may be considered subject to the approval of the Engineer. The batching plant shall include bins, weighing hoppers and scales for the fine aggregate and for each separated size of coarse aggregate. If cement is used in bulk, a bin, hopper and scales for the cement shall be included. The container shall be watertight.

Provisions satisfactory to the Engineer shall be made for batching other components of the mix at the batching plant or at the mixer, as may be necessary. The batching plant may be either of stationary or of mobile type. It shall always be properly leveled within the accuracy required for the proper operation of the weighing mechanisms.

BINS AND HOPPERS

Bins with adequate separate compartments for fine aggregate and for each required size of coarse aggregate shall be provided in the batching plant. Each compartment shall discharge efficiently and freely in to the weighing hopper. Means of control shall be provided so that as the quantity desired in the weighing hopper is being approached, the material may be added slowly and shut off with precision. A port or other opening for removing an overload of the several materials from the hopper shall be provided.

Weighing hoppers shall be constructed so as to discharge fully.

SCALES

The scales for weighing aggregates and cement shall be of either the beam type or the dial type without spring. They shall be accurate within one-half of 1% under operating conditions throughout the range of use. Ten 25 kilogram weights shall be available for checking the accuracy. All exposed fulcrums, clevises and similar working parts of scales shall be kept clean. When beam-type scales are used, provision shall be made for indicating to the operator that the required load in the weighing hopper is being approached. The device shall indicate at least the last 100 kilograms of load and upto 25 kilograms over-load. All weighing and indicating devices shall be in full view of the operator while charging the hopper and he shall have convenient access to all controls.

Cement may be measured by weight, or in standard bags weighing 50 kilograms net each. When measured by weight, a separate satisfactory scale and hopper shall be provided together with a boot or other approved device to transfer the cement from the weighing hopper.

The amount of water shall be measured by weight separately on an individual scale or may be measured by volume.

Any solid admixture, to be added, shall be measured by weight. However, liquid or pest admixtures may be measured by volume or weight.

9.1.11 QUALITY CONTROL OF CONCRETE

GENERAL

The Contractor shall assume the full responsibility that the quality of the concrete conforms to the Specifications and this responsibility shall not be waived by the tests carried out and the test results approved by the Engineer.

The Contractor shall thus at his own discretion establish additional testing procedures as necessary.

The Contractor shall be responsible for providing samples of concrete and its constituent materials either for testing by himself or for testing at the Engineer's laboratory or laboratory designated by the Engineer. For this purpose, concrete test cylinders, which shall be made in accordance with BS 1881/ASTM C 31 shall be deemed to be 'Samples'. All sampling of constituent materials shall be carried out in accordance with the provisions of the appropriate British/American Standard and all sampling of fresh and of hardened concrete shall be carried out in accordance with the provisions of BS 1881/ASTM C 31 unless such provision is at variance with the Specification.

The tests, which the Contractor is required to undertake on behalf of the Engineer, are those to be carried out on fresh concrete at the place of final deposit, or elsewhere at Site as directed by the Engineer.

ADJUSTMENT OF WATER/CEMENT RATIO

The Contractor shall test aggregates for moisture content and so determine the water- cement ratio of the fresh concrete. Determination of water-cement ratio shall be carried out as required by the Engineer and the results and calculations shall be submitted to him.

SLUMP TESTS

Slump testing of concrete shall be carried out as required by the Engineer. The minimum is one test at the commencement of each casting, one per hour of casting and one each time a strength test specimen is taken.

The Engineer shall make available a slump cone at Site and the testing shall be carried out in accordance with ASTM C-143.

The slump of concrete to be used in the works shall not exceed the slump of the trial mix by more than 10% and shall in any case be not more than the maximum specified.

COMPRESSIVE STRENGTH

The Contractor shall, in the presence of the Engineer, sample concrete for testing from the batching and mixing plant at the time of pouring of concrete into the forms or elsewhere. Samples shall be obtained at uniform intervals throughout the production or delivery of concrete for a given placement.

The Contractor shall carry out cylinder testing of concrete strength as required by the Engineer. A minimum of three test cylinders shall be taken for each day's casting or for every 15 cubic meters of concrete cast in larger pours.

After stripping, each cylinder shall be indelibly marked with the date of taking cylinder, location in the structure and prescribed number.

The Engineer shall make available 2 sets of three test moulds (cylinder) at Site. Samples for testing shall be taken in the presence of the Engineer and shall be dated.

Tests cylinder shall be tested for 7 days and 28 days compressive strength in accordance with ASTM C-39.

A strength test result shall be the average of the strengths of two cylinders made from the same sample of concrete and tested at 28 days. Strength level of an individual class of concrete shall be considered satisfactory if both of the following requirements are met:

i. Average of three consecutive strength tests equals of exceeds the specified strength.
ii. No individual strength test (average of two cylinders) falls below the specified strength by more than 3.5 N/mm2.

However, the following may be an alternative –

The average strength of the three consecutive cylinders, tested at 28 days, shall exceed the specified strength. One out of the three cylinders tested may have a value less than the specified strength provided that it is not less than 85% of the specified strength, except that not more than one test result per element may be below the specified strength.

FAILURE TO PASS TESTS

If cylinders taken at Site during the progress of the works fail to reach the specified strength, no further pouring of concrete shall take place until the cause of the failure has been established and corrective measures have been taken to the satisfaction of the Engineer.

The Engineer may require that core samples are taken and tested in accordance with ASTM C 42 or similar standard or other tests be performed on sections of the works made from the suspect concrete. If such tests fail to demonstrate the integrity of the sections of the works, all sections made with the suspect concrete shall be removed from the Site. Costs of all such tests and removal of concrete including the cost of the concrete shall be borne by the Contractor.

TESTING HARDENED CONCRETE

Entire operation shall be carried out as per the approval of the Engineer with due precaution so that the structural integrity is no way affected. The Contractor shall remain responsible for any negligence. If approved by the Engineer, on each specific occasion, hardened concrete liable to rejection shall be tested for compressive strength in accordance with ASTM C 42 at the Contractor's expenses. Unless otherwise directed, cores shall be 150mm in diameter. At least three specimens shall be cored and tested from the locations as directed by the Engineer.

If the average compressive strength of the core specimens, so obtained, is equal to or greater than 85% of the specified 28-days cylinder, compressive strength for that section of the work (the concrete represented by the core specimen) shall be considered to be structurally satisfactory.

If the concrete is considered to be structurally satisfactory, the holes left by the removal of the test cores shall be appropriately repaired or as directed by the Engineer. Unless otherwise directed, concrete that will fail to meet the requirements of the Specifications shall be removed and replaced in an approved manner without any extra costs to the Employer.

9.1.12 CONCRETE CONSTRUCTION

GENERAL

The Contractor shall, in due time and as soon as possible, submit his proposed construction methods and work programme along with Shop Drawings to the Engineer and shall obtain his approval before commencement of any works.

The Contractor shall maintain an adequate number of trained and experienced supervisors and foremen at the Site to supervise and control the Work.

MIXING CONCRETE

All concrete shall be mixed in batch mixers. It may be mixed at the Site of construction, at a central plant, or in transit. Each mixer shall have attached to it, in a prominent place, a manufacturer's plate showing the capacity of the drum in terms of mixed concrete and the speed of rotation of the mixing drum.

MIXERS AT THE SITE OF CONSTRUCTION

Mixers at local Sites shall be approved drum-type capable of combining the aggregate, cement, and water into a thoroughly mixed and uniform mass within the specified mixing period and of discharging the mixture without segregation.

The mixer shall be equipped with a suitable charging hopper, water storage and a water-measuring device, accurate within 1%. Controls shall be so arranged that the water can be applied only while the mixer is being charged. Suitable equipment for discharging the concrete shall be provided. The

mixer shall be cleaned at suitable intervals. The pickup and throw over blades in the drum shall be replaced when they have lost 10% of their depth. The mixer shall be operated at a drum speed of not less than 15 nor more than 20 revolutions per minute at the recommended speed of the manufacturer. The batched materials shall be so charged into the drum that a portion of the water shall enter in advance of the cement and aggregates and the water shall continue to flow into the drum for a minimum time of 5 seconds after all the cement and aggregates are in the drum. Mixing time shall be measured from the time all materials, except water, are in the drum and shall, in the case of mixers having a capacity of 1 cubic meter or less, not be less than 50 seconds nor more than 70 seconds. Mixing shall be continued for at least 90 seconds after all materials are in the drum, unless a shorter time is shown to be satisfactory by the mixing uniformity tests of 'Specification for Ready Mixed Concrete' (ASTM C 94). In the case of dual drum mixers, the mixing time shall not include transfer time. The contents of an individual mixer drum shall be removed before a succeeding batch is emptied therein. Any concrete mixed less than the specified minimum time shall be discarded and disposed of by the Contractor at his own expenses.

The volume of concrete, mixed per batch, shall not exceed the mixer's nominal capacity in cubic meters as shown on the manufacturer's guaranteed capacity standard rating plate on the mixer. However, an overload upto 20% of the mixers nominal capacity may be permitted provided concrete test data for strength, segregation and uniform consistency are satisfactory, and provided no spillage of concrete takes place.

Re-tempering concrete by adding water or by other means shall not be permitted. Concrete, which is not of the required consistency at the time of placement, shall not be used.

CENTRAL PLANT MIXERS

These mixers shall be of approved drum type capable of combining the aggregate, cement and water into a thoroughly mixed and uniform mass within the specified mixing period and of discharging the mixture without segregation. Central plant mixers shall be equipped with an acceptable timing device that will not permit the batch to be discharged until the specified mixing time has elapsed. The water system for a central mixer shall be either a calibrated measuring tank or a meter and shall not necessarily be an integral part of the mixer.

The mixer shall be cleaned at suitable intervals. It shall be examined daily for changes in interior condition. The pick-up and throw-over blades in the drum shall be replaced when they have lost 10% of their depth.

Central plant mixers, which have a capacity of 2-5 cubic meters and greater than 5 cubic meters, may permit a minimum mixing time of 90 seconds and 120 seconds respectively provided a mixing analysis and tests of the job materials indicate such produced concrete is equivalent to strength and uniformity to that attained as stated in the preceding paragraphs

HAND MIXING

The Engineer shall normally not allow any hand mixing in the preparation of concrete. However, under some special circumstances, exigencies and for small works, it may be compelling to allow

hand mixing while preparing the concrete. In the case hand mixing is allowed, the procedures stated below shall be followed in a chronological order: i. Water-tight platform should be constructed with cement concrete or bricks. The size of the platform shall be such that it will be possible to accommodate the requisite quantity of mixture in a single batch. The materials of a single batch should be calculated out carefully.

ii. The requisite quantity of sand, being determined at a certain proportion, should be measured in a wooden box of specified size and to be spread on the platform with uniform thickness and the top is to be leveled. The requisite quantity of cement should also be measured and spread with uniform thickness over the stack of sand.

iii. Sand and cement as stacked above shall have to be mixed up by reversing with spade starting from one end and progressing towards the other. This procedure to be carried on carefully, thoroughly and repeatedly in such a manner that the mixture ultimately turns into a uniform colour and density. The mixture should then be stacked in a heap on a portion of the platform.

iv. The requisite quantity of coarse aggregate should then be stacked on the left out spaces of the platform and the top surface be leveled. The previously mixed sand and cement mixture shall than be spread with uniform thickness over the coarse aggregate. The height of these two layers in combination should better not to exceed 250mm. They are then to be thoroughly mixed with spade for several times. In each time, the mixing should proceed from one end. The mixing shall be continued until the mixture takes a uniform colour and density. The mixture will than be stacked with uniform height and leveled (the height of the stack may normally be maintained at 250mm).

v. The top surface of the stack will than be shaped concave and the requisite amount of water to be poured in. It is then be thoroughly mixed with spade with caution and as quickly as possible. The mixing shall be continued till the mixture takes a uniform colour and density. The mixture shall invariably be conveyed, placed, compacted and to be given the final shape within 45 minutes on mixing.

CONVEYING CONCRETE

Concrete shall be conveyed from the mixer/batching plant to the place of final deposit as rapidly as possible by methods that will prevent segregation or loss of materials. Conveying equipment shall be capable of providing a supply of concrete to the place of deposit without segregation of ingredients and without interruptions sufficient to permit loss of plasticity between successive increments. Remixing of concrete shall not be allowed. Concrete, which does not reach its final position in the forms within the stipulated time, shall not be used.

Mixed concrete shall be transported from the central mixing plant to the work Site in agitator trucks or upon written permission by the Engineer in non-agitator trucks. Delivery of concrete shall be so regulated that placing is at a continuous rate unless delayed by the placing operations. The intervals between delivery of batches shall not be so great as to allow the concrete in place to harden partially, and in no case such an interval shall exceed 30 minutes

AGITATOR TRUCKS

Unless otherwise permitted in writing by the Engineer, agitator trucks may be used for transportation of central plant mixed concrete. Agitator trucks shall have watertight revolving drums suitably mounted and shall be capable of transporting and discharging the concrete without segregation. The agitating speed of the drum shall not be less than 2 or more than 6 revolutions per minute. The volume of the mixed concrete permitted in the drum shall not exceed the manufacturer's rating nor exceed 80% the gross volume of the drum.

Upon approval by the Engineer, open-top revolving-blade truck mixers may be used in lieu of agitating trucks for transportation of central plant mixed concrete.

The interval between introduction of water into the mixer drum and final discharge of the concrete from the agitator shall not exceed 45 minutes. During this interval the mix shall be agitated continuously.

NON-AGITATOR TRUCKS

Bodies of non-agitating equipment shall be smooth, watertight metal containers equipped with gates that will permit control of the discharge of the concrete. Covers shall be provided when needed for protection against weather.

The non-agitating equipment shall permit delivery of the concrete to the work Site in a thoroughly mixed and uniform mass with a satisfactory degree of discharge.

Uniformity shall be satisfactory, if samples from the one-quarter and three-quarter points of the load do not differ by more than 30mm in slump. Discharge of concrete shall be completed within 30 minutes after the introduction of the mixing water to the cement and aggregate.

TRUCK OR TRANSIT MIXERS

These shall be equipped with electrically actuated counters by which the number of revolutions of the drum or blades may readily be verified and the counters shall be actuated at the commencement of mixing operations at designated mixing speeds. The mixer when loaded shall not be filled to more than 60% of the drum gross volume. The mixer shall be capable of combining the ingredients of the concrete in to a thoroughly mixed and uniform mass and of discharging the concrete with a satisfactory degree of uniformity.

Except when intended for use exclusively as agitators, truck mixers shall be provided with a water-measuring device to measure accurately the quantity of water for each batch. The delivered amount of water shall be within plus or minus 1% of the indicated amount.

Truck mixers may be used for complete mixing at the batch plant and as truck agitators for delivery of concrete to job Site or they may be used for complete mixing of the concrete at the job Site. They shall either be a closed watertight revolving drum or an open top revolving blade or paddle type.

The amount of mixing shall be designated in number of revolutions of the mixer drum. When a truck mixer is used for complete mixing, each batch of concrete shall be mixed for not less than 70 nor more than 100 revolutions of the drum or blades at the rate of rotation designated by the manufacturer of the equipment as the "mixing speed". Such designation shall appear on a metal plate attached to the mixer. If the batch is at least 0.5 cubic meter less than guaranteed capacity, the number of revolutions at mixing speed may be reduced to not less than 50. Mixing in excess of 100

revolutions shall be at the agitating speed. All materials, including the mixing water, shall be in the mixer drum before actuating the revolution counter, which will indicate the number of revolutions of the drum or blades. When wash water (flush water) is used as a portion of the mixing water for the succeeding batch, it shall be accurately measured and taken into account in determining the amount of additional mixing water required.

When wash water is carried on the truck mixer, it shall be carried in a compartment separate from the one used for carrying or measuring the mixing water. The Engineer will specify the amount of wash or flush water and may specify a "dry" drum, if wash water is used without measurement or without supervision.

When a truck is used for complete mixing at the batch plant, mixing operations shall begin within 30 minutes after the cement has been added to the aggregate. After mixing, the truck mixer shall be used as an agitator, when transporting concrete, at the speed designated as agitating speed by the manufacturer of the equipment. Concrete discharge shall be completed within 45 minutes after the addition of cement to the aggregates. Each batch of concrete, delivered at the job Site, shall be accompanied by a time slip issued at the batching plant, bearing the time of departure therefrom. When the truck mixer is used for the complete mixing of the concrete at the job Site, the mixing operation shall begin within 30 minutes after cement has been added to the aggregates.

The rate of discharge of the plastic concrete from the mixer drum shall be controlled by the speed of rotation of the drum in the discharge direction with the discharge gate fully opened.

HANDLING AND PLACING OF CONCRETE

Concrete placing shall not be commenced without the written approval of the Engineer or his representative. This approval shall be in the form of a standard checklist approved by the Engineer prior to the commencement of the Work. The checklist shall be filled in and approved by the Engineer or his representative during his inspection and acceptance of materials, plant and equipment, concrete pouring arrangements, the positioning, fixing and condition of reinforcement and any other items to be embedded including the cleanliness, alignment and suitability of the containing surfaces or formwork.

The temperature of concrete at the time of placing shall not exceed 35°C.

In preparation for the placing of concrete all sawdust, chips and other construction debris and extraneous matter shall be removed from the interior of forms. Struts, stays and braces, serving temporarily to hold the forms in correct shape and alignment, pending the placing of concrete at their locations, shall be removed when the concrete placing has reached an elevation rendering their service unnecessary. These temporary members shall entirely be removed from the forms and not be buried in the concrete. The concrete shall be placed in the position and sequences indicated on the Drawings, and Specification or as directed by the Engineer. The concrete shall be placed in clean, oiled formwork and compacted before initial set has occurred. In any event concrete shall not be placed later than 30 minutes from the time of mixing.

Concrete shall be placed in horizontal layers and each layer shall not be more than 600mm thick except as hereinafter provided. When less than a complete layer is placed in one operation, it shall be terminated in a vertical bulkhead. Each layer shall be placed and compacted before the preceding batch has taken initial set to prevent injury to the green concrete and avoid surfaces of separation

between the batches. Each layer shall be compacted so as to avoid the formation of a construction joint with a preceding layer that has not taken the initial set.

The concrete shall be deposited as far as possible in its final position without re-handling or segregation and in such a manner so as to avoid displacement of the reinforcement and other embedded items or formwork.

Open troughs and chutes shall be of metal or metal line. The use of long troughs, chutes and pipes for conveying concrete from the mixer to the forms shall be permitted only on written authorization of the Engineer. Where chutes are used to convey the concrete, their slopes shall not be such as to cause segregation. Where long steep slopes are required, the chutes shall be equipped with baffles or be in short lengths that reverse the direction of movement. In case an inferior quality of concrete is produced by the use of such conveyors, the Engineer may order discontinuation of their use and the installation of a satisfactory method of placing.

Pneumatic placing of concrete shall be permitted only if authorized by the Engineer. The equipment shall be so arranged that a vibration does not damage freshly placed concrete.

Where concrete is conveyed and placed by pneumatic means, the equipment shall be suitable in kind and adequate in capacity for the work. The machine shall be located as close as practicable to the place of deposit. The position of the discharge end of the line shall not be more than 3m from the point of deposit. The discharge lines shall be horizontal or inclined upwards from the machine. At the conclusion of placement, the entire equipment shall be thoroughly cleaned.

Placement of concrete by pumping shall be permitted only if authorized by the Engineer. The equipment shall be so arranged that vibrations do not damage freshly placed concrete. Where concrete is conveyed and placed by mechanically applied pressure, the equipment shall be suitable in kind and adequate in capacity for the work. The operation of the pump shall be such that a continuous stream of concrete without air pockets is produced. When pumping is completed, the concrete remaining in the pipeline, if it is to be used, shall be ejected in such a manner that there is no contamination of the concrete or separation of the ingredients. After this operation, the entire equipment shall be thoroughly cleaned.

For simple spans, concrete shall preferably be deposited by beginning at the centre of the span and working from the centre towards the ends. Concrete in girders shall be deposited uniformly for the full length of the girder and brought up evenly in horizontal layers. For continuous spans, the concrete placing sequence shall be as shown on the plans or agreed by the Engineer.

Concrete in slab and girder haunches less than 1m in height shall be placed at the same time as that in the girder stem.

Concrete in slab spans shall be placed in one continuous operation for each span unless otherwise provided.

Concrete in T-beam or deck girder may be placed in one continuous operation, if permitted by the Engineer.

Concrete in columns and pier shafts shall be placed in one continuous operation unless otherwise directed.

Unless otherwise permitted by the Engineer, no concrete shall be placed in the superstructure until the column forms have been stripped off sufficiently to determine the character of the concrete in

the columns. The load of the superstructure shall not be applied to the supporting structures until they have been in place at least 14 days unless otherwise permitted by the Engineer.

When the placing of concrete is temporarily discontinued, the concrete, after becoming firm enough to retain its form, shall be cleaned of Latinate and other objectionable materials to a sufficient depth to expose sound concrete. To avoid visible joints as far as possible upon exposed faces, the top surface of the concrete adjacent to the forms shall be smoothen with a trowel. Where a "feather edge" might be produced at a construction joint, an inset form shall be used to produce a blocked out portion in the preceding layer which shall produce an edge thickness of not less than 150mm in the succeeding layer. Work shall not be discontinued within 450mm of the top of any face unless provision has been made for a coping less than 450mm thick, in which case, if permitted by the Engineer, a construction joint may be made at the under side of the coping.

Immediately following the discontinuance of placing concrete, all accumulations of mortar splashed upon the reinforcement steel and the surfaces of forms shall be removed. Dried mortar chips and dust shall not be puddled into the unset concrete. If the accumulations are not removed prior to the concrete becoming set, care shall be exercised not to injure or break the concrete-steel bond at and near the surface of the concrete while cleaning the reinforcement steels.

Where concrete is required to be placed against undisturbed ground, the entire space between the finished concrete surface and the ground, including any over-break, is to be completely filled with concrete of the specified class. The concrete shall be well rammed and compacted to ensure that all cavities are filled and the concrete is everywhere in contact with the ground. Where permitted by the Engineer, any extensive patches of over-break may first be filled with concrete belonging to the appropriate Class as directed by the Engineer.

Where concrete is required to be placed against a metal surface to which it is required to adhere, care shall be taken to work the concrete well into the re-entrant angles and to ensure contact by hammering the metal part on its free side provided that this is done without damaging the metal or its protective coating, if any.

Concrete shall not be dropped through a height greater than 1200mm except with the approval of the Engineer who may order the use of bankers and the turning over of the deposited concrete by hand before being placed.

When placing operations would involve dropping the concrete more than 1200mm, it shall be deposited through sheet metal or other approved pipes. As far as practicable, the pipes shall be kept full of concrete during placing and their lower ends shall be kept buried in the newly placed concrete. After initial set of the concrete, the forms shall not be jarred and no strain shall be placed on the ends of reinforcement bars, which are projected.

All chutes, troughs and pipes shall be kept clean and free from coatings of harden concrete by thoroughly flushing with water after each run. Water used for flushing shall be discharged clean.

The laying of concrete shall be carried out in such a way that the exposed faces of concrete shall be plain, smooth, sound and solid, free from honeycomb and excrescencies. After compaction the exposed concrete surface shall be struck off smooth with hand held steel floats. No plastering of imperfect concrete faces will be allowed. Any concrete that is defective in any way shall, if so ordered by the Engineer, be cut out and replaced to such depth or be made good in such manner as the Engineer may direct.

Construction joints shall be formed in the work where indicated on the Drawings or as previously approved by the Engineer. Where necessary, the Contractor shall allow for working beyond ordinary working hours to allow each section of concrete to be completed in a continuous pour with the placing of concrete carried upto each construction joint.

DEPOSITING CONCRETE UNDER WATER

Concrete shall not be deposited in water except with the approval of the Engineer and under his immediate supervision and in this case the method of placing shall be as defined in this portion.

Concrete deposited in water shall be with 10 percent excess cement. It shall be carefully placed in a compact mass in its final position by means of Tremie, a bottom opening bucket or other approved methods and shall not be disturbed after being deposited. Special cares must be exercised to maintain still water at the point of deposit. Concrete shall not be placed in running water. The method of depositing concrete shall be so regulated as to produce approximately horizontal surfaces. The forms under water shall be watertight.

The discharge end of the Tremie shall be closed at the start of work so as to prevent water entering the tube and shall be entirely sealed at all times. The Tremie tube shall be kept full to the bottom of the hopper. When a batch is dumped into the hopper, the flow of concrete shall be induced by slightly raising the discharge end, always keeping it in the deposited concrete. The flow shall be continuous until the work is completed. Concrete slump shall be in between 100mm and 150mm.

Depositing of concrete by the opening bucket method shall conform to the following specifications. The top of the bucket shall be open. The bottom doors shall open freely downward and outward when tripped. The bucket shall be completely filled and slowly lowered to avoid backwash. It shall not be dumped until it rests on the surface upon which the concrete is to be deposited. When discharged, it shall be withdrawn slowly until it goes well above the concrete.

COMPACTION OF CONCRETE

Concrete, during and immediately after depositing, shall be thoroughly compacted. The compaction shall be done by mechanical vibration subject to the following provisions:

i. The vibration shall be internal unless special authorizations of other methods are given by the Engineer or as provided herein.

ii. Mechanical vibrators of the capacity as approved by the Engineer shall be used in conjunction with or without hand rammers, pokers or any other means as directed by the Engineer.

iii. Vibrators shall be of a type and design as approved by the Engineer. They shall be capable of transmitting vibration to the concrete at frequencies of not less than 4,500 impulses per minute.

iv. The intensity of vibration shall be such as to visibly affect a mass of concrete of 20mm slump over a radius of at least 450mm.

v. Vibrators must be operated by skilled workmen engaged/appointed by the Contractor mainly for this job.

vi. Surface vibrators of the type of Pan-vibrators, or vibrating screens shall be used for compacting castings of shallow depth as directed by the Engineer.

vi. The Contractor shall provide a sufficient number of vibrators to properly compact each batch immediately after it is placed in the forms. Spare vibrators shall be readily on hand in case of breakdown.

vii. viii. Vibrators shall be manipulated so as to thoroughly work the concrete around the reinforcement and embedded fixtures, and into the corners and angles of the forms.

viii. ix. Vibration shall be applied at the point of deposit and in the area of freshly deposited concrete. The vibrators shall be inserted and withdrawn from the concrete slowly. The vibration shall be of sufficient duration and intensity to thoroughly compact the concrete, but shall not be continued so as to cause segregation. Vibration shall not be continued at any one point, to the extent that localized areas of grout are formed.

ix. x. While using immersion vibrators in walls, these should be lowered to the bottom of the wall before depositing of concrete is started and pulled up as it proceeds. When using vibrators, concrete can be placed from bottom to top of wall in one process, provided it is laid in regular layers. Cares should be taken to ensure that vibrators are not trapped under a great depth of concrete.

x. xi. Application of vibrators shall be at points uniformly spaced and not further apart than twice the radius over which the vibration is visibly effective.

xi. xii. Vibration shall not be applied directly or through the reinforcement to sections or layers of concrete, which have hardened to the degree that the concrete ceases to be plastic under vibration. It shall not be used to make concrete flow in the forms over distances so great as to cause segregation, and vibrators shall not be used to transport concrete in the forms.

xii. xiii. Vibration shall be supplemented by such spading as is necessary to ensure smooth surface and dense concrete along form surfaces and in corners and locations impossible to reach with the vibrators.

xiii. xiv. In columns, deep beams and walls mild striking by mallets at the outer faces of the form works should also be done simultaneously during use of vibrator for compaction.

The provisions of this Sub-section shall also apply to pre-cast piling, concrete cribbing and other precast members except that the manufacturer's methods of vibration may be used, if approved by the Engineer.

9.1.13 PROTECTION OF CONCRETE FROM ADVERSE CONDITIONS

Concrete shall be protected from damage from the effects of sunshine, dry wind, rain, running water or mechanical damage for a continuous period, until the concrete has reached at least three quarters of its 28-days strength, but for not less than 10-days. Temperature of the concrete mixture shall require to be maintained between 10°C and 32°C unless otherwise provided herein. The Contractor shall submit his proposals to achieve this protection for the Engineer's approval.

Damaged concrete shall be removed and replaced generally. However, it may be repaired to an acceptable condition if found appropriate by the Engineer.

PROTECTION FROM RAIN

During rainy weather, proper protection shall be given to ingredients, production methods, handling and placing of concrete. If required in the opinion of the Engineer, the concrete depositing operation shall be postponed and newly placed concrete shall be protected from rain after forming proper construction joint for future continuation.

PROTECTION FROM HOT WEATHER

During hot weather, proper attention shall be given to ingredients, production methods, handling, placing, protection, and curing to prevent excessive concrete temperatures or water evaporation that could impair required strength or serviceability of the member or structure.

Under a temperature above 32oC surfaces of forms, reinforcing steel, steel beam flanges etc. that remain in contact with the mix shall be cooled down below this temperature by means of water spray or by any other appropriate methods.

PROTECTION FROM COLD WEATHER

Under a cold weather condition, temperature of the concrete shall be maintained not below 7°C during the curing period for the first six days on placement of concrete unless pozzolan cement or fly ash cement is used. Periods to be followed in the latter case have been shown in the table given below:

% of cement replaced by weight with pozzolans	Required period of controlled temperature
10%	8 days
11-15%	9 days
16-20%	10 days

However, this requirement may be waived in the case the compressive strength of 65% of the specified 28-days design strength is achieved in 6-days.

If external heating is used in maintaining the requisite temperature, heat shall be applied and withdrawn gradually and uniformly so that the concrete surface is not heated more than 32°C.

Temperature of concrete at the time of placement in sections less than 300mm in thickness shall not be less than 16°C when the air temperature is below 2°C.

SPECIAL REQUIREMENTS FOR ROOF SLABS

Prior to the application or curing, concrete being placed and finished for roof slabs shall be protected from damage due to rapid evaporation when the weather is low humid, windy or having high temperature. Such protection shall be adequate to prevent premature crusting of the surface or an increase in dry cracking. In providing such protection the humidity of the surrounding air shall be raised with fog sprayers operated upwind of the deck.

CONCRETE EXPOSED TO SALT WATER

Unless otherwise specifically provided, concrete for structures exposed to salt water shall be mixed for a period of not less than 2 minutes and water content of the mixture shall be carefully controlled and regulated so as to produce concrete of maximum impermeability. The concrete shall be thoroughly consolidated as necessary to produce maximum density and a complete lack of rock pockets. Unless otherwise shown on the Drawings, the clear distance from the face of the concrete to the reinforcing steel shall not be less than 100mm. No construction joints shall be formed between levels of extreme low water and extreme high water or the upper limit of wave action as determined by the Engineer. Between these levels the forms shall not be removed, or other means provided to prevent salt water from coming in direct contact with the concrete for a period of not less than 30

days after placement. Except for the repair of any rock pockets and the plugging of form tie holes, the original surface, as the concrete comes from the forms, shall be left undisturbed. Special handling shall be provided for pre-cast members to avoid even slight deformation cracks.

9.1.14 PERFORATIONS AND EMBEDDING OF SPECIAL DEVICES

The Contractor is responsible for determining in advance of making any concrete pours, all requirements for perforation of concrete sections or embedding therein of special devices of other trades, such as conduits, pipes, weep holes, drainage pipes, fastenings, etc. Any concrete, poured without prior provision having been made, shall be subject to correction at the Contractor's own expenses.

Devices to be embedded in the concrete shall be shown on the Drawings or directed by the Engineer.

Conduits, pipes and sleeves of any material not harmful to concrete and within the limitations specified herein shall be permitted to be embedded in concrete with the approval of the Engineer, provided they are not considered to replace structurally the displaced concrete.

Conduits and pipes of aluminium shall not be embedded in structural concrete unless effectively coated or covered to prevent aluminium concrete reaction or electrolytic action between aluminium and steel.

Conduits, pipes, and sleeves passing through a slab, wall, or beam shall not impair significantly the strength of the construction. Conduits and pipes, with their fittings, embedded within a column, shall not displace more than 4% of the area of cross-section on which strength is calculated or which is required for fire protection.

Except when the Engineer approves Drawings for conduits and pipes, embedded conduits and pipes within a slab, wall or beam (other than those merely passing through) shall satisfy the following: xv. They shall not be larger in outside dimension than 1/3rd the overall thickness of slab, wall, or beam in which they are embedded.

xvi. They shall not be spaced closer than 3 diameters or widths on centers. xvii. They shall not impair significantly the strength of the construction. Conduits, pipes and sleeves shall be permitted provided that they are not exposed to rusting or other deterioration, have nominal inside diameter not over 50mm and are spaced not less than 3 diameters on centers. Pipes and fittings shall be designed to resist effects of the material, pressure, and temperature to which they will be subjected. No liquid, gas, or vapor excepting water, not exceeding 30°C nor 0.3 N/mm2 pressure, shall be placed in the pipes until the concrete has attained its design strength.

Piping in solid slabs, unless it is for radiant heating, shall be placed between the top and bottom reinforcements.

Concrete cover for pipes, conduits, and fittings shall be not less than 40mm for concrete exposed to earth or weather nor 20mm for concrete not exposed to weather or in contact with the ground.

Reinforcement with an area not less than 0.002 times the area of concrete section shall be provided normal to piping.

Piping and conduit shall be so fabricated and installed that cutting, bending, or displacement of reinforcement will not be required.

9.1.15 CURING OF CONCRETE GENERAL

In order to prevent loss of water, all newly placed concrete shall be cured by use of one or more of the methods specified herein. The Engineer shall select the method that should be followed for curing a concrete of particular type of work or member. Curing shall commence immediately after the free water has left the surface and finishing operations are complete. In the case the concrete surface begins to dry before the selected cure method is applied, the surface of the concrete shall be kept moist by a fog spray application so as to prevent any damages to the surfaces.

Curing by other than steam or radiant heat methods shall continue uninterrupted for at least 7 days except that when pozzolans in excess of 10 percent, by weight, of the Portland cement are used in the mix. When such pozzolans are used, the curing period shall be at least 10 days. For other than top slabs of structures, the above curing periods may be reduced and curing may be terminated when test cylinders, cured under the same conditions as the structure, indicate that concrete strength of at least 70 percent of that specified has been reached.

High early strength concrete shall be maintained above 10°C and in a moist condition for at least the first three days, except when cured in accordance with Accelerated Curing Method.

During periods of hot weather, water shall be applied to the concrete surfaces being cured by the liquid membrane method or by the forms-in-place method, if considered necessary by the Engineer, The process shall continue for a period that the Engineer determines a cooling effect is no longer required.

MATERIALS WATER

Water used in curing of concrete shall be subject to approval and shall be reasonably clean and free of oil, salt, acid, alkali, sugar, vegetable, or other injurious substances. Water shall be tested in accordance with and shall meet the suggested requirements of AASHTO T 26. Where the source of water is relatively shallow, the intake shall be so enclosed as to exclude silt, mud, grass, or other foreign materials.

LIQUID MEMBRANES

Liquid membrane forming compounds for curing concrete shall conform to the requirements of ASTM C 309.

WATERPROOF SHEET MATERIALS

Waterproof paper, polyethylene film, and white burlap polyethylene sheet shall conform to the requirements of ASTM C 171.

METHODS

FORMS-IN-PLACE METHOD

Formed surfaces of concrete may be cured by retaining the forms in place for the required time.

WATER METHOD

Concrete surface shall be kept continuously wet by ponding, spraying or covering with materials that are kept continuously and thoroughly wet. Such materials may consist of cotton mats, multiple layers of burlap or other approved materials, which do not discolour or otherwise damage the concrete.

LIQUID MEMBRANE CURING COMPOUND METHOD

The liquid membrane method shall not be used on surfaces where a rubbed finish is required or on surfaces of construction joints unless it is removed by sand blasting prior to placement of concrete against the joint. Type 2 white pigmented liquid membranes may be used only on the surfaces that will not be exposed to view in the completed works or on surfaces where their use has been approved by the Engineer.

When membrane curing is used, the exposed concrete shall be thoroughly sealed immediately after the free water has left the surface. Formed surfaces shall be sealed immediately after the forms are removed and necessary finishing has been done. The solution shall be applied by power-operated atomizing spray equipment in one or two separate applications. Hand-operated sprayers may be used for coating small areas. Membrane solutions containing pigments shall be thoroughly mixed prior to use and agitated during application. If the solution is applied in two increments, the second

application shall follow the first application within 30 minutes. Satisfactory equipment shall be provided, together with means to properly control and assure the direct application of the curing solution on the concrete surface so as to result in a uniform coverage at the rate of 4.5 liters for each 14 square meter of area.

If the film is damaged by inclement weather condition or in any other manner during the curing period and before the film has dried sufficiently, a new coat of the solution shall be applied to the affected portions equal in curing value to that specified above.

WATERPROOF COVER METHOD

This method shall consist of covering the surface with a waterproof sheet material so as to prevent moisture loss from the concrete. This method may be used only when the covering can be secured adequately to prevent moisture loss.

The concrete shall be wet at the time the cover is installed. The sheets shall be of the widest practicable width and adjacent sheets shall overlap a minimum of 150mm and shall be tightly sealed with pressure sensitive tape, mastic, glue, or other approved methods to form a complete waterproof cover of the entire concrete surface. The paper shall be secured so that wind will not displace it. Should any portion of the sheets be broken or damaged before expiration of the curing period, the broken or damaged portions shall be immediately repaired. Sections that have lost their waterproofing qualities shall not be used.

ACCELERATED CURING

Curing by high-pressure steam, steam at atmospheric pressure, heat and moisture or other accepted processes, shall be permitted to accelerate strength gaining and reduce time of curing.

Accelerated curing shall provide a compressive strength of the concrete at the load stage considered, at least equal to the required design strength at that load stage.

Curing process shall be such, as to produce concrete with a durability at least equivalent to that obtained for concrete cured by the above methods.

The use of accelerated curing method for concrete containing other types of cement or any admixture shall be subject to the Engineer's acceptance.

FIELD CURED SPECIMENS

The Engineer may require strength tests of cylinders cured under field conditions to check adequacy of curing and protection of concrete in the structure.

Field cured cylinders shall be cured under field conditions in accordance with "Practice for Making and Curing Concrete Test Specimens in the Field" (ASTM C 31).

Field cured test cylinders shall be moulded at the same time and from the same samples as laboratory cured test cylinders.

Procedures for protecting and curing concrete shall be improved when the strength of field cured cylinders at the test age designated for determination of f'c is less than 85% of that of companion laboratory cured cylinders. The 85% limitation shall not apply, if field cured strength exceeds f'c by more than 3.5 N/mm2.

9.1.16 FINISH AND FINISHING

Surface irregularities shall be classified as "abrupt" or "gradual". Offsets caused by displaced or misplaced form sheathing or lining of form sections, or loose knots in forms or otherwise defective

formwork, will be considered as "abrupt" irregularities. All other irregularities will be considered as gradual irregularities.

Where a surface is partly below and partly above the final ground level, the finish for the exposed surface shall extend for 0.15m below the ground level.

The formed surfaces, which will be permanently buried under earth, will require no treatment for abrupt or gradual irregularities. However, repair of defective concrete and filling of holes left by the removal of fasteners from the ends of tie rods shall be undertaken.

All abrupt and gradual irregularities on all exposed surfaces shall be removed by sack rubbing or sand blasting or grinding or by all these methods or any other methods approved by the Engineer, which is not harmful to the concrete. The permissible surface irregularities shall not exceed 6mm for abrupt irregularities and 13mm for gradual irregularities. The permissible irregularities may be reduced at places of the surface where, in the opinion of the Engineer, the formed finish does not provide the desired effect and no extra payment shall be permissible for such work.

Holes, honeycombs, or other defects left by forms shall be promptly repaired in accordance with the relevant Sub-section of this Specification.

All surfaces such as blinding concrete, opening for second stage concrete etc. on which concrete is to be placed subsequently, shall not be finished for abrupt or gradual irregularities.

Generally, concrete surface shall remain as cast and no plastering work will be performed on it. The formwork shall be lined with a material approved by the Engineer to provide a smooth finish of uniform texture and appearance. This material shall leave no stain on the concrete and shall be so joined and fixed to its backing that it imparts no blemishes. It shall be of the same type and obtained from only one source throughout any one structure. The Contractor shall repair any imperfections in the resulting finish as required by the Engineer for which no extra payment shall be made to him. Internal ties and embedded metal parts will be allowed only with the Engineer's specific approval.

CONCRETE SURFACE FINISHING

Skilled workmen shall perform finishing of concrete surfaces to the satisfaction of the Engineer. Exposed flat concrete surfaces shall be screed to produce an even and uniform surface and then they shall be given a trowel finish unless otherwise specified on the Drawings. All exposed and unprotected edges shall be given 20mm x 20mm chamfers.

The Concrete surface finish on upward facing, horizontal or sloping faces shall be, except for blinding concrete or otherwise stated on the Drawings, a "fair" surface. A 'fair' surface shall be obtained by screeding and trowelling with a wood float.

Screeding shall be carried out following compaction of the concrete by the slicing and tamping action of a screed board running on the top edges of the formwork or screeding guides to give a dense concrete skin true to line and level.

Wood float trowelling shall be carried out after the concrete has stiffened and the film moisture has disappeared. Working should be kept to the minimum compatible with a good finish and the surface shall be true to the required profile to fine tolerance. Whenever necessary, the Contractor shall

provide and erect overhead covers to prevent the finished surfaces from being marred by rain drops or dripping water.

The surface of blinding concrete shall be obtained by screeding as described above. Where a "fine" surface is indicated on the Drawings, this shall be obtained in a similar manner to "fair" surface except that a steel float shall be used in lieu of the wood float.

Formed surface for painting exposed to view shall be smooth and free from projections and shall be rubbed smooth immediately after the forms are removed. Formed surfaces shall be classified as follows:

xviii. Unexposed concrete surfaces upon or against which backfill or concrete is to be placed, require no treatment except the removal and repair of defective concrete.

xix. Exposed surfaces shall have a very smooth, sound surface by control of formwork, concrete placement and repair of abrupt surface irregularities by grinding or rubbing of high spots and filling of voids.

ORDINARY FINISH

An ordinary finish is defined as the finish left on a surface after the removal of the forms when all holes left by form ties have been filled and all irregular projections and any other minor surface defects have been mended. The surface shall be true and even, free from depression fins or projections.

The concrete shall be struck off with a straight edge and floated to true grade. Under no circumstance, the use of mortar topping for concrete surfaces shall be permitted.

GROUT CLEANING

Grout cleaning may be called for on the Drawings or required by the Engineer because of unsatisfactory appearance. The operation requires that the surface is wetted and uniformly covered with a grout consisting of 1 part cement to 1.5 parts fine sand. White cement shall be used for all or part of the cement in the grout to give the colour required to match the concrete. The grout shall be uniformly applied with brushes or a spray gun and all air bubbles and holes shall be completely filled. Immediately after the application of the grout, the surface shall be vigorously scoured with a cork or other suitable float.

While the grout is still plastic, the surface shall be finished with a sponge rubber or other suitable float removing all excess grout. This finishing shall be done at the time when grout will not be pulled from the holes or depressions. After being allowed to be thoroughly dry, the surface shall be vigorously rubbed with a dry burlap to completely remove any dried grout. There shall be no visible film of grout remaining on the surface after this rubbing and the entire cleaning operation of any area must be completed on the day it is started. If any dark spot or steak remains after this operation, they shall be removed with a fine- grained silicon carbide stone, but the rubbing shall not be as much to change the texture of the surface. Unless it is required by the Drawings or directed by the Engineer, grout cleaning should be delayed until the final cleanup of the Work.

RUBBED FINISH

On removal of forms, the rubbing of concrete shall be started as soon as its condition permits. Immediately before starting this work, the concrete shall be kept thoroughly saturated with water for a minimum period of 3 hours. Sufficient time shall elapse before wetting down to allow the mortar used in patching to have thoroughly set. A medium coarse carborundum stone shall be used for

rubbing a small amount of mortar on the face. The mortar used shall be composed of cement and fine aggregate mixed in the same proportions as that used in the concrete being finished. Rubbing shall be continued until all form marks, projections and irregularities have been removed, all voids filled, and a uniform surface has been obtained. The paste produced by this rubbing shall be left in place at this time. The final finish shall be obtained by rubbing with a fine carborundum stone and water until the entire surface is of a smooth texture and uniform colour.

After the final rubbing has been completed and the surface has dried up, burlap shall be used to remove loose powder. The final surface shall be free from unsound patches, paste, powder and objectionable marks.

Any surface that has been given a rubbed finish shall be protected from subsequent construction operations. Any surface not protected, shall be cleaned and again rubbed, if necessary to secure a uniform and satisfactory surface at the own expenses of the Contractor.

On completion of initial rubbing, curing shall be continued.

TOOLED FINISHS

Tooled finishing shall be carried out by treating the surface with an approved heavy-duty power hammer fitted with a multi-point tool, which shall be operated over the surface to remove 5mm to 6mm of concrete and expose maximum areas of coarse aggregate.

Aggregate left embedded shall not be fractured or loose. 25mm wide bands at all corners and arises shall be left as cast. The finished surfaces shall have even and of uniform appearance and shall be washed with water upon completion.

BLASTED FINISH

Sandblasted finishing will be carried out on a thoroughly cured concrete surface with hard, sharp sand to produce an even fine-grained surface in which the mortar has been cut away, leaving the aggregate exposed.

WIRE BRUSHED OR SCRUBBED FINISH

Wire brushed or scrubbed finish will be performed as soon as the forms are removed and while the concrete is yet comparatively green. The surface shall be thoroughly and evenly scrubbed with stiff wire or fiber brushes, using a solution of muriatic acid. The proportion of the solution shall constitute of one part acid to four parts water. This shall be continued until the cement film or surface is completely removed and the aggregate particles are exposed, leaving an even-pebbled texture presenting an appearance grading from that of fine granite to coarse conglomerate, depending upon the size and grading of aggregate used. When the scrubbing has progressed sufficiently to produce the texture desired, the entire surface shall be thoroughly washed with water to which a small amount of Ammonia has been added in order to remove all traces of acid.

INSPECTION AND MAKING GOOD

Concrete surface shall be inspected for defects and for conformity with the Specifications and where appropriate, for comparison with approved sample finishes. Subject to the strength and durability of the concrete being unimpaired, the making good of surface defects may be permitted but the standard of acceptance shall be appropriate to the type and quality of the finish specified to ensure satisfactory performance and durability. On permanently exposed surfaces, great care is essential in selecting the materials and the mix proportions to ensure that the final colour of the faced area blends with the parent concrete in the finished structure.

Voids can be filled with fine mortar, preferably incorporating Styrene Butadiene Rubber (SBR) or Polyvinyl Acetate (PVA), while the concrete is still green or when it has hardened. Fine cracks can be filled by wiping a cement grout, a SBR, PVA or latex emulsion, a cement/SBR or a cement/PVA slurry across them. Fins and other projections shall be rubbed down.

PROTECTION

High quality surface finishes are susceptible to damage during subsequent construction operations and temporary protection may have to be provided in vulnerable areas. The protective measures, among others, include the strapping of laths to arrises and the prevention of rust being carried from exposed starter bars to finished surfaces.

9.1.17 SECOND STAGE CONCRETE

Unless shown on the Drawings or otherwise instructed by the Engineer, second stage concrete shall be of class for major RCC structures.

Block-outs for second stage concrete and the specifications and locations of the embedded parts shall be in accordance with the Drawings.

The surface against which the second stage concrete are to be placed shall be thoroughly cleaned to make the surface free from all loose particles, organic substances, oil, grease, rust, plastic materials, wood and defective concrete.

The projected parts of the embedded items or the parts that will remain embedded shall be thoroughly cleaned of oil, grease and rust. All such parts shall be true to dimensions, plumb and levels as shown on the Drawings and directed by the Engineer.

9.1.18 FACTORY MADE PRE-CAST CONCRETE ELEMENTS

The Engineer shall approve in writing any supplies of pre-cast concrete elements. The Engineer, if he so desires, may withdraw the approval later on.

All concrete works of such elements shall fully conform all requirements of this Specification.

The supplier shall maintain standard laboratory facilities.

Concrete members, specified to be fabricated as pre-cast concrete units, shall be fabricated with concrete of the specified class placed into a grout tight mould. If so required, the mould shall be laid on a vibrating table and vibration should be applied while concrete is placed.

Members, structurally dependent on a rigid fixing with the adjoining structures, should not in general be permitted to be pre-cast.

Unless otherwise approved by the Engineer, pre-cast concrete members shall neither be moved from the casting position until the concrete has attained a compressive strength of 80% of the specified 28-days strength, nor transported until it has gained a strength of 90% of the specified 28days strength.

Extreme cares shall be taken in handling and moving pre-cast concrete members. Pre-cast girders and slabs shall be transported in an upright position. Shock shall be avoided and the points of support and directions of the reactions with respect to the member shall be approximately the same during

transportation and storage as and when the member would be in its final position. If the Contractor finds it expedient to transport or store pre-cast units in other than this position, it shall be done at his own risks after notifying the Engineer of his intention to do so. Any units rejected shall be replaced at the Contractor's own expenses by an acceptable unit.

All details on the handling and transportation of pre-cast members shall be submitted in writing to the Engineer for his approval. Each pre-cast member is to be uniquely and permanently marked so as to show its type, date of casting and reinforcement.

HANDLING AND STACKING OF PRE-CAST UNITS

The Contractor shall give the Engineer full details of his proposed methods of handling, transportation and stacking of pre-cast concrete units. The Engineer will examine these in details and will either approve the methods or order modifications to ensure that the units are not subject to excessive stresses.

The finally approved methods are to be adhered to at all times and the Contractor shall be deemed to have included in his rates for all measures required to handle, transport and stack the units safely and without undue stressing. However, such approval by the Engineer shall neither relieve the Contractor from his full responsibilities and liabilities of safe transportation and installation of any pre-cast units at the designated location as shown on the Drawings or as directed by the Engineer without any damage nor to make any deviation from the Specifications in fabricating the unit.

9.1.19 CONTROL OF HEAT IN STRUCTURES

The Contractor shall establish measures to control the heat deriving from the hydration of the concrete in structures of major dimensions. Temperature gradients introducing risks of cracking shall not occur and the temperature shall not exceed 70°C.

The Contractor shall also establish measures to avoid harmful excessive heat generation in massive structures, such as cooling down aggregates before mixing.

The Contractor shall submit in due time a proposal for the establishment of the aforementioned measures to the Engineer for his approval. The measures shall immediately be changed, if requested by the Engineer even later.

9.1.20 BACK-FILL TO STRUCTURES

All spaces, which have been excavated but are not occupied by the concrete structure shall be back-filled and compacted with materials acceptable to the Engineer or as shown on the Drawings and/or as per the directions of the Engineer.

9.1.21 CLEANING UP

Upon completion of structure and before final acceptance, the Contractor shall remove all forms and scaffoldings, etc. down to 0.5m below the finished ground line. Excavated or garbage materials, rubbish etc. shall be removed from the Site, which shall be left in a neat condition satisfactory to the Engineer.

9.1.22 MEASUREMENT

The concrete of the several different grades and types completed in place in accordance with the Specifications stated herein and/or as per the provisions of the BOQ and/or as shown on the Drawings and/or as directed by the Engineer and accepted by the Engineer shall be measured by either the cubic meter for each class of concrete included in the BOQ or by the unit for each type of pre-cast concrete member listed in the BOQ. In computing quantities, the dimensions used shall be those shown on the Drawings or ordered by the Engineer; but the measurement shall not include any concrete used for the construction of temporary works or which is included in other billed items. No deduction from the measured quantity shall be made for drainage openings and pipes of less than 300mm in diameter, conduits, chamfers, reinforcement bars and expansion joint filler materials. However, deduction will be made for the volume of concrete displaced by piles embedded in the concrete.

The quantities of reinforcing steel and other related items as shown in the Contract Documents, which are included in the completed and accepted structure shall be separately measured for payment as per the provisions made under the Section on 'Reinforcing Steel' of this Specification.

Formwork and false work shall not be measured separately but shall be deemed to be an integral part of the concrete items.

Surface finishes shall not be measured separately but shall be deemed to be an integral part of the concrete items.

Joints including fillers and expansion joints shall not be measured separately unless they are specified as separate items in the BOQ.

The number of pre-cast concrete members of each type listed in the BOQ will be the number of acceptable members of each type furnished and installed in the work.

9.1.23 PAYMENT

The cubic meters of concrete and the number of pre-cast concrete members, measured as provided above will be paid for at the Contract unit prices per cubic meter or the Contract unit prices per each member for each type or class as would be applicable as per the BOQ.

Payment for concrete of the various classes and for pre-cast concrete members of the various types shall be considered to be the full compensation for the costs for furnishing all materials including their transportation and storage, providing all equipment, labourers and incidentals and for doing all works involved in constructing the concrete work complete in place as shown on the Drawings and as specified. Such payment shall also include the full compensation for placing of rod in position, mixing the concrete mixture, concrete pouring, compacting by vibrator machine and curing, furnishing and placing expansion joint fillers, sealed joints, water-stops, drains, vents, miscellaneous metal devices and the drilling of holes for dowels and the grouting of dowels in drilled holes, unless payment for such works would be specified under another item of the BOQ.

Payment for all types of concrete work shall be considered to be the full compensation for the costs of furnishing and installing and removal of all temporary works like staging, formwork, working

platforms, cranes, transporting, placing, compaction, finishing, curing and rendering of the concrete as specified till the concrete work becomes self-supporting and can perform its intended functions.

The Contractor's rates shall be fully inclusive of all costs of all laboratory tests to be carried out as specified under different sub-items unless any payment is separately specified under the BOQ.

The payment shall be the full compensation of all incidentals necessary to complete the Work.

Payment for pre-cast units shall include all concrete, formwork, transport and erection and where applicable any bolts or other devices and bedding necessary to fix them in their permanent positions, all incidentals and all other works that will be necessary for full completion from transportation to safe erection of the members at the designated locations as shown on the Drawings or as directed by the Engineer.

Item of Payment	Unit
Concrete Class as detailed and as specified in the BOQ.	Cubic meter / Cubic feet
Pre-cast concrete elements as detailed on the drawings and as specified in the BOQ.	Cubic meter / Cubic feet

9.2 FALSE WORK AND FORMS

SCAFFOLDING (FALSE WORK)

Scaffolding is defined to be any temporary structure required to support structural elements of concrete, steel, masonry, or other materials at the time of their construction or erection.

Plans, Drawings and structural calculations in details shall be submitted to the Engineer for approval, but in no case shall the Contractor be relieved of his responsibilities for results obtained by using this Document.

All scaffolding shall be designed and constructed to provide the necessary rigidity and strength to safely support all loads imposed and produced in the finished structure, the lines and grades indicated on the Drawings. The supports shall be designed to withstand the worst combination of self-weight, formwork weight, formwork forces, reinforcement weight, wet concrete weight, construction and wind loads, together with all incidental dynamic effects caused by placing, vibrating and compacting the concrete. No harmful cracking should occur in the placed concrete. The Engineer may require the Contractor to employ screw jacks or hardwood wedges to take up any settlement in the formwork either before or during the placing of concrete.

All scaffolding, exceeding 20m or six storeys in height, shall be constructed of noncombustible or fire- retardant materials.

Scaffolding shall be founded on a solid base, which is safe against undermining, protected from softening and capable of supporting the loads imposed on it. Scaffolding which cannot be founded on a satisfactory footing shall be supported on piling, which shall be spaced, driven and removed in a manner approved by the Engineer.

Horizontal and inclined bracings shall be provided for posts higher than 3m. Spans of beam bottoms shall be supported by posts with maximum 1m apart when steel is used and instructions from the manufacturer/supplier shall be strictly followed. Spacing of the props under beams shall consider the increased load and shall be posted closer than those under the floor slab.

Scaffolding can, in certain cases, be supported on structures already constructed. In that case, the Contractor shall submit in due time to the Engineer in writing all information on the loading from the scaffolding as requested. The Engineer shall consider the loading and submit his approval in writing.

Scaffolding shall be set to give the finished structure the camber shown on the Drawings or specified by the Engineer. If any weakness develops or the scaffolding shows undue settlement or distortion during construction, the work shall be stopped and any structure affected thereby shall be removed and the scaffolding shall be further strengthened before work is resumed. Suitable screw jacks, pairs of wages or other devices shall be used at each post to adjust scaffolding to grade.

All materials used in the construction of the scaffolding shall conform to the corresponding ASTM or BS Standards or any other equivalent International Standards. Material tests and certificates may be required by the Engineer. Examinations of welding may also be requested. Test loading of the scaffoldings may be requested for the determination of the flexibility and the strength. All expenses of the tests and examinations of scaffoldings shall be borne by the Contractor on non-reimbursable basis.

Scaffolds shall be made from strong bamboo poles, wooden posts, steel pipes or any other suitable materials. They shall be adequately tied to vertical members resting on firm floor. Strong ropes shall be used to tie up bamboo poles. In addition, cross-bracing with bamboo or wooden posts shall be provided along with ties or guys of steel wire or rod not less than 6mm in diameter.

Good, sound and uniform bamboo shall be collected in sufficient quantities for providing scaffolding, propping, temporary staging, ramp etc. The bamboos shall be free from any defects, firmly ties to each other and joints made smooth. Joining members only with nails shall be prohibited. Bamboos for vertical support shall not be less than 75mm in diameter and shall be straight as far as possible. Bamboos may be used as vertical support for up to a height of 4m, if horizontal bracings are provided at the centre. Splicing shall be prohibited.

After stripping the formwork, the bamboo posts shall be cleaned and stacked vertically in shade protected from rain and sun. Defective or damaged bamboo posts shall be removed from the Site.

Timber posts shall be used in supporting formwork upto a height of 6m. The posts shall not be less than 80mm in diameter at any place and shall spread to at least 150mm in diameter at the top. The timber posts shall be supported on timber planks at the bottom. Either the bottom or the top of the posts shall be wedged with a piece of triangular wood peg for easy removal. Adequate horizontal and inclined braces shall be used for all timber centering. All timber posts shall be carefully inspected before use and members with cracks and excessive knots and crookedness shall be discarded. The joints shall normally be made with bolts and nuts. No rusted or spoilt threaded bolts and nuts shall be used.

When steel scaffoldings are used, it shall be painted in a manner that no mark of corrosion shall appear on the permanent concrete structures.

The Engineer shall only select the type of scaffolding. Bamboo scaffolding will only be used, if agreed and allowed by the Engineer. All scaffoldings shall remain in place for a period, which shall be determined by the Engineer.

Scaffold shall be dismantled after use piece by piece. Holes in the wall shall be filled up with the same materials as that of the wall. Filled up holes shall have uniformity in texture and colour with the surrounding surface. Crash striking shall not be allowed.

Triangular wooden wedges shall be put under the posts for easy dismantling of the members. Timber planks or steel sheets shall be placed at a time below the vertical or inclined posts covering several posts.

Materials and joints in scaffolding shall be inspected from time to time both before and after erection for the soundness, strength, damage due to weathering etc. Inspections shall be made for spillage of material or liquids, loose material lying on the gangways and proper access to the platform.

The scaffold shall be secured to the building at enough places; no ties shall be removed. Warning sign, prohibiting the use of any defective or incomplete scaffold and working in bad weather and high wind, shall be posted in a prominent place. Inspections shall be made for the observance of these requirements.

10. FORMWORK

Formwork is defined to be an enclosure or panel, which contain the fluid concrete and withstand the forces due to its placement and consolidation. Forms in turn be supported on scaffolding.

The work to be performed under this Sub-section includes the furnishing and installing and removing of forms for all cast-in-places concrete work as shown and noted on the Drawings and as specified herein or as directed by the Engineer.

Forms shall be substantial and sufficiently tight to prevent leakage of mortar. Forms shall be of sufficient rigidity to prevent objectionable distortion of the formed concrete surface due to pressure of the concrete and other loads incidental to construction operations. They shall be properly braced or tied together to maintain position and shape. Forms and their supports shall be so designed as not to damage previously placed structure.

Relevant provisions of the American Concrete Institute (ACI) issue of ACI 347 on 'Recommended Practice for Concrete Formwork' or some other generally accepted Standards shall apply for the structural designing of the formwork, except as they may be modified herein.

10.1 MATERIALS

Formwork shall be constructed from sound materials of sufficient strength, properly braced, strutted and shored as to ensure rigidity throughout the placing and compaction of the concrete without visible deflection. The materials used to be of wood, steel or other approved materials and shall be mortartight. Formwork shall be so constructed that it can be removed without shock or vibration to the concrete.

Formwork for concrete, permanently exposed to public inspection, shall be faced with plain 28/26gauge steel sheet fitted over 38mm thick wooden plank panels suitably braced or steel framing faced with minimum 12/14 BWG mild steel sheet. Formwork for cement concrete blocks shall be fabricated from M.S. sheet of sufficient thickness to prevent any distortion.

Where metal forms are used, all bolts and rivets shall be countersunk and well-grounded to provide a smooth plane surface.

Where timber is used, it shall be well seasoned, free from loose knots, projecting nails, splits or other defects that may mark the surface of concrete.

Form ties shall be prefabricated rod, flat band, or wire type, or threaded internal disconnected type, of sufficient tensile capacity to resist all imposed load of freshly placed concrete and having external holding devices of adequate bearing area. Ties shall permit tightening and spreading of forms and shall leave no metal closer than 25mm from surface. Ties shall fit tight to prevent mortar leakage at holes in forms. Removable ties shall be coated with non-staining bond breaker. All ties shall be protected from rusting at all times. No wire ties or wood spreaders shall be permitted. Cutting ties back from concrete face will not be permitted. Ties for exposed Architectural Concrete shall be plastic cone snap ties.

10.2 CONSTRUCTION METHOD

The Contractor shall submit for the approval of the Engineer details of the methods and materials proposed for formwork to each section of the Work. Details of all proposed wrought formwork and formwork to produce special finishes are to be submitted for approval in writing to the Engineer before any material is hauled at Site. If the Engineer so requires, samples of formwork shall be constructed and concrete be placed so that the proposed methods and finish effect can be demonstrated.

All joints shall be close fitting to prevent leakage of grout. At construction joints the formwork shall be tightly secured against previously cast or hardened concrete in order to prevent stepping or ridges to exposed surfaces.

Where the Contractor proposes to make the formwork from standard sized manufactured formwork panels, the dimensions of such panels shall be approved by the Engineer before they are used for construction of the Work. The finished appearance of the entire elevation of the structure and the adjoining structures shall be considered when planning the patterns of joint lines caused by the formwork and by construction joints to ensure continuity of horizontal and vertical lines.

Formwork shall be constructed to provide the correct shape, lines and dimensions of the concrete shown on the Drawings. Due allowance shall be made for any deflection, which will occur during the placing of concrete within the formwork. Panels shall have true edges to permit accurate alignment and provide a neat line with adjacent panels and at all construction joints. All panels shall be fixed with their joints either vertical or horizontal, unless otherwise specified or approved.

Formwork shall be provided for the top surfaces of sloping work where the slope exceeds 15o with the horizontal and shall be anchored to enable the concrete to be properly compacted and prevent floating. Cares shall be taken to prevent air being entrapped. Openings for inspection of the inside of the formwork and for the removal of water used for washing shall be provided and so formed as to be easily closed before placing concrete.

10.3 FORMWORK FOR EXPOSED CONCRETE SURFACES

All exposed concrete surfaces are to be 'form finish' and shall be cast in any approved formwork and shall be free from honeycomb, fins, projections and air holes. All external angles to form finish concrete surfaces shall be chamfered as directed.

Forms for concrete surfaces exposed to view shall produce a smooth surface of uniform texture and color substantially equal to that which would be obtained with the use of plywood conforming to the National Institute of Standards and Technology Product Standard PSI for Exterior B-B Class I Plywood. Panels lining such forms shall be arranged so that the joint lines form a symmetrical pattern conforming to the general lines of the structure. The same type of form lining material shall be used throughout each element of a structure. Such forms shall be sufficiently rigid so that the undulation of the concrete surface shall not exceed 3mm when checked with a 1.5m long straight edge or template.

The Contractor shall submit shuttering Drawings and details of pattern and the method of forming joints in the exposed (form finish) concrete to the Engineer for his approval. All changes and modification made by the later shall be appropriately incorporated by the former and final approval whereof be obtained from the Engineer.

Unless otherwise stated on the Drawings, wrought formwork shall be used for all permanently visible concrete surfaces. Wrought formwork shall be such as to produce a smooth and even surface free from perceptible irregularities. Tongues and grooved paneled boards, plywood or steel forms shall have their joints flushed with the surface. The formwork shall be formed with approved standard size panels. The panels shall be arranged in a uniform approved pattern, free from defects likely to be detected in the resulting concrete surface.

In all types of formwork to form finished exposed concrete, only non-staining mold oil shall be used as approved by the Engineer.

The respective usage of the same formwork to cast form-finished exposed concrete shall be as decided by the Engineer and in no case the formwork, not guaranteed to produce the required form-finish to the satisfaction of the Engineer, shall be used.

The exposed concrete shall have a uniform finish. The finish of the concrete when shuttering and formwork are removed will generally be without any blemish and will be such as will not require touch up. Slight touch up for a small spot or two, if necessary shall be carried out skillfully so as to be synonymous with the entire surfaces.

The finished surfaces shall be within the specified tolerances and full cover to the reinforcement steel shall be maintained.

10.4 FORMWORK FOR NON-EXPOSED CONCRETE SURFACES

Unless otherwise stated on the Drawings, rough formwork may be used for all surfaces, which are not permanently exposed. Rough formwork may be constructed of plain butt-joined sawn timber. But the Contractor shall ensure that all joints between boards shall be grout-tight.

The finished surfaces shall be within the specified tolerances and full cover to the reinforcement steel shall be maintained.

10.5 FORMED SURFACES AND FINISH

The formwork shall be lined with a material approved by the Engineer so as to provide a smooth finish of uniform texture and appearance. This material shall leave no stain on the concrete and so joined and fixed to its backing as not to impart any blemish. It shall be of the same type and obtained from only one source throughout the construction of any individual structure. The Contractor shall make good any imperfection in the finish as required by the Engineer. Internal ties and embedded metal parts will be allowed only with the specific approval of the Engineer.

10.6 SIZES OF TIMBER AND OTHER SECTIONS FOR FORMWORK

Scaffolds, formwork and components thereof shall be capable of supporting without failure, at least two times the maximum intended load. The following types of loading shall be considered in designing the formwork:

i. Weight of wet concrete: 20 KN/m3.

ii. Live load due to workmen and impact of ramming or vibrating: 15-40 kPa (light duty for carpenter and stone setters, medium duty for brick layers and plasterers, heavy duty for stone masons).

iii. Allowable bending stress (flexural tensile stress) in soft timbers: 8,000 kPa. The sizes for form-work elements specified in the Table given below are applicable for spans of up to 5m and height of up to 4m. In case of longer span and height, formwork and support sizes shall be determined by calculating the load and approved by the Engineer before use.

Sizes of timber and other sections for formwork

Types of Formwork	**Members Size in mm**
Flat sheeting for slab bottoms, columns and beam sides	25 to 50
Beam bottoms	75x100 to 150x150
Vertical posts	75x100 to 150x150
Bamboo posts	Minimum 75 dia
Timber posts	Not less than 100 dia at mid-length and 80dia at thin end
Joist and ledgers supporting sheeting of slab	50x100 to 75x200
Studs for supporting vertical wall sheeting	50x100 to 150x150
Columns yokes-horizontal cross, pieces supporting vertical sheeting	50x100 to 100x100

10.7 QUALITY OF SHUTTERING

The shuttering shall have smooth and even surface and its joints shall not permit leakage of cement grout.

Ply-board shuttering material shall be well seasoned free from projecting nails, splits or other defects that may mark the surface of concrete. It shall not be so dry as to absorb water from concrete and swell and bulge, nor so green or wet as to shrink after erection.

The timber shall be accurately sawn and plain on the sides and the surface coming in contact with concrete.

Wooden formwork with metal sheet lining or steel plates stiffened by steel angles shall also be permitted. Where metal forms are used, all bolts and nuts shall be countersunk and well-grounded to provide a smooth plain surface.

The chamfers, leveled edges and moldings shall be made in the formwork itself. Opening for fixture and other fittings connected with the services shall be provided in the shuttering as directed by the Engineer.

Clamps shall be used, to its practicality, to hold the forms together. Where use of nails is unavoidable, it shall be kept to minimum number and these shall be left projected so that they can easily be withdrawn. Use of double-headed nails shall be preferred.

10.8 TOLERANCES

The formwork shall be made so as to produce a finished concrete true to shape, lines, levels, plumb and dimensions as shown on the Drawings subject to the following tolerances unless otherwise specified in this document or Drawings or as directed by the Engineer.

i. Sectional dimension	± 5mm
ii. Plumb	± 1 in 1000 of height
iii. Levels	± 3mm before any deflection has been taken place

Tolerances given above are specified for local aberrations in the finished concrete surface and should not be taken as tolerance for the entire structure taken as a whole or for the setting and alignment of formwork, which should be as accurate as possible to the entire satisfaction of the Engineer. Errors, if noticed in any lift/tilt of the structure after stripping of forms, shall be corrected in the subsequent work to bring back the surface of the structure to its true alignment.

10.9 FIXING OF FORMWORK

The formwork shall be arranged in a manner as to readily be dismantled and removed from the cast concrete without shock, disturbance or damage. Where necessary, the formwork shall be so arranged that the soffit form, properly supported on props only, can be retained in position for such period as may be required by maturing conditions or Specification.

The surfaces of formwork shall be free from foreign matters, projecting nails and the like, splits or other defects, and all formwork shall be cleaned and made free from standing water, dirt, shavings, chippings or other foreign matter before concrete is placed.

Before placing concrete, all built-in reinforcement bars, anchoring, steel beams, cables, fixing truss, bolts, pipes or conduits or any other fixtures shall be fixed in their correct positions. The cores and other devices for forming holes shall be held fast by fixing to the formwork or otherwise. Holes shall not be cut in any concrete without the approval of the Engineer.

All exterior and interior angles on the finished concrete of 900 or less shall be given 12mm – 20mm chamfers unless otherwise shown on the Drawings or directed by the Engineer. When chamfers are to be formed, the fillets shall be accurately cut to size to provide a smooth and continuous chamfer.

No ties or bolts or other devices shall be built into the concrete for the purpose of supporting formwork without the prior approval of the Engineer. The whole or part of any such support embedded in the Reinforced Concrete shall be capable of removal so that no part, remaining embedded in the concrete, shall be nearer than 75mm from the surface. Holes left after removal of such supports

shall be neatly filled with well-reamed dry-pack mortar following the procedures described in the relevant Sub-section of this Specification.

All rubbish shall be removed from the interior of the forms before the concrete is placed. After cleaning and prior to placement of reinforcing steel, the formwork in contact with the concrete shall be treated with a suitable non-staining mold oil or suitable approved release agent to prevent sticking of the concrete. Such works shall not discolor or otherwise injure the surface of the concrete. Care shall be taken to prevent the oil from coming in contact with the reinforcement or mixing with the concrete. At construction joints, surface-retarding agents shall be used only where ordered by the Engineer.

All formwork shall be inspected and approved by the Engineer before concrete is placed in it. However, this shall not relieve the Contractor from the requirements as to soundness, finish and tolerances of the concrete specified in this Specification or elsewhere acknowledged as Standard. If, at any period of the work during or after placing the concrete, the forms show signs of sagging or bulging, the concrete shall be removed to the extent directed by the Engineer, the forms brought to the proper position and new concrete placed. No allowance shall be made to the Contractor for such extra works.

10.10 REMOVAL OF FORMS

Forms shall not be removed without the approval of the Engineer. In the determination of the time for the removal of forms, consideration shall be given to the location and character of the structure, the weather, the materials used in the mix and other conditions influencing the early strength of the concrete. Extreme cares shall be taken to ensure that the method of removal shall not cause overstressing of the concrete or damage to its surface.

Forms shall be removed in such a manner as to permit the structure to uniformly and gradually take the stresses due to its own weight as not to impair safety and serviceability of the structure. All concrete to be exposed by form removal shall have sufficient strength not to be damaged thereby.

Forms shall not be removed in the cases of footing forms where the removal would endanger the safety of the cofferdams, forms from enclosed cells where access is not provided, deck forms in the cells that do not interfere with the future installation of utilities shown on the Drawings, or other works.

Except for concrete being post-tensioned, no concrete shall be subjected to loading which will induce a compressive stress in it exceeding one-third of its compressive strength at the time of loading, or one- third of the specified characteristic strength whichever is less. It may be possible to use shorter periods before striking forms by determining the strength of the concrete in the structural element.

Forms supporting cast-in-situ concrete in flexure may be struck when the strength of the concrete in the element is 10 N/mm2 or twice the stress to which it will be subjected, whichever is greater provided that striking at this time will not result in an unacceptable deflection. This strength may be assessed by test on cylinder/cube cured under the same conditions as the concrete in the element as far as possible.

Forms on upper sloping faces of concrete shall be removed as soon as the concrete has attained sufficient stiffness to prevent sagging. Any repair or treatment required on such sloping surfaces shall be performed at once.

If the floor is to be used to support construction loads, props should be retained for 28 days unless the Contractor can prove the requisite concrete strength by tests.

The form shall be removed slowly, as the sudden removal of wedges is equivalent to a shock load on the partly hardened concrete.

Materials and plants shall not be stacked on any newly constructed floor unless sufficient support is maintained to withstand such loads without damaging the floor.

The following table is a guide to the minimum periods that must elapse between the completion of the concreting operations and the removal of formwork. No formwork shall be removed without the permission of the Engineer and such permission shall not relieve the Contractor of his responsibilities regarding the safety of the structure.

Type and position of Formwork	**Approximate period (days)**
Side of beams, walls and columns (unloaded)	5
Slab soffits (props supporting)	14
Removal of props to slabs	21
Beam soffits (props supporting)	21
Removal of props to beams	28

Notwithstanding the foregoing, the Contractor shall be held responsible for any damages arising from removal of formwork before the structure is capable of carrying its own weight and any incidental loading.

10.11 OPENINGS

Temporary and permanent openings in concrete shall be framed neatly with provisions for keys or reinforcing steel as shown on the Drawings or as directed by the Engineer.

10.12 DEFECTS IN FORMED SURFACES

Workmanship in formwork along with concrete placing shall be such that concrete shall normally require no repair to surfaces being perfectly compacted and smooth. If any blemish is revealed after removal of formwork, the Contractor shall obtain immediately the Engineer's decision concerning remedial measures to be undertaken. Notwithstanding the specifications and provisions stated under the Sub-section on 'Finish and Finishing' of this Specification, such measures may include but shall not be limited to the following: i. Fins, pinholes, bubbles, surface discoloring and mirror defects may be rubbed down with sacks immediately on removal of the form.

ii. Abrupt and gradual irregularities may be rubbed down with carborundum stone and water after concrete has been fully cured.

iii. Deep honeycombed concrete shall be repaired within 24 hours of striking the formwork by cutting back to sound concrete. The concrete shall be cut back at least 50mm behind face reinforcement. Cut edges shall be regular and not feathered. Recasting shall be with the same concrete as the original casting. The Engineer shall approve the formwork and its method of placing in this case also. iv. Under some circumstances, abrupt and gradual irregularities of shallow honeycombed concrete may be repaired by cutting back and reforming with an approved epoxy resin or mortar in accordance with the manufacturer's instructions.

Regardless of the above repairing measures, any structure containing excessive honeycomb, as would be termed by the Engineer, shall be subject to rejection by the Engineer. The Contractor, on receipt of written orders from the Engineer, shall remove and rebuild such portions of the structure at his own expenses.

10.13 HOLES TO BE FILLED

Holes on the concrete surfaces formed by formwork supports or the like shall be filled with dry pack mortar made from one part by weight of ordinary Portland cement and three parts of specified fine aggregate approved by the Engineer. The mortar shall be mixed with sufficient water only to make the materials stick together when being molded in the hands. All construction materials shall conform to the requirements as described previously and under the relevant Sub-sections of the Section on 'Construction Materials' of this Specification.

The Contractor shall thoroughly clean any hole that is to be filled and break out any loose, broken or cracked concrete or aggregate and remove any dry cement from the hole. The surrounding concrete shall be soaked until the whole surface that will come into contact with the dry pack mortar has been covered and darkened by absorption of the free water by the cement. The surface shall then be dried so as to leave a small amount of free water on it.

The dry pack material shall then be placed and packed in layers having a compacted thickness of not more than 10mm. Compaction shall be carried out by using a hardwood stick and a hammer and shall extend over the full area of the layer. Special cares should be taken to compact the dry pack against the sides of the holes.

After compaction, the surface of each layer shall be scratched before further loose material is added. The holes shall be slightly overfilled. The surface shall be finished by laying a hardwood block against the dry pack fill and striking the block several times.

10.14 APPROVAL OF SCAFFOLDINGS AND FORM

Plans, Drawings and structural calculations shall be submitted to the Engineer on time so that no construction of such scaffoldings and forms shall take place before the Engineer's approval is accorded in writing. Such approval shall not relieve the Contractor of his responsibilities for the involved structure.

The Engineer shall have reasonable time for his examination of the Contractor's plans and calculations, if scaffoldings are introducing temporary loading on new structures in particular. For this purpose, the Contractor shall not be allowed any extension of time beyond the stipulated period of the Contract.

Before concrete is placed, the Engineer shall inspect all formworks and scaffoldings. No concrete shall be placed until inspection is made and approval is given by the Engineer. Such approval shall not relieve the Contractor of any of his responsibilities under the Contract for the successful completion and the soundness of the structure.

10.15 MEASUREMENT

Formwork and false work shall not be measured separately but shall be deemed to be an integral part of the concrete items.

10.16 PAYMENT

The Contractor's rates for concrete work, inter-alia, shall be inclusive of all costs of all formwork, false work and centering and for their subsequent removal. No additional payment will be made to the Contractor for these works.

10.17 WATER PROOFING POLYTHENE SHEET

10.17.1 DESCRIPTION

Works covered under this item shall consist of supplying and laying in place one layer of polythene sheet of weight in accordance with the applicable Drawings, BOQ and these specifications and/or as directed by the Engineer.

10.17.2 CONSTRUCTION REQUIREMENT

Sheets shall be laid covering the entire inside area under the Cement Concrete. Before laying the sheets, the surface shall be cleaned to give a surface free from damage, tear or other imperfections and shall be laid such that there is a minimum of 300mm overlap of the adjacent strips.

10.17.3 MEASUREMENT

Measurement shall be taken for payment in square meter of the actual area covered by the sheets and accepted by the Engineer. No allowance shall be made for overlaps.

10.17.4 PAYMENT

The amount of completed and accepted work measured as provided above shall be made at the Contract unit price per square meter and the payment shall constitute full compensation for furnishing all materials, equipment including their storage, handling and transport and all labors, cleaning, preparing, cutting, laying, fixing and all incidentals necessary to complete the work. No additional payment shall be made for the overlaps.

Item of Payment	Unit
Supplying and laying of polythene sheet	Square meter / Square feet

11. JOINTS IN CONCRETE

11.1 CONSTRUCTION JOINTS

Construction joints are defined as concrete surfaces upon or against which concrete is to be placed and to which new concrete is to be placed, that have become so rigid that the new concrete cannot be incorporated integrally with that previously placed. Construction joints shall be formed wherever there is a discontinuity in placing concrete in external elements of concrete structures. Formed vertical or inclined construction joints as well as unformed joints, which are due to interruption of concrete placement, shall be made only where located on the Drawings or shown in the pouring schedule or as directed by the Engineer. All exposed faces of construction joints shall be made absolutely straight, leveled or plumbed and normal to the finished surface.

Spacing of construction joints shall be in accordance with good concreting practice as defined in BS 8110 or equivalent and enabling adequate precautions to be taken against shrinkage cracking. Placing of concrete shall be carried out continuously. The joints shall be at right angle to the general direction of the member and shall take due account of shear and other stresses.

All planned reinforcing steel shall extend uninterrupted through joints. Additional reinforcing steel dowels shall be placed across the joints, if and when directed by the Engineer. Such additional steel shall be furnished and placed at the Contractor's expenses.

11.1.1 BONDING

Unless otherwise shown on the Drawing, horizontal joints may be made without keys and vertical joints shall be constructed with shear keys. Surfaces of fresh concrete at horizontal construction joints shall be rough floated sufficiently to thoroughly consolidate the surface and intentionally left in a rough condition. Shear keys shall consist of formed depressions in the surface covering approximately one-third of the contact surface. The forms for keys shall be beveled so that removal will not damage the concrete.

Surfaces of construction joints shall be prepared as early as possible after casting. The preparation shall consist of the removal of all laitance, lose or defective concrete coatings, sand and other deleterious materials. Preparation shall be carried out preferably when the concrete has set but not hardened by jetting with a fine spray of water or brushing with a stiff brush, just sufficient to remove the outer mortar skin and to expose the larger aggregate without it is being disturbed. Where this treatment is impracticable and work is resumed on a surface, which has set, the whole surface shall be thoroughly roughened or scrapped with suitable tools so that no smooth skin of concrete that may be left from the previous work is visible.

The prepared joint face shall be thoroughly cleaned by compressed air and water jets or other approved means and brushed and watered immediately before depositing concrete. The cleaned and saturated surfaces that also include vertical and inclined surfaces, shall first be thoroughly covered with a thin coating of mortar or neat cement grout against which the new concrete shall be placed before the grout has attained its initial set.

The placing of concrete shall be carried continuously from joint to joint. The face edges of all joints, which are exposed to view, shall be carefully finished true to line and elevation.

Construction joints in floors shall be located within the middle third of spans of slabs, beams and girders. Joints in girders shall be offset a minimum distance of two times the width of intersecting beams.

11.1.2 BONDING AND DOWELING TO EXISTING STRUCTURES

When reinforcing dowels grouted into the holes drilled in the existing concrete is required at such construction joints, the holes shall be drilled by methods that will not damage the concrete around the holes. The diameters of the holes shall be 6mm larger than the nominal diameter of the dowels unless shown otherwise on the Drawings. The dowel bars shall be round mild steel bar of the diameter and length as indicated on the Drawings and/or as per the directions of the Engineer. The grout shall be a neat cement paste of Portland cement and water or an epoxy. Immediately prior to placing the dowel bars, the holes shall be cleaned off dust and other deleterious materials, shall be thoroughly saturated with water, have all free water removed and shall be dried to a saturated surface dry condition. Sufficient grout or an epoxy shall be placed inside the holes so as not to remain any void after the dowels are inserted. Grout shall be cured for a period of at least 3 (three) days or until dowel bars are encased in concrete. When an epoxy is used, the mixing and placing shall conform to the manufacturer's recommendations.

11.1.3 FORMS AT CONSTRUCTION JOINTS

When forms at construction joints overlap previously placed concrete, they shall be re-tightened before depositing new concrete. Exposed face edges of all joints shall be neatly formed with straight bulkheads or grade strips, or otherwise properly finished true to line and elevation.

11.2 EXPANSION AND CONTRACTION JOINTS

11.2.1 EXPANSION JOINTS

Expansion joints are intended to accommodate relative movement between adjoining parts of a structure. Compressible filler shall be placed between the joint faces to provide freedom for expansion for the two adjacent concrete masses. Care shall be taken to ensure that the material fills the joint completely and that no concrete or hard material is left in the joint after the second face of the joint has been cast

Material

One of the following specifications shall be used as pre-mould fillers:

i. Specification for Preformed Expansion Joint Fillers for Concrete Paving and Structural Construction, ASTM 1751.

ii. Specification for Preformed Sponge Rubber and Cork Expansion Joint Fillers for Concrete Paving and Structural Construction ASTM D 1752. Type-II (cork) shall not be used when resiliency is required.

iii. Specification for Preformed Expansion Joint Filler for Concrete, ASTM D 994. The bitumen sheet, laid on the horizontal top surface of the expansion joint keys, shall be a 10mm thick material approved by the Engineer.

Metal armour

Expansion joint armor assemblies shall be fabricated from steel with the following materials:

i. Steel bars, plates and shapes shall conform to the requirements of ASTM A 36.

ii. Bolts and nuts shall conform to the requirements of ASTM A 307.

iii. High strength bolts, nuts and washers shall conform to the requirements of ASTM A 325.

iv. Steel castings shall conform to the requirements of ASTM A 486 or ASTM A 27.

v. Grey iron castings shall conform to the requirements of ASTM A 48.

vi. Sheet metal shall be of commercial quality.

Armour assemblies

All assemblies shall be accurately fabricated and straightened at the workshop, as necessary to conform to the concrete sections. The assemblies shall be installed so that their top surface matches the plane of the adjacent finished concrete surface throughout the length of the assembly. Appropriate methods shall be followed in placing the assemblies to keep them in correct position during the placing of concrete. The opening at expansion joints shall be that designated on the Drawings at normal temperature or as directed by the Engineer for other temperatures. Cares shall be taken to avoid impairment of the clearance in any manner.

11.2.2 CONTRACTION JOINTS

General

Joints placed in structures or slabs to provide for volumetric shrinkage of monolithic unit or movement between monolithic units are defined as contraction joints. Contraction joints shall be constructed so that there will be no bond between the concrete surface forming the joints.

Material

Material placed in contraction joints shall consist of asphalt saturated felt paper or other approved bond- breaking materials

11.3 POURABLE JOINT SEALANTS

Pourable sealants shall be placed along the top edges of contraction or filled expansion joints. It shall conform to the following considerations:

i. Unless otherwise shown on the Drawings and/or ordered by the Engineer, joint sealants shall be a hot poured rubber bitumen compound for horizontal joints and either a bituminous compound or an elastomeric two parts polysulphide sealant for sloping, vertical and soffit joints.

ii. Bituminous compounds shall comply with BS 2499 for horizontal joints and BS 2499 Type A1 for sloping or vertical joints. Polysulphide compound shall comply with BS 4254.

iii. Joint sealants and the requisite priming materials shall be obtained from manufacturers approved by the Engineer. The application of joint sealant shall not be commenced without the Contractor obtains its approval by the Engineer.

11.4 COMPRESSIVE FILLER

Unless otherwise specified, the joint filler shall be of resin or bituminous bonded corks such as 'Hydrocor' manufactured by Expandite Ltd. The filler shall be obtained from a manufacturer approved by the Engineer and shall be stored and fixed in accordance with the manufacturer's instructions.

Types

Water stops to be used may be of the following types:

11.5 WATER STOPS

Water stops shall be of the type, size and shape shown on the Drawings and/or as directed by the Engineer. They shall be dense, homogeneous and without holes or other defects.

11.5.1 POLYVINYL CHLORIDE (PVC) WATER STOPS

Where shown on the Drawings, construction (as required and approved by the Engineer), contraction and expansion joints shall be made watertight by the provision of a continuous Water Stop strip of Poly Vinyl Chloride (PVC) manufactured by the extrusion process from an elastomeric plastic compound, the basic resin of which shall be Poly Vinyl Chloride. Unless otherwise specified or ordered, a two bulb dumbbell section PVC. Water Stop shall be used in construction joints and a three bulb section PVC Water Stop shall be used in expansion joints.

Water Stops shall be of high grade PVC, containing no filler or reclaimed or scrap material. PVC shall comply with the requirements of BS 2571 for PVC Type A, Class 1. The quality of Water Stops shall comply with the following major requirements:

i. Specific gravity..... 1.30 (maximum)

ii. Hardness .....80 (minimum)

iii. Tensile strength..... 138 kg/cm2 (minimum)

iv. Elongation duro..... 225% (minimum)

11.5.2 RUBBER WATER STOPS

Rubber Water Stops shall be manufactured with synthetic rubber made exclusively from neoprene, reinforcing carbon black, zinc oxide, polymerization agents and softeners. The quality shall conform the following major requirements:

Neoprene content..... 70% by volume (minimum)

Hardness..... 50-60 duro

Tensile strength..... 193 kg/cm2 (minimum)

Elongation..... 600% (minimum)

Rubber Water Stops shall be formed with an integral cross section in suitable molds so as to produce a uniform section with a permissible variation in dimension of 0.8mm plus or minus. No splices will be permitted in straight strips. Strips and special connection pieces shall be well cured in a manner such that any cross section shall be dense, homogeneous, and free from all porosity. Junctions in

the special connection pieces shall be full molded. During the vulcanizing period, the joints shall be securely held by suitable clamps. The material at the splices shall be dense and homogeneous throughout the cross-section.

11.5.3 INSTALLATION

Open joints

Open joints shall be constructed by the insertion and subsequent removal of a wood strip, metal plate, or other approved material. The insertion and removal of the template shall be accomplished without chipping or breaking the corners of the concrete. When not protected by metal armour, open joints in slabs shall be finished with an edging tool. Upon completion of concrete finishing work, all mortars and other debris shall be removed from the open joints.

Filled joints

When filled joints are shown on the Drawings or asked by the Engineer, pre-mold type fillers shall be used unless Poly Styrene board is specifically called for. Filler for each joint shall consist of as few pieces of material as possible. Abutting edges of filler material shall be accurately held in alignment with each other and tightly fit or taped as necessary to prevent the intrusion of grout. Joint filler material shall be anchored to one side of the joint by waterproof adhesive or other methods so as to prevent it from working out of the joint but not interfere with the compression of the material.

Sealed joints

Prior to installation of the pourable joint sealants, all foreign materials shall be removed from the joint. The filler material shall be cut back to the depth shown or approved and the surface of the concrete, in contact with the sealant, be cleaned by light sand blasting. When required, a Poly Ethylene foam strip shall be placed in the joint to retain the sealant and isolate it from the filler material. The sealant materials shall then be mixed and installed in accordance with the manufacturer's directions. Any material that fails to bond the sides of the joint within 24 hours after placement shall be removed and replaced.

Water stops

Water Stops shall be obtained from a manufacturer approved by the Engineer, and shall be fixed and joined according to the manufacturer's instructions. All strips shall be stored in a place as cool as practicable and shall in no case be exposed to the direct sun light.

Water Stops shall be installed with approximately half of the width of the material embedded in the concrete on either side of the joint. It shall be firmly supported by split stop-end shuttering and in no case shall Water Stop be pierced to assist in fixing. Special care shall be taken to ensure that the concrete is well worked against the embedded parts of the strips and is free from honeycomb. Precautions are to be taken to protect any projected portions of the strips from damage during the progress of the works and from sunlight and heat.

If, after placing concrete, Water Stops are moved out of position or shape, the surrounding concrete shall be removed, the Water Stop reset, and the concrete replaced at the Contractor's own expenses.

Two 9mm diameter reinforcing bars shall be provided to support the Water Stops and shall be securely held in position by the use of spacers, supporting wires, or other approved devices.

Flexible Water Stops shall be fully supported in the formwork, free from nails and clear of reinforcement and other fixtures. Damaged Water Stops shall be replaced and care shall be taken to place the concrete so that Water Stops do not bend or distort.

Splicing of Poly Vinyl Chloride Water Stop shall be performed in accordance with the manufacturer's recommendations. A thermostatically controlled electric source of heat shall be used to make all splices. The heat shall be sufficient to melt but not to char the plastic. Splices shall develop at least 90% of the tensile strength of un-spliced materials and shall withstand bending 180o around a 50mm diameter pin without cracking or separating.

The Contractor, at least before the commencement of concrete work, shall submit to the Engineer for his approval details of the Contractor's proposals for the installation of water stops. These shall show where joints in the Water Stops are to be located and details of the intersections and changes of direction to a scale that shows the position of any joint or shape of any mould section.

As far as possible, jointing of PVC Water Stops on Site shall be confined to the making butt joints in straight runs of Water Stops. Where it is agreed with the Engineer that it is necessary to make an intersection or change of direction of any joint other than a butt joint in a straight run, a preliminary joint, intersection or change of direction piece shall be made and subjected to such tests as the Engineer may require.

Precautions shall be taken so that the Water Stops shall neither be displaced nor damaged by construction operations or other means. All surfaces of the Water Stops shall be kept free from oil, grease, dried mortar or any other foreign matters while the Water Stop is being embedded in concrete. Means shall be used to ensure that all portions of the Water Stop designed for embedding shall be tightly enclosed by dense concrete.

11.6 MEASUREMENT

Construction Joints shall not be measured. Expansion and Contraction joints shall be measured in linear meter of the joints considered satisfactory by the Engineer and accepted by him. There will be no additional measurement for joint fillers, sealed joints, Water Stops, miscellaneous metal devices etc.

11.7 PAYMENT

Payment for construction joints shall be deemed included in the items of concrete and there will be no extra payment for it. For expansion and Contraction joints the amount of completed and accepted works measured as provided above shall be paid at the Contract Unit Price per linear meter and the payment shall constitute the full compensation for furnishing and placing joint fillers, sealed joints, Water Stops, drains, vents, miscellaneous metal devices including all labour and incidentals for full completion of the Work as per Specifications.

Item of Payment	Unit
Expansion joints Linear	meter / Linear feet

Contraction joints Linear	meter / Linear feet

12. REINFORCING STEEL

12.1 REINFORCEMENT FOR RCC

12.1.1 DESCRIPTION

Works covered by this item shall consist of supplying and placing of steel reinforcement in different types of concrete structures including board cast-in-situ piles and pre-cast concrete piles but not includes reinforcement for pre-stressed concrete. The works shall conform to the specifications, the types, sizes and positions of reinforcement requirements shown on the Drawings and this specification.

12.1.2 MATERIALS REINFORCEMENT

Reinforcing bars discussed under this Section shall be made of Mild Steel or High yield Steel, plain or deformed, for all Reinforced Concrete Works but excluding Pre-stressing Concrete.

Bars shall be rolled and produced from steel in the form of new and clean billets directly reduced from ingot of properly identified heats of open hearth, basic oxygen or electric arc furnace steel or lots of acid besmear steel.

Reference Standards

Deformed reinforcement

Deformed and Plain Billet Steel Bars for Concrete Reinforcement − ASTM A 615

Rail Steel Deformed and Plain Bars for Concrete Reinforcement − ASTM A 616

Axle Steel Deformed and Plain Bars for Concrete Reinforcement − ASTM A 617

Low Alloy Steel Deformed Bars for Concrete Reinforcement − ASTM A 706

Deformed Steel Wire − ASTM A 496

Welded Deformed Steel Wire Fabric − ASTM A 497

Zinc Coated (Galvanized) Steel Bars − ASTM A 767

Epoxy − Coated Reinforcing Steel − ASTM A 775

Plain reinforcement

ASTM A 615 M, ASTM A 616 M, ASTM A 617 M, ASTM A 185

Smooth steel wire

Cold − Drawn Steel Wire - ASTM A 82

Cold − worked steel reinforcement

IS 1786: 1985, BS 4461: 1978

Mild steel plain round bar

This is a type of bar plain and round in shape of a structural or intermediate grade with yield strength of not less than 280 MPa (N/mm2) i.e. 40 grade.

Deformed bars

Reinforcing steel under this type comprises Mild Steel Grade 40 and High Strength Grade 60 Deformed re-bars with yield strength of not less than 280 MPa (N/mm2) in case of Grade 40 and with yield strength of not less than 410 MPa (N/mm2) in case of Grade 60.

Other bars

Steel welded wire, fabric plain reinforcement conforming to ASTM A 185 may be used, except that for wire with specified yield strength fy exceeding 410 MPa (N/mm2), fy will be the stress corresponding to a strain of 0.35 percent.

Smooth steel wire conforming to ASTM A 82 may be used in concrete except that for a wire with a specified yield strength fy exceeding 410 MPa (N/mm2), fy will be the stress corresponding to a strain of 0.35 percent.

Fabricated deformed steel bar mats conforming to ASTM A 184 and deformed steel wire complying with ASTM A 496 may be used. Deformed wire for concrete reinforcement shall not be smaller than a nominal diameter of 5.72mm, and for a wire with specified yield strength (fy) exceeding 410 MPa (N/mm2), fy shall be the stress corresponding to a strain of 0.35 percent.

Welded deformed steel wire fabric conforming ASTM A 497 may be used for a wire with specified yield strength exceeding (fy) 410 MPa (N/mm2), fy will be the stress corresponding to a strain of 0.35 percent.

12.1.3 CHEMICAL COMPOSITION

The structural grade shall be made from billets. The ends of the bar shall be machine sheared perpendicular to the axis of the bar. The bars shall be free from injurious defects and shall have a workman like finish.

The chemical composition should conform to the requirements of ASTM 706-82

12.1.4 PROCESS

The steel shall have been made by one or more of the following processes:

i. open-hearth
ii. basic oxygen
iii. electric furnace
iv. acid besmear

12.1.5 DIMENSIONAL REQUIREMENTS

The nominal diameter, cross sectional areas and perimeter of a deformed bar are equivalent to that of a plain bar having the same standard weight per unit length. Dimensional requirements of such bars have been shown in the Table given below:

Bar Designation No.*	Nominal Dimensions**			Nominal weight, lb/ft [Nominal mass, kg/m]
	Diameter, in. [mm]	Cross Sectional Area, in.² [mm²]	Perimeter, in. [mm]	
3 [10]	0.375 [9.5]	0.11 [71]	1.178 [29.9]	0.376 [0.560]
4 [13]	0.500 [12.7]	0.20 [129]	1.571 [39.9]	0.668 [0.994]
5 [16]	0.625 [15.9]	0.31 [199]	1.963 [49.9]	1.043 [1.552]
6 [19]	0.750 [19.1]	0.44 [284]	2.356 [59.8]	1.502 [2.235]
7 [22]	0.875 [22.2]	0.60 [387]	2.749 [69.8]	2.044 [3.042]
8 [25]	1.000 [25.4]	0.79 [510]	3.142 [79.8]	2.670 [3.973]
9 [29]	1.128 [28.7]	1.00 [645]	3.544 [90.0]	3.400 [5.060]
10 [32]	1.270 [32.3]	1.27 [819]	3.990 [101.3]	4.303 [6.404]
11 [36]	1.410 [35.8]	1.56 [1006]	4.430 [112.5]	5.313 [7.907]
14 [43]	1.693 [43.0]	2.25 [1452]	5.32 [135.1]	7.65 [11.38]
18 [57]	2.257 [57.3]	4.00 [2581]	7.09 [180.1]	13.60 [20.24]

*Bar numbers are based on the number of eighths of an inch including in the nominal diameter of the bars [bar numbers approximate the number of millimeters of the nominal diameter of the bar]

** The nominal dimension of a deformed bar are equivalent to those of a plain round bar having the same weight [mass] per foot [meter] as the deformed bar.

12.1.6 TENSILE PROPERTIES

The tensile properties of the Grade 40 and Grade 60 steel have been shown in the Table given below:

Item	Requirements	
	Grade 40 [300]*	Grade 60 [420]
Tensile strength, min, psi [MPa]	70,000 [500]	90,000 [620]
Yield strength, min, psi [MPa]	40,000 [300]	60,000 [420]
Elongation in 8 in. [203.2 mm], min, %		
Bar Designation No.		
3 [10]	11	9
4, 5 [13, 16]	12	9
6 [19]	12	9
7, 8 [22, 25]	-	8
9, 10, 11 [29, 32, 36]	-	7
14, 18 [43, 57]	-	7

* Grade 40 [300] bars are furnished only in sizes 3 through 6 [10 through 19].

12.1.7 BEND TEST REQUIREMENT

The pin diameter required for performing bend tests shall conform to ASTM A 615. The following table contains such requirements:

Bar Designation No.	Pin Diameter for Bend Tests *	
	Grade 40 [300]	Grade 60 [420]
3, 4, 5 [10, 13, 16]	3.5d	3.5d
6 [19]	5d	5d
7, 8 [22, 25]	-	5d
9, 10, 11 [29, 32, 36]	-	7d
14, 18 [43, 57] (90°)	-	9d

* Test bends 1800 unless noted otherwise.

d = Nominal diameter of specimen

Permissible variation

For lots from standard weights + 5% for 6mm dia

+ 3.5% for 10mm dia and above

Individual + 6% for all sizes

Length

Length of the bar shall be maximum possible, but each bar shall not be less than 12m in length or 45.36 kg in weight whichever is greater.

12.1.8 ASTM CODE REQUIREMENTS FOR DEFORMATIONS

Deformations shall be spaced along the bar at substantially uniform distances. The deformations on the opposite sides of the bar shall be similar in size and shape.

The deformations shall be placed with respect to the axis of the bar so that the included angle is not less than 45°. Where the line of deformation forms an included angle with the axis of the bar from 45° to 70° inclusive, the deformations shall alternately reverse in direction on each side, or those on one side shall be reversed in direction from those on the opposite side. Where the line of deformation is over 70°, a reversal in direction is not required.

Average spacing or distance between deformations on each side of the bar shall not exceed 17 (seventeen) times of the nominal diameter of the bar.

Overall length of deformations shall be such that the gap between the ends of the deformations on the opposite sides of the bar shall not exceed 12.5% of the nominal perimeter of the bar. Where the ends terminate in a longitudinal rib, the width of the longitudinal rib shall be considered as the gap. Where more than two longitudinal ribs are involved, the total width of all longitudinal ribs shall not exceed 25% of the nominal perimeter of the bar. Furthermore, the summation of gaps shall not exceed 25% of the nominal perimeter of the bar. Nominal perimeter of the bar shall be 3.14 times the nominal diameter (db).

Spacing, height and gap of deformations as to be conformed have been shown in the following table:

Deformation requirements, in. [mm]

Bar designation	Maximum average spacing	Minimum average height	Maximum gap (Chord of 12.5% of Nominal Perimeter)
3 [10]	0.262 [6.7]	0.015 [0.38]	0.143 [3.6]
4 [13]	0.350 [8.9]	0.020 [0.51]	0.191 [4.9]
5 [16]	0.437 [11.1]	0.028 [0.71]	0.239 [6.1]
6 [19]	0.525 [13.3]	0.038 [0.97]	0.286 [7.3]
7 [22]	0.612 [15.5]	0.044 [1.12]	0.334 [8.5]
8 [25]	0.700 [17.8]	0.050 [1.27]	0.383 [9.7]
9 [29]	0.790 [20.1]	0.056 [1.42]	0.431 [10.9]
10 [32]	0.889 [22.6]	0.064 [1.63]	0.487 [12.4]
11 [36]	0.987 [25.1]	0.071 [1.80]	0.540 [13.7]
14 [43]	1.185 [30.1]	0.085 [2.16]	0.648 [16.5]
18 [57]	1.58 [40.1]	0.102 [2.59]	0.864 [21.9]

Note: Any bar that fails to satisfy the aforementioned all requirements is to be treated as plain reinforcement

12.1.9 BINDING WIRE

Reinforcement binding wire shall be the best black annealed mild steel wire and not less than 1.6mm in diameter in approximation/18 - 22 BWG or 26 BWG galvanized iron wire.

12.1.10 WIRE MESH

Wire mesh shall conform to the requirements of AASHTO Standard Specification M 55 Welded Steel Wire Fabric for Concrete Reinforcement.

12.1.11 ORDERING MATERIAL

The name of the proposed supplier of the reinforcement shall be submitted as soon possible to the Engineer for his approval. The Contractor shall submit necessary information concerning the supplier as requested by the Engineer.

Copies of orders placed shall be submitted to the Engineer.

The manufacturer shall submit all requested relevant data on the steel, i.e. breaking strength, yield strength, characteristics on elongation, chemical composition etc., to the Engineer for his approval.

No steel shall be delivered without a certificate guaranteeing the yield stress.

The steel shall be stored and marked in a way that it enables identification of the steel corresponding to each certificate later on.

12.1.12 TESTS

Test results in addition to those to be submitted by the Contractor and specified above shall be required.

The Contractor shall cut out samples as directed by the Engineer.

The samples shall be tested according to the Engineer's instructions by an approved Testing Institution. Approximately three samples shall be tested from each 10 tons of reinforcement delivered at the Site. Expenses incurred in connection with cutting, carrying and testing the samples shall be borne by the Contractor at his own costs.

12.1.13 CONSTRUCTION METHODS OF REINFORCING BAR

Storage and care

All reinforcing steel when received at the Site, prior to its use, shall be stacked off the ground on platforms, skids or any other support and shall be kept free from dirt, oil and grease. All cares shall be taken to prevent the steel reinforcement from any mechanical injury and surface loss resulting from its exposition to weather conditions that produce rust. It shall be clean and kept free from loose rust and loose mill scale at the time of fixing in position and subsequent pouring of concrete. However, reinforcement steel may not be rejected on the ground of bonded rust, surface seams, surface irregularities and mill scale so long minimum dimensions, cross-sectional area and tensile properties of a hand wire brushed specimen meet the specified physical requirements for the size and grade of steel.

Reinforcement shall be handled and stored in a manner that will prevent bending out of the desired shape and any accumulation of dirt, oil and paint. When placed in the works, it shall be free from dirt, oil, grease, paint, mill scale and loose or thick rust.

Bar reinforcement shall be shipped in standard bundles, tagged and marked in accordance with the Codes of Practice of the Concrete Reinforcing Steel Institute.

Fabrication

All bars shall be fabricated following Specifications, methods and procedures stated below. Fabrication tolerances shall be in accordance with ACI 315.

Cutting and bending

All reinforcement bars shall be cut and bent cold to the specified shape and pertinent dimensions shown on the Drawings using a proper bar bender, operated by hand or power to attain proper radii of bends. The equipment used and methods followed for this purpose shall get the approval of the Engineer.

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

Bars partially embedded in concrete shall not be field bent unless otherwise shown on the Drawings or directed by the Engineer.

Errors in alignment of reinforcement partially embedded in hardened concrete shall not be corrected by bending in place, except as permitted by the Engineer.

Bars bent during transportation or handling shall be straightened before being used in work. It shall not be heated to facilitate bending.

Fabrication tolerances shall be in accordance with ACI 315.

All plain bars shall have standard hooks at the end, which shall meet the following requirements unless otherwise specified on the Drawings. When the dimensions of hooks or the diameter of bends are not prescribed, they shall be in accordance with ACI 318 'Building Code requirements for Reinforced Concrete'. Some of the standard requirements have been specified below:

i. 180° turn plus an extension of at least 4 bar diameters but not less than 60mm at the free end of the bar.
ii. 90° turn plus an extension of at least 12 bar diameters at the free end of the bar.
iii. For stirrup and the anchorage only:
   - For 16 mm dia bar and smaller : 90° bend plus an extension of at least 6 bar diameters or 75mm whichever is greater at the free end of the bar.
   - For 20mm and 25mm dia bar : 90° bend plus an extension of at least 12 bar diameters or 150mm whichever is greater at the free end of the bar.
   - For 25mm dia bar and smaller : 135° bend plus an extension of at least 6 bar diameters at the free end of the bar.
   - For closed ties and continuously wounded ties : 135° bend plus an extension of at least 6 bar diameters, but not less than 75mm.

The minimum diameter of bend measured on the inside of the bar, for standard hooks other than for stirrups and ties in sizes 10mm Φ thorough 16mm Φ, shall not be less than the values shown in the table given below.

Minimum diameters of Bend

Bar size	Minimum diameter of bend
$10mm \leq d_b \leq 25mm$	$6d_b$
$25mm \leq d_b \leq 40mm$	$8d_b$
$40mm \leq d_b \leq 55mm$	$10d_b$

* db is the nominal diameter of bar, mm

For stirrups and tie hooks, inside diameter of bend shall not be less than 4 bar diameters for 16mm Φ bar and smaller. For bars larger than 16mm Φ, diameter of bend shall be in accordance with the specifications shown in the above table.

Bends for other bars, where full tension in the bar may occur, shall be made around a pin having a diameter not less than 20 bar diameters. Hooks shall conform to American Concrete Institute Standard.

Building Code Requirements for reinforced concrete ACI 316-89, or as shown on the Drawings or as directed by the Engineer.

Placing, supporting and fastening

All bar reinforcement shall be accurately placed, supported and secured in position as shown on the Drawings using approved spacer blocks and chairs prior to any concrete pouring. Displacement tolerance may be allowed within the permissible tolerance limit as shown in the table given below unless otherwise specified by the Engineer. The reinforcement shall be checked and approved by the Engineer before pouring of concrete.

Tolerance for Placing Reinforcement

	Tolerance for depth (d)	Tolerance for Minimum Concrete Cover
$d \leq 200mm$	± 10mm	- 10mm
$d \leq 200mm$	± 12mm	- 12mm

Notwithstanding the above provisions, tolerance for the clear distance to formed soffits shall be minus 6mm and tolerance for cover shall not exceed minus one-third the minimum concrete cover required in the design Drawings or specifications.

Tolerance for longitudinal location of bends and ends of reinforcement shall be ± 50mm, except at discontinuous ends of members where tolerance shall be ± 12mm.

Welding of crossing bars shall not be permitted for assembly of reinforcement unless authorized by the Engineer.

The Contractor shall be responsible for the accuracy of cutting, bending and placing of the reinforcement. Reinforcement will be inspected for compliance with the requirements as to grade, size, shape, length, splicing locations, overlapping length and position after it has been placed.

Before the reinforcement is placed, the surfaces of the bars and the surfaces of any metal bar supports shall be cleaned of heavy rust, loose mill scale, dirt, grease and other objectionable foreign substances. Heavy flaky rust, which can be removed in firm rubbing with hessian or equivalent treatment, shall be considered objectionable. After being placed, the reinforcing bars shall be maintained in a clean condition until they are completely embedded in the concrete.

Reinforcement shall be accurately placed in the position shown on the Drawings and/or as directed by the Engineer and shall be securely held by blocking against the forms, by supporting on concrete or approved metal or plastic chairs or by using metal hangers and by wiring together at intersections using annealed wire of specified diameter with the ends turned in to the main body of concrete. Bars shall be tied at all intersections except where spacing is less than 300mm in any direction when alternate intersections shall be tied. Wire ties shall be securely tied and folded so that they do not project beyond the planes formed by the reinforcing bars. The adequacy of the supports and ties to secure the reinforcement properly shall be subject to the approval of the Engineer.

Reinforcement supports shall be strong enough to withstand the imposed loads without movement of the reinforcement. They shall be positively attached to the reinforcement and of such size and number as to maintain the specified cover.

There shall be a clear distance of at least 25mm between the bars and any adjacent embedded metal works. The Contractor shall ensure that there is no disturbance of the reinforcing bars in concrete that has already been placed.

Reinforcement binding wire shall be best black annealed mild steel wire and not less than approximately 1.6mm in diameter/18 - 22 BWG galvanized iron wire.

Cover blocks required for ensuring that the reinforcement is correctly positioned shall be as small as possible, consistent with their purpose, or a shape and material acceptable to the Engineer and designated so that they will not overturn when the concrete is placed. The concrete cover blocks or space blocks shall be made of concrete having 1 part cement, 1 part sand and 2 part coarse aggregate. The coarse aggregate would be 6mm downgraded. The blocks would be cast in mould and continuously cured for 21 days before use. Wire shall be cast in the block for the purpose of tying it to the reinforcement. The wire must not be closer than 30mm from the concrete surface. The use of small stones or wood blocks shall not be permitted.

If concrete cylinder blocks are used for proper spacing of vertical bars in column, the height shall be 2.54cm and radius shall be equal to the distance of the centre line of the bar from column face.

Top reinforcement in slabs shall be maintained in position by means of chairs made out of ferrous metal and shall conform to industry practice as described in the Manual on 'Standard Practice of the Concrete Reinforcing Steel Institute'. The diameter and quantity being sufficient to ensure security of the reinforcement shall be used to support access ways, working platforms, or the placing equipment or for conducting of an electric current.

Platforms for the support of workers and equipment and machines shall be placed directly on the forms without any disturbance of the reinforcing steel during concrete placement.

Before any steel reinforcement is embedded in the concrete, any loose mill scale, loose rust and any oil, grease or other deleterious matter shall be removed. Partially set concrete, which may adhere to the exposed bars during concrete placing operations, shall also be removed.

12.1.14 LATERAL REINFORCEMENT FOR COLUMNS

Spirals

Spiral reinforcement for columns shall conform to the following:

i. Spirals shall consist of evenly spaced continuous bar or wire of such size and so assembled as to permit handling and placing without distortion from designed dimensions.
ii. Size of spirals shall not be less than 10mm diameter for cast-in-place construction.
iii. The minimum and maximum clear spacing between spirals shall be 25mm and 75mm respectively.
iv. Anchorage of spiral reinforcement shall be provided by 1.5 extra turns of spiral bar or wire at each end of a spiral unit.
v. Splices in spiral reinforcement shall be lap splices of 48 spiral diameter, but not less than 300mm.
vi. Spirals shall extend from the top of footing or slab in any story to the level of the lowest horizontal reinforcement in members supported above.
vii. Spirals shall extend above termination of spiral to bottom of slab or drop panel, where beams or brackets do not frame in to all sides of a column.
viii. Spirals shall extend to a level at which the diameter or width of capital is 2 times that of the column, in case of columns with capitals.
ix. Spirals shall be held firmly in place and true to line.

Ties

Tie reinforcement for compression members shall conform to the following: i. All bars shall be enclosed by lateral ties, at least 10mm diameter in size for longitudinal bars 30mm diameter or smaller, and at least 12mm diameter in size for 35mm diameter to 55mm diameter and bundled longitudinal bars. ii. Vertical spacing of ties shall not exceed 16 longitudinal bar diameters or 48 tie diameters, or the least dimension of the compression members.

iii. Ties shall be arranged such that every corner and alternate longitudinal bar shall have lateral support provided by the corner of a tie with an included angle of not more than 135°. No vertical bar shall be farther than 150mm clear on each side along the tie from such a laterally supported

bar. Where longitudinal bars are located around the perimeter of a circle, a complete circular tie is allowed.

iv. The lowest tie in any story shall be placed within one-half the required tie spacing from the top most horizontal reinforcement in the slab or footing below. The uppermost tie in any story shall be within one-half the required tie spacing from the lowest horizontal reinforcement in the slab or drop panel above.

v. Where beams or brackets provide concrete confinement at the top of the column on all (four) sides, the top tie shall be within 75mm of the lowest horizontal reinforcement in the shallowest of such beams or brackets.

Lateral reinforcement for beams

Compression reinforcement in beams shall be enclosed by ties or stirrups satisfying the size and spacing limitations as stated above. Such ties or stirrups shall be provided throughout the distance where compression reinforcement is required.

Lateral reinforcement for flexural framing members subject to stress reversals or to torsion at supports shall consist of closed ties, closed stirrups, or spirals extending around the flexural reinforcement.

Closed ties or stirrups shall be formed in one piece by overlapping standard stirrup or tie end hooks around a longitudinal bar, or formed in one or two pieces laps, spliced with a lap of development length

12.1.15 SPACING OF REINFORCEMENT

The minimum clear spacing between parallel bars in a layer shall be equal to one bar diameter, but not less than 25mm.

Where parallel reinforcement is placed in two or more layers, bars in the upper layers shall be placed directly above those in the bottom layer with clear distance between layers not less than 25mm.

For compression members, the clear distance between longitudinal bars shall be not less than 1.5 bar diameters or 35mm.

Clear distance limitation between bars shall apply also to the clear distance between a contact lap splice and adjacent splices or bars.

In walls and one-way slabs, the maximum bar spacing shall be three times the wall or slab thickness (h) but not more than 450mm.

For two-way slabs, maximum spacing of bars shall be 2h but not more than 450mm.

For temperature steel only, maximum spacing shall be 5h but not more than 450mm.

12.1.16 SPLICING

General

All reinforcement shall be furnished in the full lengths indicated on the Drawings unless otherwise permitted by the Engineer. Except for splices shown on the Drawings and splices for No. 5 or smaller

bars, splicing of bars shall not be permitted without the written approval of the Engineer. Splices shall be staggered as far as possible.

Where the Drawings do not detail laps that will be necessary, the Contractor shall furnish working Drawings to the Engineer for his approval.

If such additional lap splices are approved, the extra weight occasioned by such lap splices shall not be included in the measurement of reinforcement for payment unless provided for in these Specifications.

Lapped splices

All splices for high yield strength steel bars shall have a lap length as shown on the Drawings or if not shown therein shall be in accordance with the American Concrete Institute Building Code Requirements for Reinforced Concrete (ACI 318-89).

All splices for mild steel shall have a lap length as shown on the Drawings or if not shown therein, of not less than 40 diameters of the smaller bar when hooks are used and 50 diameters for bars without hooks.

Lap splices shall not be used for 35mm diameter bars and larger, except when bars of different diameters are lap spliced in compression, the splice length shall be the larger development length of the larger bar, or the splice length of the smaller bar.

Lap splices of bundled bars shall be based on the lap splice length required for individual bars within the bundle, increased in accordance with development of bundled bars. Individual bar splices within a bundle shall not overlap. Entire bundles shall not be lap spliced.

Bars spliced by non-contact lap splices in flexural members shall not be spaced transversely farther apart than one-fifth the required lap splice length, nor 150mm.

Lap splices shall generally be located at points of minimum tension in bars. Except where otherwise shown on the Drawings, lap splices shall be made with the bars placed in contact and securely wired together.

Welded splices

Welding on Site shall be avoided wherever possible, but where suitable safeguards and techniques are employed and provided that the types of steel including high-yield steels to SS 2 have the required welding properties, it may be undertaken with the acceptance of the Engineer. Before welding any reinforcement, the Contractor shall supply to the Engineer a Welding Procedure Specification (WPS) and an example of the weld for the type of steel, connection and weld being proposed. If suchevidence is not available, the Contractor shall demonstrate satisfactory performance by means of testing as agreed by the Engineer. Unless satisfactory performance of the proposed welded connection is established by either of the two methods described above, approval for use of the welded connection shall not be given.

In addition, and as required by the Engineer, the competence of the operators shall be demonstrated prior to and periodically during welding operations by submission of independent Welder Qualification Records (WQR) for each welder to be used on Site.

Welding may be used in fixing reinforcement in position, for example, by welding between crossing or lapping reinforcement, or between bars and other steel members.

Welded intersections shall not be spaced farther apart than 300mm in the direction of calculated stress, except for wire fabric used as stirrups.

Structural welding shall not be carried out unless specifically shown on the Drawings.

Notwithstanding the above, the Engineer will not permit tack welding of bars, which will be subject to fluctuating stresses in the completed structure.

Welding shall conform to the Structural Welding Code, Reinforcing Steel, AWS D 1.4 of the American Welding Society and applicable special provisions.

Welded splices shall be butted and welded to develop in tension at least 125 percent of specified yield strength fy of the bar. A full mechanical connection shall develop in tension or compression, as required, at least 125 percent of specified yield strength fy of the bar. Welded splices and mechanical connections not meeting the above requirements are allowed where area of reinforcement is at least twice that required by analysis shall meet the following: i. Splices shall be staggered at least 600mm and in such manner as to develop at every section at least twice the calculated tensile force at the section but not less than 140 N/mm2 for total area of reinforcement provided.

ii. Spliced reinforcement may be rated at the specified splice strength, in computing tensile force developed at each section. Non-spliced reinforcement shall be rated at that fraction of fy defined by the ratio of the shorter actual development required to develop the specified yield strength (fy).

Splices of deformed bars in tension

The minimum length of lap for tension splices shall be as required for Class A or B splice, but not less than 300mm, where the classification shall be as follows:

Class A splice……. 1.0Ld

Class B splice……. 1.3Ld

* Ld is the development length

Lap splices of deformed bars in tension, shall be Class-B splices except that Class-A splices are allowed when the area of reinforcement provided is at least twice that required by analysis over the entire length of the splice, and one-half or less of the total reinforcement is spliced within the required lap length. Where area of reinforcement provided is less than twice that required by analysis, welded splices or mechanical connections used shall meet the following requirements. This is also applicable in case of splices in tension tie members those shall be made with a full welded splice or full mechanical connection. i. Welded splices shall be butted and welded to develop in tension at least 125 percent of specified yield strength fy of the bar.

ii. A full mechanical connection shall develop in tension or compression, as required, at least 125 percent of specified yeild strength fy of the bar.

Welded splices or mechanical connections used where area of reinforcement provided is at least twice that required by analysis shall meet the following: i. Splices shall be staggered at least 600mm and in such manner as to develop at every section at least twice the calculated tensile force at the section but not less than 140 N/mm2 for total area of reinforcement provided. ii. Spliced reinforcement may be rated at the specified splice strength, in computing tensile force developed at each section. Non-spliced reinforcement shall be rated at that fraction of fy defined by the ratio of the shorter actual development length to ld required to develop the specified yield strength fy.

Splices in adjacent bars shall be staggered at least 750mm.
Splices of deformed bars in compression The minimum length of lap for compression splice shall be 0.07 fy.db for fy equal to 410 N/mm2 or less or (0.13 fy – 24)db for fy greater than 410 N/mm2, but not less than 300mm. For f'c (specified compressive strength of concrete, N/mm2) less than 20 N/mm2, length of lap shall be increased by one-third.

When bars of different diameters are lap spliced in compression, the splice length shall be the larger of the development length of the larger bar, or the splice length of the smaller bar. Welded splices or mechanical connections used in compression shall also satisfy the following requirements: i. Welded splices shall be butted and welded to develop in tension at least 125 percent of the specified yield strength fy of the bar.

ii. A full mechanical connection shall develop in tension or compression, as required, at least 125 percent of the specified yield strength fy of the bar.

End bearing splices

i. Compression splices for bars required to transmit compressive stress only, may consist of end bearing of square cut ends held in concentric contact by a suitable device.

ii. Bar ends shall terminate in flat surfaces within 1.5° of a right angle to the axis of the bars, and shall be fitted within 3° of full bearing after assembly.

iii. End bearing splices shall be used only in members containing closed ties, closed stirrups or spirals.

Special splice requirements for columns.

Lap splices, butt-welded splices, mechanical connections, or end-bearing splices shall be used with the limitations as stated below. A splice shall satisfy the requirements for all load combinations for the column.

Lap splices in columns
i. Lap splices shall conform to the first two requirements stated above under the Sub-section on 'Splices of Deformed Bars in Compression' and where applicable to (d) or (e) below where the bar stress due to factored loads is compressive.

ii. Where the bar stress due to factored loads is tensile and does not exceed 0.5fy in tension, lap splices shall be Class B tension lap splices, if more than one half of the bars are spliced at any

section, or Class A tension lap splices, if half or fewer of the bars are spliced at any section and alternate lap splices are staggered by ld (development length).

iii. Where the bar stress due to factored loads is greater than 0.5fy in tension, lap splices shall be Class B tension lap splices.

iv. If spiral reinforcement confines the splice, the lengths required may be multiplied by 0.75, but lap length shall not be less than 300mm.

Welded splices or mechanical connectors in columns

Welded splices or mechanical connectors in columns shall also meet the following requirements. i. Welded splices shall be butted and welded to develop in tension at least 125 percent of specified yield strength fy of the bar. ii. A full mechanical connection shall develop in tension or compression, as required, at least 125 percent of specified yield strength fy of the bar.

End bearing splices in columns

End bearing splices complying with the requirements stated above under Sub-section on "End Bearing Splices' may be used for column bars stressed in compression provided that the splices are staggered or additional bars are provided at splice locations. The continuing bars in each face of the column shall have a tensile strength at least 0.25fy times the area of the vertical reinforcement in that face.

Splices of plain bars

For plain bars, the minimum length of lap shall be twice that of deformed bars.

Mechanical anchorage

Any mechanical device capable of developing the strength of reinforcement without damage to concrete is allowed as anchorage.

Mechanical device may be used only when its adequacy can be proven by test results to the satisfaction of the Engineer.

Development of reinforcement may consist of a combination of mechanical anchorage plus additional embedded length of reinforcement between the point of maximum bar stress and the mechanical anchorage.

12.1.17 SUBSTITUTIONS

Substitutions of different size bars shall be permitted only with specific authorization by the Engineer and at no additional cost to the Employer. If bars are substituted, they shall have a cross sectional area equivalent to the design area or larger.

The Contractor shall also provide, also in the case of substitutions, at his own expenses and to the approval of the Engineer, such necessary detailing of the reinforcement as he requires for the execution of the work to the Engineer's satisfaction.

12.1.18 CONCRETE COVER TO REINFORCEMENT

Unless specified on the Drawings, the clear concrete cover to reinforcement shall be as tabulated below:

Description of Concrete Element	Clear Cover (mm)	
	Normal Exposure	Saline Water
Wall and footing a) Contact with earth b) Expose to weather and water	 60 50	 75 60
Piles a) Cast-in-place b) Pre-cast	 75 40	 100 50
Beam, Girder, Column	40	50
Building roof and floor slab	25	25

12.1.19 PROTECTIVE COATING

All exposed reinforcing steel at construction joints shall be protected with a brush coat of neat cement mixed to a consistency of thick paint within one week after the placing of the initial concrete, unless it is definitely known that the steel will be embedded within 30 days. This coating shall be entirely removed, by light tapping with a hammer or other tools, not more than one week before the placing of the final pour.

12.1.20 BUNDLED BARS

i. Groups of parallel reinforcing bars bundled in contact to act as one unit, shall be limited to four in any one bundle.

ii. Bundled bars shall be enclosed within stirrups or ties.

iii. Bars larger than 35mm diameter shall not be bundled in beams.

iv. Individual bars within a bundle terminated within the span of flexural members shall terminate at different points with at least 40 times the nominal diameter of bar staggered.

v. Where spacing limitations and minimum concrete cover are based on nominal bar diameter, a unit of bundled bars shall be treated as a single bar of a diameter derived from the equivalent total area.

vi. Minimum concrete cover shall be equal to the equivalent diameter of the bundle, but need not be greater than 50mm.

12.1.21 INSPECTION

The Contractor shall notify the Engineer when the steel has been placed in position and ready for concrete placing. No concrete shall be placed until the Engineer inspected the steel and given his approval in writing.

12.1.22 MEASUREMENT

The quantity of reinforcement to be measured under this Section shall be the computed weight in kilogram of material used and accepted as shown on the Drawings provided that the quantity shall not include the reinforcement in any item of works. In computing the weight to be measured, the theoretical weights of bars of the cross section shown in this Specification shall be used.

The computed weight shall not include the extra materials incurred, when bars larger than those specified are used or the extra materials necessary for splices, when bars shorter than those specified are used even with the permission of the Engineer. It shall not also include the weight of any devices used to support or fasten the reinforcement in correct position.

12.1.23 PAYMENT

This work measured as provided above, shall be paid for at the Contract unit price per kilogram of reinforcement for the particular Bill of Item. The payment shall be considered to be the full compensation for furnishing, fabricating, splicing and placing of the reinforcing steel, supports and binding wire, cutting and bending, all labours, equipment, tools and incidentals necessary to complete the works prescribed in this Section.

No separate payment shall be allowed for chairs, laps, splices, separators etc. The costs of these shall be considered included in the unit rate.

Item of Payment	Unit
Mild steel reinforcing bars	Kilogram
High yield steel reinforcing bars	Kilogram

12.2 WELDING

12.2.1 GENERAL

All welding shall be performed by certified welders and in accordance with the American Welding Society (AWS) D1.1 'Structural Welding Code' or similar approved standard.

The principal forms of welding metals are as follows:

i. Electric arc welding
ii. Gas welding

The electric arc welding process is the most important and is most extensively used for mild steels ranging from light articles with a wall or thickness of 16 gauge to heavy fabrications. This is a process whereby the metal of the two members to be welded is fused together through hit generated by an electric arc. Fusion should be complete over the whole area of the joint surface.

Gas welding is done using oxy-acetylene flame and is not adapted to structural steel works, but is generally used for small jobs. The flame produced by burning oxy-acetylene is fed through a blow-pipe, which is ignited at its tip. The flame is played on the two pieces to be welded until the metal becomes hot enough to fuse together adding additional metal to the joint as necessary by melting in to it a suitable electrode.

Unless otherwise specified, all welding shall be performed following the Shielded Metal Arc Process with low hydrogen electrodes for manual welding.

The Contractor shall be responsible for the quality of the welding performed by his welding organization. All welding by the Contractor shall be carried out by the electric arc method using coated electrodes or other means whereby the air is excluded from the molten metal and where applicable, automatic machines with correct procedure control shall be used.

12.2.2 WORKMANSHIP AND VISUAL QUALITY REQUIREMENTS

In addition to conforming with the procedural and quality requirements set forth in the Structural Welding Code and/or these Specifications, all manual welding shall meet the following requirements for workmanship and visual quality.

i. Each weld shall be uniform in width and size throughout its full length and each layer of welding shall be smooth, free of slag, cracks, pinholes and undercut and shall be completely fused to the adjacent weld beads and base metal. In addition, the cover pass shall be free of coarse ripples, irregular surface, non-uniform bead pattern, high crown, deep ridges or valleys between beads and shall blend smoothly and gradually into the surface of the base metal.

ii. Butt Welds shall be slightly convex, of uniform height and shall have full penetration.

iii. Fillet Welds shall be of specified size with full throat and with each leg of uniform length.

iv. Repair, chipping or grinding of welds shall be done in such a manner as not to gouge, groove, or reduce the base metal thickness.

12.2.3 WELDING REPAIRS

All weld defects which are determined unacceptable, shall be removed by chipping, grinding, arc or flame gouging, following which the area shall be properly prepared for welding, repaired by an approved qualified welding procedure and re-tested as necessary. The Contractor shall establish the cause of all defects and show that such defects have been corrected before welding will be permitted. All repairing shall be done by and at the expenses of the Contractor.

12.2.4 PEENING

The Contractor shall not be allowed to peen welds without prior approval of the Engineer.

12.2.5 ELECTRODES

All electrodes shall be purchased in sealed containers and shall be thoroughly dry when used. Electrodes, taken from sealed containers, shall be used within four hours. Electrodes not used within four hours shall be stored in electrode storage ovens. The electrode storage oven temperature shall be in accordance with the electrode manufacturer's recommendations. Electrodes with wet or damaged coatings shall not be used.

A simple test indicates the quality of an electrode or welding or welding wire can be made by laying the wire flat on a clean surface and applying the welding flame to it for a distance of about 8 - 10cm by moving the flame backward and forward until the wire becomes red and then slowly melting the wire, moving the flame in such a manner so that the wire melts only half-way through its diameter. If the flame is withdrawn as soon as the rod metal begins to melt, the impurities can readily be seen

being thrown off in the form of sparks, or a boiling action in the case of inferior metal. When cold, an inferior metal will contain numerous spongy, volcano-like irregularities. A good metal welding rod will melt and flow evenly without any disturbing actions.

Cracks may occur in welding alloy steels owing to the rapidity with which these harden. This may largely be avoided by preheating the parent metal at 300oC or above in advance of welding to lower the normal cooling rate.

The maximum diameters of electrodes for welding have been shown in the following table:

Average thickness of plate or section	**Maximum gauge or diameter of electrode to be used**
Less than 5mm	3.2mm – 10 SWG
5mm to Less than 8mm	4mm – 8 SWG
8mm to Less than 10mm	5mm – 6 SWG
10mm to Less than 16mm	6mm – 4 SWG
16mm to Less than 25mm	9mm
25mm and over	9mm

The maximum width of any bead of welding, other than a cover pass, shall not exceed 3 times the diameter of the electrode being used.

Subject to the approval of the Engineer, electrodes shall be carefully selected in order to provide metal welds with mechanical properties similar to those of the metal being welded, except that for welding higher strength steel to lower strength steel, the electrodes shall be chosen to provide metal welds with mechanical properties comparable to those of the lower strength material.

12.2.6 CUTTING AND EDGE PREPARATION

Members of structural steel and miscellaneous metal works, which are to be joined by welding shall be cut accurately to size and where required, shall be rolled or pressed to the proper curvature in accordance with dimensions shown. The edges of these members shall be sheared, flame-cut or machined to suit the required type of welding and to allow thorough penetration. The cut surfaces shall expose sound metal, free from laminations, surface defects caused by shearing or flame-cutting operations, or other injurious defects. The surface to be welded shall be free from rust, grease, paint and other foreign matter for a distance of at least 150mm back from the edge of the weld.

12.2.7 GRINDING WHEELS

Grinding wheels, which leave a deposit detrimental to subsequent welding will not be permitted. Grinding wheels, which are determined by the Engineer to be detrimental to welding shall not be used.

12.2.8 QUALIFICATION OF WELDERS AND WELDING OPERATORS

All welders and welding operators assigned to the work shall have passed the qualification test for welding operators as specified in the AWS Structural Welding Code. If, as determined by the Engineer, the work of any welder appears questionable, such welder will be required to pass additional qualification tests to determine his ability to perform the type of work on which he is engaged. Such additional qualification tests for welders and the physical tests of the welded specimens shall be made in the presence of the Engineer. If required, the Contractor shall furnish to the Engineer a certified copy of reports of the results of physical tests of specimens welded in the qualification tests. Fulfillment of such qualification shall be at the expenses of the Contractor.

12.2.9 WELDING METHODS

General

Methods which are essentially required to be followed while welding are as follows:

i. Welds should be made in the flat position as far as practicable.
ii. Freedom of movement of one member should be allowed as far as possible.
iii. The work should be securely held in position by means of spot welds, service bolts, clamps or jigs before commencing welding so as to prevent any relative movement due to distortion, wind or other causes.
iv. The parts to be welded must be thoroughly cleaned and proper flux used. Any paint or rust and loose mill scales, etc. should be removed from the surfaces to be welded and surrounding materials for a distance of at least 12mm from the weld. A coating of boiled linseed oil may be permitted. Steel to be welded should not be painted or oiled until after erection, unless all ends to be welded are left bare.
v. The sequence of welding should be such that when possible the members, offering the highest resistance to compression, are welded first.

Extreme care shall be taken to ensure that correct welding sequences and procedures are observed to avoid any strains and internal stresses arising in welding.

Welding of stainless steel

Unless otherwise specified, all welding shall conform with AWD D1.1. Electrodes used for welding of stainless steel shall be Series E308 and electrodes used for welding of stainless steel to carbon steel shall be Series E309.

Welders and welding operators assigned to the work shall have passed the qualification test for welding operators as specified above under 'Qualification of Welders and Welding Operators' of this Sub-section.

Welding of reinforcement

Electric Arc Butt-welding is most suitable for bars of diameter greater than 20mm and lap welding for smaller diameters and lap welding with longitudinal beads for 6mm to 40mm diameters. However, reinforcement, specified to be welded, shall be welded by any process the Contractor can demonstrate by bend and tensile tests, which will ensure that the strength of the parent metal is not reduced and that the weld possesses a strength no less than that of the parent metal. The

welding procedure established by the successful weld tests shall be maintained and no departure from this procedure shall be permitted. Following the establishment of a satisfactory welding procedures, each welder to be employed on the work shall carry out welder performance qualification tests on reinforcing bars of the same metal and size as those on the works.

Welds in positions other than those shown on the Drawings and/or as directed by the Engineer shall not be permitted.

12.2.10 DEFECTS IN WELDED JOINTS

The usual defects in welded joints are:

i. Lack of penetration or fusion of the metal to the bottom of the joint or welded members
ii. Laps in the metal of the weld not properly fused together. Defects are most likely to occur at the root of the weld and in this position they are liable to have the maximum effects in reducing the strength of the weld.

12.2.11 INSPECTION AND TESTING OF WELDS

The metal in a good weld when cold should show its original color. If the metal has a rusty or dull red color or appears crystallized, it is an indication that the heat has become too high and the metal has been burnt. A good weld will show an evenness of ripples or waves and well-formed beads with good fusion along the edges of the welds. There should be no unfilled cavities, small pockets of slags or burnt metal and small air or gas pockets. The strength of a welded joint may be taken only about 75 per cent of the stress usually allowed for common works, although tests have shown that if the welding is properly done it is possible to develop the full strength of the members jointed. The following tests shall be carried out on the procedure, qualification, test plates and production test plates:

i. Tensile and bend tests: all welds shall be subject to visual inspection.
ii. The procedures of visual examination shall conform to the requirements of the ASME Boiler and Pressure Vessels Code.

The following defects are unacceptable unless otherwise noted:

i. Dimensional defects such as insufficient throat or leg length, excess convexity, excess or insufficient reinforcement.
ii. Undercuts, overlap, blowholes, slag inclusion, seams and excess weave.
iii. Any crack or liner indication. Plates with laminations discovered during gas cutting, welding or any other time shall be rejected, unless approval to repair the plate is obtained from the Engineer. Welds may also be subject to anyone or a combination of the examinations as may be required to establish the soundness of welds. The inspection procedures for testing of all welds shall be prepared on the above basis by the Contractor and submitted to the Engineer for approval before any fabrication work is started.

12.2.12 MEASUREMENT AND PAYMENT

Welding shall not be measured and no direct payment shall be made. All costs of welding shall be deemed included in the related items of the Bill of Quantities unless otherwise it has been specifically mentioned in the BOQ.

13. SUB-SOIL BORING AND TESTING

13.1 GENERAL

Confirmatory Sub-Soil investigation shall be carried out at the actual locations of each foundation. The objective of the subsoil investigation is to ascertain the actual soil strata at the location, the engineering properties at each stratum and to ascertain the level at which the foundation can be laid. The investigation shall be carried out as per the following specifications and as directed by the Engineer.

13.2 BORING

Boring shall be carried out in accordance with the specifications of ASTM D 1586 and D 1587. The bore holes shall have a minimum diameter of 100mm and shall be lined throughout. Minimum depths shall be 20m unless otherwise directed by the Engineer. The toe of the lining shall at no time be more than 1m above the level to which the soil has been removed from the bore hole.

Before taking any undisturbed sample or making any in-situ test, the lining shall be carried down to the bottom of the bore hole at the test depth.

Auger of proper size shall be used in very soft to soft clays and silts to avoid suction. The use of shell shall only be restricted to moderately stiff to very stiff and hard clays and also in sandy strata below water table. The use of a chisel would be permitted only in case of boulder or rock formation or through local obstructions or other situation demanding its use as would be decided by the Engineer.

Uncased bore holes may be permitted only upto a depth where the sides of the hole can stand unsupported. In case of side fall or squeezing, steps shall be taken immediately to stabilize the sides of the bore hole by casing pipes as directed by the Engineer. Use of Bentonite slurry of 5% concentration may be permitted to stabilize the bore hole.

No water shall be added while boring through cohesive soils and non-cohesive soils above the water table. While boring through non-cohesive soil below water table, water level in the casing shall always be maintained at or above the water table.

The cutting brought up by the auger shell or the split-spoon or undisturbed sampler shall be carefully examined and the soil description duly recorded after performing field identification tests.

On completion of boring at any bore hole, a bore log shall be prepared in an approved standard format in consultation with the Engineer and submitted to the Engineer in triplicate. Position of the water table shall be observed after 24 hours and back filling of the bore hole shall be carried out with approved materials in a manner as directed by the Engineer.

13.3 DISTURBED SAMPLES

Disturbed samples shall be taken from bore hole cuttings and split-spoon for visual classification tests at the Site. The samples shall be taken at 1.5m interval or at every identifiable change of strata, whichever is met earlier to give a reliable record of the variation in the conditions of the soils. Disturbed samples shall be sent to the laboratory in airtight plastic container with proper label for the purpose of record and laboratory testing.

13.4 UNDISTURBED SAMPLES

Collection of undisturbed samples from cohesive soil layers shall be conducted as per ASTM D 1587 and/or any other equivalent.

13.5 HANDING AND LABELING OF SAMPLES

The following conditions of handling and protection of undisturbed samples shall be undertaken on undisturbed sample.

i. Immediately after being taken from the bore hole, the ends of the sample shall be cut and removed to a depth of about 2.5cm (or more in the top to cover any obviously disturbed soil). Several layers of molten wax should then be applied to each end to give a plug about 2.5cm thick. If the sample is very porous, a layer of waxed paper should first be placed over the ends of the sample.Any space left between the end of the sample tube and the top of the wax should be tightly packed with saw dust or other suitable materials and a close fitting lid or screwed cap shall be placed on each end of the sample tube. The lids should, if necessary, be held in position by adhesive tape.

ii. A label bearing the number of the sample, bore hole number, depth of sample, date, etc. preferably typed, shall be placed inside the container just under the lid. It shall be placed at the top of the sample. In addition, the number of the sample shall be painted on the outside of the container and the top or bottom of the sample shall be indicated.

iii. Undisturbed soil sample tubes shall be placed in a strong wooden box and packed with moist saw dust, paper, etc. to prevent damage during dispatch to the laboratory.

13.6 STANDARD PENETRATION TEST

Standard penetration test shall be conducted as per ASTM D 1586 at an interval of 1.5m or at every identifiable change of strata, whichever is earlier.

The driving of split-spoon shall be recorded for every 150mm penetration till the total penetration is 450mm.

Driving of the split-spoon shall be terminated when standard penetration resistance value, N>100 blows / 30cm of penetration is received, unless otherwise directed by the Engineer. The test shall be conducted after driving the casing to the bottom of the bore hole and after cleaning it. N-values, as observed in the field, shall be reported in the bore logs without any correction.

13.7 DISPATCH OF SAMPLES

Samples shall be dispatched to the laboratory as soon as possible after being obtained and shall not be allowed to accumulate at Site. In the event a danger of sample's deterioration through further storage is noticed, the Contractor shall dispatch such samples immediately on receiving direction from the Engineer.

13.8 LABORATORY TESTS

General

Laboratory tests shall be carried out as per relevant ASTM or BS Procedures or by any other procedures approved under equivalent recognized standards. The results of all tests shall be submitted in the format as approved by the Engineer.

13.8.1 PREPARATION OF THE TEST SPECIMENS

Preparation of test specimens for the various tests shall be carried out as per the procedures laid down in the various relevant ASTM or BS Codes or by any other procedures approved under equivalent recognized standards.

In case of soft to firm cohesive undisturbed soil samples, test samples for all types of shear tests shall be prepared strictly by hand trimming on soil lathe. Care shall be taken against bending of soil samples at the time of horizontal ejection of the samples from the sampling tubes. Samples shall be ejected from the sampling tubes preferably in the same direction of travel in which the samples entered the sampling tubes.

Similarly test specimens for consolidation tests shall also be prepared to the required size by hand trimming only and the ring of the consolidation apparatus shall be inserted by pressing gently with the hands and carefully removing the material around the ring. In no case the ring should be forced into the soil. Great cares shall be taken during trimming of the sample from the top and the bottom of the ring. The test specimen shall be prepared in the same orientation as that to the actual strata so that the laboratory test load compresses the soil in the same direction relative to the soil strata as the applied load in the field.

13.8.2 UNCONFINED COMPRESSION TEST

Unconfined compression test shall be conducted both on natural and remolded soil samples. Remolded soil specimen shall be prepared by the dynamic method of compaction.

Each unconfined compression test (natural or remolded) shall comprise tests on minimum of three soil specimens, not less than 38mm diameter and a height to diameter ratio of 2 together with the determination of natural moisture content and density. Water content of the specimen shall be taken from the failure zone of the specimen. Test results shall be observed and reported as per the standard practice.

13.8.3 TRIAXIAL TEST

Triaxial test shall be conducted on the undisturbed samples selected by the Engineer. Each test shall be conducted on a minimum of three specimens tested at different cell pressures (0.5 kg/cm2, 1.0 kg/cm2 and 1.5 kg/cm2). The moisture content before and after the test and the density shall be determined.

The stress-strain diagrams as well as the Mohr circle envelop for these tests shall be submitted.

13.8.4 CONSOLIDATION TEST

Consolidation tests shall be conducted on undisturbed samples selected by the Engineer. The coefficient of consolidation (Cv.), the coefficient of volume compressibility (Mv.), Laboratory Compression Index (Ccl.), Field Compression Index (Ccf.) including field virgin slope and the coefficient of

permeability (k) shall be determined and results shall be submitted. The loading on the test specimens shall be applied at the stages of 0.1 kg/cm2, 0.25 kg/cm2, 0.5 kg/cm2, 1.0 kg/cm2, 2.0 kg/cm2, 4.0 kg/cm2 and 8.0 kg/cm2.

Unloading of the test specimens shall be done at suitable stages.

13.8.5 ROUTINE TEST

All routine tests like natural moisture content, bulk density, liquid and plastic limits, grain size distribution, specific gravity, shall be conducted on selected representative samples as directed by the Engineer.

13.8.6 REPORT AND RECORDS

On completion of each bore hole, three copies of a bore hole log shall be submitted to the Engineer together with one copy of the list of disturbed and undisturbed samples taken from the bore hole.

These bore logs shall show:

i. Ground level referred to the reduced level.
ii. Locations of the bore holes on a plan.
iii. Detailed description of each stratum.
iv. Position, type and identification of each sample and SPT value.
v. Any other Site test results available.
vi. Levels at which each separate ground water level is first encountered and at which it comes to rest (standing water level).
vii. On completion of all field and laboratory tests, all results shall be submitted to the Engineer in 3 (three) copies in the form of reports with comments and views.

13.8.7 MEASUREMENT

The work will be measured for payment as an item on a lump sum basis or as specified in the Schedule of Items and BOQ.

13.8.8 PAYMENT

Payment shall only be admissible on implementation of the item as measured and provided above and on being certified by the Engineer that the investigations have been carried out as per specifications as contained herein. Payment shall be made as lump sum rate or as specified in the Schedule of Items and BOQ, which shall cover the full costs of boring, collection and dispatch of samples, standard penetration test and all necessary Laboratory tests, preparation and submission of records, cost of all labour, equipment, materials, tools, test fees and all incidentals required for undertaking the test and submission of requisite reports to the Engineer in its totality. No payment shall be made until the testing results and other information in the form of reports with requisite number of copies are submitted to the Engineer.

Item of Payment	Unit
Sub-soil investigation	Lump sum

14. DAMP PROOF COURSE

14.1 DESCRIPTION

Works covered under this item shall consist of constructing a layer of cement concrete with specified proportion and in required thickness with top surface painted with Asphalt/Coal tar.

14.2 MATERIALS

Cement

Cement used in the works shall be ordinary Portland cement complying with the requirements of ASTM C150 Type 1 or BS 12 or equivalent standard and those stated under the Section on 'Construction Materials' of this Specification.

Coarse aggregate

Coarse aggregate shall conform to the requirements of ASTM C 330.

Coarse aggregate shall be hard, durable, clean, free from dust and other deleterious material to be obtained by crushing 1st class/picked jhama bricks. The grading of the coarse aggregate shall be such that when combined with the approved fine aggregate and cement, it shall produce a workable concrete of maximum density which has been considered to be 10mm down graded in this case.

Materials shall also conform to the requirements specified in the relevant Sub-section of the Section titled 'Construction Materials' of this Specification.

Fine aggregate

Fine aggregates shall be non-saline clean natural sand and have a specific gravity not less than 2.6, a Fineness Modulus not less than what will be specified for a particular type of DPC and conform to the requirement of ASTM C 33 and those stated under the relevant Sub-section(s) of the Section on 'Construction Materials' of this Specification. Sand, to be used for Damp Proof Course, will be of FM normally not below 1.8 or as directed by the Engineer.

Water

Water shall be clean, free from injurious quantities of oil, alkali, salts and organic materials or other substances that may be deleterious to concrete or reinforcement and shall not contain any visibly solid material. If requested by the Engineer, water shall be tested by comparing with water of known satisfactory quality. All other requirements shall be similar to what have been stated under the relevant Sub-sections of the Sections on 'Concrete Work' and 'Construction Materials' of this Specification.

Asphalt

Asphalt shall conform to the requirements of ASTM D 312. Type-1 shall be used below ground and Type- 2 shall be used above ground.

14.3 CONSTRUCTION METHODS

25mm to below 40mm thick cement concrete mixture prepared with 1 part cement, 2 parts sand and 4 parts brick chips is to be installed following the procedures stated under the Section on 'Concrete Work' of this Specification. In case of DPC designed with a 40mm thickness, the cement concrete mixture may be prepared with 1 part cement, 1½ parts sand and 3 parts brick chips. Two

coats of hot asphalt should be applied over the cement concrete when the concrete has been fully cured and dried. The surface to be damp-proofed shall be primed and thoroughly mopped with asphalt. When the first mopping of asphalt has set sufficiently, the entire surface shall be mopped with second coating of hot asphalt. Special care shall be taken to see that there are no skips in the coatings and that all surfaces are thoroughly covered. The asphalt used should not melt or soften in the hottest days and should not get squeezed due to pressure of the masonry over it.

All concrete surfaces, which are to be damp-proofed shall be reasonably smooth and free from foreign material that would prevent bond. The surface shall be dry and immediately before the application of the primer, the surface shall be thoroughly cleaned of dust and loose materials.

The damp-proof course should be laid flush with the floor surface and should not be carried across doorways or other openings. The upper layer of cement concrete floors should be continued over such openings and should be laid at the same time as the floors. The asphalt or tar layer should be laid under the concrete at the openings. Where concrete is laid on bitumen or tar, the surface of the bitumen or tar must be sprinkled with dry sand.

The position of the damp proof course is also an important factor and it should be laid at such a height that it is above the normal level to which water splashes from the ground when it is raining. A damp proof course should not be less than 15cm above the highest level of the ground.

14.4 MEASUREMENT

Damp proofing shall be measured in square meter of the works completed in place, in accordance with the Specifications stated herein and/or with the provisions of the Bill of Quantities and/or as shown on the Drawings and/or as directed by the Engineer. Only the completed works as accepted by the Engineer will be eligible for payment.

14.5 PAYMENT

The amount of completed and accepted work as measured above shall be paid for at the Contract unit price per square meter. The payment shall constitute the full compensation for the cost of furnishing all equipment, materials, labour for preparation of concrete mixture and its casting, compacting, curing, including, asphalt painting including all storage, handling and transport and all incidentals necessary for the satisfactory completion of the damp-proofing as per specifications and requirements described under this Sub-section the Bill of Quantities, as shown on the Drawings and as directed by the Engineer.

Item of Payment	Unit
Damp-proofing	Square meter / Square feet

15. ROAD WORKS

15.1 CLEARING AND GRUBBING

15.1.1 DESCRIPTION

This work shall consist of removal to the specified depth, grubbing and disposal of all surface objects, as and where directed in writing by the Engineer, including, bushes, trees with stumps and roots of less than 150 mm girth, vegetation, logs, rubbish and all other objectionable material except such objects as are designated to remain or are to be removed in accordance with other sections of specification.

Such organic topsoil would carefully be stored, and re-applied on top of new surfaces as directed by Engineer upon completion of work. In this way new vegetation would be facilitated for early/quick regeneration.

15.1.2 CONSTRUCTION REQUIREMENTS

Clearing/Grubbing

In roadway cut areas, all surface objects or any object to the depth of 30 Cm, below subgrade level such as stumps, roots, vegetation, bushes, logs, rubbish shall be cleared and/or grubbed as directed by the Engineer. In roadway fill areas where clearing and grubbing is required, same shall be carried out to the depth of 30 cm below original surface level as described above.

Original surface is the surface of the ground received by the contractor for the purpose of road construction under contract and upon which joint levels were taken and joint cross section were prepared prior to clearing grubbing.

Operation of clearing and grubbing shall in no way be deemed to effect any level or volume change of the area and the Embankment quantities shall be calculated/ measured and paid from the joint levels prior to clearing and grubbing operation.

After clearing and grubbing, which includes the removal of top 15 cm soil or any layer of unsuitable material or after excavation; the compaction of cleared/grubbed surface, suitable filling material shall be placed and compacted, up to original ground level as determined by joint leveling and the compaction of the area will be restored to its original value without any extra payment.

Before bottom layer of embankment is placed, contractor will grub up and remove without extra payment, any vegetation that may, in the meantime have grown on surface previously cleared and grubbed.

All trees having girth less than 150 mm measured at (600) mm above ground and falling within the construction limits shall be felled & removed by the contractor. The excavation and removal of trees, roots and stumps including backfilling and compacting of holes and restoring the natural ground to the original condition shall be responsibility of the contractor for which no extra payment shall be made to him. The trees, stumps & roots remains the property of the Employer, which shall be delivered at designated place as directed by the Engineer.

Protection and Restoration

The Contractor shall prevent damage to all pipes, conduits, wires, cables or structure above or below ground. No land monuments, property markers, or official datum points shall be damaged or re-

moved until the Employer/Engineer has witnessed or otherwise referenced their locations and approved their removal. The Contractor shall so control his operations as to prevent damage tonshrubs, which are to be preserved. Protection may include fences and boards latched to shrubs, to prevent damage from machine operations. Any damage as a result of contractor's operation shall immediately be rectified by him at his own expense.

15.1.3 MEASUREMENT AND PAYMENT

Measurement

Clearing and grubbing will be measured for payment only on areas so designated in writing by the Engineer or shown on the drawings. The quantity to be paid for shall be satisfactorily clearing and-ngrubbing & disposal of 15 cm top soil & filling with suitable material and compacting it to the required density as defined below, to attain the levels determined by joint leveling prior to the clearing and grubbing works.

Depth below sub grade level.	Percent of Maximum Dry Density as determined by AASHTO T -180.*
0 to 30 cm	95
30 to 75cm	93
Over 75 cm	90
Below the foundation of structures	95

Any tree having girth of less than 150 mm (measured 600 mm above ground level) shall be measured under this item and no separate payment shall be admissible for this, as it is included in clearing & grubbing.

Clearing and grubbing carried out by the Contractor in roadway cut areas and borrow pits is not payable, as such, shall not be measured for payment.

Payment

The quantities determined as provided above will be paid for at the contract unit price for the pay item shown in the Bill of Quantities, which price and payment shall be full compensation for clearing and grubbing as per the requirement of this item and restoration of area, to its original level up to the required density as determined by joint leveling.

15.2 COMPACTION OF NATURAL GROUND

15.2.1 DESCRIPTION

The natural ground or surface ready for construction purposes after stripping (if required) and/or excavation will be considered for natural ground compaction in this item only. The compaction of cleared / grubbed surface after Clearing and Grubbing is covered in "Clearing and Grubbing".

The compaction of natural ground shall be carried out through a written order by the Engineer

15.2.2 CONSTRUCTION REQUIREMENTS

After striping of the topsoil or any layer of unsuitable material or after excavation, the ground up to a depth of 20 cms below the surface of exposed road bed (natural ground) shall be broken up by ploughing and scarifying to compact to a degree as defined below:

Depth below sub grade level.	Percent of Maximum Dry Density as determined by AASHTO T -180.*
0 to 30 cm	95
30 to 75cm	93
Over 75 cm	90
Below the foundation of structures	95

Compaction of original ground in areas of high water levels and salinity
Compaction of natural ground surface in such areas will be difficult if not impossible.

Accordingly, the locations/ areas shall be strengthened with stones of a minimum 30cm thick layer soling or as directed by the Engineer.

15.2.3 MEASUREMENT AND PAYMENT

Measurement

The measurement shall be made by multiplying the length and breadth of the area approved in writing by the Engineer to be paid under this item. The measurement of the item shall be as per the BOQ.

Any subsidence of levels of Natural Ground due to compaction under this item shall not be measured for payment; the Contractor is expected to take care of such factors while bidding.

Payment

The payment under this item shall be made at the contract unit price shown in BOQ of compaction of (natural) ground measured as above and shall be deemed to include cost of scarification, ploughing, watering, mixing, leveling, rolling, labour, equipment, tools, and incidentals necessary to complete this item.

15.3 EXCAVATION OF UNSUITABLE OR SURPLUS MATERIAL

15.3.1 DESCRIPTION

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 provision.

15.3.2 CONSTRUCTION REQUIREMENT

All suitable material excavated within the limits and scope of the project shall be used in the cost-effective manner for the formation of the embankment for widening of roadway for backfill or for bother 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 leveled in thin layers by the contractor outside the right of way within 7 Km of excavation.

The Engineers hall 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 of NHA Specification. 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.

15.3.3 MEASUREMENT AND PAYMENT

Measurement

When the contractor is directed to excavate unsuitable material below the surface of original ground

in fill areas, the depth to which these unsuitable materials are to be removed will be determined by the Engineer. The contractor shall schedule his work in a such a way that authorized cross sections can be taken before and after the material has been removed. Only material which is surplus to the requirements of the project or is declared in writing by the Engineer to be unsuitable will qualify for payments under pay Item mentioned in BOQ as the case may be.

The cost of excavation of material which is used anywhere in the project shall be deemed to be included in the pay item relating to the part of the work where the material is used. The pay items mentioned in BOQ shall include the cost of obtaining the consent of the owner or tenant of the land where the disposal of surplus or unsuitable material is made. Unsuitable or surplus material shall be measured in its original position and its volume shall be calculated in cubic meters using end area method.

Payment

The quantities determined as provided above shall be paid for at the Contract unit price for each of the particular pay items shown in the Bill of Quantities which prices and payment shall constitute full compensation for all costs involved in the proper completion of the work prescribed in this item.

15.4 FORMATION OF EMBANKMENT

15.4.1 DESCRIPTION

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 or established by the Engineer.

15.4.2 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.

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, soil as specified in AASHTO M-145 or any other combination of proportionately blended materials as approved by Engineer, which must meet the requirements as shown on the Drawings (Wherever required noncohesive/granular materials used in the formation of embankment shall be confined by cohesive materials to the satisfaction of the Engineer.)
b. The material shall have a soaked CBR value as stated on the Drawings and determined in accordance with ASSHTO T-193. CBR value shall be obtained at a density corresponding to the degree of compaction for the layer concerned. The swell value for the material used in the construction of embankment shall not exceed one and half (1.5) percent. However while establishing the swell value, surcharge rates representing the over burden will be used.
c. In case sandy material be used for embankment formation, it shall be properly confined with a material approved by the Engineer and 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, and other roadway areas or lengths, the material used in embankment, unless rock,

shall be AASHTO Class A-1, A-3 and A-2-4 soils. Other soils may be used only with the written consent of Engineer.

e. In areas as stated under sub-section 3.5 (Formation of Embankment in water logged area working platform, if required, shall be constructed as per provision of sub-section 3.5 and as directed by the Engineer.

15.4.3 CONSTRUCTION REQUIREMENT

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 below subgrade Level	Percent of Maximum Dry Density as determined by AASHTO T -80.*
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 up 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.

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 down 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) cent meters 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 roller (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
4300-5000	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. Moreover 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. The Engineer must approve each layer 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.

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.

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.

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:

Percentage of Sieve Description	Weight Passing Mesh Sieve.
3 inch (75 mm) 100	AASHTO T -27

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.

D15 (Working Platform Material)

---------- is less than 5.

D85 (Natural Ground Material)

D85 and D15

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 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. and compaction of the working table shall be carried out by use of light equipment or as directed bythe Engineer.

No density requirements are specified for the working platform, however, subsequent layers above it shall be compacted to the densities.

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 material is 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.

15.4.4 MEASUREMENT AND PAYMENT

Measurement

The quantities to be paid for shall be calculated on theoretical designed lines and grades and the original ground levels, using Average End Area Method compacted in place, accepted by the Engineer formed with material resulting from:

a). Formation of Embankment from Borrow Excavation

Measurement shall be made as under:-

Formation from Borrow = Total Embankment Quantity

(cal. from original ground level by Average End

Area Method)

(Minus) Roadway excavation Quantity (Minus)

structural excavation Quantity

b). Formation from structural Excavation

This quantity shall be the same as calculated for structural excavation irrespective of its haulage distance except that declared unsuitable by the Engineer, which shall not be placed in Embankment and shall be disposed off as per the direction of Engineer.

c). Formation from Roadway Excavation

This quantity shall be the same as calculated for Roadway Excavation except that declared unsuitable by the Engineer which shall not be placed in embankment and shall be disposed off as directed by the Engineer. The contractor will be supposed to use only declared suitable material from Roadway Excavation irrespective of haulage distance. However if contractor, forhis own convenience, uses the material from borrow, the payment will still be made.In the measurement of

"Formation of Embankment on steep slopes" no allowance will be made for the benching or volume of material cut out from the hill side or from the first half width fill to accommodate the compacting equipment but will be calculated only on the net volume of fill placed against the original hill sides, the old embankment or the first half width fill.

PAYMENT

a). Formation from Borrow Excavation

The quantity to be paid for shall be placed in embankment, measured as provided in BOQ for material from borrow excavation and such a payment will be deemed to include cost of excavation, payment of royalty, levies and taxes of Local, Provincial and Federal Government, cost of hauling including all lead and lift, spreading, watering, rolling, labour, equipment, tools and incidental necessary to complete this item.

b). Formation from Structural Excavation

The quantity to be paid for shall be placed in embankment irrespective of the haulage distance and measured as provided above for suitable material from structural excavation and such payment will be deemed to include cost of excavation, hauling, dumping, spreading, watering, rolling, labour, equipment, tools and incidentals necessary to complete this item.

c). Formation from Roadway Excavation

The quantity to be paid for shall be placed in embankment irrespective of the haulage distance and measured as provided above for suitable material from roadway excavation and such payment will be deemed to include cost of excavation, hauling, dumping, spreading, watering, rolling, labour, equipment, tools and incidental necessary to complete this item.

15.5 SUBGRADE PREPARATION

15.5.1 DESCRIPTION

The sub grade preparation shall be that part of the work on which, the sub base is placed or in the absence of sub base, acts 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.

15.5.2 CONSTRUCTION REQUIREMENT

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.

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 'D' whichever is applicable, or corresponding Relative Density as per D-4254-83 (ASTM).

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 is 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.

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 'D'.

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) centimetres above the undercut section elevation. The under cut material shall be placed in embankment or disposed of at the direction of Engineer.

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) centimetres below subgrade level shall meet compaction requirements of 2.2 above. Soils having a minimum value of C.B.R of five (05) percent and swell value of not more than 0.3 percent shall be used. 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 equipment's 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 equipment's 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, Formation of Embankment.

Sub-grade 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 leveling 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.

When the width of the new road is greater than the existing road then the part of the new road subgrade which comprises the existing road surface shall be prepared as herein provided and the part that falls outside the existing road surface shall be prepared as provided in items above as the case may be.

Sub-grade 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 for Formation of Embankment, if declared unsuitable it shall be disposed of and paid under the contract price for Excavation of unsuitable material. The finished compacted surface shall be as specified in item.

Protection of Completed 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, without additional payment, repair, re-roll, or recompact the subgrade as may be necessary to restore it to the state specified herein.

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 refer to the "Table for Allowable Tolerances" in NHA specifications.

15.5.3 MEASUREMENT AND PAYMENT

Measurement

The quantity to be paid for shall be as per BOQ of subgrade prepared as herein before prescribed and accepted. Subgrade in rock cuts and on embankment not consisting of the existing road surface in fill area shall not be measured for direct payment.

Subgrade preparation on "Existing Surface" shall only be measured for payment when ordered by the Engineer.

Payment

The quantities, determined as provided above, shall be paid for at the contract unit price respectively, for each of the particular pay items shown in the Bill of Quantities which prices and payment shall be full compensation for furnishing of material, water, equipment, tools, labour and all other items plus incidentals necessary for completion of work.

15.6 IMPROVED SUBGRADE

15.6.1 DESCRIPTION

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.

15.6.2 MATERIAL REQUIREMENTS

The major component of improved subgrade shall consist of material conforming to item "Material requirements for embankment" of these specifications.

The blending material shall be any soil that classifies as A-1(a), A-1(b),A-2-a or A-3 according to AASHTO M-145 with Pl 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.

15.6.3 CONSTRUCTION REQUIREMENT

Preparation

The surface of the roadbed on which the improved subgrade is to be constructed shall be compacted to the density specified under item "Formation of Embankment with Borrow Common Material" of these specifications.

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.

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.

15.6.4 MEASUREMENT AND PAYMENT

Measurement

The quantity of improved subgrade to be paid for shall be measured in square meter by the theoretical area covered in place as shown on the Drawings, completed and accepted improved subgrade in a thickness of 30 cms.

Payment

The accepted quantities measured as provided above shall be paid for at the contract unit price per cubic meter of improved subgrade for the pay item listed below and shown in the Bill of Quantities, which price and payment shall constitute full compensation for furnishing all materials, hauling, mixing, placing in layers, watering and compacting, labour, equipment, tools and incidentals necessary to complete the item.

15.7 GRANULAR SUBBASE

15.7.1 DESCRIPTION

This item shall consist of furnishing, spreading in one or more layers and compacting granular su base according to the specifications and drawings and/or as directed by the Engineer.

Grading Requirements for Subbase Material

Sieve Designation		Mass Percent Passing Grading	
Mm	**Inch**	**A**	**B**
60.0	(2.1/2)	100	--
50.0	(2)	90-100	100
25.0	(1)	50-80	55-85
9.5	(3/8)	--	40-70
4.75	No.4	35-70	30-60
2.0	No.10	--	20-50
0.425	No.40	--	10-30
0.075	No.200	5-15	5-15

The Coefficient of Uniformity D60 / D10 shall be not less than 3, where D60 and D10 are the particle diameters corresponding to 60% and 10%, respectively, passing (by weight) in a grain size analysis, curve.

b) The Material shall have a CBR value of at least 30%, determined according to AASHTO T-193. The CBR value shall be obtained at a density corresponding to Ninety eight (98) percent of the maximum dry density determined according to AASHTO T-180 Method-D.

c) The coarse aggregate material retained on sieve No.4 shall have a percentage of wear by the Los Angeles Abrasion (AASHTO T-96) of not more than forty (40) percent.

d) In order to avoid intrusion of silty and clayey material from the subgrade in the subbase, the ratio D15 (Subbase)/D85 (Subgrade) should be less than 5.

Where D85 and D15 are the particle diameters corresponding to eighty five (85) % and fifteen (15) %, respectively passing (by weight) in a grain size analysis curve.

e) The fraction passing the 0.075 mm (No.200) sieve shall not be greater than two third of the fraction passing the 0.425 mm (No. 40) sieve. The fraction passing the 0.425 mm sieve shall have a liquid limit of not greater than 25 and a plasticity index of 6 or less.

f) If over-size is encountered, screening of material at source shall invariably be done, no hand picking shall be allowed, however hand picking may be allowed by the Engineer, if over-size quantity is less than 5% of the total mass.

g) Sand equivalent for all classes shall be 25 min.

15.7.2 CONSTRUCTION REQUIREMENT

Spreading

Granular subbase shall be spread on approved subgrade layer as a uniform mixture. Segregation shall be avoided during spreading and the final compacted layer shall be free from concentration of coarse or fine materials.

Granular subbase shall be deposited on the roadbed or shoulders in a quantity which will provide the required compacted thickness without resorting to spotting, picking up or otherwise shifting the subbase material. In case any material is to be added to compensate for levels, the same shall be done after scarifying the existing material, to ensure proper bonding of additional material. Where the required thickness is fifteen (15) cm or less, the aggregates may be spread and compacted as one layer, but in no case shall a layer be less than seven and one half (7.5) centimeters thick. Where the required thickness is more than 15 cm, the aggregates shall be spread and compacted in 2 or more layers of approximately equal thickness, but in any case the maximum compacted thickness of one layer shall not exceed 15 cm. All subsequent layers shall be spread and compacted in a similar manner.

Granular subbase shall be spread with equipment that will provide a uniform layer conforming to the specified item both transversely and longitudinally within the tolerances as specified in "Table for Allowable Tolerances" in these specifications. 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 operation will cause cutting or rutting of subgrade or contamination of sub base material.

Compaction Trials

Prior to commencement of granular subbase operation, contractor shall construct a trial length, not to exceed, five hundred (500) meters and not less than two hundred (200) meters with the approved

subbase material as will be used during construction to determine the adequacy of the contractor's equipment, loose depth measurement 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.

Compaction

The moisture content of subbase material shall be adjusted prior to compaction, by watering with approved sprinklers mounted on trucks or by drying out, as required, in order to obtain the specified compaction. The subbase material shall be compacted by means of approved vibrating rollers or steel wheel rollers (rubber type rollers may be used as a supplement), progressing gradually from the outside towards the centre, except on super elevated curves, where the rolling shall begin at the low side and progress to the high side. Each succeeding pass shall overlap the previous pass by at least one third of the roller width. While the rolling progresses, the entire surface of each layer shall be properly shaped and dressed with a motor grader, to attain a smooth surface free from ruts or ridges and having proper section and crown. Rolling shall continue until entire thickness of each layer is thoroughly and uniformly compacted to the specified density.

Any area inaccessible to rolling equipment shall be compacted by means of hand guided rollers, plate compactors or mechanical tampers, where the thickness in loose layer shall not be more than 10 cm.

If the layer of subbase material or part thereof does not conform to the required finish, the Contractor shall, at his own expense, rework, water, and re-compact the material before succeeding layer of the pavement structure is constructed.

Immediately prior to the placing of first layer of base course the subbase layer (both under the travelled way and the shoulders) shall conform to the required level and shape. Prior to placing the succeeding layers of the material, the top surface of each layer shall be made sufficiently moist to ensure bond between the layers. The edges or edge slopes shall be bladed or otherwise dressed to conform to the lines and dimensions shown on the plans.

No material for construction of the base shall be placed until the subbase has been approved by the Engineer.

Compaction requirements

The relative compaction of each layer of the compacted subbase shall not be less than Ninety Eight (98) percent of the maximum dry density determined according to AASHTO T-180 Method-D. The field density shall be determined according to AASHTO T-191 or other approved method. For all materials, the field density thus obtained shall be adjusted to account for oversize particles (retained on 19 mm sieve) as directed by the Engineer. Also for adjustment of any material retained on 4.75 mm sieve, AASHTO Method T-224 shall be used.

Moisture Content Determination

As it is customary in the project laboratories that small samples of materials are placed in ovens for moisture determination for proctor, following precautions are necessary to ensure proper compaction results.

a) Same size of sample is placed in oven for moisture determination in case of laboratory density (modified proctor) and field density.

b) Moisture content for calculation of field density and proctor shall be observed on material passing 4.75 mm sieve.

Tolerance

The subbase shall be compacted to the desired level and cross slopes as shown on the drawings. The allowable tolerance shall be according to the "Table for Allowable Tolerances" in these specifications.

15.7.3 MEASUREMENT AND PAYMENT

Measurement

The quantity of subbase to be paid for shall be measured by the theoretical volume in place as shown on the drawings or as directed and approved for construction by the Engineer, placed, compacted and accepted in the completed granular subbase course. No allowance will be given for materials placed outside the theoretical limits as shown on the cross-sections.

Payment

The accepted quantities measured as provided above shall be for the Pay Item shown in the Bill of Quantities, which price and payment shall constitute full compensation for furnishing all materials, hauling, placing, watering, rolling, labour, equipment, tools and incidentals necessary to complete the item.

15.8 AGGREGATE BASE COURSE

15.8.1 DESCRIPTION

This item shall consist of furnishing, spreading and compacting one (1) or more layers of aggregate base on a prepared subgrade, subgrade or existing road surface, in accordance with the specifications and the drawings and/or as directed by the Engineer.

15.8.2 MATERIAL REQUIREMENTS

Material for aggregate base course shall consist of crushed hard durable gravel, rock or stone fragments. It shall be clean and free from organic matters, lumps of clay and other deleterious substances. The material shall be of such a nature that it can be compacted readily under watering and rolling to form a firm, stable base for both flexible and rigid pavements. The aggregate base shall comply with the following grading and quality requirements.

a) The gradation curve of the material shall be smooth and within the envelope limits for Grading A or B given below;

Grading Requirements for Subbase Material			
Sieve Designation		Mass Percent Passing Grading	
Mm	Inch	A	B
50.0	2	100	100
25.0	1	70-95	75-95
9.5	3/8	30-65	40-75
4.75	No.4	25-55	30-60
2.0	No.10	15-40	20-50
0.425	No.40	8-20	12-25
0.075	No.200	2-8	5-10

The material shall be well graded such that the coefficient of Uniformity D60/D10 shall be greater than four (4).

b) Crushed Aggregate (material retained on sieve NO.4) shall consist of material of which at least ninety (90) percent by weight shall be crushed particles, having a minimum of two (2) fractured faces.
c) The Coarse aggregate shall have a percentage of wear by the Loss, Angeles Abrasion test (AASHTO T-96) of not more than forty (40).
d) The material shall have a loss of less than twelve (12) percent when subjected to five cycles of the Sodium Sulphate Soundness test according to AASHTO T-104.
e) The sand equivalent determined according to AASHTO T-176 shall not be less than 40 or the material shall have a Liquid limit of not more than twenty five (25) and a plasticity Index of not more than 6 as determined by AASHTO T-89 and T-90.
f) The material passing the 19 mm sieve shall have a CBR value of minimum eighty (80) per-cent, tested according to the AASHTO T193. The CBR value shall be obtained at the maxi-mum dry density determined according to AASHTO T 180, Method D.
g) Laminated material shall not exceed 15% of total volume of Aggregate Base Course.

If filler, in addition to that naturally present in the aggregate base material is necessary for meeting the grading requirement or for satisfactory bonding of the material, it shall be uniformly blended with the base course material at the crushing plant or in a pugmill unless otherwise approved. The material for such purpose shall be obtained from sources approved by the Engineer. The material shall be free from organic matter, dirt, shale, clay and clay lump or other deleterious matter and shall conform to following requirement.

AASHTO Sieve	Percent Passing
3/8 Inch	100
No. 4	85-100
No. 100	10-30
Plasticity Index (AASHTO T -90)	6 maximum
Sand Equivalent (AASHTO T -176)	30 minimum

However, the combined aggregates prepared by mixing the coarse material and filler shall satisfy the requirements.

15.8.3 CONSTRUCTION REQUIREMENT

Preparation of surface for Aggregate base course

In case crushed aggregate base is to be laid over prepared sub base course, the subbase course shall not have loose material or moisture in excess to optimum moisture content.

Compaction

Compaction process shall conform in all respect to the requirements specified.

Compaction Requirement

The relative compaction of each layer of the compacted base shall not be less than 100 percent to the maximum dry density determined according to AASHTO T -180, Method D (Modified). The field density shall be determined according to AASHTO T -191 or other approved method. For all

materials, the field density thus obtained shall be adjusted to account for oversize particles (retained on 19 mm sieve) as directed by the Engineer. Also for adjustment of any material retained on 4.75 mm sieve, AASHTO Method T-224 shall be used. Completed base course shall be maintained in an acceptable condition at all times until prime coat is applied. When base course is to carry traffic for an indefinite length of time before receiving surfacing, the contractor shall maintain the surface until final acceptance and shall prevent reveling by wetting, blading, rolling and addition of fines as may be required to keep the base tightly bound and leave a slight excess of material over the entire surface which must be removed and the surface finish restored before application of prime coat.

Moisture Content Determination

Moisture content determination shall conform in all respects to the requirements specified.

Trial Sections

Prior to commencement of aggregate base course operations, a trial section of two hundred (200) meters minimum, but not to exceed five hundred (500) meters shall be prepared by the contractor using same material and equipment as will be used at site to determine the adequacy of equipment, loose depth measurement necessary to result in the specified compacted layer depths, field moisture content and relationship between the number of compaction passes and the resulting density of material.

Tolerance

The completed base course shall be tested for required thickness and smoothness before acceptance. Any area having waves, irregularities in excess of one (1) cm in three (3) M Or two (2) cm in fifteen (15) M shall be corrected by scarifying the surface, adding approved material, reshaping, re-compacting and finishing as specified. Skin patching of an area without scarifying the surface to permit proper bonding of added material shall not be permitted. The allowable tolerances shall be according to the "Table for Allowable Tolerances" in these specifications.

Acceptance, Sampling and Testing

Acceptance of sampling and testing with respect to materials and construction requirements shall be governed by the relevant, "Table for Sampling and Testing Frequency" or as approved by the Engineer.

15.8.4 MEASUREMENT AND PAYMENT

Measurement

The quantity of aggregate base to be paid for shall be measured by the theoretical volume in place as shown on the drawings or as directed and approved for construction by the Engineer, placed and accepted in the completed crushed aggregate base course. No allowance will be given for materials placed outside the theoretical limits as shown on the cross sections.

Payment

The accepted quantities measured as above shall be paid for at the contract unit price, for the item shown in the Bill of Quantities, which price and payment shall constitute full compensation for furnishing all materials, hauling, placing, watering, rolling, labour, equipment, tools and incidentals necessary to complete this item.

15.9 SURFACE TREATMENT

15.9.1 DESCRIPTION

This work shall consist of upto three applications of asphaltic material each followed by a cover of aggregates or an application of asphaltic material without aggregates applied in accordance with these specifications and in conformity with the lines and width shown on the drawings or as established by the Engineer.

15.9.2 MATERIAL REQUIREMENTS

Aggregate

Aggregate shall consist of clean, dry, hard, durable, tough, angular, sound crushed stone or crushed gravel of uniform quality and free from dirt, clay and other objectionable matter. Aggregates from only the sources of established adhesion properties would be used. The percentage of wear by the Los Angeles Abrasion test (AASHTO T-96) shall not be more than forty (40). Aggregate crushing value (ACV) when tested as per BS-812 (1990) shall not exceed 25%. When subjected to five (5) cycles of sodium-sulphate soundness testing as determined by AASHTO T-104, it shall have a weight loss of not greater than ten (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 (1/2) 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.

The portion of aggregate retained on the 9.5 mm (3/8 inch) sieve shall not contain more than fifteen (15) percent of particles by weight of flat or elongated, or both, that the ratio between the maximum and the minimum dimensions exceeds 2.5:1.

Flakiness Index, tested under BS-812 (1990) part 105, shall be 25 (max) for nominal size 18 mmand 12 mm and 30 (max) for nominal size 9mm.

The nominal sizes of aggregates used for surface treatment shall be as under:-

Size No. 1 Nominal size 18 mm

Size No. 2 Nominal size 12 mm

Size No. 3 Nominal size 9 mm

Size No. 4 Nominal size 6 mm

The nominal sizes are defined in the table below: -

Nominal Sizes (mm)	Specified size *			
	Passing		Retained	
	Sieve (mm)	%age	Sieve (mm)	%age
18	19	100	12.5	85
12	12.5	100	9.5	85
9	9.5	100	6.3	85
6	6.3	100	4.75	85

* By convention, this item defines a fraction of material within the respective sieve.

For Material passing 3/8″ Sieve, following Table shall be used:

Sieve Designation		Percent Passing by Weight			
mm	Inch	Size No.1	Size No.2	Size No.3	Size No.4
9.5	3/8	0-15	0-10	-	-
4.75	No. 4	0-5	0-5	0-10	-
2.38	No. 8	-	-	0-5	0-5
1.18	No. 16	-	-	-	0-3
0.075	No. 200	0-2	0-2	0-1	0-1

Asphaltic Material

The asphaltic material shall conform to the requirements of NHA Specifications of 'Asphaltic Materials'. The type shall be one of the following, as shown in the Bill of Quantities or ordered by the Engineer. Spraying temperature shall be as shown against each type.

Table: Spraying Temperatures (^{0}C) for Surface Treatments

Asphalt Type / Grade	Spraying Temperature for Surface Treatments
a. Asphalt Cements	
AC-2.5	130 min.
AC-5	140 min.
AC-10	140 min.
AC-20	145 min.
AC-40	150 min.
AR-1000	155 min.
AR-2000	140 min.
AR-4000	145 min.
AR-8000	145 min.
AR-16000	-
200-300pen.	130 min.
120-150pen.	130 min.
85-100pen.	140 min.
60-70pen.	145 min.
40-50pen.	150 min.
b. Emulsified Asphalts	
RS-1	20-60
RS-2	50-85
MS-1	20-70
MS-2	-
MS-2h	-
HFMS-1	20-70
HFMS-2	-
HFMS-2h	-
HFMS-2s	-
SS-1	-
SS-1h	-
CRS-1	50-85
CRS-2	50-85
CMS-2	-
CMS-2h	-
CSS-1	-
CSS-1h	-
c. Cutback Asphalts (RC, MC, SC)	
30 (MC only)	30 min.
70	50 min.
250	75 min.
800	95 min.
3000	110 min.

15.9.3 CONSTRUCTION REQUIREMENT

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) degree C for at least one hour prior to the commencement of spraying operations, and the temperature shall not be less than twenty (20) degree 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 as per NHA Specifications of "Bituminous Prime Coat". 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.

Equipment

Equipment shall conform in all respects to the provisions under NHA Specifications "Bituminous Prime Coat - Equipment". The equipment shall be operated by the manpower specially trained for this work. Necessary safety arrangement for the workers, equipment and traffic shall be ensured during the operations.

Preparation of Surface

Irregularities and surface damage e.g. potholes, depressions, raveling, shall be corrected prior to surface dressing. The Engineer shall also satisfy himself that fundamental pavement defects e.g. base failure, drainage problems etc. have been remedied before surface dressing is attempted. Areas, which are excessively rich in bitumen e.g. 'bleeding', shall be cut out and patched. All patches, however, occasioned shall be thoroughly compacted, sealed and blinded with crusher dust before opening to traffic for several days before surface dressing commences.

Immediately prior to the application of binder all dirt, dust are foreign material shall be removed by thorough brooming and or the use of compressed air. Adhering mud or other soiling may be removed using water and brushes, the general use of water to wash the road shall not be permitted.

No application of asphaltic material shall be undertaken until the surface has been cleaned to the satisfaction of the Engineer.

For application of prime coat, asphaltic material shall be medium curing cut-back asphalt consisting of an asphaltic base fluxed with suitable petroleum distillates.

Where a prime cat has been applied to the surface, any area in which the prime coat has been insufficiently applied and is defective in any way shall be re-primed as directed by the Engineer. For re-primed surfaces, atleast a waiting period of 48 hours may be necessary for the prime to become completely dry before any further asphaltic operation, shall be applied above it.

Application of Asphaltic Materials

Asphalt cement, liquid asphalt and emulsified asphalt shall applied by means of pressure distributor manual or automatic at the temperature specified for the type and grade of asphalt being used. The rates of application shall be within the ranges given in Table "Quantities of Materials for Bituminous Surface Treatments".

The spread of bituminous materials shall be at least ten (10) cm more than the width to be covered by the aggregate from the spreading device. 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 exceed than that which trucks loaded with cover coat material can immediately cover. 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 material 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.

The angle of the spray nozzles and the height of the spray bar shall be so adjusted and frequently

checked that uniform distribution is ensured. The distribution shall cease immediately upon any clogging or interference of any nozzle and corrective measures shall be taken before distribution is resumed.

Asphalt cement, liquid asphalt and emulsified asphalt shall be applied by means of a pressure distributor manual or automatic at the temperature specified for the type and grade of asphalt being used.

Spreading of Aggregate

Immediately after applying the asphaltic material, dry aggregate shall be uniformly and evenly distributed over the treated surface from an approved mechanical aggregate spreader. The truck carrying the aggregate shall move backward, so as to prevent the tyres of the truck and the mechanical aggregate spreader from driving directly on the newly sprayed asphalt. No portion of the binder shall remain uncovered for a period in excess of twenty (20) minutes after spraying. Immediately after spreading of the aggregate, the treated surface shall be rolled with a self-propelled Pneumatic-Tyre roller having a minimum contact pressure of 2.8 Kg/square centimetres. A steel whispering of Aggregate Immediately after applying the asphaltic material, dry aggregate shall be uniformly and evenly distributed over the treated surface from an approved mechanical aggregate spreader. The truck carrying the aggregate shall move backward, so as to prevent the tyres of the truck and the mechanical aggregate spreader from driving directly on the newly sprayed asphalt. No portion of the binder shall remain uncovered for a period in excess of twenty (20) minutes after spraying.

Immediately after spreading of the aggregate, the treated surface shall be rolled with a self-propelled Pneumatic-Tyre roller having a minimum contact pressure of 2.8 Kg/square centimetres. A steel wheeled roller weighing between six (6) to eight (8) tons may be used as a second roller. Rolling shall continue only until a smooth, thoroughly compacted surface is obtained. 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 be prohibited.

Any place where binder shows undulation on the surface shall be covered with additional aggregate and further rolled and broom dragged until an even surface results and does not adhere to wheels of vehicles. Overlapping the applications of cover material shall be avoided and' all spillage shall be removed from the surface.

The quantity of aggregates to be applied shall be within the ranges specified in Table "Quantities of Materials for Bituminous Surface Treatments".

Maintenance of Traffic

Detouring of highway traffic for this work on running road will not be provided for or permitted, except when authorized by the Engineer. All construction operations shall be coordinated to result in the least practicable delay of traffic. One way traffic shall be maintained and traffic speeds restricted to fifteen (15) Km per hour. The contractor shall provide flagmen, warning signs, barricades, and a sufficient number of pilot cars to control traffic through the bituminous sealing operations when so directed by the Engineer. Pilot cars shall be used to lead the traffic through the areas of all distribution and sealing operations. Pilot cars shall be light "Pick up" trucks or other approved vehicles and shall be equipped with signs reading "PILOT CAR -DO NOT PASS" in both English

and Urdu languages. Two (2) signs shall be mounted on the vehicles so as to be clearly visible from both directions. One (1) flagman shall be stationed immediately ahead of the application of the bituminous material and one (1) flagman immediately behind the section being rolled. Suitable speed limit signs shall be displayed, and the signs shall move forward with the flagman as the work

Progresses.

No separate payment shall be made for conformance to this paragraph. All these items being considered subsidiary to the item (s) given in the Bill of Quantities.

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 as fixed by the Engineer who shall determine it by using his experience and looking into weather conditions.

Maintenance of completed work

When directed by the Engineer, the Contractor will be required to add bituminous material oraggregate or both to the portion of road identified for such purpose on 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 relevant item of "Bituminous Surface Treatment".

Opening to Traffic and after-care.

There shall be no delay in opening a completed surface dressing to traffic at a controlled speed. Prior to opening to traffic any spillage of aggregates shall be removed and any binder drips or windblown contamination shall be dusted. After 2-3 days under traffic, excess stone will be removed by brushing. droller weighing between six (6) to eight (8) tons may be used as a second roller. Rolling shall continue only until a smooth, thoroughly compacted surface is obtained. 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 be prohibited.

Any place where binder shows undulation on the surface shall be covered with additional aggregate and further rolled and broom dragged until an even surface results, and does not adhere to wheels of vehicles. Overlapping the applications of cover material shall be avoided and' all spillage shall be removed from the surface.

The quantity of aggregates to be applied shall be within the ranges specified in Table "Quantities of Materials for Bituminous Surface Treatments".

Maintenance of Traffic

Detouring of highway traffic for this work on running road will not be provided for or permitted, except when authorized by the Engineer. All construction operations shall be coordinated to result in the least practicable delay of traffic. One way traffic shall be maintained and traffic speeds restricted to fifteen (15) Km per hour. The contractor shall provide flagmen, warning signs, barricades, and a sufficient number of pilot cars to control traffic through the bituminous sealing operations when so directed by the Engineer. Pilot cars shall be used to lead the traffic through the areas of all distribution and sealing operations. Pilot cars shall be light "Pick up" trucks or other approved vehicles and shall be equipped with signs reading "PILOT CAR -DO NOT PASS" in both English and Urdu languages. Two (2) signs shall be mounted on the vehicles so as to be clearly visible from both

directions. One (1) flagman shall be stationed immediately ahead of the application of the bituminous material and one (1) flagman immediately behind the section being rolled. Suitable speed limit signs shall be displayed, and the signs shall move forward with the flagman as the work progresses.

No separate payment shall be made for conformance to this paragraph. All these items being considered subsidiary to the item (s) given in the Bill of Quantities.

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 as fixed by the Engineer who shall determine it by using his experience and looking into weather conditions.

Maintenance of completed work

When directed by the Engineer, the Contractor will be required to add bituminous material or aggregate or both to the portion of road identified for such purpose on 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 relevant item of "Bituminous Surface Treatment".

Opening to Traffic and after-care

There shall be no delay in opening a completed surface dressing to traffic at a controlled speed. Prior to opening to traffic any spillage of aggregates shall be removed and any binder drips or windblown contamination shall be dusted. After 2-3 days under traffic, excess stone will be removed by brushing.

15.9.4 MEASUREMENT AND PAYMENT

Measurement

The quantity of surface treatment to be paid for shall be measure in as per unit shown in BOQ within the theoretical line in place as shown on drawings., no allowance will be given for material placed outside the theoretical limits of finished surfacing whether placed for, due to requirement of contractor's operations or placed outside the limits due to inadequate control.

Payment

The aggregate and asphaltic material measured as stated above shall be paid for a particular item at the contract unit price shown in Bill of Quantities, which payment shall be full compensation for furnishing all labour, materials, tools equipment and incidental for performing all the work in the construction of bituminous surface treatment complete in place and according to specification, including priming of surface.

Quantities of Materials for Bituminous Surface Treatments

Surface treatment		Aggregate		Bituminous material	
Type	Application	Size No.	Quantity Kg./Sq.M	Quantity Litres/ Sq.M	Type
Single	Single	2	12.5	1.19	(a)
				1.63	(b)
Double	First	1	24.0	1.90	(a)
				2.14	(b)
	Second	3	12.5	1.19	(a)
				1.63	(b)
Triple	First	1	24.0	1.90	(a)
				2.14	(b)
	Second	2	12.5	1.19	(a)
				1.63	(b)
	Third	3	6.5	0.68	(c)

i. Bituminous material types area (a) asphalt cement, (b) cut-back or emulsified and (c) asphalt cement, cut-back and emulsified.

ii. Quantities of bituminous material may be varied by the Engineer by ±15% depending on site conditions.

iii. Prime coat shall be applied prior to the surface treatment for the newly constructed pavement at the rate as specified in the NHA Specifications "Bituminous Prime Coat –Application of Asphaltic Material.

15.10 PRIME COAT

15.10.1 DESCRIPTION

This work shall consist of furnishing all plant, labour, equipment, material and performing all operations in applying a liquid asphalt prime coat on a previously prepared and untreated earth subgrade, water-bound base course, crushed aggregate base course, tops of roadway shoulders and as otherwise shown on the plans in strict accordance with the specification and in conformity with the lines shown on the drawings.

15.10.2 MATERIAL REQUIREMENTS

Asphaltic material shall conform to the requirements of asphalt cement, cutback or emulsified asphalt, whichever is specified in the Bill of Quantities.

15.10.3 CONSTRUCTION REQUIREMENT

Prime coat shall be applied when the surface to be treated is dry except that when emulsified asphalt is used, the surface may be reasonably moist. The application is prohibited when the weather is foggy or rainy, or when the atmospheric temperature is below fifteen (15) degree C unless otherwise directed by the Engineer. Prior to the application of the prime coat, all loose materials shall be removed from the surface and the same 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. No traffic shall be permitted on the surface after it has been prepared to receive the bituminous material. Prior to the application of prime coat on bridge decks and concrete pavements, the surfaces shall be cleaned of all loose material. All expansion joints shall be cleaned and filled with bituminous material as directed by the Engineer. Areas to be primed will be classified as under:

a) The top of earth surface or water bound base courses from a point twenty (20) centimetres
b) outside the edge of the pavement line to 20 cm outside the line on the opposite side of the roadway.
c) The top of the shoulders from the inter-section of embankment slope and top of subgrade to the edge of the pavement line.
d) The bridge wearing surface from curb to curb and end to end of bridge wearing surface.
e) Other surfaces as shown on the drawings or ordered by the Engineer.
f) Primed surface shall be kept undisturbed for at least 24 hours, so that the bituminous material travels beneath and leaves the top surface in non-tacky condition. No further asphaltic operations shall start on a tacky condition.

Equipment

The liquid asphaltic material shall be sprayed by means of a pressure distributor of not less than 1000-liter capacity, mounted on pneumatic tyres of such width and number that the load produced on the road surface will not exceed hundred (100) Kg per cm width of tyre. It shall be of recognized manufacturer.

The tank shall have a heating device able to heat a complete charge of asphaltic liquid up to one hundred eighty (180) degree C. The heating device shall be so that overheating will not occur. Consequently, the flames must not touch directly on the casting of the tank containing the asphaltic liquid or gases there-from. The Contractor will be responsible for any fire or accident resulting from heating of bituminous materials. The liquid shall be circulated or stirred during the heating. The tank shall be insulated in such a way that the drop in temperature when the tank is filled and not heated, will be less than two (2) degree C per hour. A thermometer shall be fixed to the tank in order to be able to control continuously the temperature of the liquid. The thermometer shall be placed in such away that the highest temperature in the tank is measured. The tank shall be furnished with a device that indicates the contents. The pipes for filling the tank shall be furnished with an easily interchangeable filter.

The distributor shall be able to vary the spray width of the asphaltic liquid in steps of maximum 10 cm, to a total width of four (4) M. The spraying bar shall have nozzles from which the liquid is sprayed fan-shaped on the road surface equally distributed over the total spraying width. The distributor shall have a pump for spraying the liquid driven by a separate motor, or the speed of the pump shall be synchronized with the speed of the distributor. The pump shall be furnished with an indicator showing the performance in litres per minute. At the suction side the pump shall have a filter easily exchangeable. A thermometer shall be fixed, which indicates the temperature of the liquid immediately before it leaves the spraying bar.

The distributor shall be furnished with a tachometer indicating the speed in meter per minute. The tachometer shall be visible from the driver's seat. The function of the distributor shall be so exact that the deviation from the prescribed quantity to be spread on any square meter does not exceed 10% The distributor shall be equipped with a device for hand spraying of the bituminous liquid, to cover any irregular area or covering the area improperly sprayed.

Application of Asphaltic Material

Immediately before applying prime coat, the full area of surface to be treated shall be swept with a power broom to remove all dirt and other objectionable material. If required by the Engineer, the

surface shall be made moist but not saturated. Asphaltic Materials shall be applied temperature by approved pressure distributors operated by skilled workmen. The spray nozzles and spray bars shall be adjusted and frequently checked so as to ensure uniform distribution. Spraying shall cease immediately upon any clogging or interference of any nozzle and remedial measures taken before spraying is resumed. The rate for application of asphaltic material (cut back/emulsified) shall be as under: -

TYPE OF SURFACE	LITRES PER SOUARE METER	
	Minimum	Maximum
1. Subgrade, Subbase, Water bound base courses, and Crushed stone base course.	0.65	1.75
2. Bridge, Wearing Surfaces, Concrete Pavement	0.15	0.4

However, the exact rate shall be specified by the Engineer determined from field trials. The test methods shall be determined by the Engineer and performed by the Contractor in the presence of Engineer.

The prime coat shall be left undisturbed for a period of at least 24 hours, and shall not be opened to traffic until it has penetrated and cured sufficiently so that it will not be picked up by the wheels of passing vehicles. The Contractor shall maintain the prime coat until the next course is applied. Care shall be taken that the application of bituminous material is not in excess of the specified amounts; any excess shall be blotted with sand or similar treatment. All areas inaccessible by the distributor shall be sprayed manually using the device for hand spraying from the distributor.

The surface of structures and trees adjacent to the area being treated shall be protected in such manner as to prevent their being spattered or marred.

Where no convenient detour is available for traffic, operations shall be confined to one-half the roadway width at a time. The Contractor shall provide proper traffic control so that vehicles may proceed without damage to the primed area. Work shall not be started on the portion of the road not covered by previous application until the surface previously covered has dried.

Any area which gets damaged by traffic or otherwise due to the negligence of the contractor shall be re-primed by the contractor at his own cost.

15.10.4 MEASUREMENT AND PAYMENT

Measurement

The unit of measurement shall be for the area as actually covered by prime coat in accordance with these specifications. No measurement or payment will be made for the areas primed outside the limits, specified, herein shown on the Drawings or designated by the Engineer. Blotting material will not be measured for payment and shall be considered subsidiary to the prime coat.

Payment

The payment for area primed measured as stated above, shall be made for the adjusted contract unit price as shown in BOQ item, which payment shall be full compensation for furnishing all labour, material, tools, equipment and incidentals and for performing all the work involved in applying prime coat, complete in place.

15.11 ASPHALT CONCRETE WEARING COURSE - PLANT MIX

15.11.1 DESCRIPTION

This work shall consist of furnishing aggregates and asphalt binder at a central mixing plant, to a specified mixing temperature, transporting, spreading and compacting the mixture in an approved manner on primed on tacked base, sub base. Subgrade, bridge deck or concrete pavement in accordance with these specifications and in conformity with the lines, grades and typical cross-sections shown in the drawings or as directed by the Engineer.

15.11.2 MATERIAL REQUIRMENTS

Mineral Aggregates

The Aggregates shall consist of coarse aggregates, fine aggregates and filler material, if required and shall be clean, hard, tough, durable and sound particles of uniform quality, geology, petrology and free from decomposed material, vegetable matter, soil, clay, lumps and other deleterious substances. Coarse aggregate which is the material retained on an AASHTO No. 4 Sieve, shall consist of one hundred (100) % crushed rock or crushed gravel having two (2) faces mechanically crushed. The type of source shall be uniform throughout the quarry location from where such a material is obtained. The coarse aggregates shall be free from an excess of flat or/and elongated particles. Fine aggregate which is the material passing from AASHTO No. 4 sieve, shall consist of 100% crushed material from rock or boulder. Fine aggregate shall be stored separately, and no natural sand will be allowed in the mix.

When the combined grading of the coarse and fine aggregates is deficient in material passing the-AASHTO No. 200 sieve, mineral filler material shall be added as approved by the Engineer. Thefiller shall consist of finely divided mineral matter such as rock dust, hydrated lime, hydraulic, calcined dust cement or other suitable mineral matter free from lumps, balls or other deleterious material and shall conform to the following graduation.

US Standard Sieve		Percent Passing by Weight
mm	Inch	
0.600	No. 30	100
0.300	No. 50	95 - 100
0.075	No. 200	70 - 100

The coarse and fine aggregates shall meet the Joilowin9 requirements:

a) The percent of Wear by the Los Angeles Abrasion test (AASHTO T 96) shall not be more than thirty (30).
b) The loss when subjected to five cycles of the Sodium Sulphate Soundness test (AASHTO T 104) shall be less than twelve (12) percent.
c) The Sand Equivalent (AASHTO T 176).determined after all processing except for addition of asphalt cement shall not be less than 45.
d) All aggregates shall have a liquid limit of not more than twenty five (25) and a Plasticity Index of not more than four (4) as determined by AASHTO T-89 and T-90.
e) The portion of aggregates retained on the 9.5 mm (3/8 inch) sieve shall not contain more than 10 percent by weight of flat and/or elongated particles (ratio of maximum to minimum dimension = 2.5:1)

f) Stripping test shall be performed on crush aggregates as described under AASHTO-182 and only that material shall be allowed which qualifies the test.

g) The coarse aggregates shall be checked if desired by the Engineer for cationic and anionic behaviour so that their affinity with the bitumen to be used is verified.

h) Petrographic examination of the coarse aggregate shall be conducted if so directed by the Engineer.

The percentage of particles having certain, proportions between their largest and smallest dimensions (i.e. between the largest distance the particles can fill out between two parallel planes that will permit the particle to pass), shall be determined in the following way:

i. Form a sample of coarse aggregates, all particles passing No. 4 sieve are eliminated. The sample shall be of sufficient quantity that at least 100 particles remain.

ii. By means of a sliding caliper, the largest and smallest dimensions, as defined above, are determined for each particle and its proportion calculated (with one decimal).

iii. The total weights of particles having the proportions two and a half (2-5) or less and three (3) or less, are determined and their percentage in relation to the total sample are calculated.

Asphaltic Material

Asphaltic binder to be mixed with the aggregate to produce asphaltic base shall be asphalt cement penetration grade 40-50, 60-70 or 80-100 as specified by the Engineer. Generally it will meet the requirement of AASHTO M-20.

Asphalt Concrete Wearing Course Mixture

The composition of the asphaltic concrete paving mixture for wearing course shall conform to Class A and/or Class B shown in the following table:

Asphalt Concrete Wearing Course Requirements

Mix Designation	Class A	Class B
Compacted Thickness	50-80mm	35-60 mm

Combined Aggregate Grading Requirements:

US Standard Sieve Sizes		Percent Passing by Weight	
mm	Inch		
25	1	100	-
19	¾	90 - 100	100
12.5	½	-	75 - 90
9.5	3/8	56 - 70	60 - 80
4.75	No. 4	35 - 50	40 - 60
2.38	No. 8	23 - 35	20 - 40
1.18	No. 16	5 - 12	5 - 15
0.075	No. 200	2 - 8	3 - 8
Asphalt Content weight percent of total mix		3.5 (Min.)	3.5 (Min.)

The asphalt concrete wearing course mixture shall meet the following Marshal Test Criteria:-

Compaction, number of blows at each end of specimen	75
Stability	1000 Kg (Min)
Flow, 0.25 mm (0.01 inch)	8-14
Percent air voids in mix	4-7
Percent voids in mineral aggregates	According to table 5.3 Ms-2 (Asphalt Institute – USA), sixth addition, 1993
Loss of Stability	20% (Max)

Job-M ix Formula

At least one week prior to production, a Job-Mix Formula (JMF) for the asphaltic wearing course mixture or mixtures to, be used for the project, shall be established jointly by the Engineer and the Contractor.

The JMF shall be established by Marshall Method of Mix Design according to the procedure prescribed in the Asphalt Institute Manual Series No. 2 (MS-2), sixth edition 1993 or the latest Edition.

The JMF, with the allowable tolerances, shall be within the master. Each JMF shall indicate a single percentage of aggregate passing each required sieve and a single percentage of bitumen to be added to the aggregates.

The ratio of weight of filler (passing No. 200) to that of asphalt shall range between 1 - 1.5 for hat climate areas with temperature more than 40o C.

After the JMF is established, all mixtures furnished for the project represented by samples taken from the asphalt plant- during operation, shall conform thereto with the following ranges of tolerances:

Combined aggregates gradation:	
Passing No. 4 and larger sieves	± 6.0%
Passing No. 8 to No. 100 sieves	± 4.0%0
Passing No. 200	± 2.0%
Asphalt Content:	
Weight percent of total mix	± 0.3%

In addition to meeting the requirements specified in the preceding items, the mixture as established by the JMF shall also satisfy the following physical property.

Loss of Marshall Stability by immersion of specimen in water at sixty (60) degree C. for twenty-four (24) hours as compared with the stability measured after immersion in water at sixty (60) degree C. for twenty (20) minutes shall not exceed twenty (20) percent. If the mixture fails to meet this criterion, the JMF shall be modified or an anti-stripping agent shall be used.

Should a change of sources of materials be made a new Job Mix Formula shall be established before the new material is used. When unsatisfactory results or other conditions make it necessary, a new Job Mix Formula will be required.

15.11.3 CONSTRUCTION REQUIREMENT

Construction requirements for this item shall conform to the same as specified for Asphaltic Concrete Base Course Plant mix, except as modified in the following sub-items.

Preparation of Base Course Surface.

Before spreading materials, the surface of the previously constructed and accepted base course on which the mix is to be placed shall be conditioned by application of a lack coat, if directed by the Engineer.

Pavement Thickness and Tolerance.

The asphalt concrete wearing course shall be compacted to the desired level and cross slope as shown on the drawing or as directed by the Engineer.

The tolerances in compacted thickness of the wearing course shall be ± 3mm from the desired thickness shown on the drawings. For determination of thickness one (1) core per hundred meters of each lane will be taken. If the thickness so determined is deficient by more than three (3) mm, but not more than ten (10) mm, payment will be made at an adjusted price of this specification.

The surface of the wearing course shall be tested by the Engineer using a 5 meters straightedge at selected locations. The variation of the surface from the testing edge of the straightedge between any two contacts, longitudinal or transverse with the surface shall at no point exceed five (5) millimetres, The cross fall (camber) shall be with ± 0.2 percent of that specified, and the level at any point shall be within + three (3) mm of the level shown on the Drawings. All humps or depressions exceeding the specified tolerance shall be corrected by removing the defective work and replacing it with new material, by overlaying, or by other means satisfactory to the Engineer.

Acceptance Sampling and Testing

Acceptance of sampling and testing for this Item with respect to materials and construction requirements, not specified herein, shall be in accordance with the relevant, "Tables for Sampling and Testing Frequency" in these specifications.

15.11.4 MEASUREMENT AND PAYMENT

Measurement

The quantities of Asphaltic wearing course shall be measured and compacted in place. Measurements shall be based on the dimension as shown on plans or as otherwise directed or authorized by the Engineer. A tolerance of ± three (3) mm shall be allowed in compacted thickness of wearing course however, any asphalt in excess of 3 mm shall not be paid and any layer deficient by more than 3 mm but not exceeding 10 mm shall be paid.

The quantity of bitumen material used is included in the asphalt concrete mixture and will not be measured separately.

Quantities of Bitumen, wasted or remaining on hand after completion of the work, shall not be measured or paid for.

Payment

The quantities measured as determined above shall be paid for the pay item as shown in the Bill of Quantities, which price and payment shall be full compensation for the furnishing all labour, materials, tools, equipment, and for excavation, concreting, backfilling and erection of posts, installation of sign panels and all incidental costs necessary to complete the work as prescribed in this item.

Price adjustment

If the thickness determined of this specification is deficient by more than three (3) mm, but not more than ten (10) mm, payment will be made at an adjusted price as specified in table-1 below:

Deficiency in thickness as determined by cores	Proportional Rate of contract Price allowed
0.0 mm to 3.0 mm	100%
3.1 mm to 50.0 mm	90%
5.1 mm to 10.0 mm	80%

When wearing course is more than ten (10) mm deficient in thickness, the contractor shall remove such deficient areas and replace them with wearing course of an approved quality and thickness or the contractor may opt to place an additional layer of wearing course asphalt, grading with a minimum thickness of 35 mm. The contractor will receive no compensation for the above addition work. Alternately, the contractor may choose to overlay the area in a thickness of 30 mm (min.) with smooth transition as approved by the Engineer on either side with no extra compensation.

15.12 TRAFFIC ROAD SIGNS

15.12.1 DESCRIPTION

This work shall comprise of furnishing and installing traffic signs, permanent safety devices and post assemblies in accordance with these specifications and to the details shown on the Drawings. All sign faces and lettering shall be in accordance with the latest NTRC sign standards. 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. The permanent safety devices shall consist of road posts and hazard markers and will be provided as per specifications, drawings or as directed by the Engineer.

15.12.2 MATERIAL REQUIRMENTS

Sign Panels

Sign panels for regulator, warning and informatorily signs shall be manufactured from aluminium alloy conforming to ASTM B 209, alloy 6061-T6 or 5052 - H38 plates of three (3) mm thickness as shown on the drawings. Alternatively, Polyvinyl panels can also be used as per direction of the Engineer.

The blank sheets of panels shall be free form laminations, blisters, open seams, pits, holes, or other defects that may affect their appearance or use. The thickness shall be uniform and the blank commercially flat. Perform shearing, cutting and punching before preparing the blanks for application of reflective material.

The blanks shall be cleaned, degreased and chromate or otherwise properly prepared according to methods recommended by the sheeting manufacturer.

Reflective Sheeting

Reflective sheeting used on road sign made of flexible white or coloured, wide angle retro-reflective sheeting (herein after called sheeting) and related processing materials designed to enhance nighttime visibility. The sheeting shall consist of optical elements adhered to a synthetic resin and encapsulated by a flexible transparent plastic that has a smooth outer surface.

The sheeting shall have either a precoated pressure sensitive adhesive or a tack-free adhesive activated by heat applied in a heat vacuum applicator in a manner recommended by the sheeting manufacturer. Both adhesive classes shall be protected by an easily removable liner.

The manufacturer of the sheeting being offered shall furnish the process inks, clears and thinners produced by the sheeting manufacturer recommended for and compatible with the sheeting to meet the performance requirements of this specification and shall further be responsible for technical assistance in the use for these inks or alternatively sheeting can be used on sheeting.

The sheeting manufacturer must provide documented evidence to the satisfactions of the Engineer that representative production materials of the type to be supplied has been used successfully in a substantial traffic signing program in similar climatic conditions for at least three years.

a) Colour Requirements

Colour shall be specified and conform to the requirements of the following Table I.

Table I
Color Specification Limits * and Reference Standards

Color	X	Y	X	Y	X	Y	X	Y	Reflectance Limit (Y) Munsell ** Min	Max	Paper
White	.303	.287	.368	.353	.340	.380	.274	.316	27.0		5PB 7/1
Yellow	.498	.412	.557	.442	.479	.520	.438	.472	15.0	40.0	1.25Y 6/12
Red	.613	.297	.708	.292	.636	.364	.558	.352	2.5	11.0	7.5R 3/12
Blue	.144	.030	.244	.202	.190	.247	.066	.208	1.0	10.0	5.8PB 1.32/6.8
Orange	.550	.360	.630	.370	.581	.418	.516	.394	14.0	30.0	2.5YR 5.5/14
Brown	.430	.340	.430	.390	.550	.450	.610	.390	3.0	9.0	5YR 3.6
Green	.30	.380	.166	.346	.286	.4288	.201	.776	3.0	8.0	10G 3/8

*Table II

The four pairs of chromaticity coordinates determine the acceptable color in terms of the CIE 1931 standard colormeteric system measured with standard illumination source C.

** Available from Munsell Color Company, 2441 Calvert Street, Baltimore, Maryland 21218. Catalog No. MCP-90040.

b) Coefficient of Retro reflection

The coefficient of retro reflection shall conform to the minimum requirements of the following Table II.

Minimum Coefficient of Retro Reflection
(Candelas per foot Candle per square foot)

Observation Angle (°)	Entrance Angle (°)	White	Red	Yellow	Green	Blue	Brown	Orange
0.2	-4	250	45	170	45	20.0	12.0	100.0
0.2	+30	150	25	100	25	11.0	8.5	60.0
0.5	-4	95	15	62	15	7.5	5.0	30.0
0.5	+30	65	10	45	10	5.0	3.5	25.0

For screen printed transparent coloured areas on white sheeting, the coefficients of retro reflection shall not be less than 70% of the values for corresponding colour in the above table. Upon demand from the Engineer the sheeting manufacturer shall provide a test report from British Standards

Institution (BSI) or any internationally recognized laboratory stating that the sheeting meets the requirements according to BSI 873 Part 6 or FP 92 of FHWA.

The brightness of the reflective sheeting totally wet by rain, shall be at least ninety (90)% of the above values.

The reflective sheeting shall be sufficiently flexible as to permit application over and adhesion to a moderately embossed surface. It shall not show damage when bent (90) degree over a fifty (50) mm diameter mandrill.

The sheeting shall show no cracking or reduction in reflection after being subjected to the dropping of a twenty five (25) mm diameter steel ball from a height of two (2) meters onto its surface. For heat activated material the adhesive shall permit the reflective sheeting to adhere securely forty eight (48) hours after application at temperatures of up to ninety (90) degree centigrade. The reflective material shall be weather-resistant and following cleaning, shall show no definite fading, darkening, cracking, blistering or peeling and not less than seventy five (75) % of the specified wet or dry minimum brightness values when exposed to weathering for five (5) years.

Performance requirements and obligations.

On demand from the Engineer the sign manufacturer shall submit a certificate from the sheeting manufacturer stating that the sheeting used for finished retroreflective signs meets all requirements listed herein.

Sheeting processed and applied to sign blank materials in accordance with sheeting manufacturer's recommendation, shall perform effectively for the number of years stated in Table-III of this specification. The retro reflective sheeting will be considered unsatisfactory if it has deteriorated due to natural causes to the extent that: (1) the sign is ineffective for its intended purpose when viewed from a moving vehicle under normal day and night driving conditions: or (2) the coefficient of retro reflection is less than the minimum specified for that sheeting during that period listed in following Table III:

Table III

Minimum Coefficient of Retro Reflection Candelas per foot Candle per square foot (.2^0 obs, and –4^o entrance)*

Sheeting colour	Minimum Coefficient of Retro reflection (7 years)	Minimum Coefficient of Retro reflection (10 years)
White	212	200
Yellow	144	136
Green	38	36
Red	38	36
Blue	17	16
Brown	10	9

* a) The entire seven years the sign manufacturer and sheeting manufacturer will replace the sheeting required to restore the sign surface to its original effectiveness. For screen printed transparent coloured areas on white sheeting, the coefficients of retro reflection shall not be less than 50% of the values for the corresponding colour in the above table. All measurements shall be made after

sign cleaning according to sheeting manufacturer's recommendations. Where it can be shown that retro reflective traffic signs supplied and used according to the sheeting manufacturer's recommendations have not met the performance requirements above the sheeting manufacturer shall cover restoration costs as follows for sheeting shown to be unsatisfactory during:- b) In addition, during the first five years sign manufacturer and sheeting manufacturer will cover the cost of restoring the sign surface to its original effectiveness at no cost to the employer for materials and labour. Samples of the reflective sheeting shall be approved by the Engineer prior to the Contractor placing his order.

Metal Posts

Wide flange of 10 x 10 centimetres metal posts shall be fabricated from structural steel conforming to the specifications of ASTM A 283 Grade D.

In lieu of wide flange steel posts the contractor may use tubular GI or Black Steel MS posts of minimum internal diameter of sixty-five (65) mm with 4.8 mm wall thickness conforming to the specifications of ASTM A 501.

All posts shall be thoroughly cleaned, free from grease, scale and rust, and shall be given one coat of anti-corrosive 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, whereas bottom of sign panel is at least hundred and eighty (180) centimetres above shoulder/footpath level.

Plates

a) Plates shall be non-porous, smooth, flat, rigid, weather proof and shall not rust or deteriorate otherwise. It shall be so cut that there are no sharp edges and that the corners are rounded off to a radius of thirty-seven and half (37.5) mm. Any trade mark or other printing shall be careful removed with liquid thinner.
b) The High Intensity Grade sheeting for the background should cover the whole area of the sign plate.
c) Prior to application of the High Intensity Grade reflective sheeting, the sign plate shall be cleaned and shall be wax-free. They shall be degreased by vapour or by alkaline immersion and etched by scrubbing with abrasive cleaner. The plate shall be rinsed thoroughly and dried with hot air before applying the sheets.
d) The sheeting after application to the sign base shall not come off the edges, which shall be sealed, nor shall it peel off nor warp. The surface shall be smooth and free from any bubbles, pimples, edge chipping or edge shattering. It shall be washable and weather-proof.

Nuts and bolts

All Nuts and bolts and metal washers shall be of heavily galvanized quality ten (10) mm dia of G.I or aluminium alloy. The bolt heads to be such that they do not protrude out too much nor show very much on the front face of the plate. The heads should be flush with the plate face and covered with sheeting galvanized according to ASTM A 153.

Rubber Washer

All rubber washers shall have thick walls and shall not get dry and brittle when exposed to weather at the site after they are in position during the life of the sign.

Caps over the pipes

These can be of heavy plastic or of aluminium well fitted so that they cannot be removed; any good adhesive can be used.

General

a). Very large signs need not be made of one piece; in that case extended panels shall be used or the various pieces of sheet shall be joined by angle-irons in anticorodal materials, and, if necessary, with connecting cross pieces in order to ensure the solidity of the joint and with slanting struts embedded in the concrete as directed by the Engineer.

b). All the nuts and bolts and metal washers must be heavily galvanized, or may be of stainless steel of high quality.

c). Relevant holes to receive ten (10) mm bolts shall be drilled into the pipes and the plates and not punched. These are to be drilled through the plates before the application of scotchlite.

d). After the plates are fixed with nuts and bolts, the nuts shall be TACK WELDED to the bolts against pilferage.

Concrete Foundation Blocks

The concrete for the foundation blocks shall be in situ Class A and shall of the size 450 x 450 x 650 mm for category 1 & 2 and variable for category 3 as per sizes shown in the drawings.

Road Posts and Hazard Markers

The road posts and hazards markers used as permanent safety devices shall conform fully with the requirements of the statutory instruments, current British standards and relevant section of the traffic signs manual. The safety device shall consist of delineators and detours of verge master, flex master, edge master, passing place post, chevroflex etc. and will be manufactured from highly durable tough plastic material withstanding vehicular impact. These shall be of high intensity grade reflective sheeting for maximum visibility during both day and night and consequently be resistant to impact, damage and vandalism.

15.12.3 CONSTRUCTION REQUIREMENT

Excavation and Backfilling

Holes shall be excavated to the required depth of the bottom of the concrete foundation as shown on the drawing.

Backfilling shall be carried out by using the surplus excavated material if approved by the engineer and shall be compacted in layers not exceeding fifteen (15) cm in depth. Surplus excavated material shall be disposed of by the contractor as directed by Engineer.

Erection of Posts / Anchor Bolts

The posts/anchor bolts shall be erected vertically in position inside the formwork of the foundation block prior to the placing of the concrete and shall be adequately supported by bracing to prevent movement of the post/anchor bolts during the setting process of the concrete. The posts /anchor bolts shall be located at the positions shown on the Drawings, or as directed by the Engineer. The post shall be covered from the top by plastic cover in order to stop the rainwater from entering the pipes and to protect the pipe from rusting.

Sign Panel Installation

Sign panels shall be installed by the Contractor in accordance with the details shown on the Drawings. Any chipping or bending of the sign panels shall be considered as sufficient cause to require replacement of the panels at the Contractor's expense.

The exposed portion of the fastening hardware on the face of the sign shall be painted with enamels matching the background colour.

All newly erected traffic road signs shall be covered with burlap or other material until their uncovering is ordered by the Engineer.

Categories of signs

Traffic road signs shall be of three categories according to type of construction.

a). Warning signs

Constructed with single post and sign of equilateral triangle shape, as shown in drawings Category 1.

b). Regulatory Signs

Constructed with single post and sign of circular shape, as shown in the drawings Category 2.

c). Informatory Signs

These signs shall be rectangular in shape and constructed with one, two or three numbers of posts or as shown on the drawings. Dimensions may vary according to the requirements, however total area of sign shall be as under.

Category 3 a = One Sq. meter

Category 3 b = Two Sq. meter

Category 3 c = as shown on drawings

d). Additional Panel

If any panel is required to be installed, it shall be of the sizes 60 x 30 cm or 90 x 30 cm. Installation of safety Devices Safety devices comprising of road posts, delineators of various types, fixed/portable safety barriers and hazard markers e.g. verge-master, flex-master chevroflex, bigmax, edge master and passing place post and others, shall be installed in accordance with the techniques and methods laid down in the manufacturer's manual or guide and in conformity to the line and level and locations shown on the drawings or as directed by the Engineer to ensure maximum visibility and safety, even in adverse weather conditions. These shall be constructed strictly with the specifications and full assistance by the manufacturer for installation with precision. These safety devices shall be used as delineators at sharp curves of highways verges, high embankments, culverts, bridges, as a visual and physical deterrent for a prohibiting car parking on grass verges and protecting kerb-side areas on public and private roads.

Sign Faces

a). Design

All sign faces shall be of the type, colour, design and size as shown in the drawings. Size and spacing of letters shall be as under.

i. The Urdu writing shall be in "Persian" Character.
ii. The Urdu and English writing shall be about the same in length, width and spacing.
iii. English letters are to be in italics except the first letter of the word, which is to be in capital.

iv.	Height of Capital letters	21 cm
v.	Height of italics letters	17 cm
vi.	Stroke width and width of border	3.5 cm
vii.	Space between words and borders (at least)	5 cm
viii.	Space between words	5 cm
ix.	Space one line will occupy	4 cm

x.	Space between digits of numerals	4 cm
xi.	Height of numerals same as capital letters	23 cm
xii.	Space between lines (at least)	5 cm
xiii.	Size of letter for km. Height	K-23 cm
xiv.	Width of letters for km including spacing	K-8 cm
xv.	Width of dividing line	2.0 cm

xvi. The size and spacing for Urdu letter and Words will generally conform to the dimensions Shown above for English letters.

xvii. The spelling of place names in Urdu and in English shall be as written in the Survey of Pakistan, maps

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 town names and their spelling shall be as provided by the Engineer. Size and style of lettering shall be as shown on the drawings or as otherwise approved by the Engineer.

15.12.4 MEASUREMENT AND PAYMENT

Measurement

The quantities of traffic road signs and safety devices to be paid for shall be measured as per unit shown in BOQ item, each category of sign supplied and installed at site as per drawings or as directed by the Engineer.

Payment

The quantities measured as determined above shall be paid for at the contract unit price for the pay items shown in the Bill of Quantities which price and payment shall be full compensation for furnishing all labour, materials, tools, equipment, and for excavation, concreting, backfilling and erection of posts, installation of sign panels and all incidental costs including sheeting/painting ne essary to complete the work as prescribed in this item.

15.13 PAVEMENT MARKING

15.13.1 DESCRIPTION

This work shall consist of furnishing non reflective or reflective chlorinated rubber based on thermoplastic paint material or retro-reflective preformed pavement marking (tape) whichever is called for in the special provisions and shown in the Bill of Quantities for sampling and packing for the preparation of the surface and for the application of the paint to the pavement surface all in accordance with these Specifications.

The paint shall be applied in conformance to the size, shape and location of the markings as shown in the Drawings.

15.13.2 MATERIAL REQUIRMENTS

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, thick-an, 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 Rutlile and extenders	100%
ii) Vehicle	Modified Chlorinated Rubber Plasticised and Resin Blend	52 ± 4%
	Solvents	45 ± 4%
	Additives i.e. Floe 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 yellow 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 is will not darken or become yellow when a then 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.

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. 32	50
No. 50	80
No. 80	100

Glass bends shall conform with AASHTO Designation M-247. At least ninety (90) percent glass bends shall be transparent reasonable stencil and free from flaws. The proportion of ballotini paint shall be not less than five hundred (500) grams per liter of paint.

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 Angle	4 (Degree)	237	118	129	75
Incidence Angle	40 (Degree)	75	43	43	32

15.13.3 CONSTRUCTION REQUIREMENT

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 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.

HOT APPLIED THERMOPLASTIC ROAD PAINTS

Material Requirements

Aggregate

The aggregate shall consist of light coloured silica sand, calcite, quartz, calcined flint, or other material approved by the Engineer.

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

Thu proportions of the constituents of the mixed material as found on analysis shall comply with the requirement of the following table;

PROPORTIONS OF CONSTITUENTS OF MIXTURE.

Constituent	Percentage by mass of total mixture	
	Minimum	Maximum
Binder (resin and oil)	18	22
Pigment	6*	-
Pigment and extender	18	22
Ballotini	20	-
Aggregate	78	82
Pigment		
Extender and 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 shown below;

Grading of Combined Aggregate, Pigment, Extender and Ballotini

Sieve	Percentage by mass passing Sprayed
2.80 mm	100
600 mm	75 - 95

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 read application contractor.

Testing

The samples shall be prepared and tested in accordance with BS 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 65o

• Color and luminance.

a) White Material

The luminance factor of white 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 color of yellow material shall be approximately BS 381C Color No. 355, Lemon. The luminance factor of yellow material as delivered by the manufacturer shall not be 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

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 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.e less than 55.

Manufacturing, Packing and Storing of Paint

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 (05) years to produce paint. The equipment for mixing and grinding shall be clean, modern and in good condition.

Packing

a) The material shall be supplied in sealed containers which do not contaminate the contents and which protect them from contamination.

b) Each container shall be clearly and indelibly marked with the manufacturer's name, Batch number, date of manufacture, reflectorisation (if applicable), color, chemical type of binder and maximum safe heating temperature.

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.

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.

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 5o

b) Preparation of material on site

The material shall be melted in accordance with the manufacturer's instruction in a heather fitting 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 hall be within the range specified by the manufacture, and shall on no account be allowed to exceed the maximum temperature stated by the manufacture. 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 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 carriage, a tack coat compatible with the marking material shall be applied in accordance with the manufacturer's instruction prior to the application of thermoplastic material.

c) Laving

Carriageway centre lines, lane lines and edge lines shall be laid to a regular alignment by self-propelled machine. Other marking 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 blister and streaks.

d) Reflectorization by surface application

When surface application of ballotini is required, additional ballotini (400 g/m2 to 500 g/m2 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 marking shall conform to the following grading.

Sieve	Percentage by mass passing
17 mm	100
600 µ	80-100
400 µ	40-100
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 thickness.

a) Sprayed lines other then 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 (1978).

Trail 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.

RETORoREFLECTIVE PREFORMED PAVEMENT MARKINGS

Material Requirement

The performed marking 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 retroflection. Ceramic skid particles shall be bonded to a top urethane layer to provide a skid resistant surface.

The performed marking shall be capable of being adhered to asphalt cement concrete (ACC) or Portland Cement Concrete (PCC) by a pre-coated 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 manufacture's instruction, approved by the Engineer.

Following proper application and tamping, the marking 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 performed marking shall be suitable for use one year after the date of receipt when stored in accordance with the manufacturer's recommendations.

The marking film shall be durable retro-reflective plisot polymer pavement marking film for performed longitudinal marking subject to low to medium traffic volumes and moderate wear conditions such as repeated shear action from crossover or encroachment on channelization lines.

The retro-reflective 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.

Colour

The day time 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 = 0.536, 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 2o standard observer.

Reflectance

The white and yellow films shall have the following initial minim 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 millicandels per square foot per foot candle (mcd.ft2 fc-1). The metric equivalent shall be expressed as millicandals per square meter per lux (mcd.m-2) 1x -1).

	White	Yellow
Entrance Angle 86.00^0	86.5^0	86.5^0
Observation Angle	1.0^0	1.0^0
Specific Luminance	300	175
SL (mcd. ft^{-2}. f^1		

Skid Resistance

The surface of the retro-reflective films shall provide and initial minim skid resistance values of 55 BPN as measured by the British Portable Skid Tester in accordance with ASTM E 303.

Patchbility

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 instruction.

Reflectance Retention

To have a good, effective performance life, the ceramic and glass beads must be strongly bonded and not be easily are moved by traffic wear. The following test shall be employed to measure reflectivity retention.

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.

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.

Bead Retention

The film shall be ceramic and glass bead retention qualities such hat 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%.

Thickness

The film without adhesive shall have a minimum thickness of 0.030 in (0.76 mm).

Effective Performance Life

The film when applied according to the recommendations of the manufacturer, shall proved neat, durable marking that will no 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 no significant tearing, roll back or other signs of poor adhesion.

Installation

The marking shall be applied in accordance with the manufacturer's instructions.

CEMENTITIOUS MARKING COMPOUND

Cementitious marking compound shall be used for Concrete Surface Dressing and Bitumen to provide enhanced night and wet, weather visibility. The 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 and white chevrons
- Concrete wall and faces – on high speed intersection and traffic merging

15.13.4 MEASUREMENT AND PAYMENT

Measurement

The quantity of non-reflective or reflective chlorinated rubber based or thermoplastic pavement marking paint shown in BOQ for the specified width as indicated in BOQ. The retro-reflective performed pavement marking (tape) shall be measured in square meters. The arrows shall be measured in number.

The measurement shall be made of painted areas, complete 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.

Payment

The quantities measured as determined above shall be paid for a the contract unit price respectively for the pay items shown in BOQ items, which price and payment shall constitute full compensation for furnishing and placing all materials including sampling packing and testing at approved laboratory. The cost shall also include the preparation of the surface and for all other coasts necessary to complete the work as prescribed in this item.

15.14 REFLECTORIZED PAVEMENT STUDS

15.14.1 DESCRIPTION

This item shall consist of furnishing and installing reflectorized pavement studs set into the travelled way of the type in accordance with the specifications and at the locations shown on the Drawings or as directed by the Engineer.

15.14.2 MATERIAL REQUIREMENT

Reflectorized Studs

Reflectorized Studs shall be "cat-eyes" with `Raised Profile' type having the following characteristics.

The `Raised Profile' reflectors shall consist of metallic or 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 or variable and thickness not more than two (2) cm or as shown on the drawings. A written approval is required from the Engineer regarding selection of reflectorized pavement studs especially with respect to material and size prior to execution of works.

The shell shall 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 drawings.

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 (S.I) values 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 centre of the reflecting face at a distance of one and half (1.5 m) from 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 from stray light. The distance from the centres 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 1,000 kg when tested in the following manner. A reflector shall be centered horizontally over the open end of a vertically 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.

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/Liter
Epoxy Resin	0.94
Titaniurn Dioxide	0.07
Colloidal Silica	0.05
Talc	0.345

Package B	Kg/Liter
Modified Asphaltic Amine	
Hardner (Reinchold 2611)	0.24
Modified Aliphatic Amine	
Hardner (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.

Cement Mortar

Cement mortar shall consist of one (1) part Portland cement to three (3) parts of fine aggregates.

15.14.3 CONSTRUCTION REQUIREMENT

Raised Profile Type

The pavement studs shall be installed in accordance with the manufacturer's instructions or to the requirements of the Engineer.

15.14.4 MEASUREMENT AND PAYMENT

Measurement

The quantity of reflectorized pavement studs to be paid for shall be the number of 'Raised Profile' type provided and installed as mentioned above.

Payment

The quantities measured as described above shall be paid for at the contract unit price for the pay items shown in the Bill of Quantities, which payment shall constitute full compensation for furnishing and placing all materials, excavating cavities, preparation of surfaces, applying adhesive and mortar, for all labour, equipment, tools and incidentals necessary to complete the item.

15.15 PRECASE CEMENT CONCRETE ROAD KERB BLOCK

15.15.1 DESCRIPTION

This work shall consist of CC pre cast kerb block constructed of the following materials and in accordance with the specifications, dimensions and designs shown on the drawings or as approved by Engineer.

15.15.2 MATERIAL REQUIREMENTS

Pre cast concrete kerbing units industrial made shall consist of cement concrete 1:1½:3 having a minimum works cylindrical strength of 3000 lbs. per sq. inch at 28 days, hydraulically compressed, steam cured & to the lengths, shapes and other details shown on the drawing. Kerbing which shows surface irregularities of more then 5 mm when checked with 3 meter straight edge or surface pits more then fifteen (15) mm in diameter will be rejected.

15.15.3 CONSTRUCTION REQUIREMENT

a). Excavation and Bedding

Excavation shall be made to the required depth as shown on the Drawings. All soft and unsuitable material shall be removed and replaced with a suitable material acceptable to the Engineer.

Bedding shall consist of Class B Concrete and shall be to the section and dimension shown on the drawings.

b). Placing

Pre-cast concrete kerbs shall be set in 1:3 of cement sand mortar to the line, level and grade as shown on the Drawing or as directed buy the Engineer.

c). Joints

Joints between consecutive kerbs shall be three (3) to five (5) mm wide and filled with cement mortar to the full section of the kerb.

d). Back filling

After concrete has been cured as specified, excavation of kerb, shall be back filled with suitable earth or granular material tamped into place in layers of not more than fifteen (15) cm each until firm and solid.

15.15.4 MEASUREMENT AND PAYMENT

The unit of measurement for pre-cast concrete kerb shall be measured by the linear foot along the front face of the section at the finished grade elevation. Deduction in length will be made for drainage structure installed in the kerbings such as catch basins and drop lintels etc. measurement will not include any area in excess of those shown on the drawing except for any area authorized by the Engineer in writing.

Bed course material shall me measured by the cubic foot of material compacted in place.

a). Payment

Measurement and excepted quantities shall be paid for at the contract unit price per linear foot. Payment shall constitute full compensation for furnishing and placing all materials for concrete, drainage opening, excavation, backfilling and dumping and disposal of surplus material and for all labour, equipment tool and incidental necessary to complete the item. Payment for expansion joint filler material used in transverse expansion and contraction joint in kerb shall be understood to be included in the price tendered per linear foot for the kerbs.

Mortar required for bedding and jointing of pre-cast concrete kerbs as shown on the drawings shall not be paid for as separated item, but the cost shall be included in the contract price for pre-cast concrete kerb.

15.16 INTERLOCKING CONCRETE PAVING BLOCK

15.16.1 DESCRIPTION

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 lines, grades, thicknesses and typical cross section shown on the drawings or as directed by the Engineer.

15.16.2 MATERIAL REOUIREMENTS

For execution of this item provisions made in BS 6717 shall be applicable.

3. 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 Blast furnace 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 blast-furnace slag is used, the proportions and properties of the combination with Portland Cement shall comply with BS 146 : Part 2.

AGGREGATES

Paving blocks shall be made using one or more of the following aggregates complying with the relevant standards:

Natural Aggregates (Crushed or grading Uncrushed)	BS 882 : 1983 (except 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

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 SS 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 mm sieve.

WATER

The water shall be of drinking quality .or in accordance with the recommendations of Appendix-A of BS 3148: 1980.

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

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.

BINDER CONTENT

The cement content of the compacted concrete shall be not less than C80 kg/m3 For equivalent durability, paving blocks made with binder constituents other than ordinary Portland cement shall have 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.

SIZES AND TOLERANCES

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.

Tolerances

The maximum dimensional deviations from the stated work sizes for blocks shall be as follows:

Length	± 2 mm
Width	± 2 mm
Thickness	± 3 mm

Where a paving block includes profiled sides, the profile shall not from the manufacturer's specification by more than 2 mm.

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 48 N/mm^2

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 approximate 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.

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.

15.16.3 CONSTRUCTION REQUIREMENT

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

Tolerance

Tolerance of these layers shall be as per applicable requirement of each item of this specification. Payment for each of the above item shall be made under the relative item of work.

The total area will thereby be dividing 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.

15.16.4 MEASUREMENT AND PAYMENT

Measurement

The area to be measured shall be bound by lines shown on the drawings or as directed by the Engineer Unit of measurement shall be measured in horizontal plane.

Payment

The quality determined as provided above shall be paid for the unit price of contract shown in Bill of Quantities of paving blocks installed including sand cushion and sand filling in joints and all other work related for installing paving blocks. Cost shall include all labour, materials and equipment for proper completion of work.

NED UNIVERSITY OF ENGINEERING & TECHNOLOGY, KARACHI

CONSTRUCTION OF NEW ROAD FROM FITNESS CENTRE TO NEWLY DEVELOPED FOOTBALL GROUND AND REHABILITATION OF EXISTING ROAD FROM OVERHEAD WATER TANK TO FITNESS CENTRE

TENDER DOCUMENTS VOLUME-IV
TENDER DRAWINGS

PC/NED/Road/Sports/6963/2020

DEVELOPMENT & UPGRADATION OF SPORTS FACILITIES

Nexus Consulting
OFFICE A-202, SECOND FLOOR, BLOSSOM TRADE CENTER, OPPOSITE NED UNIVERSITY PLOT # SB-26, BLOCK-01, GULISTAN-E-JAUHAR, KARACHI
021-34177576, www.nexuscon.pk,
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DWG NO.	SHEET NO.	INDEX	DRAWING TITLE	REV NO.
GE-00	01 OF 01	-	LIST OF DRAWINGS	00
AR-00A	01 OF 01	-	CONTOUR PLAN (EXISTING)	00
AR-00B	01 OF 01	-	TOPOGRAPHIC AND CONTOUR PLAN (EXISTING)	00
AR-00C	01 OF 01	-	LAYOUT PLAN (EXISTING)	00
AR-00D	01 OF 01	-	MASTER PLAN	00
AR-01	01 OF 01	-	PROPOSED & REHABILITATION ROAD PLAN	00
AR-02a	01 OF 01	-	ROAD DETAILS	00
AR-02b	01 OF 01	-	ROAD DETAILS	00
AR-02c	01 OF 01	-	ROAD DETAILS	00

TENDER DRAWING
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CONSTRUCTION

CLIENT:-
N.E.D UNIVERSITY KARACHI

CONSULTANT:
Nexus Consulting
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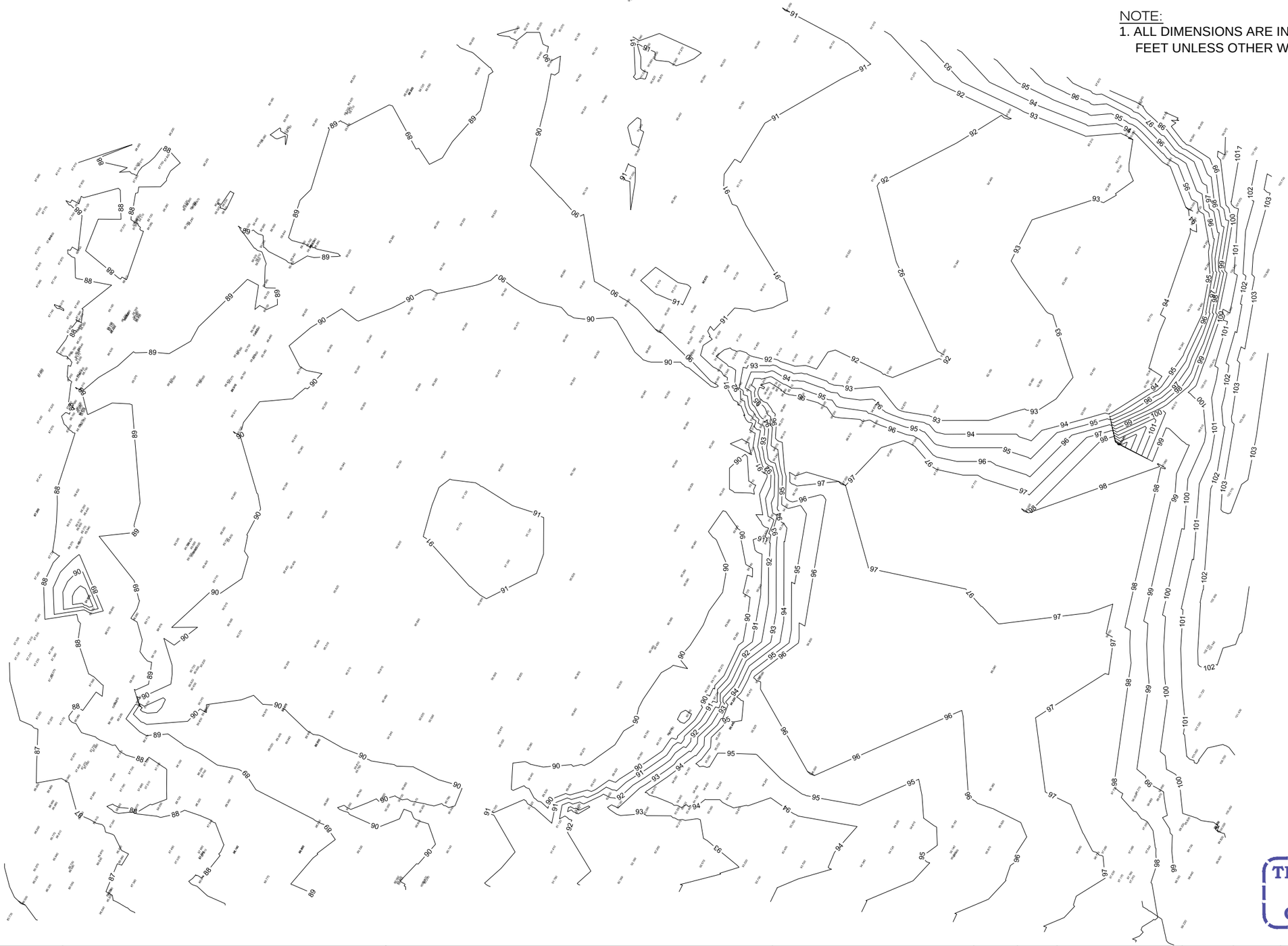
PROJECT:-
DEVELOPMENT & UP-GRADATION
OF SPORTS FACILITY AT NED UNIVERSITY KARACHI
CONSTRUCTION OF NEW ROAD FROM FITNESS CENTER TO NEWLY DEVELOPED FOOTBALL GROUND AND REHABILITATION OF EXISTING ROAD FROM OVERHEAD WATER TANK TO FITNESS CENTER

TITLE:-
LIST OF DRAWING

REV #	DATE	DESCRIPTION	CH'K'D	APP'D

Project Ref: .
DRAWN BY A-A
CHECKED BY O-A
DATE SEP. 2020
SCALE AS SHOWN
DWG. NO. GE-00

NOTE:
1. ALL DIMENSIONS ARE IN FEET AND LEVELS ARE IN FEET UNLESS OTHER WISE SPECIFIED AND NOTED.



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CONSULTANT:

Nexus Consulting

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PROJECT:-

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TITLE:-

CONTOUR PLAN (EXISTING)

REV #	DATE	DESCRIPTION	CHK'D	APP'D

Project Ref: .

DRAWN BY: A-A

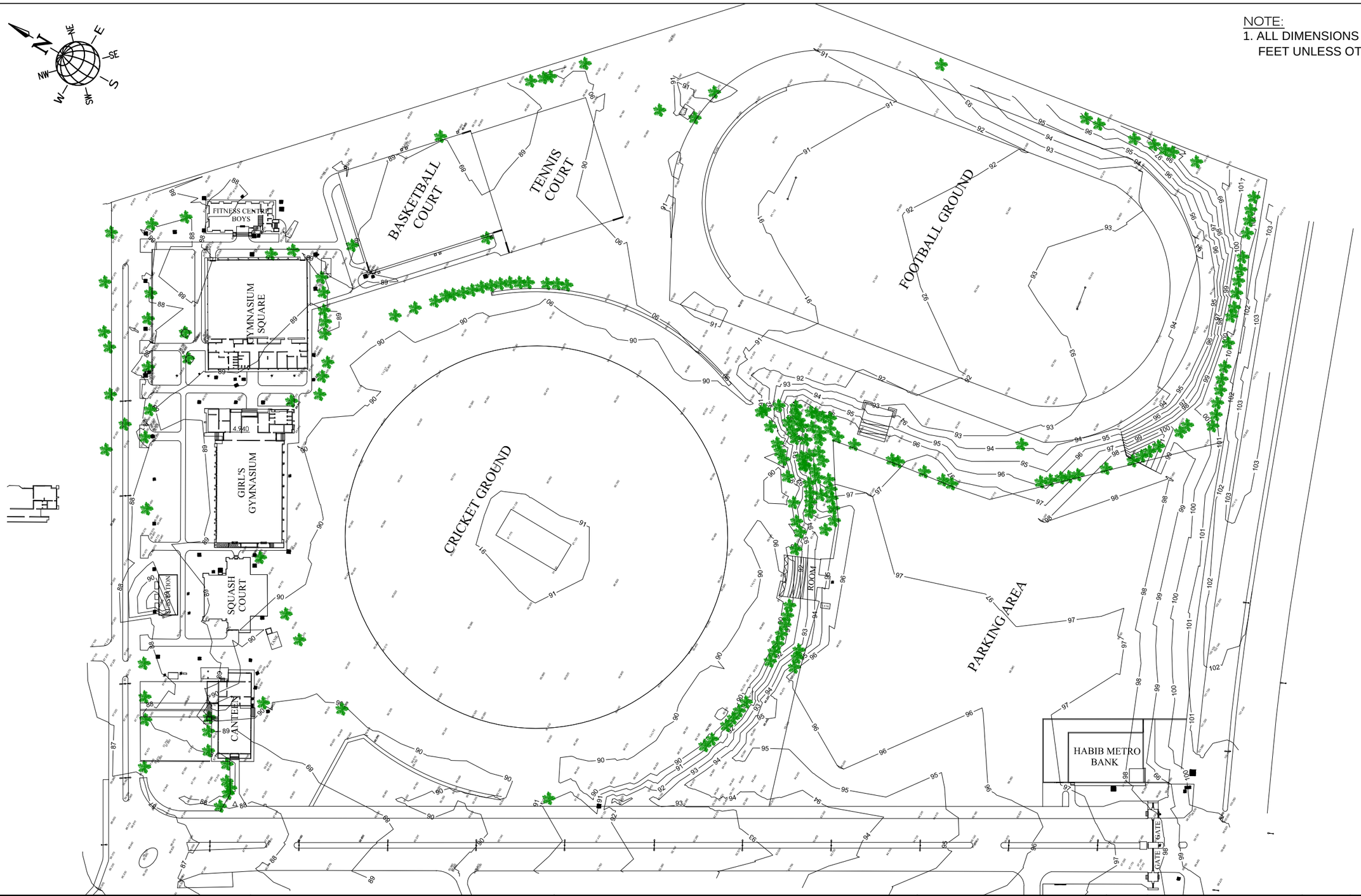
CHECKED BY: O-A

DATE: SEP. 2020

SCALE: AS SHOWN

DWG. NO.: AR-00A

NOTE:
1. ALL DIMENSIONS ARE IN FEET AND LEVELS ARE IN FEET UNLESS OTHER WISE SPECIFIED AND NOTED.



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PROJECT:-
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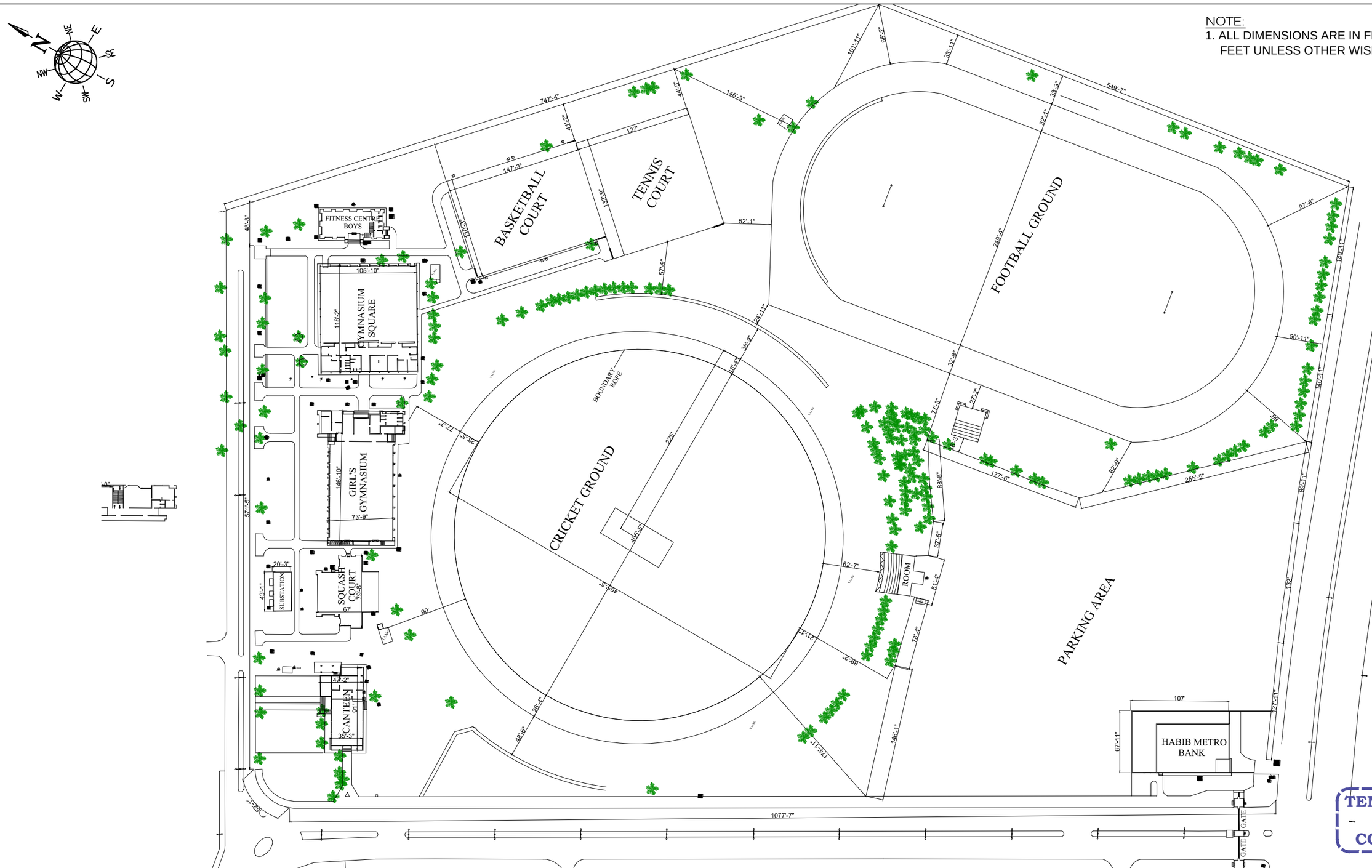
TITLE:-
TOPOGRAPHIC AND CONTOUR PLAN (EXISTING)

REV #	DATE	DESCRIPTION	CHK'D	APP'D

Project Ref: .	DATE SEP. 2020
DRAWN BY A-A	SCALE AS SHOWN
CHECKED BY O-A	DWG. NO. AR-00B

NOTE:
1. ALL DIMENSIONS ARE IN FEET AND LEVELS ARE IN FEET UNLESS OTHER WISE SPECIFIED AND NOTED.



TENDER DRAWING – NOT FOR CONSTRUCTION

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N.E.D UNIVERSITY KARACHI

CONSULTANT:
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Office A-202, Second Floor,Blossom Trade Center Opposite NED University University Road, SB-26,Block No.01 University Road, SB-26,Block No.01 Gulistan-e-Jouhar, Karachi Pakistan 021-34177576, 03018265289, 03012163075 Email:nexusconsulttingcompany@gmail.com Web:www.Nexuscon.pk

PROJECT:-
DEVELOPMENT & UP-GRADATION
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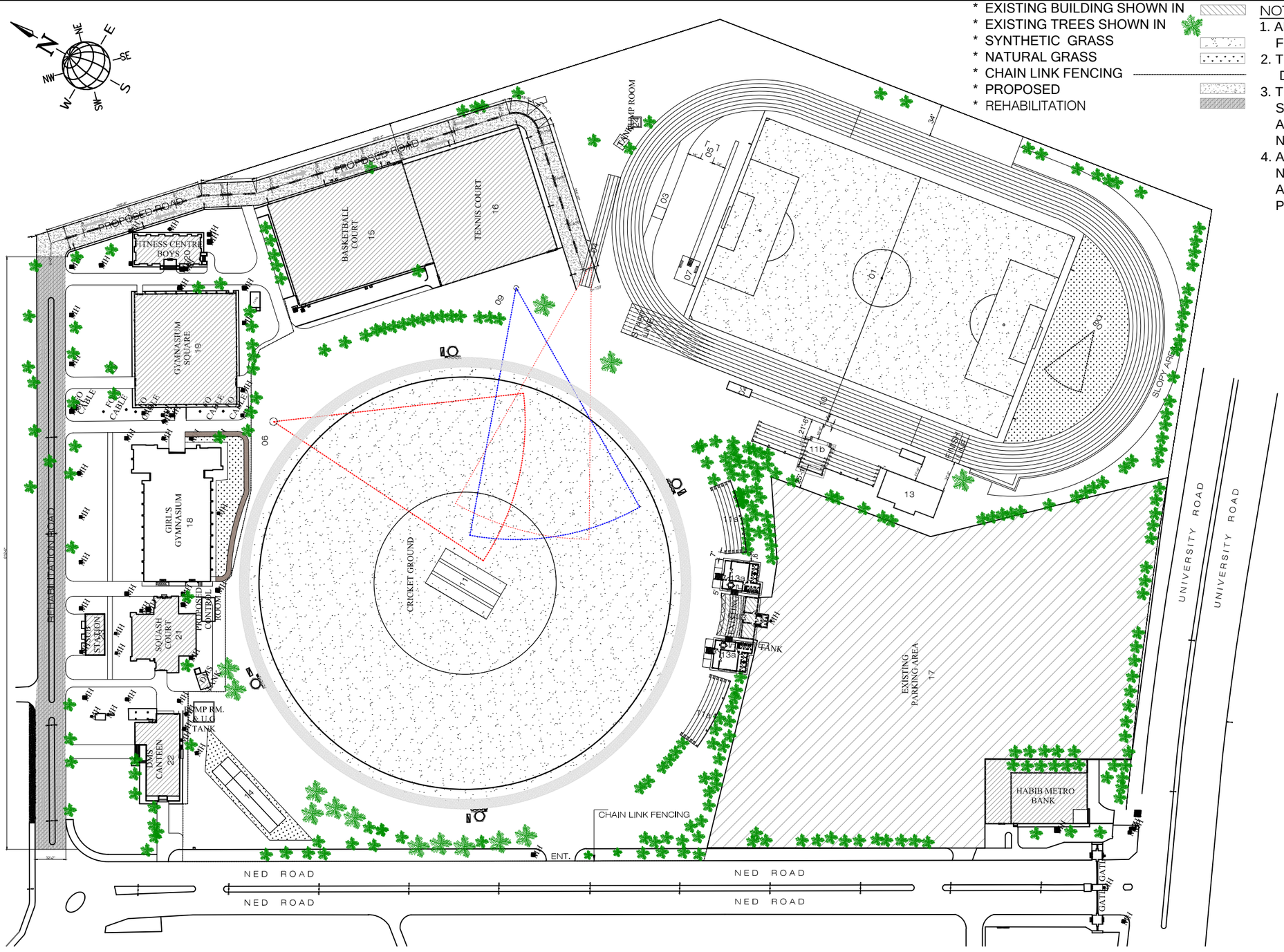
TITLE:-
LAYOUT PLAN (EXISTING)

REV #	DATE	DESCRIPTION	CHK'D	APP'D

Project Ref: .
DATE: SEP. 2020
DRAWN BY: A-A
SCALE: AS SHOWN
CHECKED BY: O-A
DWG. NO.: AR-00C



NOTE:

1. ALL DIMENSIONS ARE IN FEET AND LEVELS ARE IN FEET UNLESS OTHER WISE SPECIFIED AND NOTED.
2. THE CONTRACTOR TO VERIFY EXISTING CONDITIONS AND DIMENSIONS ON THE SITE PRIOR TO START OF ANY WORK.
3. THE CONTRACTOR SHALL VERIFY AND CONFIRM ITEM OF STRUCTURE AND OTHER MATERIALS DESIGNATED FOR SALVAGE AND WILL STORE THEM AS PER INSTRUCTION FROM THE N.E.D UNIVERSITY KARACHI
4. ANY DISCREPANCY ARISING IN PROPOSED WORK A NECESSARY ADJUSTMENT SHALL BE DONE WITH THE APPROVAL OF N.E.D UNIVERSITY KARACHI REPRESENTATIVE PRIOR TO IMPLEMENTATION OF WORKS.

00	MASTER PLAN
01	PLAYING FIELD (105m X 68m)
02	LONG AND TRIPLE JUMP
03	WATER JUMP
04	JAVELIN THROW
05	HIGH JUMP
06	DISCUSS THROW FACILITY
07	POLE VAULT FACILITY
08	SHOT PUT FACILITY
09	DISCUSS AND HAMMER THROW FACILITY
10	RUNNING TRACK (9.76m x 130m)
11a	PUBLIC SITTING STAND (CRICKET GROUND)
11b	PUBLIC SITTING STAND (FOOTBALL GROUND)
12	CRICKET GROUND (EXISTING)
13a	PAVILION (CRICKET GROUND)
13b	PAVILION (FOOTBALL GROUND)
14	CRICKET NET PRACTICE
15	BASKET BALL / VOLLEYBALL COURT (EXISTING)
16	TENNIS COURT (EXISTING)
17	PARKING (EXISTING)
18	GIRL'S GYMNASIUM (EXISTING)
19	GYMNASIUM SQUARE (EXISTING)
20	FITNESS CENTRE BOYS (EXISTING)
21	SQUASH COURT (EXISTING)
22	CANTEEN (EXISTING)
23	SUB STATION (EXISTING)
24	PUMP ROOM

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CLIENT:-

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CONSULTANT:

Nexus Consulting

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PROJECT:-

DEVELOPMENT & UP-GRADATION
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CONSTRUCTION OF NEW ROAD FROM FITNESS CENTER TO NEWLY DEVELOPED FOOTBALL GROUND AND REHABILITATION OF EXISTING ROAD FROM OVERHEAD WATER TANK TO FITNESS CENTER

TITLE:-

MASTER PLAN

REV #	DATE	DESCRIPTION	CHK'D	APP'D

Project Ref: .

DATE: SEP. 2020

DRAWN BY: A-A

SCALE: AS SHOWN

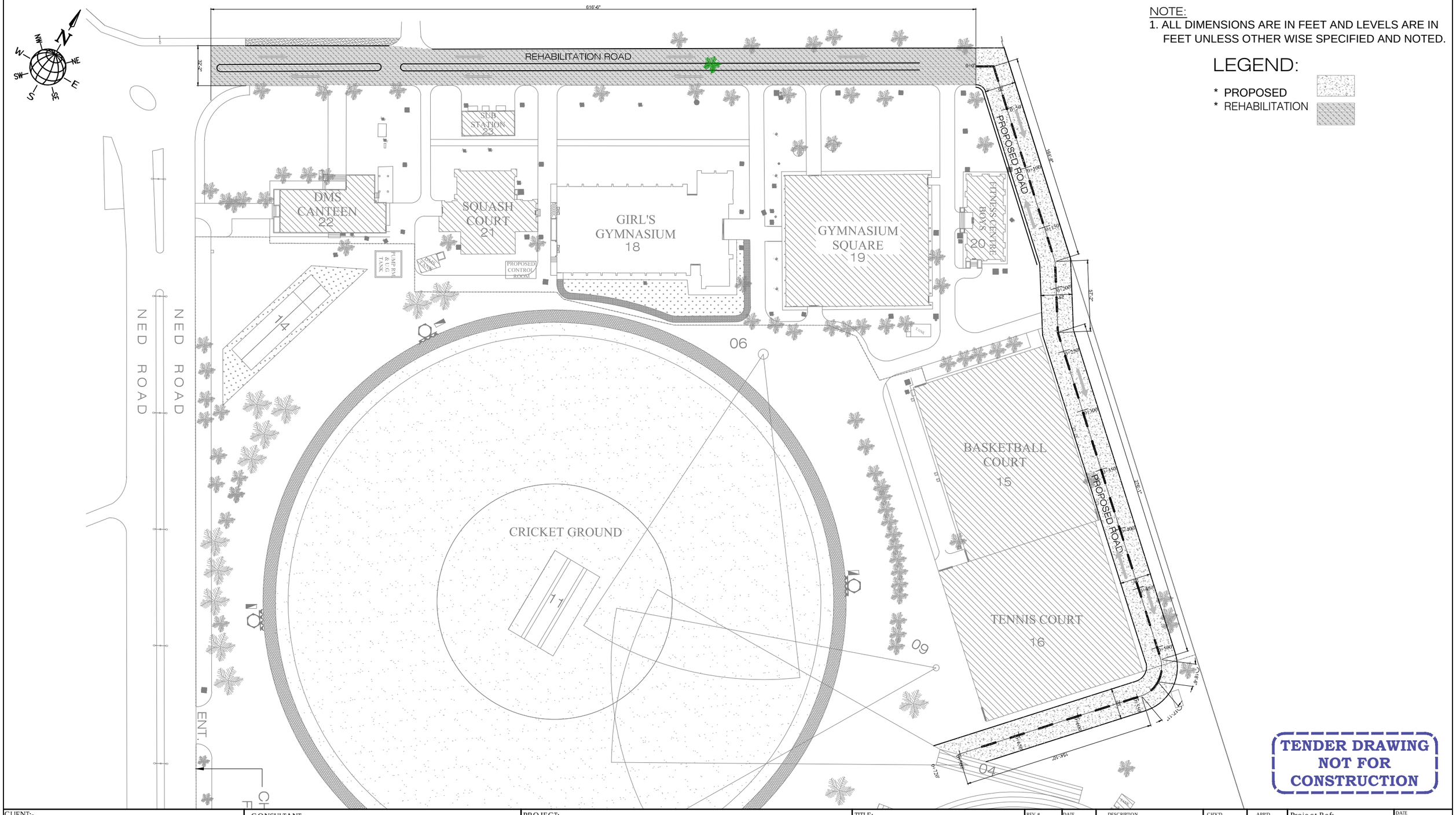
CHECKED BY: O-A

DWG. NO.: AR-00D

NOTE:
1. ALL DIMENSIONS ARE IN FEET AND LEVELS ARE IN FEET UNLESS OTHER WISE SPECIFIED AND NOTED.

LEGEND:

* PROPOSED
* REHABILITATION



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CLIENT:-
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CONSULTANT:
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PROJECT:-
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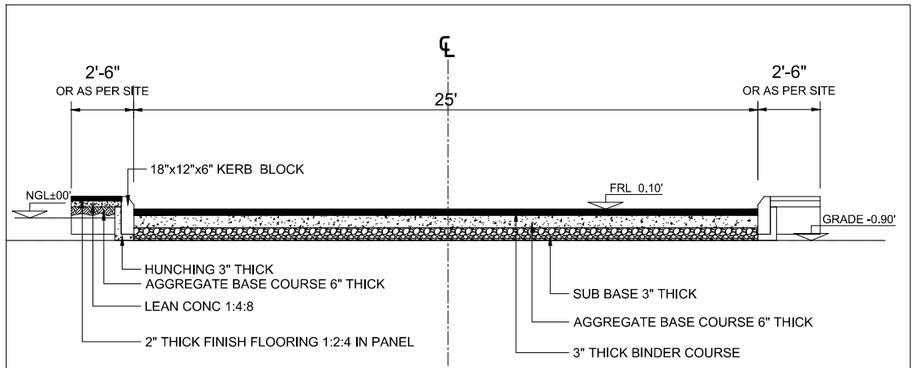
TITLE:-
PROPOSED & REHABILITATION ROAD PLAN

REV #	DATE	DESCRIPTION	CH'K'D	APP'D

Project Ref: .
DATE: SEP. 2020
DRAWN BY: A-A
SCALE: AS SHOWN
CHECKED BY: O-A
DWG. NO.: AR-01

NOTE:
1. ALL DIMENSIONS ARE IN FEET AND LEVELS ARE IN FEET UNLESS OTHER WISE SPECIFIED AND NOTED.



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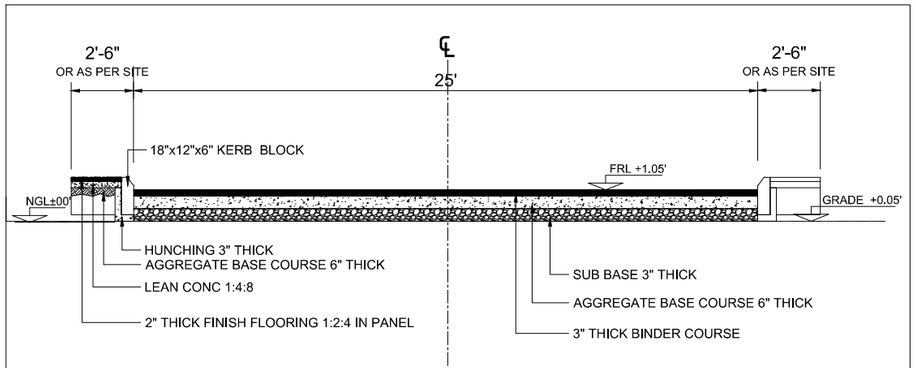

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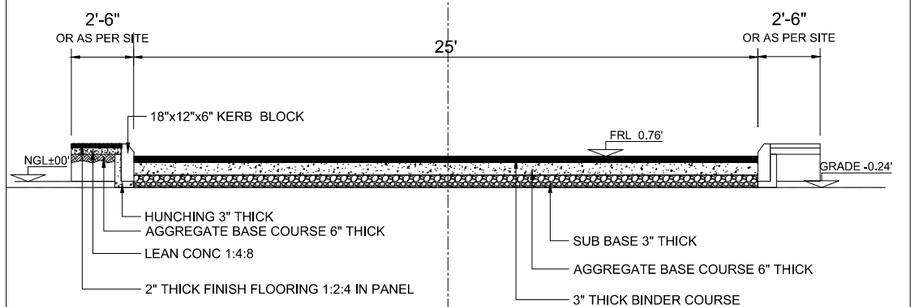

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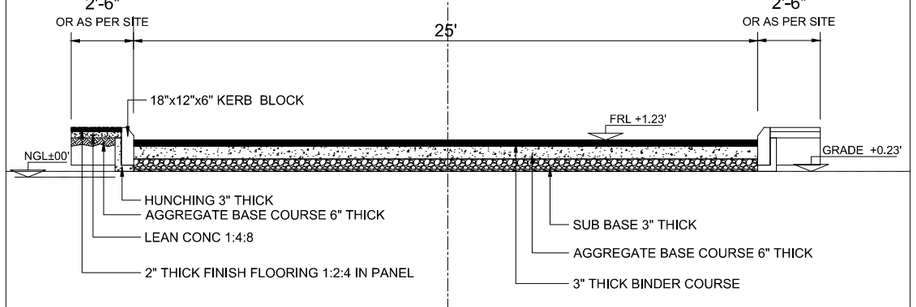

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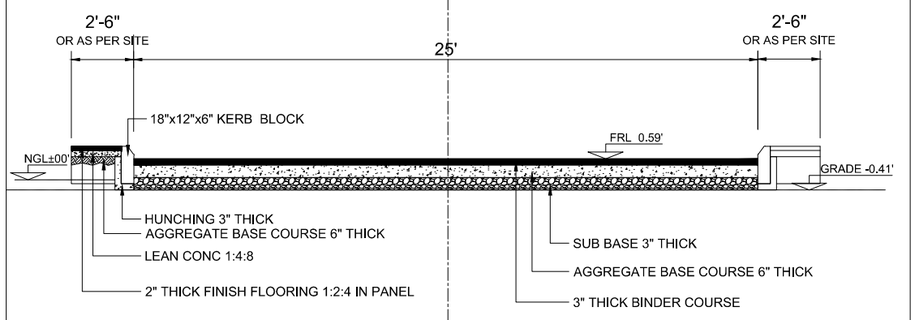

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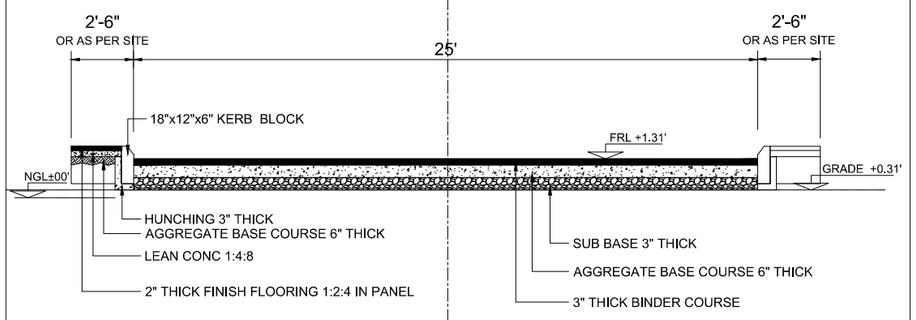

SECTION @ CHAINAGE 250'-0"

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CLIENT:-
N.E.D UNIVERSITY KARACHI

CONSULTANT:
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Gulistan-e-Jouhar, Karachi Pakistan 021-34177576, 03018265289, 03012163075
Email:nexusconsulttingcompany@gmail.com Web:www.Nexuscon.pk

PROJECT:-
DEVELOPMENT & UP-GRADATION
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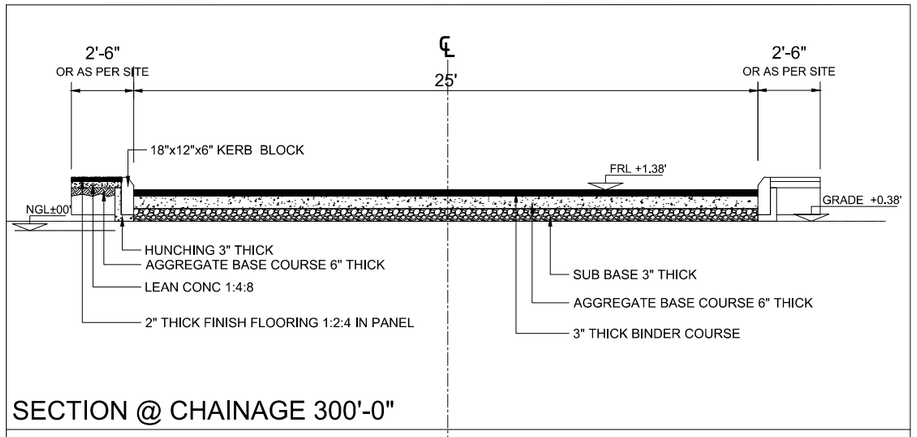
CONSTRUCTION OF NEW ROAD FROM FITNESS
CENTER TO NEWLY DEVELOPED FOOTBALL GROUND
AND REHABILITATION OF EXISTING ROAD FROM
OVERHEAD WATER TANK TO FITNESS CENTER

TITLE:-
ROAD DETAILS

REV #	DATE	DESCRIPTION	CHK'D	APP'D

Project Ref: .
DATE: SEP. 2020
DRAWN BY: A-A
SCALE: AS SHOWN
CHECKED BY: O-A
DWG. NO.: AR-02a

NOTE:
1. ALL DIMENSIONS ARE IN FEET AND LEVELS ARE IN FEET UNLESS OTHER WISE SPECIFIED AND NOTED.



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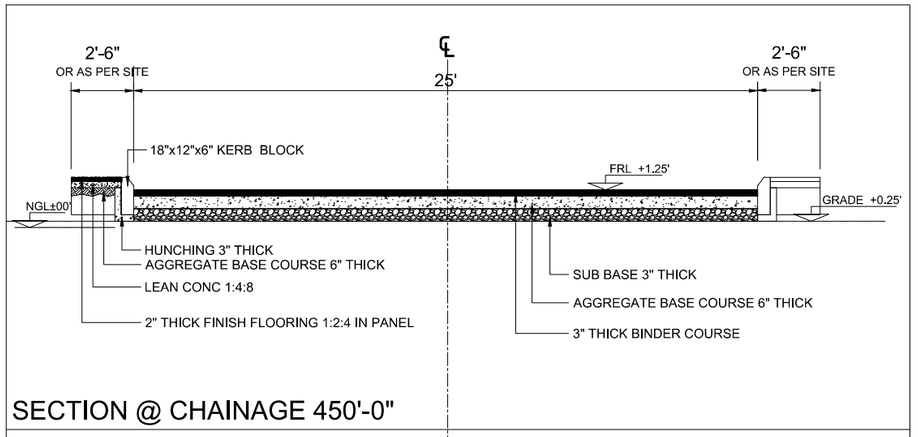

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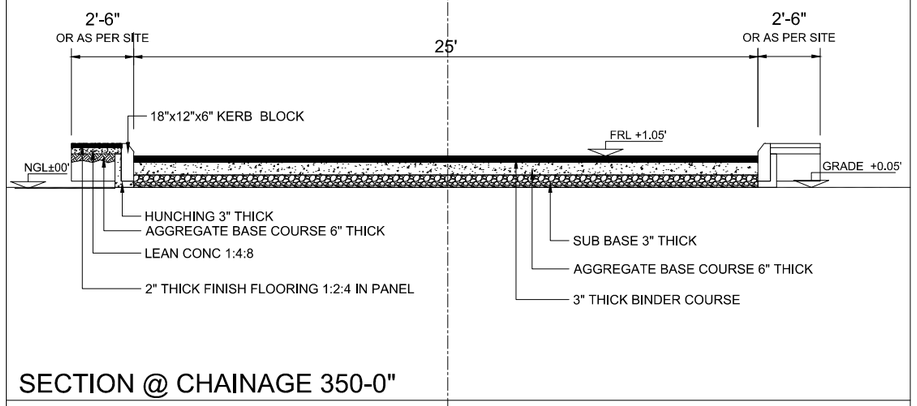

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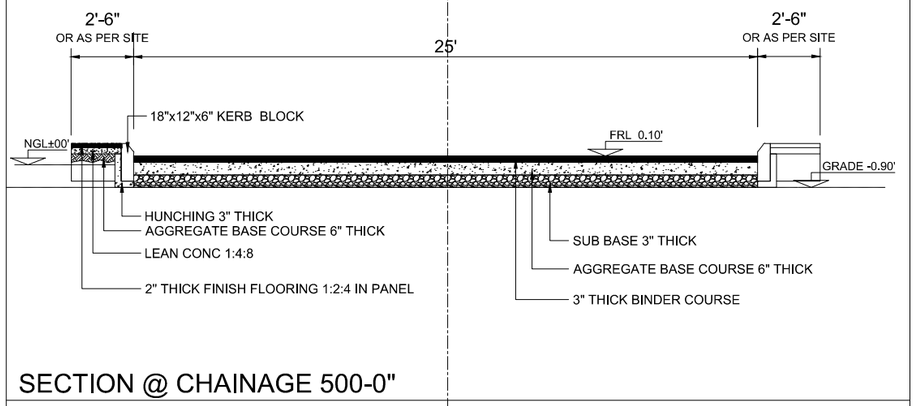

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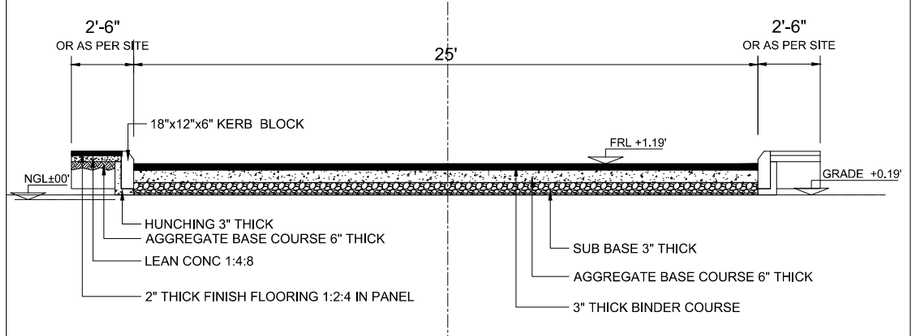

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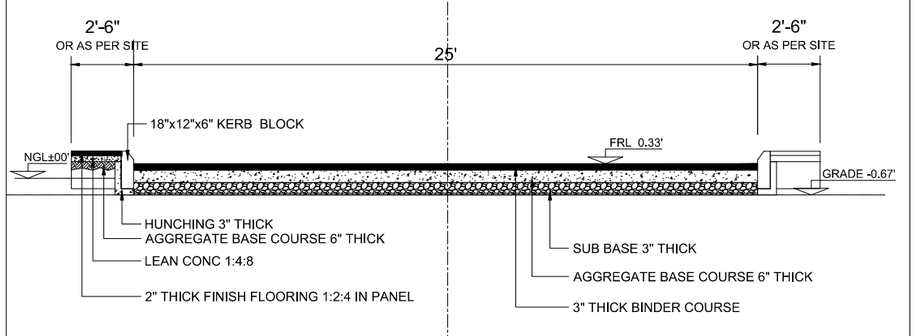

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TENDER DRAWING
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CONSTRUCTION

CLIENT:-
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CONSULTANT:
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PROJECT:-
DEVELOPMENT & UP-GRADATION
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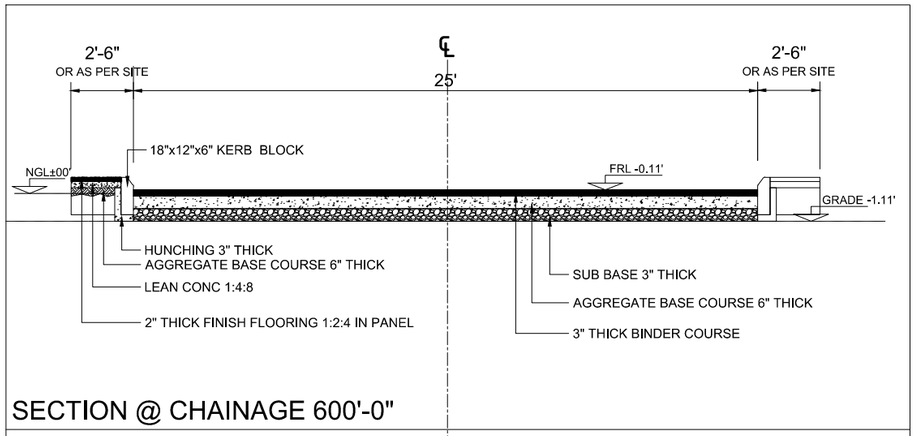
TITLE:-
ROAD DETAILS

REV #	DATE	DESCRIPTION	CHK'D	APP'D

Project Ref: .
DATE: SEP. 2020
DRAWN BY: A-A
SCALE: AS SHOWN
CHECKED BY: O-A
DWG. NO.: AR-02b

NOTE:
1. ALL DIMENSIONS ARE IN FEET AND LEVELS ARE IN FEET UNLESS OTHER WISE SPECIFIED AND NOTED.



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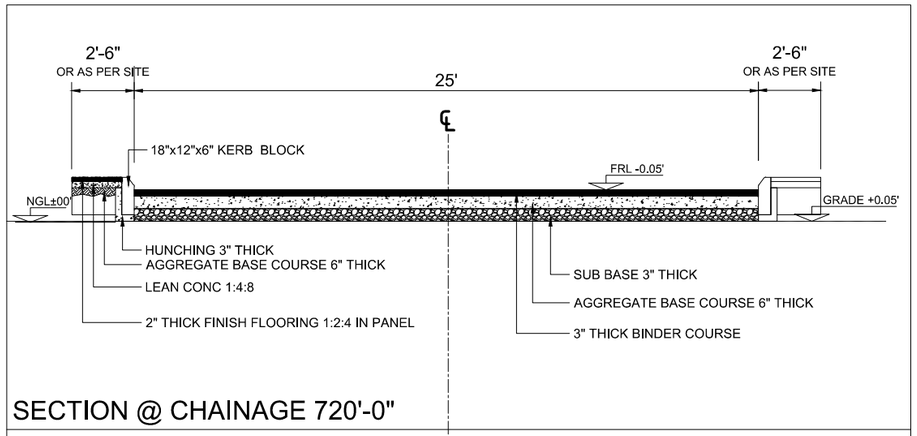

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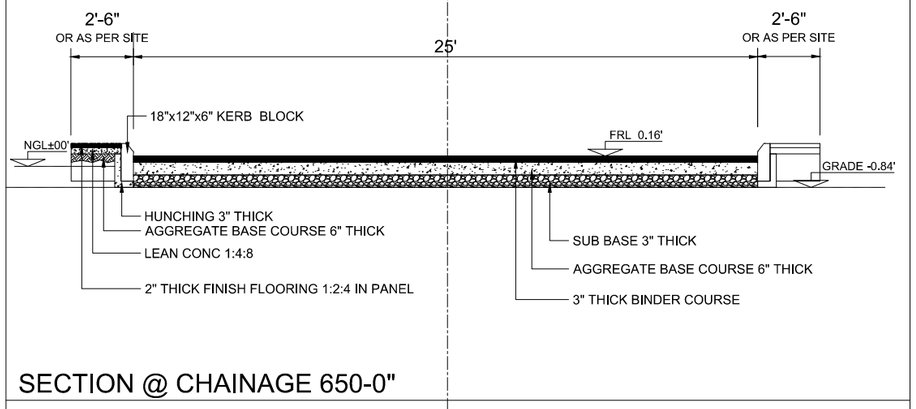

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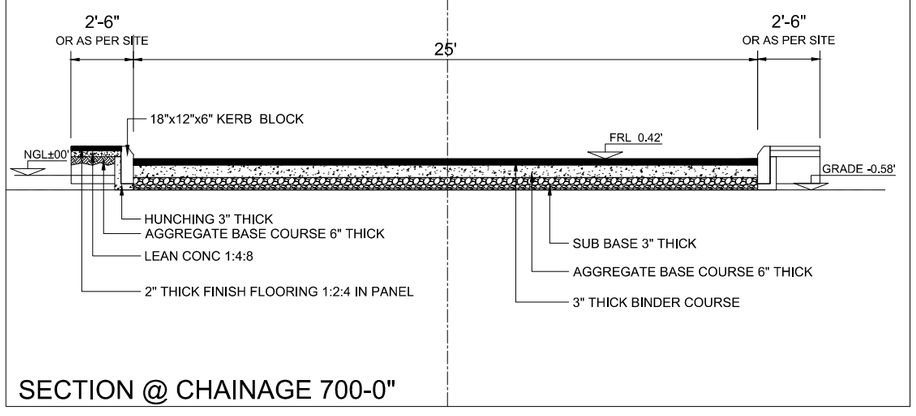

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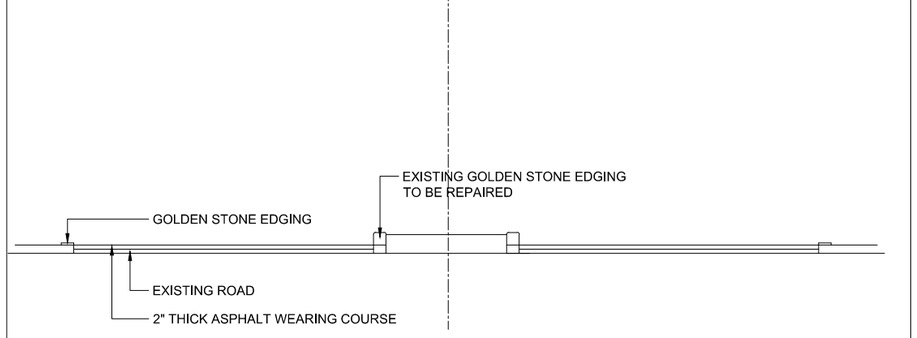


TYPICAL SECTION OF EXISTING ROAD

TENDER DRAWING
NOT FOR
CONSTRUCTION

CLIENT:-
N.E.D UNIVERSITY KARACHI

CONSULTANT:
Nexus Consulting
Office A-202, Second Floor,Blossom Trade Center Opposite NED University University Road, SB-26,Block No.01 University Road, SB-26,Block No.01 Gulistan-e-Jouhar, Karachi Pakistan 021-34177576, 03018265289, 03012163075 Email:nexusconsulttingcompany@gmail.com Web:www.Nexuscon.pk

PROJECT:-
DEVELOPMENT & UP-GRADATION
OF SPORTS FACILITY AT NED UNIVERSITY KARACHI
CONSTRUCTION OF NEW ROAD FROM FITNESS CENTER TO NEWLY DEVELOPED FOOTBALL GROUND AND REHABILITATION OF EXISTING ROAD FROM OVERHEAD WATER TANK TO FITNESS CENTER

TITLE:-
ROAD DETAILS

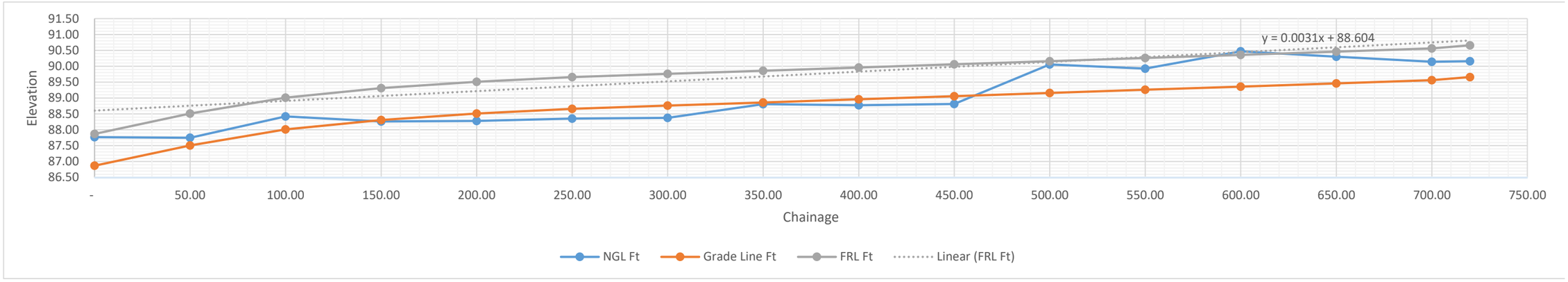
REV #	DATE	DESCRIPTION	CHK'D	APP'D

Project Ref: .
DATE: SEP. 2020
DRAWN BY: A-A
SCALE: AS SHOWN
CHECKED BY: O-A
DWG. NO.: AR-02c

NED UNIVERSITY OF ENGINEERING & TECHNOLOGY KARACHI

CONSTRUCTION OF NEW ROAD FROM FITNESS CENTER TO NEWLY DEVELOPED FOOTBALL GROUND AND REHABILITATION OF EXISTING ROAD FROM OVERHEAD WATER TANK TO FITNESS CENTER

ROAD PROFILE



Chainage Ft	-	50.00	100.00	150.00	200.00	250.00	300.00	350.00	400.00	450.00	500.00	550.00	600.00	650.00	700.00	720.00
NGL Ft	87.77	87.75	88.42	88.26	88.28	88.35	88.38	88.81	88.77	88.81	90.06	89.92	90.47	90.30	90.14	90.16
Grade Line Ft	86.87	87.51	88.01	88.31	88.51	88.66	88.76	88.86	88.96	89.06	89.16	89.26	89.36	89.46	89.56	89.66
FRL Ft	87.87	88.51	89.01	89.31	89.51	89.66	89.76	89.86	89.96	90.06	90.16	90.26	90.36	90.46	90.56	90.66

Excavation ft	-0.90	-0.24	-0.41	0.05	0.23	0.31	0.38	0.05	0.19	0.25	-0.90	-0.67	-1.11	-0.84	-0.58	-0.50
FRL ft (absolute)	0.10	0.76	0.59	1.05	1.23	1.31	1.38	1.05	1.19	1.25	0.10	0.33	-0.11	0.16	0.42	0.50

Cutting **Avg Cutting** **0.68ft**

Filling **Avg Filling** **0.21ft**

NED UNIVERSITY OF ENGINEERING & TECHNOLOGY

No. DR (Estab)/(1003)/1990 Dated: 12/02/ 2016

OFFICE ORDER

The University Administration has constituted the Procurement Committee comprising of the following officers for Construction, Renovation and Rehabilitation of work and Services

1.	**Prof. Dr. Abdul Jabbar Sangi** Professor Dept. of Civil Engg.	Convener
2.	**Engr. Khurshid Akhtar** Deputy Director of Services (Civil) Services Department	Member
3.	**Engr. Sadia Jabeen** Senior Civil Engineer (HEJ) University Karachi	Member

Ag. REGISTRAR

12/2/2016

To:

The Convener & all members

Copy for information to:

1 Dean (CEA)
2 Chairman, Dept. of Civil Engg.
3 Director of Services
4 Director Finance
5 Resident Auditor

Saleem

NED UNIVERSITY OF ENGINEERING & TECHNOLOGY

No. DR (Estab)/(1003)/5730 Dated: 27/05/ 2016

OFFICE ORDER

In supersession of this office order No. DR (Estab)/(1003)/11418 dated 02-11-2015, the University Administration has constituted the Complaint Redressal Standing Committee comprising of the following officers to address complaints regarding all procurement issues in the University in pursuance of Clause 31(1) of the SPPRA rules:

1.	**Prof. Dr. Saad Ahmed Qazi** Dean (ECE)	Convener
2.	**Independent Professional from the relevant field**	Member
3.	**Nominee of Accountant General Sindh**	Member

27/5/2016

Ag. REGISTRAR

To:

The Convener & all members

Copy for information to:

1 Dean (ECE)
2 Director Planning & Projects
3 Director Finance
4 Director, Procurement Cell
5 Ag. Resident Auditor

NED UNIVERSITY OF ENGINEERING & TECHNOLOGY
PROCUREMENT CELL

Tele # 99261261– 2291, (Ext. 2471) Fax # 99261255,

E-mail: dp@neduet.edu.pk

Director Procurement

"Say NO to Corruption"

No. DP/NED/139112/6963/2020
Dated: 03-12-2020

R&I Incharge
Advertisement Section
Information Department
Govt. of Sindh, Karachi.
03/12/2020

The Director Information Advertisement
Government of Sindh,
Information Department
Directorate of Advertisement
Karachi.

SUBJECT: PUBLICATION OF NOTICE INVITING TENDER

Enclosed kindly find herewith the Notice Inviting Tender (NIT) for publication in three newspapers for job mentioned below:

Notice Inviting Tender	**Construction of New Road from Fitness Centre to newly developed Football Ground and Rehabilitation of Existing Road from overhead water Tank to Fitness Centre.** **Tender No. PC/NED/ Sports/ Road / 6963/ 2020**

Kindly ensure the publication of the aforementioned NIT as under:

Name of Newspapers	Ordinary Page	Date of Publication
Daily "Dawn" - English Daily "Jang" - Urdu Daily "Awami Awaz" – Sindhi	Black & White	On or before 10-12-2020

The aforesaid NIT please be published on or before 10-12-2020. The bill along-with tear sheet of newspapers may be sent to Director Finance of this University for payment.

Director Procurement
03/12/2020

Copy to DF

DAWN SATURDAY DECEMBER 12, 2020

NED UNIVERSITY OF ENGINEERING & TECHNOLOGY

PROCUREMENT CELL

Phone # 99261261- 68, (Ext. 2471 & 2501) Fax # 99261255, e-mail: dp@neduet.edu.pk

DIRECTOR PROCUREMENT "Say No to Corruption" No. DP/D&USF-139112/6963 / December 03, 2020

NOTICE INVITING TENDER

NED University of Engineering & Technology invites sealed bids on Single Stage One Envelope procedure from Reputable and Well Experienced Firms/Companies to carry out following works:

S. #	Tender / Number	Tender Schedule - Date and Time				Estimated Cost (Rs. in Million)	Tender Fee Rs.	Time of Completion
		Issue / Sale		Submission	Opening			
		From	To					
1	Construction of New Road from Fitness Centre to newly developed Football Ground and Rehabilitation of existing road from overhead water tank to Fitness Centre. Tender no. PC/NED/Sports/Road /6963//2020	17-12-2020	04-01-2021	05-01-2021 10:30 A.M.	05-01-2021 11:00 A.M.	10.38	3,000/-	Two Months

Eligibility Criteria

1. Valid Registration of the firm with tax authorities (Federal Board of Revenue, Sindh Revenue Board) with proof of company in Active Tax Payer list, Professional Tax paid & copy of CNIC along with company registration.
2. Valid Registration with Pakistan Engineering Council in relevant category **C-5 & above** having relevant civil works codes, **CE01** (i) Road and pavement, drainage and retaining structures.
3. List of Similar Project against which the contractor bid for (Roads) executed in last 05 years, atleast 01 project completed with similar Cost of work with Documentary Proof (Work Order, Completion Certificate).
4. Details of equipments, machineries and transport owned by firm/contractor with Documented proofs;
5. Audit Report/ Bank Statement of the firm last 03 years showing the required yearly turnover above 50M.
6. Income tax returns filed for the last 03 years, Documentary Proof attached.
7. Bid Security of the required amount in the shape of pay order.
8. Affidavit upon original stamp paper that the firm has never been black listed, not involved in any Litigation with any Government, Semi-Government & Autonomous Body.

Terms & Conditions

(a) Under the following conditions bid shell be rejected:
   i. Black listed firms/ companies.
   ii. Bid received after specified time and date.
   iii. Incomplete, Conditional, electronic and telegraphic bids/tenders.
   iv. Bids not accompanied by bid security of required amount and form.

(b) **Bid validity Period:** (90) days from the date of opening of tender.

(c) **Bid Security:** 2% of bid cost in the form of Deposit at Call or Pay Order or Demand Draft or a Bank Guarantee issued by a scheduled bank in Pakistan or from a foreign bank duly counter guaranteed by scheduled bank in Pakistan in favor of Director Finance NEDUET, Karachi.

Tender Fee in shape of Payorder / Bank draft should be in favor of Director Finance, NEDUET. Bidding documents can be obtained and shall be submitted in the office of ADP - II in the University as per above schedule. Bidders are requested to give their Best and Final Price as "No Negotiations" is permitted. Bidding Documents containing detailed terms and conditions are available at Websites www.neduet.edu.pk and www.ppms.spprasindh.gov.pk. In case of public holiday or any holiday or non-working day due to Force Majeure, the next official working day shall be deemed to be date for issuance, submission and opening of tenders. NEDUET shall not be responsible for any cost or expenses incurred by bidders. Procuring Agency reserves the right to reject all or any bids subject to the relevant provisions of Sindh Public Procurement Rules 2010 (Amended up to date).

INF/KRY/3648/2020 **DIRECTOR PROCUREMENT**

NED یونیورسٹی آف انجینئرنگ اینڈ ٹیکنالوجی...... پروکیورمنٹ سیل

فون نمبر 68-99261261 (ایکسٹینشن 2501&2471)، فیکس نمبر 99261255، ای میل: dp@neduet.edu.pk

DIRECTOR PROCUREMENT "Say No to Corruption" No.DP/D&USF-139112/6963/December03,2020

ٹینڈر طلبی نوٹس

NED یونیورسٹی آف انجینئرنگ اینڈ ٹیکنالوجی کو مندرجہ ذیل کاموں کی انجام دہی کیلئے مشہور و معروف اور خوب تجربہ کار فرم/کمپنیز سے سنگل اسٹیج ایک لفافہ طریقہ پر سربمہر پیشکشیں مطلوب ہیں۔

نمبر شمار	ٹینڈر نمبر	ٹینڈر شیڈول۔ تاریخ اور وقت: اجرا از	اجرا تا	جمع کرانا	کھولنا	تخمینی لاگت	ٹینڈر فیس روپے (ناقابل واپسی)	مدت تکمیل
1	تعمیر نئی سڑک از جمنازیم سینٹر تا نیا تیار شدہ فٹبال گراؤنڈ اور موجودہ سڑک کی بحالی از اور ہیڈ واٹر ٹینک تا جمنازیم سینٹر۔ ٹینڈر نمبر PC/NED/Sports/Road/6963/2020	17-12-2020	04-01-2021	05-01-2021 صبح 10:30 بجے	05-01-2021 دن کے 11:00 بجے	10.38 ملین	3000/-	[illegible]

اہلیت کا معیار

1- ٹیکس حکام (فیڈرل بورڈ آف ریونیو، سندھ ریونیو بورڈ) کے پاس فرم کا کارآمد رجسٹریشن مع فعال ٹیکس دہندہ فہرست میں ٹیکس کا ثبوت ادا شدہ پروفیشنل ٹیکس اور CNIC کی کاپی مع ٹیکس رجسٹریشن۔ (2) متعلقہ کیٹگری C-5 اور بالا میں حامل متعلقہ سول ورکس کوڈز CE-01 پاکستان انجینئرنگ کونسل کے پاس کارآمد رجسٹریشن۔ (3) گزشتہ 05 برسوں میں مکمل کردہ اسی نوعیت کے پروجیکٹس کی فہرست جس کے تحت کنٹریکٹر نے (سڑکوں) کیلئے پیشکش دی، دستاویزی ثبوت (ورک آرڈر، تکمیل کا سرٹیفکیٹ) کے ساتھ مکمل شدہ کم از کم 01 پروجیکٹ مع کام کی یہی لاگت۔ (4) فرم/کنٹریکٹر کے ملازمین، ٹیکنیکل اسٹاف، مشینری اور ٹرانسپورٹ کی تفصیلات مع دستاویزی ثبوت۔ (5) گزشتہ 03 برسوں کی فرم کی آڈٹ رپورٹ/بینک اسٹیٹمنٹ جس میں 50 ملین سے بالا مطلوبہ سالانہ ٹرن اوور ظاہر کیا گیا ہو۔ (6) گزشتہ 03 برسوں کے داخل کردہ انکم ٹیکس ریٹرنز دستاویزی ثبوت منسلک کریں۔ (7) مطلوبہ رقم کی بڈ سیکیورٹی بشکل پے آرڈر۔ (8) حلف نامہ اسٹامپ پیپر پر حلفاً کہ فرم کو کبھی بلیک لسٹ نہیں کیا گیا نہ ہی کسی سرکاری، نیم سرکاری اور خودمختار ادارے کے پاس کسی مقدمہ بازی میں ملوث رہی ہے۔

شرائط و ضوابط

(الف) مندرجہ ذیل شرائط کے تحت پیشکش مسترد کر دی جائے گی:

(i) ایک لفافہ فرم/کمپنیز۔

(ii) مقررہ تاریخ اور وقت کے بعد موصول پیشکش۔

(iii) نامکمل، مشروط، بغیر دستخط اور غیر کارآمد بڈز/ٹینڈرز۔

(iv) جن پیشکشوں کے ساتھ مطلوبہ رقم اور شکل کی بڈ سیکیورٹی موجود نہیں ہوگی۔

(ب) بڈ کے کارآمد رہنے کی مدت ٹینڈر کھلنے کی تاریخ سے (90) یوم۔

(ج) بڈ سیکیورٹی بڈ لاگت کی 2% بشکل ڈپازٹ ایٹ کال یا پے آرڈر یا ڈیمانڈ ڈرافٹ یا بینک گارنٹی جاری شدہ پاکستان میں شیڈولڈ بینک یا فارن بینک سے پاکستان میں شیڈولڈ بینک کی جانب سے باقاعدہ ڈائریکٹر فنانس NEDUET کراچی ہو۔

ٹینڈر فیس بشکل پے آرڈر/بینک ڈرافٹ بحق ڈائریکٹر فنانس NEDUET ہو۔ مندرجہ بالا شیڈول کے مطابق بڈنگ دستاویزات حاصل کی جاسکتی ہیں اور یونیورسٹی میں دفتر ADP-II میں جمع کرائی ہوگی۔ پیشکش دہندگان سے التماس ہے کہ وہ اپنی بہترین اور حتمی قیمت دیں چونکہ "گفت و شنید" کی اجازت نہیں ہے۔ مفصل شرائط و ضوابط پر مشتمل بڈنگ دستاویزات ویب سائٹس www.neduet.edu.pk اور www.pprns.spprasindh.gov.pk پر دستیاب ہیں۔ عام تعطیل یا کوئی اور تعطیل یا گزیر حالات کی بنا پر کام کا دن نہ ہونے کی صورت میں اگلا سرکاری ایام کار ٹینڈر کے اجرا، داخل کرنے اور کھلنے کا یوم سمجھا جائے گا۔ NEDUET پیشکش دہندگان کی جانب سے کئے جانے والے کسی بھی لاگت یا اخراجات کی ذمہ داری نہیں ہوگی۔ پروکیورنگ ایجنسی کا حق محفوظ ہے کہ وہ سندھ پبلک پروکیورمنٹ رولز 2010 (تا حال ترمیم شدہ) کے متعلقہ مندرجات سے مشروط تمام یا کوئی پیشکش مسترد کر دے۔

ڈائریکٹر پروکیورمنٹ

INF/KRY/3648/2020