Public Health Engineering Department Haryana

NATIONAL CAPITAL REGION URBAN INFRASTRUCTURE FINANCING FACILITY
(ADB Loan No 2660 IND)

Bidding Document for Procurement of

Construction of Storm Water Drains in Sonepat Town

Single Stage Two Envelope Bidding Procedure under National Competitive Bidding on Item Rate Basis

Volume-1: Part 1

Issued on :

Invitation for Bids No.:

NCB No. :

Employer: : Public Health Engineering Department,

Employers Representative: Executive Engineer, Public Health Engineering Department, Division No.2, Sonepat Distt. Sonepat – 131001 Ph. 0130-2220254

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Bidding Document

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Preface

This Bidding Document for Procurement of Works has been prepared by Public Health Engineering Department and is based on the Standard Bidding Document for “Procurement of Works, Small Contracts” issued by the Asian Development Bank.

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Volume-1: Part I

Section 1: Instructions to Bidders

Section 1 - Instructions to Bidders

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Section 1 - Instructions to Bidders

A. General

1. Scope of Bid

1.1 The Employer, as indicated in the BDS, issues this Bidding Document for the procurement of the Works as specified in Section 6 (Works Requirements). The name, identification, and number of contracts of this bidding are provided in the BDS.

1.2 Throughout this Bidding Document:

(a) the term "in writing" means communicated in written form and delivered against receipt;

(b) except where the context requires otherwise, words indicating the singular also include the plural and words indicating the plural also include the singular; and

(c) "day" means calendar day.

2. Source of Funds

2.1 The Borrower or Recipient (hereinafter called "Borrower") indicated in the BDS has applied for or received financing (hereinafter called "funds") from the Asian Development Bank (hereinafter called "ADB") toward the cost of the project named in the BDS. The Borrower intends to apply a portion of the funds to eligible payments under the contract(s) for which this Bidding Document is issued.

2.2 Payments by the ADB will be made only at the request of the Borrower and upon approval by the ADB in accordance with the terms and conditions of the financing agreement between the Borrower and the ADB (hereinafter called the Loan Agreement), and will be subject in all respects to the terms and conditions of that Loan Agreement. No party other than the Borrower shall derive any rights from the Loan Agreement or have any claim to the funds.

3. Fraud and **Corruption**

3.1 ADB's Anticorruption Policy requires borrowers (including beneficiaries of ADB-financed activity), as well as bidders, suppliers, and contractors under ADB-financed contracts, observe the highest standard of ethics during the procurement and execution of such contracts. In pursuance of this policy, the ADB:

(a) defines, for the purposes of this provision, the terms set forth below as follows:

(i) "corrupt practice" means the offering, giving, receiving, or soliciting, directly or indirectly, anything of value to influence improperly the actions of another party;

(ii) "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;

(iii) "coercive practice" means impairing or harming, or threatening to impair or harm, directly or indirectly, any party or the property of the party to influence improperly the

actions of a party;

(iv) "collusive practice" means an arrangement between two or more parties designed to achieve an improper purpose, including influencing improperly the actions of another party;

(b) will reject a proposal for award if it determines that the bidder recommended for award has, directly or through an agent, engaged in corrupt, fraudulent, collusive, or coercive practices in competing for the Contract;

(c) will cancel the portion of the financing allocated to a contract if it determines at any time that representatives of the borrower or of a beneficiary of ADB-financing engaged in corrupt, fraudulent, collusive, or coercive practices during the procurement or the execution of that contract, without the borrower having taken timely and appropriate action satisfactory to ADB to remedy the situation;

(d) will sanction a firm or an individual, at any time, in accordance with ADB's Anticorruption Policy and Integrity Principles and Guidelines (both as amended from time to time), including declaring ineligible, either indefinitely or for a stated period of time, to participate in ADB-financed or ADB-administered activities or to benefit from an ADB-financed or ADB-administered contract, financially or otherwise, if it at any time determines that the firm or individual has, directly or through an agent, engaged in corrupt, fraudulent, collusive, or coercive or other prohibited practices; and

(e) will have the right to require that a provision be included in bidding documents and in contracts financed by ADB, requiring bidders, suppliers and contractors to permit ADB or its representative to inspect their accounts and records and other documents relating to the bid submission and contract performance and to have them audited by auditors appointed by ADB.

3.2 Furthermore, Bidders shall be aware of the provisions of GCC 22.2, and 56.2 (h).

4. Eligible Bidders

4.1 A Bidder may be a natural person, private entity, government-owned entity – subject to ITB 4.5 – or any combination of them with a formal intent to enter into an agreement or under an existing agreement in the form of a Joint Venture (JV). In the case of a JV:

(a) all partners shall be jointly and severally liable, and

(b) the JV shall nominate a Representative who shall have the authority to conduct all business for and on behalf of any and all the parties of the JV during the bidding process and, in the event the JV is awarded the Contract, during contract execution.

4.2 A Bidder, and all parties constituting the Bidder, shall have the nationality of an eligible country, in accordance with Section 5 (Eligible Countries). A Bidder shall be deemed to have the nationality of a country if the Bidder is a citizen or is constituted, or incorporated, and operates in conformity with the provisions of the laws of that country.

This criterion shall also apply to the determination of the nationality of proposed subcontractors or suppliers for any part of the Contract including related services.

4.3 ADB considers a conflict of interest to be a situation in which a party has interests that could improperly influence that party's performance of official duties or responsibilities, contractual obligations, or compliance with applicable laws and regulations, and that such conflict of interest may contribute to or constitute a prohibited practice under ADB's Anticorruption Policy. In pursuance of ADB's Anticorruption Policy's requirement that Borrowers (including beneficiaries of ADB-financed activity), as well as bidders, suppliers, and contractors under ADB-financed contracts, observe the highest standard of ethics, ADB will take appropriate actions, which include not financing the contract, if it determines that a conflict of interest has flawed the integrity of any procurement process. Consequently all Bidders found to have a conflict of interest shall be disqualified. A Bidder may be considered to be in a conflict of interest with one or more parties in this bidding process if, including but not limited to:

(a) they have controlling shareholders in common; or

(b) they receive or have received any direct or indirect subsidy from any of them; or

(c) they have the same legal representative for purposes of this bid; or

(d) they have a relationship with each other, directly or through common third parties, that puts them in a position to have access to information about or influence on the Bid of another Bidder, or influence the decisions of the Employer regarding this bidding process; or

(e) a Bidder participates in more than one bid in this bidding process. Participation by a Bidder in more than one Bid will result in the disqualification of all Bids in which the party is involved. However, this does not limit the inclusion of the same subcontractor, not otherwise participating as a Bidder, in more than one bid; or

(f) a Bidder participated as a consultant in the preparation of the design or technical specifications of the contract that is the subject of the Bid; or

(g) a Bidder was affiliated with a firm or entity that has been hired (or is proposed to be hired) by the Employer or Borrower as Engineer for the contract.

4.4 A firm shall not be eligible to participate in any procurement activities under an ADB-financed or ADB-supported project while under sanction by ADB pursuant to its Anticorruption Policy (see ITB 3), whether such sanction was directly imposed by ADB, or imposed by ADB pursuant to the Agreement for Mutual Enforcement of Debarment Decisions. A bid from a sanctioned or cross-debarred firm will be rejected.

4.5 Government-owned enterprises in the Employer's country shall be eligible only if they can establish that they are legally and financially autonomous and operate under commercial law, and that they are not a dependent agency of the Employer.

4.6 Bidders shall provide such evidence of their continued eligibility satisfactory to the Employer, as the Employer shall reasonably request.

4.7 Firms shall be excluded if by an act of compliance with a decision of the United Nations Security Council taken under Chapter VII of the Charter of the United Nations, the Borrower's country prohibits any import of goods or contracting of works or services from that country or any payments to persons or entities in that country.

4.8 In case a prequalification process has been conducted prior to the bidding process, this bidding is open only to prequalified Bidders.

5. Eligible Materials, Equipment and Services

5.1 The materials, equipment and services to be supplied under the Contract shall have their origin in eligible source countries as defined in ITB 4.2 above and all expenditures under the Contract will be limited to such materials, equipment, and services. At the Employer's request, Bidders may be required to provide evidence of the origin of materials, equipment and services.

5.2 For purposes of ITB 5.1 above, "origin" means the place where the materials and equipment are mined, grown, produced or manufactured, and from which the services are provided. Materials and equipment are produced when, through manufacturing, processing, or substantial or major assembling of components, a commercially recognized product results that differs substantially in its basic characteristics or in purpose or utility from its components.

B. Contents of Bidding Document

6. Sections of Bidding Document

6.1 The Bidding Document consist of Parts I, II, and III, which include all the Sections indicated below, and should be read in conjunction with any Addenda issued in accordance with ITB 8.

PART I Bidding Procedures
Section 1 - Instructions to Bidders (ITB)
Section 2 - Bid Data Sheet (BDS)
Section 3 - Evaluation and Qualification Criteria (EQC)
Section 4 - Bidding Forms (BDF)
Section 5 - Eligible Countries (ELC)

PART II Requirements
Section 6 – Works Requirements (WRQ)

PART III Conditions of Contract and Contract Forms
Section 7 - General Conditions (GCC)
Section 8 - Particular Conditions (PCC)
Section 9 - Contract Forms (COF)

6.2 The Invitation for Bids issued by the Employer is not part of the Bidding Document.

6.3 The Employer is not responsible for the completeness of the Bidding Document and their Addenda, if they were not obtained directly from the source stated by the Employer in the Invitation for Bids.

6.4 The Bidder is expected to examine all instructions, forms, terms, and specifications in the Bidding Document. Failure to furnish all information or documentation required by the Bidding Document may result in the rejection of the bid.

7. Clarification of Bidding Document, Site Visit, Pre-Bid Meeting

7.1 A prospective Bidder requiring any clarification of the Bidding Document shall contact the Employer in writing at the Employer's address indicated in the BDS or raise his inquiries during the pre-bid meeting if provided for in accordance with ITB 7.4. The Employer will respond in writing to any request for clarification, provided that such request is received no later than twenty-one (21) days prior to the deadline for submission of bids. The Employer shall forward copies of its response to all Bidders who have acquired the Bidding Document in accordance with ITB 6.3, including a description of the inquiry but without identifying its source. Should the Employer deem it necessary to amend the Bidding Document as a result of a request for clarification, it shall do so following the procedure under ITB 8 and ITB 22.2.

7.2 The Bidder is advised to visit and examine the Site of Works and its surroundings and obtain for itself, on its own risk and responsibility, all information that may be necessary for preparing the bid and entering into a contract for construction of the Works. The costs of visiting the Site shall be at the Bidder's own expense.

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

7.4 The Bidder's designated representative is invited to attend a pre-bid meeting, if provided for in the BDS. The purpose of the meeting will be to clarify issues and to answer questions on any matter that may be raised at that stage.

7.5 The Bidder is requested, as far as possible, to submit any questions in writing, to reach the Employer not later than one week before the meeting.

7.6 Minutes of the pre-bid meeting, including the text of the questions raised, without identifying the source, and the responses given, together with any responses prepared after the meeting, will be transmitted promptly to all Bidders who have acquired the Bidding Document in accordance with ITB 6.3. Any modification to the Bidding Document that may become necessary as a result of the pre-bid meeting shall be made by the Employer exclusively through the issue of an addendum pursuant to ITB 8 and not through the minutes of the pre-bid meeting.

7.7 Nonattendance at the pre-bid meeting will not be a cause for disqualification of a Bidder.

8. Amendment of Bidding Document

8.1 At any time prior to the deadline for submission of bids, the Employer may amend the Bidding Document by issuing addenda.

8.2 Any addendum issued shall be part of the Bidding Document and shall be communicated in writing to all who have obtained the Bidding Document from the Employer in accordance with ITB 6.3.

8.3 To give prospective Bidders reasonable time in which to take an addendum into account in preparing their bids, the Employer may, at its discretion, extend the deadline for the submission of bids, pursuant to ITB 22.2

C. Preparation of Bids

9. Cost of Bidding

9.1 The Bidder shall bear all costs associated with the preparation and submission of its Bid, and the Employer shall not be responsible or liable for those costs, regardless of the conduct or outcome of the bidding process.

10. Language of Bid

10.1 The Bid, as well as all correspondence and documents relating to the bid exchanged by the Bidder and the Employer, shall be written in the language specified in the BDS. Supporting documents and printed literature that are part of the Bid may be in another language provided they are accompanied by an accurate translation of the relevant passages in the language specified in the BDS, in which case, for purposes of interpretation of the Bid, such translation shall govern.

11. Documents Comprising the Bid

11.1 The Bid shall comprise two envelopes submitted simultaneously, one called the Technical Bid containing the documents listed in ITB 11.2 and the other the Price Bid containing the documents listed in ITB 11.3, both envelopes enclosed together in an outer single envelope.

11.2 The Technical Bid shall comprise the following:

(a) Letter of Technical Bid;

(b) Bid Security or Bid Securing Declaration, in accordance with ITB 19;

(c) alternative bids, if permissible, in accordance with ITB 13;

(d) written confirmation authorizing the signatory of the Bid to commit the Bidder, in accordance with ITB 20.2;

(e) documentary evidence in accordance with ITB 17 establishing the Bidder's qualifications to perform the contract;

(f) Technical Proposal in accordance with ITB 16;

(g) Any other document required in the BDS.

11.3 The Price Bid shall comprise the following:

(a) Letter of Price Bid;

(b) completed Price Schedules, in accordance with ITB 12 and 14, or as stipulated in the BDS;

(c) alternative price bids, at Bidder's option and if permissible, in accordance with ITB 13;

(d) Any other document required in the BDS.

11.4 In addition to the requirements under ITB 11.2, bids submitted by a JV shall include a copy of the Joint Venture Agreement entered into by all partners. Alternatively, a Letter of Intent to execute a Joint Venture Agreement in the event of a successful bid shall be signed by all partners and submitted with the bid, together with a copy of the proposed agreement.

12. Letters of Bid and Schedules

12.1 The Letters of Technical Bid and Price Bid, and the Schedules, and all documents listed under ITB 11, shall be prepared using the relevant forms furnished in Section 4 (Bidding Forms). The forms must be completed without any alterations to the text, and no substitutes shall be accepted. All blank spaces shall be filled in with the information requested.

13. Alternative Bids

13.1 Unless otherwise indicated in the BDS, alternative bids shall not be considered.

13.2 When alternative times for completion are explicitly invited, a statement to that effect will be included in the BDS, as will the method of evaluating different times for completion.

13.3 Except as provided under ITB 13.4 below, Bidders wishing to offer technical alternatives to the requirements of the Bidding Document must first price the Employer's design as described in the Bidding Document and shall further provide all information necessary for a complete evaluation of the alternative by the Employer, including drawings, design calculations, technical specifications, breakdown of prices, and proposed construction methodology and other relevant details. Only the technical alternatives, if any, of the lowest evaluated Bidder conforming to the basic technical requirements shall be considered by the Employer.

13.4 When specified in the BDS, Bidders are permitted to submit alternative technical solutions for specified parts of the Works. Such parts will be identified in the BDS and described in Section 6 (Works Requirements). The method for their evaluation will be stipulated in Section 3 (Evaluation and Qualification Criteria).

14. Bid Prices and Discounts

14.1 The prices and discounts quoted by the Bidder in the Letter of Price Bid and in the Schedules shall conform to the requirements specified below.

14.2 The Bidder shall submit a bid for the whole of the works described in ITB 1.1 by filling in prices for all items of the Works, as identified in Section 4 (Bidding Forms). In case of admeasurement contracts, the Bidder shall fill in rates and prices for all items of the Works described

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

14.3 The price to be quoted in the Letter of Price Bid shall be the total price of the Bid, excluding any discounts offered.

14.4 The Bidder shall quote any discounts and the methodology for their application in the Letter of Price Bid, in accordance with ITB 14.1.

14.5 Unless otherwise provided in the BDS and the Conditions of Contract, the prices quoted by the Bidder shall be fixed. If the prices quoted by the Bidder are subject to adjustment during the performance of the Contract in accordance with the provisions of the Conditions of Contract, the Bidder shall furnish the indices and weightings for the price adjustment formulae in the Schedule of Adjustment Data in Section 4 (Bidding Forms) and the Employer may require the Bidder to justify its proposed indices and weightings.

14.6 If so indicated in ITB 1.1, bids are being invited for individual contracts or for any combination of contracts (packages). Bidders wishing to offer any price reduction for the award of more than one Contract shall specify in their bid the price reductions applicable to each package, or alternatively, to individual Contracts within the package. Price reductions or discounts shall be submitted in accordance with ITB 14.4, provided the bids for all contracts are submitted and opened at the same time.

14.7 All duties, taxes, and other levies payable by the Contractor under the Contract, or for any other cause, as of the date 28 days prior to the deadline for submission of bids, shall be included in the rates and prices and the total Bid Price submitted by the Bidder.

15. Currencies of Bid and Payment

15.1 The currency(ies) of the bid and payment shall be as specified in the BDS.

15.2 Bidders may be required by the Employer to justify, to the Employer's satisfaction, their local and foreign currency requirements, and to substantiate that the amounts included in the prices shown in the appropriate form(s) of Section 4 (Bidding Forms), in which case a detailed breakdown of the foreign currency requirements shall be provided by Bidders.

16. Documents Comprising the Technical Proposal

16.1 The Bidder shall furnish, as part of the Technical Bid, a Technical Proposal including a statement of work methods, equipment, personnel, schedule and any other information as stipulated in Section 4 (Bidding Forms), in sufficient detail to demonstrate the adequacy of the Bidders' proposal to meet the work requirements and the completion time.

17. Documents Establishing the

17.1 To establish its qualifications to perform the Contract in accordance with Section 3 (Evaluation and Qualification Criteria) the Bidder shall

Qualifications of the Bidder

provide the information requested in the corresponding information sheets included in Section 4 (Bidding Forms).

17.2 Domestic Bidders, individually or in joint ventures, applying for eligibility for domestic preference shall supply all information required to satisfy the criteria for eligibility in accordance with ITB 35.

18. Period of Validity of Bids

18.1 Bids shall remain valid for the period specified in the BDS after the bid submission deadline date prescribed by the Employer. A bid valid for a shorter period shall be rejected by the Employer as nonresponsive.

18.2 In exceptional circumstances, prior to the expiration of the bid validity period, the Employer may request Bidders to extend the period of validity of their Bids. The request and the responses shall be made in writing. If a bid security is requested in accordance with ITB 19, it shall also be extended twenty-eight (28) days beyond the deadline of the extended validity period. A Bidder may refuse the request without forfeiting its bid security. A Bidder granting the request shall not be required or permitted to modify its Bid.

19. Bid Security

19.1 Unless otherwise specified in the BDS, the Bidder shall furnish as part of its bid, either a Bid Securing Declaration or a bid security as specified in the BDS, in original form. In the case of a bid security, the amount and currency shall be as specified in the BDS.

19.2 A Bid Securing Declaration shall use the form included in Section 4 (Bidding Forms). The Employer will declare a Bidder ineligible to be awarded a Contract for a specified period of time, as indicated in the BDS, if the Bid Securing Declaration is executed.

19.3 The bid security shall be, at the Bidder's option, in any of the following forms:

(a) an unconditional bank guarantee;

(b) an irrevocable letter of credit; or

(c) a cashier's or certified check;

all from a reputable bank from an eligible country. In the case of a bank guarantee, the bid security shall be submitted either using the Bid Security Form included in Section 4 (Bidding Forms) or in another substantially similar format approved by the Employer prior to bid submission. In either case, the form must include the complete name of the Bidder. The bid security shall be valid for twenty-eight days (28) beyond the original validity period of the bid, or beyond any period of extension if requested under ITB 18.2.

19.4 Any bid not accompanied by a substantially compliant bid security in accordance with ITB 19.3, or Bid Securing Declaration in accordance with ITB 19.2, if required in accordance with ITB 19.1 shall be rejected by the Employer as non-responsive.

19.5 If a bid security is specified pursuant to ITB 19.1, the bid security of unsuccessful Bidders shall be returned as promptly as possible upon the successful Bidder's furnishing of the performance security pursuant

to ITB 42.

19.6 If a bid security is specified pursuant to ITB 19.1, the bid security of the successful Bidder shall be returned as promptly as possible once the successful Bidder has signed the Contract and furnished the required performance security.

19.7 The bid security may be forfeited or the Bid Securing Declaration executed:

(a) if a Bidder withdraws its bid during the period of bid validity specified by the Bidder on the Letters of Bid, except as provided in ITB 18.2 or

(b) if the successful Bidder fails to:

(i) sign the Contract in accordance with ITB 41;

(ii) furnish a performance security in accordance with ITB 42; or

(iii) accept corrections of arithmetic errors pursuant to ITB 33; or

(iv) furnish a domestic preference security, if applicable, in accordance with ITB 42.

19.8 The Bid Security or the Bid Securing Declaration of a JV shall be in the name of the JV that submits the Bid. If the JV has not been legally constituted at the time of bidding, the Bid Security shall be in the names of all future partners as named in the letter of intent mentioned in ITB 4.1.

20. Format and Signing of Bid

20.1 The Bidder shall prepare one original of the Technical Bid and one original of the Price Bid comprising the Bid as described in ITB 11 and clearly mark it “ORIGINAL - TECHNICAL BID” and “ORIGINAL - PRICE BID”. Alternative bids, if permitted in accordance with ITB 13, shall be clearly marked “ALTERNATIVE”. In addition, the Bidder shall submit two (2) copies of the Bid, as prescribed in the BDS**,** and clearly mark each of them “COPY.” In the event of any discrepancy between the original and the copies, the original shall prevail.

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

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

D. Submission and Opening of Bids

21. Sealing and Marking of Bids

21.1 Bidders may always submit their bids by mail or by hand. When so specified in the BDS, bidders shall have the option of submitting their bids electronically. Procedures for submission, sealing and marking

are as follows:

(a) Bidders submitting bids by mail or by hand shall enclose the original of the Technical Bid, the original of the Price Bid, and each copy of the Technical Bid and each copy of the Price Bid, in separate sealed envelopes, duly marking the envelopes as "ORIGINAL - TECHNICAL BID", "ORIGINAL - PRICE BID" and "COPY NO… - TECHNICAL BID" and "COPY NO…. - PRICE BID." These envelopes, the first containing the originals and the others containing copies, shall then be enclosed in one single envelope per set. If permitted in accordance with ITB 13, alternative bids shall be similarly sealed, marked and included in the sets. The rest of the procedure shall be in accordance with ITB 21.2 and 21.3.

(b) Bidders submitting bids electronically shall follow the electronic bid submission procedures specified in the BDS.

21.2 The inner and outer envelopes shall:

(a) bear the name and address of the Bidder;

(b) be addressed to the Employer in accordance with BDS 22.1; and

(c) bear the specific identification of this bidding process indicated in the BDS 1.1.

21.3 The outer envelopes and the inner envelopes containing the Technical Bid shall bear a warning not to open before the time and date for the opening of Technical Bid, in accordance with ITB Sub-Clause 25.1.

21.4 The inner envelopes containing the Price Bid shall bear a warning not to open until advised by the Employer in accordance with ITB Sub-Clause 25.7.

21.5 If all envelopes are not sealed and marked as required, the Employer will assume no responsibility for the misplacement or premature opening of the bid.

22. Deadline for Submission of Bids

22.1 Bids must be received by the Employer at the address and no later than the date and time indicated in the BDS.

22.2 The Employer may, at its discretion, extend the deadline for the submission of bids by amending the Bidding Document in accordance with ITB 8, in which case all rights and obligations of the Employer and Bidders previously subject to the deadline shall thereafter be subject to the deadline as extended.

23. Late Bids

23.1 The Employer shall not consider any bid that arrives after the deadline for submission of bids, in accordance with ITB 22. Any bid received by the Employer after the deadline for submission of bids shall be declared late, rejected, and returned unopened to the Bidder.

24. Withdrawal, Substitution, and Modification of

24.1 A Bidder may withdraw, substitute, or modify its Bid – Technical or Price – after it has been submitted by sending a written notice, duly signed by an authorized representative, and shall include a copy of the

Bids

authorization in accordance with ITB 20.2, (except that withdrawal notices do not require copies). The corresponding substitution or modification of the bid must accompany the respective written notice. All notices must be:

(a) prepared and submitted in accordance with ITB 20 and ITB 21 (except that withdrawal notices do not require copies), and in addition, the respective envelopes shall be clearly marked "WITHDRAWAL," "SUBSTITUTION," "MODIFICATION;" and

(b) received by the Employer prior to the deadline prescribed for submission of bids, in accordance with ITB 22.

24.2 Bids requested to be withdrawn in accordance with ITB 24.1 shall be returned unopened to the Bidders.

24.3 No bid may be withdrawn, substituted, or modified in the interval between the deadline for submission of bids and the expiration of the period of bid validity specified by the Bidder on the Letter of Bid or any extension thereof.

25. Bid Opening

25.1 The Employer shall open the Technical Bids in public at the address, date and time specified in the BDS in the presence of Bidders` designated representatives and anyone who choose to attend. Any specific electronic bid opening procedures required if electronic bidding is permitted in accordance with ITB 21.1, shall be as specified in the BDS. The Price Bids will remain unopened and will be held in custody of the Employer until the specified time of their opening. If the Technical Bid and Price Bid are submitted together in one envelope, the Employer may reject the entire Bid. Alternatively, the Price Bid may be immediately resealed for later evaluation.

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

25.3 Second, outer envelopes marked "SUBSTITUTION" shall be opened. The inner envelopes containing the Substitution Technical Bid and/or Substitution Price Bid shall be exchanged for the corresponding envelopes being substituted, which are to be returned to the Bidder unopened. Only the Substitution Technical Bid, if any, shall be opened, read out, and recorded. Substitution Price Bid will remain unopened in accordance with ITB Sub-Clause 25.1. No envelope shall be substituted unless the corresponding Substitution Notice contains a valid authorization to request the substitution and is read out and recorded at bid opening.

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

accordance with ITB Sub-Clause 25.1.

25.5 All other envelopes holding the Technical Bids shall be opened one at a time, and the following read out and recorded:

(a) the name of the Bidder;

(b) whether there is a modification or substitution;

(c) the presence of a Bid Security or a bid securing declaration, if required; and

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

Only Technical Bids and alternative Technical Bids read out and recorded at bid opening shall be considered for evaluation. No Bid shall be rejected at the opening of Technical Bids except for late bids, in accordance with ITB Sub-Clause 23.1.

25.6 The Employer shall prepare a record of the opening of Technical Bids that shall include, as a minimum: the name of the Bidder and whether there is a withdrawal, substitution, or modification; alternative proposals; and the presence or absence of a bid security or a bid securing declaration, if one was required. The Bidders' representatives who are present shall be requested to sign the record. The omission of a Bidder's signature on the record shall not invalidate the contents and effect of the record. A copy of the record shall be distributed to all Bidders.

25.7 At the end of the evaluation of the Technical Bids, the Employer will invite bidders who have submitted substantially responsive Technical Bids and who have been determined as being qualified for award to attend the opening of the Price Bids. The date, time, and location of the opening of Price Bids will be advised in writing by the Employer. Bidders shall be given reasonable notice for the opening of Price Bids.

25.8 The Employer will notify Bidders in writing who have been rejected on the grounds of their Technical Bids being substantially non-responsive to the requirements of the Bidding Document and return their Price Bids unopened.

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

25.10 All envelopes containing Price Bids shall be opened one at a time and the following read out and recorded:

(a) the name of the Bidder;

(b) whether there is a modification or substitution;

(c) the Bid Prices, including any discounts and alternative offers; and

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

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

25.11 The Employer shall prepare a record of the opening of Price Bids that shall include, as a minimum: the name of the Bidder, the Bid Price (per lot if applicable), any discounts, and alternative offers. The Bidders' representatives who are present shall be requested to sign the record. The omission of a Bidder's signature on the record shall not invalidate the contents and effect of the record. A copy of the record shall be distributed to all Bidders.

E. Evaluation and Comparison of Bids

26. Confidentiality

26.1 Information relating to the examination, evaluation, comparison, and postqualification of bids and recommendation of contract award, shall not be disclosed to Bidders or any other persons not officially concerned with such process until information on Contract award is communicated to all Bidders.

26.2 Any attempt by a Bidder to influence the Employer in the evaluation of the bids or Contract award decisions may result in the rejection of its Bid.

26.3 Notwithstanding ITB 26.2, from the time of bid opening to the time of Contract award, if any Bidder wishes to contact the Employer on any matter related to the bidding process, it may do so in writing.

27. Clarification of Bids

27.1 To assist in the examination, evaluation, and comparison of the Technical and Price Bids, the Employer may, at its discretion, ask any Bidder for a clarification of its bid. Any clarification submitted by a Bidder that is not in response to a request by the Employer shall not be considered. The Employer's request for clarification and the response shall be in writing. No change in the substance of the Technical Bid or prices in the Price Bid shall be sought, offered, or permitted, except to confirm the correction of arithmetic errors discovered by the Employer in the evaluation of the Price Bids, in accordance with ITB 33.

27.2 If a Bidder does not provide clarifications of its Bid by the date and time set in the Employer's request for clarification, its bid may be rejected.

28. Deviations, Reservations, and Omissions

28.1 During the evaluation of bids, the following definitions apply:

(a) "Deviation" is a departure from the requirements specified in the Bidding Document;

(b) "Reservation" is the setting of limiting conditions or withholding from complete acceptance of the requirements specified in the Bidding Document; and

(c) "Omission" is the failure to submit part or all of the information or

documentation required in the Bidding Document.

29. Preliminary Examination of Technical Bids

29.1 The Employer shall examine the Technical Bid to confirm that all documents and technical documentation requested in ITB Sub-Clause 11.2 have been provided, and to determine the completeness of each document submitted.

29.2 The Employer shall confirm that the following documents and information have been provided in the Technical Bid. If any of these documents or information is missing, the offer shall be rejected.

(a) Letter of Technical Bid;

(b) written confirmation of authorization to commit the Bidder;

(c) Bid Security, if applicable; and

(d) Technical Proposal in accordance with ITB 16.

30. Responsiveness of Technical Bid

30.1 The Employer's determination of a Bid's responsiveness is to be based on the contents of the bid itself, as defined in ITB 11.

30.2 A substantially responsive Technical Bid is one that meets the requirements of the Bidding Document without material deviation, reservation, or omission. A material deviation, reservation, or omission is one that,

(a) if accepted, would:

(i) affect in any substantial way the scope, quality, or performance of the Works specified in the Contract; or

(ii) limit in any substantial way, inconsistent with the Bidding Document, the Employer's rights or the Bidder's obligations under the proposed Contract; or

(b) if rectified, would unfairly affect the competitive position of other Bidders presenting substantially responsive bids.

30.3 The Employer shall examine the technical aspects of the Bid submitted in accordance with ITB 16, Technical Proposal, in particular, to confirm that all requirements of Section 6 (Works Requirements) have been met without any material deviation or reservation.

30.4 If a bid is not substantially responsive to the requirements of the Bidding Document, it shall be rejected by the Employer and may not subsequently be made responsive by correction of the material deviation, reservation, or omission.

31. Nonconformities, Errors, and Omissions

31.1 Provided that a bid is substantially responsive, the Employer may waive any nonconformities in the Bid that do not constitute a material deviation, reservation or omission.

31.2 Provided that a Technical Bid is substantially responsive, the Employer may request that the Bidder submit the necessary information or documentation, within a reasonable period of time, to rectify nonmaterial nonconformities in the Technical Bid related to documentation requirements. Requesting information or

documentation on such nonconformities shall not be related to any aspect of the Price Bid. Failure of the Bidder to comply with the request may result in the rejection of its Bid.

31.3 Provided that a Technical Bid is substantially responsive, the Employer shall rectify nonmaterial nonconformities related to the Bid Price. To this effect, the Bid Price shall be adjusted, for comparison purposes only, to reflect the price of a missing or non-conforming item or component. The adjustment shall be made using the method indicated in Section 3 (Evaluation and Qualification Criteria).

32. Qualification of the Bidder

32.1 The Employer shall determine to its satisfaction during the evaluation of Technical Bids whether Bidders meet the qualifying criteria specified in Section 3 (Evaluation and Qualification Criteria).

32.2 The determination shall be based upon an examination of the documentary evidence of the Bidder's qualifications submitted by the Bidder, pursuant to ITB 17.1.

32.3 An affirmative determination shall be a prerequisite for the opening and evaluation of a Bidder's Price Bid. A negative determination shall result into the disqualification of the Bid, in which event the Employer shall return the unopened Price Bid to the Bidder.

33. Correction of Arithmetical Errors

33.1 During the evaluation of Price Bids, the Employer shall correct arithmetical errors on the following basis:

(a) if there is a discrepancy between the unit price and the total price that is obtained by multiplying the unit price and quantity, the unit price shall prevail and the total price shall be corrected, unless in the opinion of the Employer there is an obvious misplacement of the decimal point in the unit price, in which case the total price as quoted shall govern and the unit price shall be corrected;

(b) if there is an error in a total corresponding to the addition or subtraction of subtotals, the subtotals shall prevail and the total shall be corrected; and

(c) if there is a discrepancy between words and figures, the amount in words shall prevail, unless the amount expressed in words is related to an arithmetic error, in which case the amount in figures shall prevail subject to (a) and (b) above.

33.2 If the Bidder that submitted the lowest evaluated bid does not accept the correction of errors, its Bid shall be disqualified and its bid security may be forfeited or its bid securing declaration executed.

34. Conversion to Single Currency

34.1 For evaluation and comparison purposes, the currency(ies) of the bid shall be converted into a single currency as specified in the BDS.

35. Margin of Preference

35.1 Unless otherwise specified in the BDS, a margin of preference shall not apply.

36. Evaluation of Price Bids

36.1 The Employer shall use the criteria and methodologies listed in this Clause. No other evaluation criteria or methodologies shall be

permitted.

36.2 To evaluate the Price Bid, the Employer shall consider the following:

(a) the bid price, excluding Provisional Sums and the provision, if any, for contingencies in the Summary Bill of Quantities for admeasurement contracts, or Schedule of Prices for lump sum contracts, but including Daywork items, where priced competitively;

(b) price adjustment for correction of arithmetic errors in accordance with ITB 33.1;

(c) price adjustment due to discounts offered in accordance with ITB 14.4;

(d) converting the amount resulting from applying (a) to (c) above, if relevant, to a single currency in accordance with ITB 34;

(e) adjustment for nonconformities in accordance with ITB 31.3;

(f) application of all the evaluation factors indicated in Section 3 (Evaluation and Qualification Criteria);

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

36.4 If this Bidding Document allows Bidders to quote separate prices for different contracts, and the award to a single Bidder of multiple contracts, the methodology to determine the lowest evaluated price of the contract combinations, including any discounts offered in the Letter of Price Bid, is specified in Section 3 (Evaluation and Qualification Criteria).

36.5 If the Bid in an admeasurement contract, which results in the lowest Evaluated Bid Price, is seriously unbalanced or front loaded in the opinion of the Employer, the Employer may require the Bidder to produce detailed price analyses for any or all items of the Bill of Quantities, to demonstrate the internal consistency of those prices with the construction methods and schedule proposed. After evaluation of the price analyses, taking into consideration the schedule of estimated Contract payments, the Employer may require that the amount of the performance security be increased at the expense of the Bidder to a level sufficient to protect the Employer against financial loss in the event of default of the successful Bidder under the Contract.

37. Comparison of Bids

37.1 The Employer shall compare all substantially responsive Bids to determine the lowest evaluated bid, in accordance with ITB 36.2.

38. Employer's Right to Accept Any Bid, and to Reject Any or All Bids

38.1 The Employer reserves the right to accept or reject any bid, and to annul the bidding process and reject all bids at any time prior to contract award, without thereby incurring any liability to Bidders. In case of annulment, all bids submitted and specifically, bid securities, shall be promptly returned to the Bidders.

F. Award of Contract

39. Award Criteria

39.1 The Employer shall award the Contract to the Bidder whose offer has been determined to be the lowest evaluated bid and is substantially responsive to the Bidding Document, provided further that the Bidder is determined to be qualified to perform the Contract satisfactorily.

40. Notification of Award

40.1 Prior to the expiration of the period of bid validity, the Employer shall notify the successful Bidder, in writing, via the Letter of Acceptance included in the Contract Forms, that its bid has been accepted.

40.2 Until a formal contract is prepared and executed, the notification of award shall constitute a binding Contract.

40.3 At the same time, the Employer shall also notify all other Bidders of the results of the bidding, and shall publish in an English language newspaper or well-known and freely accessible website the results identifying the bid and contract numbers and the following information: (i) name of each Bidder who submitted a Bid; (ii) bid prices as read out at Bid Opening; (iii) name and evaluated prices of each Bid that was evaluated; (iv) name of bidders whose bids were rejected and the reasons for their rejection; and (v) name of the winning Bidder, and the Price it offered, as well as the duration and summary scope of the contract awarded. After publication of the award, unsuccessful bidders may request in writing to the Employer for a debriefing seeking explanations on the grounds on which their bids were not selected. The Employer shall promptly respond in writing to any unsuccessful Bidder who, after publication of contract award, requests a debriefing.

41. Signing of Contract

41.1 Promptly after notification, the Employer shall send the successful Bidder the Contract Agreement.

41.2 Within twenty-eight (28) days of receipt of the Contract Agreement, the successful Bidder shall sign, date, and return it to the Employer.

42. Performance Security

42.1 Within twenty-eight (28) days of the receipt of notification of award from the Employer, the successful Bidder shall furnish the performance security in accordance with the conditions of contract, subject to ITB 36.5, using for that purpose the Performance Security Form included in Section 9 (Contract Forms), or another form acceptable to the Employer. If the institution issuing the performance security is located outside the country of the Employer, it shall have a correspondent financial institution located in the country of the Employer to make it enforceable.

42.2 Failure of the successful Bidder to submit the above-mentioned Performance Security or to sign the Contract Agreement shall constitute sufficient grounds for the annulment of the award and forfeiture of the bid security or execution of the bid securing declaration. In that event the Employer may award the Contract to the next lowest evaluated Bidder whose offer is substantially responsive and is determined by the Employer to be qualified to perform the

Contract satisfactorily.

42.3 The above provision shall also apply to the furnishing of a domestic preference security if so required.

Public Health Engineering Department Haryana

NATIONAL CAPITAL REGION URBAN INFRASTRUCTURE FINANCING FACILITY

(ADB Loan No 2660 IND)

Bidding Document for Procurement of

Construction of Storm Water Drains in Sonepat Town

Single Stage Two Envelope Bidding Procedure under National Competitive Bidding on Item Rate Basis

Volume-1: Part I

Section 2: Bid Data Sheet

Section 2 - Bid Data Sheet

A. Introduction

ITB 1.1	The Employer is: Public Health engineering Department Haryana
ITB 1.1	**The Name of the NCB is:** Construction of storm water Drains in Sonepat Town.
ITB 1.1	The identification number of the bidding process is :NCRPB/Sonipat /WSS/1/12-13
ITB 1.1	The number and identification of lots comprising this bidding process is: One
ITB 2.1	The Borrower is: National Capital Region Planning Board
ITB 2.1	The name of the Project is MFF-National Capital Region Urban Infrastructure Financing Facility-Project 1

B. Bidding Documents

ITB 6.1	The Bidding Document consists of volume 1 and volume 2. Volume 1 consists of Parts I, II, and III, which include all the Sections indicated below, and should be read in conjunction with any Addenda issued in accordance with ITB 8. **PART I Bidding Procedures** Section 1 - Instructions to Bidders (ITB) Section 2 - Bid Data Sheet (BDS) Section 3 - Evaluation and Qualification Criteria (EQC) Section 4 A - Bidding Forms (BDF)-Technical Section 5 - Eligible Countries (ELC) **PART II Requirements** Section 6 – Works Requirements (WRQ) **PART III Conditions of Contract and Contract Forms** Section 7 - General Conditions (GCC) Section 8 - Particular Conditions (PCC) Section 9 - Contract Forms (COF) Volume 2 consists of Section 4 B- Bidding Forms-Financial
ITB 7.1	For clarification purposes only**,** the Employer's address is: A prospective Bidder requiring any clarification of the Bidding Document shall contact the Employer online at **http://haryanaphed.etenders.in** or through letter or e-mail up to 03.07.2013 at address given below: Attention: Executive Engineer Floor/Room No : Division , PHED No.2, Sonipat City : Sonipat , State: Haryana Country : India Telephone : 0130-2220254

	Facsimile number: 0130-2220254 Electronic mail address: ee2sonepat@gmail.com
ITB 7.4	A Pre-Bid meeting shall take place in the Office of Executive Engineer Division PHED, No.2, Sonipat, Haryana India at 11.30 on 04.07.2013 A site visit will be organized by the Executive Engineer PHED Division No.2, Sonipat at 15 Noon on 04.07.2013

C. Preparation of Bids

ITB 10.1	The language of the Bid is : English
ITB 11.2 (g)	The Bidder shall submit with its Technical Bid the following additional documents :NIL
ITB 11.3 (d)	The Bidder shall submit with its Price Bid the following additional documents :NIL
ITB 13.1	Alternative bids shall not be permitted.
ITB 13.2	Alternatives to the Time Schedule shall not be permitted.
ITB 13.4	Alternative technical solutions shall not be permitted
ITB 14.5	The prices quoted by the Bidder shall be: subject to adjustment during the performance of the Contract
ITB 15.1	The prices shall be quoted by the bidder and shall be paid in Indian Rupees
ITB 18.1	The bid validity period shall be 120 (One hundred and twenty) days.
ITB 19.1	The Bidder shall furnish a bid security in the amount and currency of Indian Rupees 3.47 million.
ITB 20.1	In addition to the original of the bid, the number of copies is: One
ITB 20.2	The written confirmation of authorization to sign on behalf of the Bidder shall consist of: a Power of Attorney stating the name, position held and signature of each person giving the authority, and the name, position and signature of the person authorized to submit the bid. Bids submitted by an existing or intended JV shall include an undertaking signed by all parties (i) stating that all parties shall be jointly and severally liable, and {ii) nominating a Representative who shall have the authority to conduct all business

	for and on behalf of any and all the parties of the JV during the bidding process and, in the event the JV is awarded the Contract, during contract execution.

D. Submission and Opening of Bids

ITB 21.1	Bidders shall have the option of submitting their bids electronically
ITB 21.1 (b)	The Bid Document can be downloaded online from the portal **http://haryanaphed.etenders.in** by making payment of Rs. 10000 online (electronically). Bidders who wish to participate for on line bidding will have to register on **http://haryanaphed.etenders.in.** Further bidders who wish to participate in on line bidding should have digital certificate as per Information Technology act 2000 using which they can sign their electronic bid. Bidders can procure digital certificate from any Controller of Certifying Authority (CCA) approved certifying agency. For online bidding use the portal http://haryanaphed.etenders.in and the bid preparation and hash submission must be completed by 15:00 hours on 29.07.2013. Bid submission and re encryption must be done from 20.01 hours on 29.07.2013 to 15.00 hours on 01.08.2013. Bid security and physical documents required to be submitted as part of bid but not taken (accepted) online must be submitted manually up to 15.00 hours on 29.07.2013 at the address of Executive Engineer, Public Health Engineering department, Division No.2, Sonipat City : Sonepat Distt. : Sonepat State : Haryana Country : India In case of offline (Manual) bidding, the bid and the bid security should be submitted to the Exécutive Engineer PHED, Division No.2, Sonepat on address given above up to 15.00 hours on 29.07.2013. Late bids shall be rejected.
ITB 22.1	For **bid submission purposes** only, the Employer's address is: Executive Engineer, Public Health Engineering department, Division No.2, Sonepat City : Sonipat Distt. : Sonipat State : Haryana Country : India **The deadline for bid submission is: 15 PM 29.07.2013** **The bid preparation and hash submission**: Up to 15:00 hours on 29.07.2013. **Bid submission and re encryption**: From 20.01 hours on 29.07.2013 to 15.00 hours on 01.08.2013. **Bid security and physical documents required to be submitted as part of bid but not taken (accepted) online:** Up to 15.00 hours on 29.07.2013 Manually
ITB 25.1	The Technical bid opening shall take place at office of:: Executive Engineer, Public Health Engineering department, Division No.2, Sonipat City : Sonepat

	Distt. : Sonepat State : Haryana Country : India Date: 01.08.2013 Time: 15.30 PM Electronic bid opening procedure shall be as follows: First manual bids (Volume 1 Technical) shall be opened. Then the bid security envelop and physical submission envelop of online bidders will be opened. Thereafter online bids (technical part) shall be opened. Bidders who have deposited cost of document shall be verified. Bid opening record shall be posted online immediately after opening of bids.

E. Evaluation, and Comparison of Bids

ITB 34.1	Not applicable
ITB 35.1	A margin of preference shall not apply.

Public Health Engineering Department Haryana

NATIONAL CAPITAL REGION URBAN INFRASTRUCTURE FINANCING FACILITY
(ADB Loan No 2660 IND)

Bidding Document for Procurement of

Construction of Storm water Drains in Sonepat Town

Single Stage Two Envelope Bidding Procedure under National Competitive Bidding on Item Rate Basis

Volume-1: Part I

Section 3: Evaluation and Qualification Criteria

Section 3 - Evaluation and Qualification Criteria

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1. Evaluation

In addition to the criteria listed in ITB 36.2 (a) – (f) the following criteria shall apply

1.1 Adequacy of Technical Proposal

Evaluation of the Bidder's Technical Proposal will include an assessment of the Bidder's technical capacity to mobilize key equipment and personnel for the contract consistent with its proposal regarding work methods, scheduling, and material sourcing in sufficient detail and fully in accordance with the requirements stipulated in Section 6 (Work's Requirements).

1.2 Multiple Contracts

Pursuant to ITB 36.4, if Works are grouped in multiple contracts, evaluation will be as follows:
Not applicable

1.3 Completion Time

An alternative Completion Time, if permitted under ITB 13.2, will be evaluated as follows:Alternative completion time not permitted.

1.4 Technical Alternatives

Technical alternatives , if permitted under ITB 13.4, will be evaluated as follows:Technical alternatives are not permitted.

1.5 Margin of Preference (Applicable for ICB only)

Margin of preference not applicable

1.6 Quantifiable Nonconformities, Errors and Omissions

A. To this effect, the Bid Price shall be adjusted for comparison purposes only, to reflect the price of missing or non-conforming item or component, by taking the price equal to the highest unit rate quoted for the same item(s) by other bidders. However, if there is only one bid, the rate of such missing item(s) as estimated by the employer would be taken and Bid Price shall be adjusted for evaluation and comparison purposes only. In case of award of contract, the successful bidder would be required to supply missing item(s) free of cost to the full extent i.e. for work items including increase of quantity (ies) of the ordered quantity (ies) required for completion of the work as per the actual engineering, and tax liability will be borne by the successful bidder.

B. If there is any discrepancy in unit of measurement of item(s), the BOQ unit of measurement will prevail and accordingly unit rate applied for evaluation purpose and for payment.

2. Qualification

Bidder shall meet the criteria given below.

2.1 Eligibility

Criteria	Compliance Requirements				Documents
Requirement	Single Entity	Joint Venture			Submission Requirements
		All Partners Combined	Each Partner	One Partner	
2.1.1 Nationality					
Nationality in accordance with ITB Sub-Clause 4.2.	must meet requirement	Existing or intended JV must meet requirement	must meet requirement	not applicable	Forms ELI - 1; ELI - 2 with attachments
2.1.2 Conflict of Interest					
No conflicts of interest in accordance with ITB Sub-Clause 4.3.	must meet requirement	Existing or intended JV must meet requirement	must meet requirement	not applicable	Letter of Technical Bid
2.1.3 ADB Eligibility					
Not having been declared ineligible by ADB, as described in ITB Sub-Clause 4.4.	must meet requirement	Existing or intended JV must meet requirement	must meet requirement	not applicable	Letter of Technical Bid
2.1.4 Government-owned Entity					
Bidder required to meet conditions of ITB Sub-Clause 4.5.	must meet requirement	must meet requirement	must meet requirement	not applicable	Forms ELI - 1; ELI - 2 with attachments
2.1.5 UN Eligibility					
Not having been declared ineligible based on a United Nations resolution or Employer's country law, as described in ITB Sub-Clause 4.8.	must meet requirement	must meet requirement	must meet requirement	not applicable	Letter of Technical Bid

2.2 Pending Litigation

Criteria	Compliance Requirements				Documents
Requirement	Single Entity	Joint Venture			Submission Requirements
		All Partners Combined	Each Partner	One Partner	
2.2.1 Pending Litigation					
All pending litigation shall be treated as resolved against the Bidder and so shall in total not represent more than 50 percent of the Bidder's net worth.	must meet requirement by itself or as partner to past or existing JV	not applicable	must meet requirement by itself or as partner to past or existing JV	not applicable	Form LIT - 1

2.3 Financial Situation

2.3.1 Historical Financial Performance					
Submission of audited balance sheets or, if not required by the law of the Bidder's country, other financial statements acceptable to the Employer, for the last 3 years to demonstrate the current soundness of the Bidder's financial position and its prospective long-term profitability. As a minimum, a Bidders net worth, calculated as the difference between total assets and total liabilities, should be positive.	must meet requirement	not applicable	must meet requirement	not applicable	Form FIN - 1 with attachments
2.3.2 Average Annual Turnover					
Minimum average annual construction turnover of INR 173.4 million calculated as total certified payments received for contracts in progress or completed, within the last three years.	must meet requirement	must meet requirement	must meet 25% of the requirement	must meet 40% of the requirement	Form FIN - 2

2.3.3 Financial Resources

Using the relevant Forms FIN - 3 and FIN - 4 in Section 4 A (Bidding Forms) the Bidder must demonstrate the capacity to meet the financial requirements of the contract. The Bidder must demonstrate access to, or availability of, financial resources such as liquid assets, unencumbered real assets, lines of credit, and other financial means, other than any contractual advance payments, to meet the financial requirements of the contract in the amount of his Bid. While a proper analysis of the financial statements submitted by the Bidder is preferred, as a minimum the Bidder must show that his resources, in terms of at least his latest year's working capital and lines of credit, will be adequate to cover his Bid Price and current work.

2.4 Experience

2.4.1 General Construction Experience

Experience under Construction contracts in the role of contractor, subcontractor, or management contractor for at least the last seven years prior to the bid submission deadline.	must meet requirement	not applicable	must meet requirement	not applicable	Form EXP - 1

2.4.2 Specific Construction Experience

(a) Contracts of Similar Size and Nature

Participation as contractor, management contractor, or subcontractor, in at least one contract within the last seven years, each with a value of at least INR 138.7 million that has been successfully or substantially completed RCC Civil Works	must meet requirement	must meet requirement	not applicable	not applicable	Form EXP - 2(a)

For the purpose of requirements stipulated under 2.4.2 (a) the following multiplying factors would apply to assess the cost of works at present level.

Financial year of work completed	Multiplying factor
One year old	1.10
Two years old	1.21
Three years old	1.33
Four years old	1.46
Five years old	1.60
Six years old	1.76
Seven years old	1.94

(b) Experience in Key Activities

For the above or other contracts executed during the period stipulated in 2.4.2(a) above, a minimum Construction experience in the following key activities:					Form EXP - 2(b)
Construction of 13 km drain/RCC pipe drin Work order, completion certificate shall be enclosed with the bid to substantiate above works. These certificates should be signed by the competent authority.	must meet all requirements	must meet all requirements	not applicable	not applicable	

2.5 Personnel

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

No.	Position	Total Work Experience [years]	Experience In Similar Work [years]
1	Project Manager (Graduate Civil/Mechanical./Electrical Engineer)	5	3
2	Project Engineer- Civil (Graduate)	5	3
3	Site Engineer (Diploma Civil Engineer)	5	3

The Bidder shall provide details of the proposed personnel and their experience records in the relevant Information Forms included in Section 4 A (Bidding Forms).

2.6 Equipment

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

No.	Equipment Type and Characteristics	Min. Number Required
1.	Weigh Batch type concrete mixers	2 Nos.
2.	JCB	1 no.

The Bidder shall provide further details of proposed items of equipment using the relevant Form in Section 4 A (Bidding Forms)

Public Health Engineering Department Haryana

NATIONAL CAPITAL REGION URBAN INFRASTRUCTURE FINANCING FACILITY

(ADB Loan No 2660 IND)

Bidding Document for Procurement of

Detail Project Report for construction of storm water Drains in Sonepat Town

Single Stage Two Envelope Bidding Procedure under National Competitive Bidding on Item Rate Basis

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Letter of Technical Bid

Date: .....

NCB No.: .....

Invitation for Bid No.: .....

To:

The Executive Engineer,
Public Health Engineering Division No.2,
Sonipat, Haryana

We, the undersigned, declare that:

(a) We have examined and have no reservations to the Bidding Documents, including Addenda issued in accordance with Instructions to Bidders (ITB) 8;

(b) We offer to execute in conformity with the Bidding Documents the following Works:
Construction of storm water Drains in Sonepat Town

(c) Our Bid consisting of the Technical Bid and the Price Bid shall be valid for a period of 120 days from the date fixed for the bid submission deadline in accordance with the Bidding Documents, and it shall remain binding upon us and may be accepted at any time before the expiration of that period;

(d) Our firm, including any subcontractors or suppliers for any part of the Contract, have nationalities from eligible countries [insert the nationality of the Bidder, including that of all parties that comprise the Bidder if the Bidder is a consortium or association, and the nationality of each Subcontractor and Supplier;

(e) We, including any subcontractors or suppliers for any part of the contract, do not have any conflict of interest in accordance with ITB 4.3;

(f) We are not participating, as a Bidder or as a subcontractor, in more than one bid in this bidding process in accordance with ITB 4.3, other than alternative offers submitted in accordance with ITB 13;

(g) Our firm, its affiliates or subsidiaries, including any Subcontractors or Suppliers for any part of the contract, has not been declared ineligible by ADB, under the Employer's country laws or official regulations or by an act of compliance with a decision of the United Nations Security Council;

(h) We are not a government owned entity / We are a government owned entity but meet the requirements of ITB4.5; *

(i) We agree to permit ADB or its representative to inspect our accounts and records and other documents relating to the bid submission and to have them audited by auditors appointed by ADB.

Name .....

In the capacity of .....

Signed .....

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

Date .....

---

* ***Use one of the two options as appropriate***

Bid Security

Bank Guarantee

..... *Bank's Name, and Address of Issuing Branch or Office* .....

Beneficiary: Public Health Engineering Division No.2,Sonipat, Haryana

Date:.....

Bid Security No.: .....

We have been informed that . . . . . *name of the Bidder*. . . . . (Hereinafter called "the Bidder") has submitted to you its bid dated . . . . . (Hereinafter called "the Bid") for the execution of . . . . . C**onstruction of storm water Drains in Sonepat Town** under Invitation for Bids No. . . . . (“the IFB”).

Furthermore, we understand that, according to your conditions, bids must be supported by a bid guarantee.

At the request of the Bidder, we . . . . . *name of Bank*. . . . . hereby irrevocably undertake to pay you any sum or sums not exceeding in total an amount of . . . . . .*amount in figures* . . . . . (. . . . . .*amount in words* . . . . .) upon receipt by us of your first demand in writing accompanied by a written statement stating that the Bidder is in breach of its obligation(s) under the bid conditions, because the Bidder:

(a) has withdrawn its Bid during the period of bid validity specified by the Bidder in the Form of Bid; or

(b) does not accept the correction of errors in accordance with the Instructions to Bidders (hereinafter “the ITB”); or

(c) having been notified of the acceptance of its Bid by the Employer during the period of bid validity, (i) fails or refuses to execute the Contract Agreement, or (ii) fails or refuses to furnish the Performance Security, in accordance with the ITB.

This guarantee will expire: (a) if the Bidder is the successful Bidder, upon our receipt of copies of the Contract Agreement signed by the Bidder and the performance security issued to you upon the instruction of the Bidder; and (b) if the Bidder is not the successful Bidder, upon the earlier of (i) our receipt of a copy your notification to the Bidder of the name of the successful Bidder; or (ii) twenty-eight days after the expiration of the Bidder’s bid.

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

This guarantee is subject to the Uniform Rules for Demand Guarantees, ICC Publication No. 458.

. . . . . *Bank's seal and authorized signature(s)* . . . . . .

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

Technical Proposal

Personnel

Equipment

Site Organization

Method Statement

Mobilization Schedule

Construction Schedule

Others

Personnel

Bidders should provide the names of suitably qualified personnel to meet the requirements specified in Section 3 (Evaluation and Qualification Criteria). The data on their experience should be supplied using the Form below for each candidate.

Form PER – 1: Proposed Personnel

1.	**Title of position***
	Name
2.	**Title of position***
	Name
3.	**Title of position***
	Name
4.	**Title of position***
	Name

*As listed in Section 3 (Evaluation and Qualification Criteria).

Form PER – 2: Resume of Proposed Personnel

Position		
Personnel information	**Name**	**Date of birth**
	Professional qualifications	
Present employment	**Name of employer**	
	Address of employer	
	Telephone	**Contact (manager / personnel officer)**
	Fax	**E-mail**
	Job title	**Years with present employer**

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

1.1.1 From	1.1.2 To	1.1.3 Company / Project / Position / Relevant technical and management experience

Equipment

The Bidder shall provide adequate information to demonstrate clearly that it has the capability to meet the requirements for the key equipment listed in Section 3 (Evaluation and Qualification Criteria). A separate Form shall be prepared for each item of equipment listed, or for alternative equipment proposed by the Bidder.

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

Omit the following information for equipment owned by the Bidder.

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

Site Organization

Method Statement

1.1.4 Method Statement

Bidder shall provide a comprehensive statement of the methods that it proposes to adopt for completing the works including descriptions of scheduling, mobilization of labor force, construction equipment's, quality assurance and quality control program etc. to demonstrate its overall understanding of requirements and to demonstrate bidder's capability of planning, construction, procurement and deployment of resources.

Bidder should provide full details on his procurement methods for major items of plant, equipment and materials required for implementation, including design of the plant and equipment, sources of materials, placing of orders, times required for manufacture, tests to be conducted at suppliers/manufacturers plant and at site, storage and installation.

Bidder shall clarify works to be done by contractor from site office and those from contractors head office and also state delegation of powers and responsibilities of the person in charge of site at site and of head office.

Bidder shall describe organization chart indicating relationship between the design team, site management and head/branch office, onsite operations, sub-contractors, suppliers and supervising staff. Bidder will describe responsibilities of key personnel.

Mobilization Schedule

1.1.5 Mobilization of Proposed Personnel

Bidder shall provide the proposed mobilization Schedule for each of the personnel in a bar chart form, clearly showing the proposed date of mobilization, duration of services, and date of demobilization.

Form PER-3

S No	Personnel	Nomber Reqd	Mobilization Schedule in Months from the Commencement Date													
			1	2	3	4	5	6	7	8	9	10	11	-	-	24

Construction Schedule

1.1.6 Construction Schedule

This shall consist of a detailed bar chart showing in sufficient details completion of various sections of work and the date and order in which the bidder proposes to carry out different parts of work. The bar chart shall indicate the principal quantities of work forecast for execution monthly. In preparation of the program appropriate allowance should be made for loss of time due to inclement weather. This construction schedule shall form the basis for preparation of detailed program to be furnished after award of work, on a commercially available project management software (such as Primavera, MS Project or equivalent) showing level-3 activities, together with bar charts and CPM diagrams which clearly illustrate the critical path, and the resources required to be provided by the contractor to achieve the desired results

The construction schedule should be in conformity with the following

S No	Period from the date of commencement of work	Cumulative value of work to be completed as %of total value of to be completed till the end of period mentioned in column 2	Description of works to be completed during the quarter mentioned in column 2
1	2	3	4
2	Quarter 1: 3 months from start	7%	
3	Quarter 2: 4 to 6 months from start	15%	
4	Quarter 3: 7 to 9 months from start	25%	
5	Quarter 4: 10 to 12 months from start	40%	
6	Quarter 5: 13 to 15 months from start	55%	
7	Quarter 6: 16 to 18 months from start	70%	
8	Quarter 7: 19 to 21 months from start	85%	
9	Quarter 8: 22 to 24 months from start	100%	

Contractor shall indicate the items to be executed in quantifiable manner

Bidders Qualification

To establish its qualifications to perform the contract in accordance with Section 3 (Evaluation and Qualification Criteria) the Bidder shall provide the information requested in the corresponding Information Sheets included hereunder.

Form ELI - 1: Bidder's Information Sheet

1.1.6.1.1 Bidder's Information	
Bidder's legal name	
In case of JV, legal name of each partner	
Bidder's country of constitution	
Bidder's year of constitution	
Bidder's legal address in country of constitution	
Bidder's authorized representative (name, address, telephone numbers, fax numbers, e-mail address)	

Attached are copies of the following original documents.

- ❑ 1. In case of single entity, articles of incorporation or constitution of the legal entity named above, in accordance with ITB 4.1 and 4.2.
- ❑ 2. Authorization to represent the firm or JV named in above, in accordance with ITB 20.2.
- ❑ 3. In case of JV, letter of intent to form JV or JV agreement, in accordance with ITB 4.1.
- ❑ 4. In case of a government-owned entity, any additional documents not covered under 1 above required to comply with ITB 4.5.

Form ELI - 2: JV Information Sheet

Each member of a JV must fill in this form

1.1.6.1.2 JV / Specialist Subcontractor Information	
Bidder's legal name	
JV Partner's or Subcontractor's legal name	
JV Partner's or Subcontractor's country of constitution	
JV Partner's or Subcontractor's year of constitution	
JV Partner's or Subcontractor's legal address in country of constitution	
JV Partner's or Subcontractor's authorized representative information (name, address, telephone numbers, fax numbers, e-mail address)	
Attached are copies of the following original documents. ❑ 1. Articles of incorporation or constitution of the legal entity named above, in accordance with ITB 4.1 and 4.2. ❑ 2. Authorization to represent the firm named above, in accordance with ITB 20.2. ❑ 3. In the case of government-owned entity, documents establishing legal and financial autonomy and compliance with commercial law, in accordance with ITB 4.5.	

Form LIT - Pending Litigation

Each Bidder or member of a JV must fill in this form

1.1.6.1.3 Pending Litigation

❑ **No pending litigation in accordance with Criteria 2.2 of Section 3 (Evaluation and Qualification Criteria)**

❑ **Pending litigation in accordance with Criteria 2.2 of Section 3 (Evaluation and Qualification Criteria)**

Year	Matter in Dispute	Value of Pending Claim in Indian Rs	Value of Pending Claim as a Percentage of Net Worth

Form FIN - 1: Financial Situation

Each Bidder or member of a JV must fill in this form

Financial Data for Previous 3 Years [Indian Rs]		
Year 1:	**Year 2:**	**Year 3:**

Information from Balance Sheet

Total Assets			
Total Liabilities			
Net Worth			
Current Assets			
Current Liabilities			

Information from Income Statement

Total Revenues			
Profits Before Taxes			
Profits After Taxes			

❑ Attached are copies of financial statements (balance sheets including all related notes, and income statements) for the last three years, as indicated above, complying with the following conditions.

- All such documents reflect the financial situation of the Bidder or partner to a JV, and not sister or parent companies.
- Historic financial statements must be audited by a certified accountant.
- Historic financial statements must be complete, including all notes to the financial statements.
- Historic financial statements must correspond to accounting periods already completed and audited (no statements for partial periods shall be requested or accepted).

Form FIN - 2: Average Annual Construction Turnover

Each Bidder or member of a JV must fill in this form

Annual Turnover Data for the Last 3 Years (Construction only)			
Year	**Amount Currency**	**Exchange Rate**	**Indian Rs. Equivalent**
		Average Annual Construction Turnover	

The information supplied should be the Annual Turnover of the Bidder or each member of a JV in terms of the amounts billed to clients for each year for work in progress or completed, converted to Indian Rs. at the rate of exchange at the end of the period reported.

Form FIN – 3: Financial Resources

Specify proposed sources of financing, such as liquid assets, unencumbered real assets, lines of credit, and other financial means, net of current commitments, available to meet the total construction cash flow demands of the subject contract or contracts as indicated in Section 3 (Evaluation and Qualification Criteria)

Financial Resources		
No.	**Source of financing**	**Amount (Indian Rs. equivalent)**
1		
2		
3		
4		

Form FIN- 4: Current Contract Commitments / Works in Progress

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

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

Form EXP – 1: General Construction Experience

Each Bidder or member of a JV must fill in this form

General Construction Experience				
Starting Month Year	**Ending Month Year**	**Years**	**Contract Identification and Name Name and Address of Employer Brief Description of the Works Executed by the Bidder**	**Role of Bidder**

Form EXP – 2(a): Specific Construction Experience

Fill up one (1) form per contract.

Contract of Similar Size and Nature			
Contract No . . . . . **of**	**Contract Identification**		
Award Date		**Completion Date**	
Role in Contract	❑ **Contractor**	❑ **Management Contractor**	❑ **Subcontractor**
Total Contract Amount			**INR**
If partner in a JV or subcontractor, specify participation of total contract amount	**Percent of Total**	**Amount**	
Employer's Name **Address** **Telephone/Fax Number** **E-mail**			
Description of the similarity in accordance with Criteria 2.4.2(a) of Section 3			
Participation as contractor, management contractor, or subcontractor, in at least one contract within the last seven years, each with a value of at least INR 138.7 million that has been successfully or substantially completed and that is similar to the proposed works. The similarity shall be based on the physical size, complexity, methods, technology or other characteristics as described in Section 6 (Works Requirements)			

Form EXP - 2(b): Specific Construction Experience in Key Activities

Fill up one (1) form per contract

Contract with Similar Key Activities			
Contract No . . . . . **of**	**Contract Identification**		
Award Date		**Completion Date**	
Role in Contract	❑ **Contractor**	❑ **Management Contractor**	❑ **Subcontractor**
Total Contract Amount			**Rs**
If partner in a JV or subcontractor, specify participation of total contract amount	**Percent of Total**	**Amount**	
Employer's Name **Address** **Telephone Number** **Fax Number** **E-mail**			
Description of the key activities in accordance with Criteria 2.4.2(b) of Section 3			
Construction of 13 km drain/RCC pipe drain Work order, completion certificate shall be enclosed with the bid to substantiate above works. These certificates should be signed by the competent authority			

Public Health Engineering Department Haryana

NATIONAL CAPITAL REGION URBAN INFRASTRUCTURE FINANCING FACILITY

(ADB Loan No 2660 IND)

Bidding Document for Procurement of

Construction of storm water Drains in Sonepat Town

Single Stage Two Envelope Bidding Procedure under National Competitive Bidding on Item Rate Basis

Volume-1: Part I

Section 5: Eligible Countries

Section 5 - Eligible Countries

This section contains the list of eligible countries

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2. Armenia
3. Australia
4. Austria
5. Azerbaijan
6. Bangladesh
7. Belgium
8. Bhutan
9. Brunei Darussalam
10. Cambodia
11. Canada
12. China, People's Republic of
13. Cook Islands
14. Denmark
15. Fiji
16. Finland
17. France
18. Georgia
19. Germany
20. Hong Kong, China
21. India
22. Indonesia
23. Italy
24. Ireland
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28. Korea, Republic of
29. Kyrgyz Republic
30. Lao PDR
31. Luxembourg
32. Malaysia
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34. Marshall Islands
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36. Mongolia
37. Myanmar
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46. Philippines
47. Portugal
48. Samoa
49. Singapore
50. Solomon Islands
51. Spain
52. Sri Lanka
53. Sweden
54. Switzerland
55. Tajikistan
56. Taipei,China
57. Thailand
58. Timor-Leste
59. Tonga
60. Turkey
61. Turkmenistan
62. Tuvalu
63. United Kingdom
64. United States
65. Uzbekistan
66. Vanuatu
67. Viet Nam

Public Health Engineering Department Haryana

NATIONAL CAPITAL REGION URBAN INFRASTRUCTURE FINANCING FACILITY

(ADB Loan No 2660 IND)

Bidding Document for Procurement of

Construction of storm water Drains in Sonepat Town

Single Stage Two Envelope Bidding Procedure under National Competitive Bidding on Item Rate Basis

Volume-1: Part II

Section 6: Employers Requirement

Section 6 - Employer's Requirements (ERQ)

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1 General

1.1 *Profile of Sonepat Town*

Sonepat is an important town of Haryana and is located north of Delhi at a distance of about 22 km from Azadpur and 30 km from ISBT Kashmiri Gate in Delhi. Geographically it is situated at 28^0 59' N latitude and 77^0 01' E Longitude. The area of town is 18.25 sq. km. The population of Sonepat Town as per census 2011 was 292339.

1.2 *Climate*

Climate of the district is dry with hot summers and cold winters. The weather becomes comparatively mild during monsoon period. The average temperature ranges from a minimum of 1.8oC to a maximum of 44.9^{o}C; occasional extremes may in the ranges of 0.6^{o}C to 47^{o}C.The average annual rainfall of the city is about 624 mm.

1.3 *Topography*

The average ground level of the town is 225.15 m. The entire district is a part of Punjab Plains. Soil of the district is sandy. The general slope of the town is toward the south and west. District may be divided roughly in three Regions namely the Khader, Plain and sandy region.

1.4 *Existing Drainage System.*

The storm water of the Sonepat city drains into Drain No 6. The Drain No 6 runs north south through central portion of town. The storm water from this drain flows to Drain No 8 which flows east west on the south side of town. The drainage system in most parts of the city is non-existent. Only storm water drain pipe of 1500 mm runs along the Gohana road which ultimately falls into Drain No 6. In absence of the sewerage system, this drain acts as carrier of waste water.

Drain No 6: The drain no 6 enters the city at the north boundary and flows through Shiv colony, Rishi colony, Bus stand, Nandwanu Nagar and flows towards south of city towards Shadipur Kheda

Gohana Road Drain Pipe: The RCC storm water drainage pipe of 1500 mm has been laid on this road to carry the storm water of the part of the city to Drain No 6. The drain pipe starts from The Police line/ PHED office and passes through the Gohana road. The pipe crosses the railway line at underpass and carries the storm water of Gain Nagar, Mahabir colony, Sarang cinema area, Jamalpura, Rishi colony up to the Drain 6 at near the Bus Stand. The openings at regular interval have been made on the manholes for intake of storm water. The storm water pipe also carries the sewage of the nearby area. The sewage of the city is discharged in the Drain No 6. The major drain pipe at Gohana road also carries the waste water of the nearby colonies.

1.5 *Flood Prone Areas*

The flood prone areas as per the available information are as follows:

(i) Intersection at Shambhu Dayal School
(ii) Railway Crossing at Gohana Road
(iii) Mehlana Road
(iv) Kakroi Road
(v) Rohtak Road
(vi) Area near Atlas Cycle Industry

2 Scope of Work

2.1 *Proposed Work*

Mehlana Road, Kakroi Road, Rohtak Road and Gohana road are the important roads of the town. The storm water system along this road has been considered for detail designing. The improvements required for Drain No. 6 is not considered in this DPR, as the same is under the purview of Irrigation Department. The works which fall under the scope of Public Works Department – Water and Sanitation Division, the Implementing Agency for this project, are only considered. The works proposed in Sonepat are as follows:

a) Construction of rectangular drain (1 m wide) with covers on both sides of the road at Kakroi Road, Rohtak Road and Mehlana road;
b) Providing and laying of RCC drain pipe for storm water from Shambhu Dayal school intersection to Drain No 6 via Jatwara Mohalla road- Road from Kami ;
c) Providing and laying of RCC drain pipe for storm water along Railway Colony road and PWD guest house road;
d) Construction of rectangular drain (1 m wide) with covers on both sides of Atlas cycle industry road and Blind Center road.

2.2 *Detailed Investigations & Preliminary Design*

The detail investigation of the roads and levels has been done. According to levels the path of the storm water drain was determined. The path is in Drg No NCRPB-SPT-DR-01. The details of the path are shown in the table below:-

Drain No	Path	Route
A	A2-A3-A4-A5-A6-A-7	Shambhu Dayal School intersection – Railway under bridge- Jatwara Mohalla road- Road from Kami- Drain No 6
	A1-A2	Kakroi Road - Shambhu Dayal School intersection
	A'21-A2	Rohtak Road - Shambhu Dayal School intersection
	A22-A21-A2	Mehlana road - Shambhu Dayal School intersection
B	B1-B2-B3-B4	Gohana Road-Railway under bridge- Gohana road market- Bus stand intersection – Drain No 6
C	C1-C2-C3- C4	Railway Colony road – Post & telephone office road- Gohana road market- Drain No 6
	C22-C21-C2	PWD rest house road- Gohana road market
	C31-C3	Road Near Bus Stand
D	D1-D2-D3-D4	Atlas cycle industry road- Blind Center road- Drain No 6

2.3 *Design of Drain Sections*

The option of rectangular drain with covers and RCC pipe was considered. In view of easy maintenance and depth of the invert, the rectangular drain with covers is preferred. However, in the congested area, where the space for drain is not available, the RCC pipe with manholes at 30 m interval has been considered. The drain wise section considered is shown in table below:-

S.No.	Drain	Chainage	Length	Type of Drain
1	A	A22-A2	810	CC Rectangular drain with covers on both sides of road
2	A	A'21-A2	1,410	CC Rectangular drain with covers on both sides of road
3	A	A1-A2	1,260	CC Rectangular drain with covers on both sides of road
4	A	A211-A21	720	CC Rectangular drain with covers on both sides of road
5	A	A2-A9	2,730	RCC pipe on one side of road
6	C	C22-C21-C2	2,070	RCC pipe on one side of road
7	C	C31-C2	330	RCC pipe on one side of road
8	C	C1-C2-C3-C4	960	RCC pipe on one side of road
9	D	D1-D2-D3-D4	2,070	CC Rectangular drain with covers on both sides of road
10	D	D31-D3	1,580	CC Rectangular drain with covers

3 Rain Water Harvesting

The area is located in the Water Scarcity land and the groundwater behavior varies drastically. 90% of the rainfall is confined during the months July, August, and September. In the recent year due to over exploitation of groundwater resources the water level has taken a declining trend. It is because of these reasons, the rainwater harvesting has been proposed. A study has been done on Feasibility and Design of Rainwater Harvesting System by Groundwater division of Aqua Explorers, New Delhi. This report is available in the office of the Executive Engineer PHED Sonepat.

3.1 *Rainfall*

The southwest monsoon causes heavy rain to fall in the region in rainy months starting from Last week of June to end of September. Frequency of rain is highest in the months of July and August reaching up to 338.8 mm in the month of August in 2010 causing flooding in many low lying areas.

Month/Year	Jan	Feb	Mar	Apr	May	Jun	July	Aug	Sep	Oct	Nov	Dec	Total
2006	3.2	0.0	17.8	2.8	93.2	90.2	263.6	66.3	78.5	0.4	0.3	2.4	618.7
2007	0.0	49.8	54.4	0.0	40.4	83.8	83.6	216.8	72.8	0.0	0.0	0.0	601.6
2008	1.8	0.0	0.0	31.0	136.6	100.7	166.2	299.1	115.6	0.0	0.0	0.0	815.0
2009	4.2	6.5	3.9	2.0	43.0	5.4	124.2	188.6	201.9	0.3	14.2	1.05	595.5
2010	0.0	14.2	0.0	1.2	7.6	4.6	236.8	338.8	314.2	22.0	13.4	0.3	953.1
2011	0.0	49.9	2.3	2.2	33.4	104.4	33.8	272.4	163.4	-	-	-	489.2

3.2 *Geology of the Area*

Soils of district are classified as tropical and brown sails, existing in major parts of the district. In Hathin block the organic content of soils ranging from 0.41 to 0.75 percent which is of medium category. In rest of the area

organic contents is 0.2 to 0.4 percent and falls in Low category. The average conductivity of the soil is not more than 0.80 µmhos /cm and the average pH of the soil is between 6.5 and 8.7. The area comprises almost flat plains traversed by one ridge running N-S to NNE-SSW direction, divides the alluvium into two parts.

4 Specifications

Central Public Works Department specifications www.cpwd/publications/specifications(civil) volume 1 and volume 2 shall be followed. Some important and relevant portions of specifications are given below.
(In case of any discrepancy original version as available on web site will be applicable)

4.1 Plain Cement Concrete

List of Mandatory Tests

Material	*Clause*	*Test*	*Field/ Laboratory*	*Test procedure*	*Min. qty of Material for Carrying out test*	*Frequency of Testing*
1	*2*	*3*	*4*	*5*	*6*	*7*
Stone aggregate	4.1.2.2	(a) Percentage of soft or deleterious material	Field or Laboratory-Test as required	IS 2386-Part II	As required by Engineer-in-charge	For all quantities
	4.1.2.3	Particle size	Field/ Lab	Appendix 'A'	45 cum	For every 45 cum or part thereof for RCC Work only. For rest of items as decided by Engineer-in-charge
	4.1.2.5	(a) Estimation of organic impurities	Field/ Lab	IS 2386-Part II	10 cum	For every 40 cum or part thereof
		(b) Surface moisture	Field/ Lab	IS 2386	10 cum	-do-
		(c) Determination of 10% fine value	Field/ Lab	IS 2386	10 cum	-do-
		(d) Specific gravity	Field/ Lab	IS 2386	10 cum	-do-
		(e) Bulk density	Field/ Lab	IS 2386	10 cum	-do-
		(f) Aggregate crusing strength	Field/ Lab	IS 2386	10 cum	-do-
		(g) Aggregate impact value	Field/ Lab	IS 2386	10 cum	-do-

Concrete	4.2.2	Slump test	Field	Appendix 'D'	10 cum	15 cum or part thereof

LIST OF BUREAU OF INDIAN STANDARDS CODES

S No	IS No	Subject
1.	IS 383	Specification for coarse and fine aggregate from natural sources for concrete.
2.	IS 456	Plain and reinforced concrete - Code of practice
3.	IS 516	Method of test for strength of concrete
4.	IS 1199	Method of sampling and analysis of concrete
5.	IS 1200 (Part II)	Method of measurement of building and civil engineering work (concrete work)
6.	IS 1322	Specification for bitumen felt for water proofing and damp proofing.
7.	IS 1791	General requirements for batch type conrete mixers
8.	IS 2386	Method of test for aggregates for concrete
		(a) Part I - Particle size and shape
		(b) Part II - Estimation of deleterious materials and organic impurities
		(c) Part III - Specific gravity, density, voids absorption and bulking.
		(d) Part IV - Mechanical properties.
		(e) Part V – Soundness
9.	IS 2505	General requirements for concrete vibrators - immersion type.
10.	IS 2506	General requirements for concrete vibrators - screed board concrete vibrators
11.	IS 2645	Specification for integral water proofing compounds for cement mortar and concrete
12.	IS 3068	Specification for broken brick (burnt clay) coarse aggregate for use in concrete.
13.	IS 3812	Specification for flyash for use as pozzolana and admixture in cement mortar and concrete.
14.	IS 4656	Specification for form vibrators for concrete.
15.	IS 7861	Code of practice for extreme weather concreting (Part-I) recommended (Part-I) practice for hot weather concreting.
16.	IS 7861 (Part–II)	Code of practice for extreme weather concreting (Part-II) recommended.
17.	IS 9103	Specification for concrete admixtures

4.1. MATERIAL

Water, cement, fine aggregate or sand, surkhi, and fly ash shall be as specified in Chapter 3.0 – Mortar.

4.1.1 Coarse Aggregate

4.1.1.1 ***General:*** Aggregate most of which is retained on 4.75 mm IS Sieve and contains only as much fine material as is permitted in IS 383 for various sizes and grading is known as coarse aggregate. Coarse aggregate shall be specified as stone aggregate, gravel or brick aggregate and it shall be obtained from approved/ authorized sources.

(a) *Stone Aggregate:* It shall consist of naturally occurring (uncrushed, crushed or broken) stones. It shall be hard, strong, dense, durable and clean. It shall be free from veins, adherent coating, injurious amounts of disintegrated pieces, alkali, vegetable matter and other deleterious substances. It shall be roughly cubical in shape. Flaky and elongated pieces shall be avoided. It shall conform to IS 383 unless otherwise specified.

(b) *Gravel:* It shall consist of naturally occurring (uncrushed, crushed or broken) river bed shingle or pit gravel. It shall be sound, hard and clean. It shall be free from flat particles of shale or similar laminated material, powdered clay, silt, loam, adherent coating, alkali, vegetable matter and other deleterious substances. Pit gravel shall be washed if it contains soil materials adhering to it. These shall conform to IS 383 unless otherwise specified.

(c) *Brick Aggregate:* Brick aggregate shall be obtained by breaking well burnt or overburnt dense brick/ brick bats. They shall be homogeneous in texture, roughly cubical in shape and clean. They shall be free from unburnt clay particles. Soluble salt, silt, adherent coating of soil, vegetable matter and other deleterious substances. Such aggregate should not contain more than one percent of sulphates and should not absorb more than 10% of their own mass of water, when used in cement concrete. It shall conform to IS 306 unless otherwise specified.

(d) Light weight aggregate such as sintered fly ash aggregate may also be used provided the Engineer-in-Charge is satisfied with the data on the proportion of concrete made with them.

4.1.1.2 ***Deleterious Material:*** Coarse aggregate shall not contain any deleterious material, such as pyrites, coal, lignite, mica, shale or similar laminated material, clay, alkali, soft fragments, sea shells and organic impurities in such quantity as to affect the strength or durability of the concrete. Coarse aggregate to be used for reinforced cement concrete. Coarse aggregate to be used for reinforced cement concrete shall not contain any material liable to attack the steel reinforcement. Aggregates which are chemically reactive with alkalies of cement shall not be used. The maximum quantity of deleterious material shall not be more than five percent of the weight of coarse aggregate when determined in accordance with IS 2386.

4.1.1.3 ***Size and Grading***

(i) Stone aggregate and gravel: It shall be either graded or single sized as specified. Nominal size and grading shall be as under:-

(a) Nominal sizes of graded stone aggregate or gravel shall be 40, 20, 16, or 12.5 mm as specified. For any one of the nominal sizes, the proportion of other sizes as determined by the method prescribed in Appendix 'A' of Chapter 4 shall be in accordance with Table 4.1.

TABLE 4.1
Graded Stone Aggregate or Gravel

IS Sieve Designation	*Percentage passing (by weight) for nominal size of*			
	40 mm	*20 mm*	*16 mm*	*12.5 mm*

80 mm	100	-	-	-
63 mm	-	-	-	-
40 mm	95 to 100	100	-	-
20 mm	30 to 70	95 to 100	100	100
16 mm	-	-	90 to 100	-
12.5 mm	-	-	-	90 to 100
10 mm	10 to 35	25 to 55	30 to 70	40 to 85
4.75 mm	0 to 5	0 to 10	0 to 10	0 to 10

(b) Nominal sizes of single sized stone aggregate or gravel shall be 63, 40, 20, 16, 12.5 or 10 mm as specified. For any one of the nominal size, the proportion of other sizes as determined by the method prescribed in Appendix 'A' of Chapter 4 shall be in accordance with Table 4.2.

TABLE 4.2
Single Sized (Ungraded) Stone Aggregate or Gravel

IS Sieve Designation	*Percentage passing (by weight) for nominal size of*					
	63 mm	*40 mm*	*20 mm*	*16 mm*	*12.5 mm*	*10 mm*
80 mm	100	-	-	-	-	-
63 mm	85-100	100	-	-	-	-
40 mm	0-30	85-100	100	-	-	-
20 mm	0- 5	0-20	85-100	100	-	-
16 mm	-	-	-	85-100	100	-
12.5 mm	-	-	-	-	85-100	100
10 mm	0-5	0-5	0-20	0-30	0-45	85-100
4.75 mm	-	-	0-5	0-5	0-10	0-20
2.36 mm	-	-	-	-	-	0-5

(c) When stone aggregate or gravel brought to site is single sized (ungraded), it shall be mixed with single sized aggregate of different sizes in the proportion to be determined by field tests to obtain graded aggregate of specified nominal size. For the required nominal size, the proportion of other sizes in mixed aggregate as determined by method prescribed in Appendix 'A' of Chapter 4 shall be in accordance with Table 4.1. Recommended proportions by volume for mixing of different sizes of single size (ungraded) aggregate to obtain the required nominal size of graded aggregate are given in Table 4.3.

TABLE 4.3
Single Sized (Ungraded) Stone Aggregate or Gravel

Cement concrete	*Nominal size of graded aggregate required*	*Parts of single size aggregate of size*				
		50 mm	*40 mm*	*20 mm*	*12.5 mm*	*10 mm*
(1)	*(2)*	*(3)*	*(4)*	*(5)*	*(6)*	*(7)*
1:6:12	63	9	-	3	-	-
1:6:12	40	-	9	3	-	-
1:5:10	63	7.5	-	2.5	-	-
1:5:10	40	-	7.5	2.5	-	-
1:4:8	63	6	-	2	-	-
1:4:8	40	-	6	2	-	-
1:3:6	63	4.5	-	1.5	-	-
1:3:6	40	-	4.5	1.5	-	-
1:3:6	20	-	-	4.5	-	1.5

1:2:4	40	-	2.5	1	-	1.5
1:2:4	20	-	-	3	-	1
1:2:4	12.5	-	-	-	3	1
1: $1^{1}/_{2}$:3	20	0	0	2	-	1

Note:

(i) The proportions indicated in Table 4.3 above are by volume when considered necessary, these proportions may be varied marginally by Engineer-in-Charge after making sieve analysis of aggregate brought to site for obtaining required graded aggregate. No adjustments in rate shall be made for any variation in the proportions so ordered by the Engineer-in-Charge. If single size coarse aggregate are not premixed at site to obtain the graded coarse aggregate required for the mix, the volume of single size aggregates required for the mix shall be suitably increased to account for reduction in total volume at the site of mixing.

(ii) *Brick Aggregate:* Nominal size of brick aggregate shall be 40 mm and its grading shall be as specified in Table 4.4 when tested for sieve analysis for the method prescribed in Appendix 'A' of Chapter 4.0.

TABLE 4.4
Brick Aggregate

IS Sieve Designation	*Percentage passing (by weight)*
75 mm	100
37.5 mm	95-100
20.0 mm	45-100
4.75 mm	0.50

4.1.1.4 ***Stacking:*** Aggregate shall be stacked on a hard, dry and level patch of ground. When stack piling, the aggregate shall not form pyramids resulting in segregation of different sized materials. It shall be stacked separately according to nominal size of coarse aggregates. Stacking shall be done in regular stacks, of height not exceeding 100 cm.

4.1.1.5 ***Testing:*** Coarse aggregate shall be tested for the followings (as per IS 2386)

(a) Determination of particle size and shape (Appendix 'A' of Chapter 4)
(b) Estimation of organic impurities (as per IS 2386 - Part II)
(c) Surface moisture (Appendix 'B' of Chapter 4)
(d) Determination of 10% fine value (Appendix 'C' of Chapter 4)

4.1.1.6 ***Measurements:*** The aggregates shall be measured in stacks and paid for after making a deduction of 7.5% of the gross measurements of stacks in respect of aggregates of nominal size 40 mm and above. No deduction from the gross measurements of the stacks is to be made in respect of aggregate of nominal size below 40 mm.

4.1.2 Chemical Admixtures

When required, admixtures of approved quality shall be mixed with concrete, as specified. The admixtures shall conform to IS 9103 and as specified in Chapter 5 - R.C.C.

4.1.2.1 Admixtures may be any one of the following classes for use in concrete:-

(a) Water Reducing Admixtures
(b) Retarding Admixtures
(c) Accelerating Admixtures.
(d) Water Reducing and Retarding Admixtures.
(e) Water Reducing and Accelerating Admixtures.
(f) Permeability Reducing (water proofing) Admixtures.

4.1.2.2 ***Liquid Admixtures:*** Admixtures introduced into the concrete as liquids generally fall into the

following categories.

(a) Air Entraining.
(b) Water Reducing.
(c) Water Reducing Retarders.
(d) Retarders.
(e) Water Reducing Accelerators.
(f) Accelerators.

4.1.2.3 Dosage of these admixtures may vary according to manufacturers specification.

4.1.2.4 Two or more admixtures may not be compatible in the same solution. It is therefore mandatory that when two admixtures manufactured by the same manufacturers is being used simultaneously, the manufacturer shall certify their compatibility. In case the two or more admixtures are produces by different manufacturers, then, before their use in concrete, test shall be performed by the manufacturer to establish their compatibility, all such test reports shall be furnished to the Engineer-in-Charge for his approval before their use in concrete.

4.1.2.5 Some admixture may be in the form of powder, particle or high concentration liquids which may require mixing with water prior to dosing. Under these conditions water in solution shall be considered as part of total water content in the batch in order to maintain the water-cement ratio.

4.1.2.6 Admixture manufacturer's recommendation shall be carefully followed so as to ensure complete solution of the product or to prepare a standard solution of uniform strength for easier use.

4.1.2.7 Certain admixtures may contain significant amounts of finely divided insoluble materials or active ingredients which may or may not be readily soluble. It is essential for such admixtures that precautions be taken to ensure that these constituents be kept in a state of uniform suspension before actual batching. When relatively small amounts of powered admixtures are to be used directly, these shall be pre-blended with cement.

4.1.2.8 Admixtures are sold under various trade names and may be in the form of liquids or powders. The proprietary name and the net quantity of content shall be clearly indicated in each package or container of admixtures. The admixtures shall be uniform within each batch and uniform between all batches.

4.1.2.9 No admixtures shall be accepted for use in concrete unless these are tested in accordance with IS 9103 and the test results are approved by the Engineer-in-Charge.

4.2 CEMENT CONCRETE

4.2.1 Grades of Cement Concrete

The concrete shall be in grade designated as under:

TABLE 4.5
Grades of Concrete

Group	*Grade Designation*	*Specified characteristic compressive strength of 150 mm Cube at 28 Days in N/mm^2*
(1)	(2)	(3)
Ordinary Concrete	M10	10
	M15	15
	M20	20
Standard Concrete	M25	25
	M30	30
	M35	35
	M40	40
	M45	45
	M50	50
	M55	55
High Strength Concrete	M60	60
	M65	65
	M70	70
	M75	75
	M80	80

Notes :

1. In the designation of concrete mix M refers to the mix and the number to the specified compressive strength of 150 mm size cube at 28 days, expressed in N/mm^2.
2. For concrete of compressive strength greater than M55, design parameters given in the standard may not be applicable and the values may be obtained from specialized literatures and experimental results.

4.2.1.1 The characteristic strength is defined as the strength of material below which not more than 5 percent of the test results are expected to fall.

TABLE 4.6
Minimum Cement Content, Maximum Water- Cement Ratio and Minimum Grade of Concrete for Different Exposures with Normal Weight Aggregates of 20 mm Nominal; Maximum Size
(Clause 4.2.1.1)

Sl. No.	*Exposure*	*Plain Concrete*			*Reinforced Concrete*		
		Minimum Cement Content kg/m^3	*Maximum Free Water Cement Ratio*	*Minimum Grade of Concrete*	*Minimum Cement Content kg/m^3*	*Maximum Free Water-Cement Ratio*	*Minimum Grade of Concrete*
(1)	*(2)*	*(3)*	*(4)*	*(5)*	*(6)*	*(7)*	*(8)*
(i)	Mild	220	0.60	-	300	0.55	M20
(ii)	Moderate	240	0.60	M15	300	0.50	M25
(iii)	Severe	250	0.50	M20	320	0.45	M30
(iv)	Very Severe	260	0.45	M20	340	0.45	M35
(v)	Extreme	280	0.40	M25	360	0.40	M40

Notes:

1. Cement content prescribed in this Table is irrespective of the grades of cement. The additions such as fly or ground granulated blast furnace slag may be taken into account in the concrete composition with respect to the cement content and water-cement ratio, if the suitability is established and as long as the maximum amounts taken into account do not exceed the limit of pozzolona and slag specified in IS 1489 (Part 1) and IS 455 respectively.
2. Minimum grade for plain concrete under mild exposure condition is not specified.
3. The above minimum cement content and maximum water cement ratio apply only to 20 mm nominal maximum size aggregate. For other sizes of aggregate, these should be changed as per Table 6 of IS 456.

The minimum grade of concrete for plain and reinforced concrete shall be as per Table 4.6.

4.2.1.2 Concrete of grades lower than those given in Table 4.6 may be used for lean concrete, foundation for masonry walls or temporary reinforced concrete construction.

4.2.2 Workability of Concrete

4.2.2.1 The concrete mix proportion chosen should be such that the concrete is of adequate workability for the placing conditions of the concrete and can properly be compacted with the means available. Suggested ranges of workability of concrete measured in accordance with IS 1199 are given below:

Placing Conditions	*Degree of Workability*	*Slump (mm)*
(1)	*(2)*	*(3)*
Blinding concrete: shallow sections: Pavements using pavers	Very low	See 4.2.2.2
Mass concrete: Lightly reinforced sections in slabs, beams, wall, columns, : floors	Low	25-75
Hand placed pavements: canal lining; Strip footing	Medium	50-100
Heavily reinforced sections in slabs, beams, walls, columns:		
Slip form work: Pumped concrete	Medium	75-100
Trench fill	High	100-150
Tremie concrete	Very High	See 4.2.2.3

Note:- For most of the placing conditions, internal vibrators (needle vibrators) are suitable. The diameter of the needle shall be determined based on the density and spacing of reinforcement bars and thickness of sections. For tremie concrete, vibrators are not required to be used (see also 4.2.7)

4.2.2.2 In the 'very low' category of workability where strict control is necessary, for example, pavement quality concrete, measurement of workability be determination of compacting factor will be more appropriate than slump (see IS 1199) and a value of compacting factor of 0.75 to 0.80 is suggested.

4.2.2.3 In the 'very high' category of workability, measurement of workability by determination of flow will be appropriate (see IS 9103).

4.2.3 Concrete Mix Proportioning

4.2.3.1 The determination of the proportion of cement, aggregate and water to attain the required strength shall be made as follows:

(a) *By designing the concrete mix:* such concrete shall be called 'Design mix concrete', for details reference may be made to RCC Chapter.
(b) *By adopting nominal concrete mix:* such concrete shall be called 'Nominal mix concrete'.

Design mix concrete is preferred to nominal mix. If design mix concrete cannot be used for any reason on the work for grades of M20 or lower, nominal mixes may be used with the permission of Engineer-in-Charge, which, however, is likely to involve a higher cement content.

4.2.3.2 ***Nominal Mix Concrete:*** Nominal Mix Concrete may be used for concrete of M20 or lower. The proportions of materials for nominal mix concrete shall be in accordance with Table 4.7.

The cement content of the mix specified in Table 4.7 for any nominal mix shall be proportionately increased if the quantity of water in the mix has to be increased to overcome the difficulty or placement and compaction, so that the water cement ratio as specified is not exceeded.

TABLE 4.7
Proportions for Nominal Mix Concrete
(Clause 4.2.3.2)

Grade of Concrete	*Total Quantity of Dry Aggregates by Mass per 50 kg of cement, to be taken as the Sum of the Individual Masses of Fine and Coarse Aggregates, Kg. Max*	*Proportion of Fine Aggregate to Coarse Aggregate (by Mass)*	*Quantity of Water per 50 kg of Cement, max Ltr.*
(1)	*(2)*	*(3)*	*(4)*
M5	800	Generally 1:2 but subject to an upper limit of 1: 1 ½ and a lower limit of 1:2 ½	60
M7.5	625		45
M10	480		34
M15	330		32
M20	250		30

Note : - The proportion of the fine to coarse aggregate should be adjusted from upper limit progressively as the grading of fine aggregate becomes finer and the maximum size of coarse aggregate becomes larger. Graded coarse aggregate shall be used.

Note : - Quantity of water required from durability point of view may be less than the value given above.

Example

For an average grading of fine aggregate (that is, Zone II of Table 4 of IS 383), the proportions shall be 1:1 ½ , 1:2 and 1:2 ½ for maximum size of aggregates 10 mm, 20 mm and 40 mm respectively.

4.2.4 Batching

To avoid confusion and error in batching, consideration should be given to using the smallest practical number of different concrete mixed on any site or in any one plant. In batching concrete, the quantity of both

cement and aggregate shall be determined by mass; admixture, if solid, by mass: liquidadmixture may however be measured in volume or mass: water shall be weighed or measured by volume in a calibrated tank (see also IS 4925).Ready- mixed concrete supplied by ready-mixed concrete plant shall be preferred. For large and medium project sites the concrete shall be sourced from ready-mixed concrete plants or from on site or off site batching and mixing plants (see IS 4926).

4.2.4.1 Except where it can be shown to the satisfaction of the Engineer-in-Charge that supply of properly graded aggregate of uniform quality can be maintained over a period of work, the grading aggregate should be controlled by obtaining the coarse aggregate in different sizes and blending them in the right proportions when required, the different sizes being stocked in separate stock-piles. The material should be stock-piled for several hours preferably a day before use. The grading of coarse and fine aggregate should be checked as frequently as possible, the frequency for a given job being determined by the Engineer-in-Charge to ensure that the specified grading is maintained.

4.2.4.2 The accuracy of the measuring equipment shall be within $\pm$ 2 percent of the quantity of cement being measured and within $\pm$ 3 percent of the quantity of aggregate, admixtures and water being measured.

4.2.4.3 Proportion/Type and grading of aggregates shall be made by trial in such a way so as to obtain densest possible concrete. All ingredients of the concrete should be used by mass only.

4.2.4.4 Volume batching may be allowed only where weigh-batching is not practicable and provided accurate used in concrete have earlier been established. Allowance for bilking shall be made in accordance with IS 2386 (Part 3). The mass volume relationship should be checked as frequently as necessary, the frequency for the given job being determined by Engineer-in-Charge to ensure that the specified grading is maintained.

4.2.4.5 It is important to maintain the water cement ratio constant at its correct value. To this end, determination of moisture contents in both fine and coarse aggregates shall be made as frequently as possible, the frequency for a given job being determined by the Engineer-in-Charge according to weather conditions. The amount of the added water shall be adjusted to compensate for any observed variations in the moisture contents. For the determination of moisture content in the aggregates, IS 2386 (Part 3) may be referred to. To allow for the variation in mass for aggregate due to variations in their moisture content, suitable adjustments in the masses of aggregates shall be made. In the absence of exact data, only in the case of nominal mixes, the amount of surface water may be estimated from the values given in Table 4.8.

TABLE 4.8
Surface Water Carried by Aggregate
(Clause 4.2.4.5)

Sl No.	*Aggregate*	*Approximate Quantity of Surface Water*	
		Percent by mass	*l/m^3*
(1)	*(2)*	*(3)*	*(4)*
(i)	Very wet sand	7.5	120
(ii)	Moderately wet sand	5.0	80
(iii)	Moist sand	2.5	40
(iv)	[1)] Moist gravel or crushed rock	1.25-2.5	20-40

[1)] Coarser the aggregate, less the water it will carry.

4.2.4.6 No substitutions in materials used on the work or alteration in the established proportions, except as permitted in 4.2.4.4 and 4.2.4.5 shall be made without additional tests to show that the quality and strength of concrete are satisfactory.

4.2.5 Mixing

Concrete shall be mixed in mechanical batch type concrete mixers conforming to IS 1791 having two blades and fitted with power loader (lifting hopper type). Half bag mixers and mixers without lifting hoppers shall not be used for mixing concrete. In exceptional circumstances, such as mechanical break down of mixer, work in remote areas or power breakdown and when the quantity of concrete work is very small, hand mixing may be done with the specific prior permission of the Engineer-in-Charge in writing subject to adding 10% extra cement. When hand mixing is permitted, it shall be carried out on a water tight platform and care shall be taken to ensure that mixing is continued until the concrete is uniform in colour and consistency. Before mixing the brick aggregate shall be well soaked with water for a minimum period of two hours and stone aggregate or gravel shall be washed with water to remove, dirt, dust and other foreign materials. For guidance, the mixing time may be $1^1/_2$ to 2 minutes, for hydrophobic cement it may be taken as $2^1/_2$ to 3 minutes.

4.2.5.1 ***Power Loader:*** Mixer will be fitted with a power loader complying with the following requirements.

(a) The hopper shall be of adequate capacity to receive and discharge the maximum nominal batch of unmixed materials without spillage under normal operating conditions on a level site.

Note: In such a case the volume of the maximum nominal batch of mixed material is 50% greater than the nominal mixed batch capacity.

(b) The minimum inside width of the feeding edge of the hopper shall be as specified below in Table 4.9.

TABLE 4.9

Nominal size of mixer (T, NT or R). litre	*Minimum inside width of hopper feeding edge*
140	1.0
200	1.1
280	1.2
375	1.4
500	1.5
1000	2.0

T = Tilting; NT = Non-tilting; R = Reverse

(c) The design of the loader shall be such that it allows the loading hopper to be elevated to such a height that the centre line of the chute plate of the hopper when in discharge position, is at an angle of not less than 50º to the horizontal. A mechanical device to aid discharge of the contents as quickly as possible from the hopper to the drum may also be provided. Even when a mechanical device is provided, it is recommended that the angle of centre line of the chute plate of the hopper when in discharge position, should be as larger as practicable, preferably not less than 40º to horizontal.

(d) When the means of raising and lowering the loading hopper includes flexible wire ropes winding on to a drum or drums, the method of fastening the wire to rope to the drums shall be such as to avoid, as far as possible any tendency to cut the strands of the ropes and the fastening should preferably be positioned clear of the barrel of the drum for example, outside the drums flange. When the loading hopper is lowered to its normal loading position, these should be at least one and a half drums of rope on the drum.

(e) Clutch brake and hydraulic control lever shall be designed so as to prevent displacement by liberation or by accidental contact with any person.

(f) The clutch and brake control arrangements shall also be so designed that the operator can control the falling speed of the loader.

(g) Safety device shall be provided to secure the hopper in raised position when not in use.

4.2.5.2 ***Mixing Efficiency:*** The mixer shall be tested under normal working conditions in accordance with the method specified in IS 4643 with a view to check its ability to mix the ingredients to obtain concrete having uniformity within the prescribed limits. The uniformity of mixed concrete shall be evaluated by finding the percentage variation in quantity (mass in water) of cement, fine aggregate and coarse aggregate in a freshly mixed batch of concrete.
The percentage variation between the quantities of cement, fine aggregate and coarse aggregates (as found by weighing in water) in the two halves of a batch and average of the two halve of the batch shall not be more than the following limits:

Cement	8%
Fine aggregate	6%
Coarse aggregate	5%

4.2.5.3 ***Machine Mixing:*** The mixer drum shall be flushed clean with water. Measured quantity of coarse aggregate shall be placed first in the hopper. This shall be followed with measured quantity of fine aggregate and then cement. In case fine aggregate is damp, half the required quantity of coarse aggregate shall be placed in the hopper, followed by fine aggregate and cement. Finally the balance quantity of coarse aggregate shall be fed in the hopper, & then the dry materials are slipped into the drum by raising the hopper. The dry material shall be mixed for atleast four turns of the drum. While the drum is rotating, water shall be added gradually to achieve the water cement ratio as specified or as required by the Engineer- in-Charge. After adding water, the mixing shall be continued until concrete of uniform colour, uniformly distributed material and consistency is obtained. Mixing shall be done for atleast two minutes after adding water. If there is segregation after unloading from the mixer, the concrete should be remixed.

The drum shall be emptied before recharging. When the mixer is closed down for the day or at any time exceeding 20 minutes, the drum shall be flushed cleaned with water.

4.2.5.4 ***Hand Mixing:*** When hand mixing has been specifically permitted in exceptional circumstances by the Engineer-in-Charge in writing, subject to adding 10% extra cement, it shall be carried out on a smooth, clean and water tight platform of suitable size. Measured quantity of sand shall be spread evenly on the platform and the cement shall be dumped on the sand and distributed evenly. Sand and cement shall be mixed intimately with spade until mixture is of even colour throughout. Measured quantity of coarse aggregate shall be spread on top of cement sand mixture and mixing done by showlling and turning till the coarse aggregate gets evenly distributed the cement sand mixture. Three quarters of the total quantity of water required shall be added in a hollow made in the middle of the mixed pile and the material is turned towards the middle of pile with spade. The whole mixture is turned slowly over and again and the remaining quantity of water is added gradually. The mixing shall be continued until concrete of uniform colour and consistency is obtained. The mixing platform shall be washed and cleaned at the end of the day.

4.2.5.5 ***Transportation and Handling:*** Concrete shall be transported from the mixer to the place of laying as rapidly as possible by methods which will prevent the segregation or loss of any of the ingredients and maintaining the required workability.
During hot or cold weather, concrete shall be transported in deep containers, other suitable methods to reduce the loss of water by evaporation in hot weather and heat loss in cold weather may also be adopted.

4.2.6 Placing

The concrete shall be deposited as nearly as practicable in its final position to avoid rehandling. It shall be laid gently (not thrown) and shall be thoroughly vibrated and compacted before setting commences and should not be subsequently disturbed. Method of placing shall be such as to preclude segregation. Care shall be taken to avoid displacement of reinforcement or movement of form work and damage due to rains. As a general guidance, the maximum free fall of concrete may be taken as 1.5 metre.

4.2.7 Compaction

Concrete shall be thoroughly compacted and fully worked around embedded fixtures and into corners of the

form work. Compaction shall be done by mechanical vibrator of appropriate type till a dense concrete is obtained. The mechanical vibrators shall conform to IS 2505, IS 2506, IS 2514 and IS 4656. To prevent segregation, over vibration shall be avoided.

Compaction shall be completed before the initial setting starts. For the items where mechanical vibrators are not to be used, the contractor shall take permission of the Engineer-in- Charge in writing before the start of the work. After compaction the top surface shall be finished even and smooth with wooden trowel before the concrete begins to set.

4.2.8 Construction Joints

Concreting shall be carried out continuously up to construction joints. The position and arrangement of construction joints shall be as shown in the structural drawings or as directed by the Engineer-in-Charge. Number of such joints shall be kept minimum. Joints shall be kept as straight as possible. Construction joints should comply with IS 11817.

4.2.8.1 When the work has to be resumed on a surface which has hardened, such surface shall be roughened. It shall then be swept clean and thoroughly wetted. For vertical joints, neat cement slurry, of workable consistency by using 2 kgs of cement per sqm shall be applied on the surface before it is dry. For horizontal joints, the surface shall be covered with a layer of mortar about 10-15 mm thick composed of cement and sand in the same ratio as the cement and sand in concrete mix. This layer of cement slurry of mortar shall be freshly mixed and applied immediately before placing of the concrete.

4.2.8.2 Where the concrete has not fully hardened, all laitance shall be removed by scrubbing the wet surface with wire or bristle brushes, care being taken to avoid dislodgement of particles of coarse aggregate. The surface shall be thoroughly wetted and all free water removed. The surface shall then be coated with neat cement slurry @ 2 kgs of cement per sqm. On this surface, a layer of concrete not exceeding 150 mm in thickness shall first be placed and shall be well rammed against old work particular attention being paid to corners and close spots; work, thereafter, shall proceed in the normal way.

4.2.9 Concreting under Special Conditions

4.2.9.1 ***Work in Extreme Weather Conditions:*** During hot and cold weather, the concreting shall be done as per the procedure set out in IS 7861 (Part–I)-1975 and IS 7861 (Part II)-1981 respectively. Concreting shall not be done when the temperature falls below 4.5ºC. In cold weather, the concrete placed shall be protected against frost. During hot weather, it shall be ensured that the temperature of wet concrete does not exceed 38ºC.

4.2.9.2 ***Under Water Concreting:*** Concrete shall not be deposited under water if it is practicable to de-water the area and place concrete in the regular manner. When it is necessary to deposit concrete under water, the methods, equipment, materials and proportions of the mix to be used shall be submitted to and approved by the Engineer-in-Charge before the work is started.

Under-water concrete should have a slump recommended in 4.2.2. The water- cement ratio shall not exceed 0.6 and may need to be smaller, depending on the grade of concrete or the type of chemical attack. For aggregates of 40 mm maximum particle size, the cement content shall be atleast 350 kg/m^3 of concrete.

4.2.9.3 ***Concrete in Sea Water:*** Concrete in sea-water or exposed directly along the sea-coast shall be at least M20 Grade in the case of plain concrete and M30 in case of reinforced concrete. The use of slag or pozzolana cement is advantageous under such conditions.

(i) Special attention shall be given to the design of the mix to obtain the densest possible concrete: slag, broken brick, soft lime stone, soft sandstone, or other porous or weak aggregates shall not be used.

(ii) As far as possible, preference shall be given to precast members unreinforced, well-cured and hardened, without sharp corners, and having trowel-smooth finished surfaces free from crazing, cracks or other defect; plastering should be avoided.

(iii) No construction joints shall be allowed within 600 mm below low water-level or within 60 mm of the upper and lower planes of wave action. Where unusually severe conditions or abrasion are anticipated, such parts of the work shall be protected by bituminous or silico-fluoride coatings or stone facing bedded with bitumen.

(iv) In reinforced concrete structures, care shall be taken to protect the reinforcement from exposure to saline atmosphere during storage, fabrication and use. It may be achieved by treating the surface of reinforcement with cement wash or by suitable methods.

4.2.10 Curing

Curing is the process of preventing loss of moisture from the concrete. The following methods shall be employed for effecting curing.

4.2.10.1 ***Moist Curing:*** Exposed surfaces of concrete shall be kept continuously in a damp or wet condition by ponding or by covering with a layer of sacking, canvas, Hessian or similar materials and kept constantly wet for at least 7 days from the date of placing concrete in case of ordinary Portland cement and at least 10 days where mineral admixtures or blended cements are used. The period of curing shall not be less than 10 days for concrete exposed to dry and hot weather conditions. In the case of concrete where mineral admixtures or blended cements are used, it is recommended that above minimum periods may be extended to 14 days.

4.2.10.2 ***Membrane Curing:*** Approved curing compounds may be used in lieu of moist curing with the permission of the Engineer-in-Charge. Such compound shall be applied to all exposed surfaces of the concrete as soon as possible after the concrete has set. Impermeable membrane such as polythene sheet covering the concrete surface may also be used to provide effective barrier against the evaporation.

4.2.10.3 Freshly laid concrete shall be protected from rain by suitable covering.
4.2.10.4 Over the foundation concrete, the masonry work may be started after 48 hours of its compaction but the curing of exposed surfaces of cement concrete shall be continued along with the masonry work for at least 7 days. And where cement concrete is used as base concrete for flooring, the flooring may be commenced before the curing period of base concrete is over but the curing of base concrete shall be continued along with top layer of flooring for a minimum period of 7 days.

4.2.11 Testing of Concrete

Testing of concrete shall be done as described in chapter of R.C.C.

4.2.12 Form Work

Form work shall be as specified in R.C.C. chapter and shall be paid for separately unless otherwise specified.

4.2.13 Finishes

Plastering and special finishes other than those, obtained through form work shall be specified and paid for separately unless otherwise specified.

4.2.14 Durability of Concrete

A durable concrete is one that performs satisfactorily in the working environment during its anticipated exposure conditions during service. The materials and mix proportions shall be such as to maintain its intergrity and, if applicable, to protect reinforcement from corrosion.

The factors influencing durability include:
(a) The environment;
(b) The cover to embedded steel;
(c) The type and quality of constituent materials;
(d) The cement content and water/ cement ratio of the concrete;
(e) Workmanship, to obtain full compaction and efficient curing; and
(f) The shape and size of the member.

4.2.14.1 *Requirements for Durability*

4.2.14.1.1 *General Environment:* The general environment to which the concrete will be exposed during its working life is classified into five levels of severity, that is, mild, moderate, severe, very severe and extreme as described in Table 4.9.

TABLE 4.9

Environmental Exposure Conditions

Sl. No	*Environment*	*Exposure Conditions*
(1)	*(2)*	*(3)*
(i)	Mild	Concrete surfaces protected against weather or aggressive conditions, except those situated in coastal area.
(ii)	Moderate	Concrete surfaces sheltered from severe rain or freezing whilst wet Concrete exposed to condensation and rain Concrete continuously under water Concrete in contact or buried under non-aggressive soil/ ground water Concrete surfaces sheltered from saturated salt air in coastal area
(iii)	Severe	Concrete surfaces exposed to severe rain, alternate weting and drying or occasional freezing whilst wet or severe condensation. Concrete completely immersed in sea water. Concrete exposed to coastal environment.
(iv)	Very severe	Concrete surface exposed to sea water spray, corrosive fumes or severe freezing conditions whilts wet. Concrete in contact with or buried under aggressive sub-soil/ ground water.
(v)	Extreme	Surface of members in tidal zone. Members in direct contact with liquid/ solid aggressive chemicals.

Note: For the purpose of determining exposure conditions, all places within a distance of 10 kms. of coastal line, sea front would be treated as coastal area.

4.2.14.1.2 *Freezing and Thawing:* Where freezing and thawing actions under wet conditions exist, enhanced durability can be obtained by the use of suitable air entraining admixtures. When concrete lower than grade M50 is used under these conditions, the mean total air content by volume of the fresh concrete at the time of delivery into the construction should be:

Nominal Maximum Size Aggregate (mm)	*Entrained Air Percentage*

20	5 ± 1
40	4 ± 1

Exposure to Sulphate Attack: For the very high sulphate concentration in Class 5 conditions given in Table 4.11, some form of lining such as polyethylene or polychloroprene sheet: or surface coating based on asphalt, chlorinated rubber, epoxy; or polyurethane materials should also be used to prevent access by the sulphate solution.

Chlorides in Concrete: The total amount of chlorides content (as Cl) in the concrete at the time of placing shall be as under:

Sl. No.	*Type of Use of Concrete*	*Maximum Total Acid Soluble Chloride Content expressed as kg/ m^3 of Concrete*
(1)	(2)	(3)
(i)	Concrete containing metal and steam cured at elevated temperature and pre-stressed concrete	0.4
(ii)	Reinforced concrete or plain concrete containing embedded metal	0.6
(iii)	Concrete not containing embedded metal or any material requiring protection from chloride	3.0

4.2.14.1.5 *Sulphates in Concrete :* The total water-soluble sulphate content of the concrete mix, expressed as SO_3 should not exceed 4 per cent by mass of the cement in the mix. The sulphate content should be calculated as the total from the various constituents of the mix. The 4 per cent limit does not apply to concrete made with supersulphate cement complying with IS 6909.

TABLE 4.11
Requirements for Concrete Exposed to Sulphate Attack
(Clause 4.2.14.1.3)

Sl No.	*Class*	*Concentration of sulphates, Expresed as SO3 Concrete.*			*Type of Cement*	*Dense, Fully compacted made with 20 mm nominal maximum size Aggregates complying with IS 383*	
		In Soil		*In Ground Water (g/l)*		*Minimum Cement Content kg/m³*	*Maximum Free Water-Cement Ratio*
		Total SO3 (%)	*SO3 in 2:1 (Water: Soil Extract) (g/l)*				
(1)	*(2)*	*(3)*	*(4)*	*(5)*	*(6)*	*(7)*	*(8)*
(i)	1	Traces (<0.2)	Less than 1.0	Less than 0.3	Ordinary Portland cement or Portland slag cement or Portland - pozzolana cement	280	0.55
(ii)	2	0.2 to 0.5	1.0 to 1.9	0.3 to 1.2	Ordianry Portland cement or Portland slag Portlan cement or d pozzolana cement	330	0.50
					Supersulphate d cement resistin or sulphate g Portland cement	310	0.50
(iii)	3	0.5 to 1.0	1.9 to 3.1	1.2 to 2.5	Supersulphate d cement or sulphate resisting Portland cement	330	0.50
					Portland Pozzolana cement or Portland slag cement	350	0.45
(iv)	4	1.0 to 2.0	3.1 to 5.0	2.5 to 5.0	Supersulphated or sulphate resisting Portland cement	370	0.45
(v)	5	More	More than	More than	Sulphate resisting	400	0.40

		than 2.0	5.0	5.0	Portland cement or supersulphated cement with protective coatings		

Notes

1. Cement content given in this Table is irrespective of grades of cement.
2. Use of supersulphated cement is generally restricted where the prevailing temperature is above 40°C.
3. Supersulphated cement gives an acceptable life provided that the concrete is dense and prepared with a water-cement ratio of 0.4 or less, in mineral acids, down to pH 3.5.
4. The cement contents given in col. 7 of this Table are the minimum recommended. For SO_3 contents near the upper limit of any class, cement contents above these minimum are advised.
5. For severe conditions, such as thin sections under hydrostatic pressure on one side only and sections partly immersed, considerations should be given to a further reduction of water-cement ratio.
6. Portland slag cement conforming to IS 455 with slag content more than 50 per cent exhibits better sulphate resisting properties.
7. Where chloride is encountered along with sulphates in soil or ground water, ordinary Portland cement with C_3A content from 5 to 8 per cent shall be desirable to be used in concrete, instead of suplhate resisting cement. Alternatively, Portland slag cement conforming to IS 455 having more than 50 per cent slag or a blend of ordinary Portland cement and slag may be used provided sufficient information is available on performance of such blended cements in these conditions.

4.2.15 Measurements

4.2.15.1 Dimensions of length, breadth and thickness shall be measured correct to nearest cm. except for the thickness of slab and partition which shall be measured to nearest 5 mm. Areas shall be worked out to nearest 0.01 sq.m and the cubic contents of consolidated concrete shall be worked out to nearest 0.01 cum. Any work done in excess over the specified dimension or sections shown in the drawing shall be ignored.

4.2.15.2 Concrete work executed in the following conditions shall be measured separately:

(a) Work in or under water
(b) Work in liquid mud
(c) Work in or under foul positions

4.2.15.3 ***Cast-in-situ concrete*** and or precast concrete work shall be measured in stages described in the item of work, such as:

(a) At or near the ground level
(b) Upto specified floor level
(c) Between two specified floor levels
(d) Upto specified height above or depth below plinth level/ defined datum level.
(e) Between tow specified heights or depths with reference to plinth/defined datum level.

4.2.15.4 No deduction shall be made for the following:

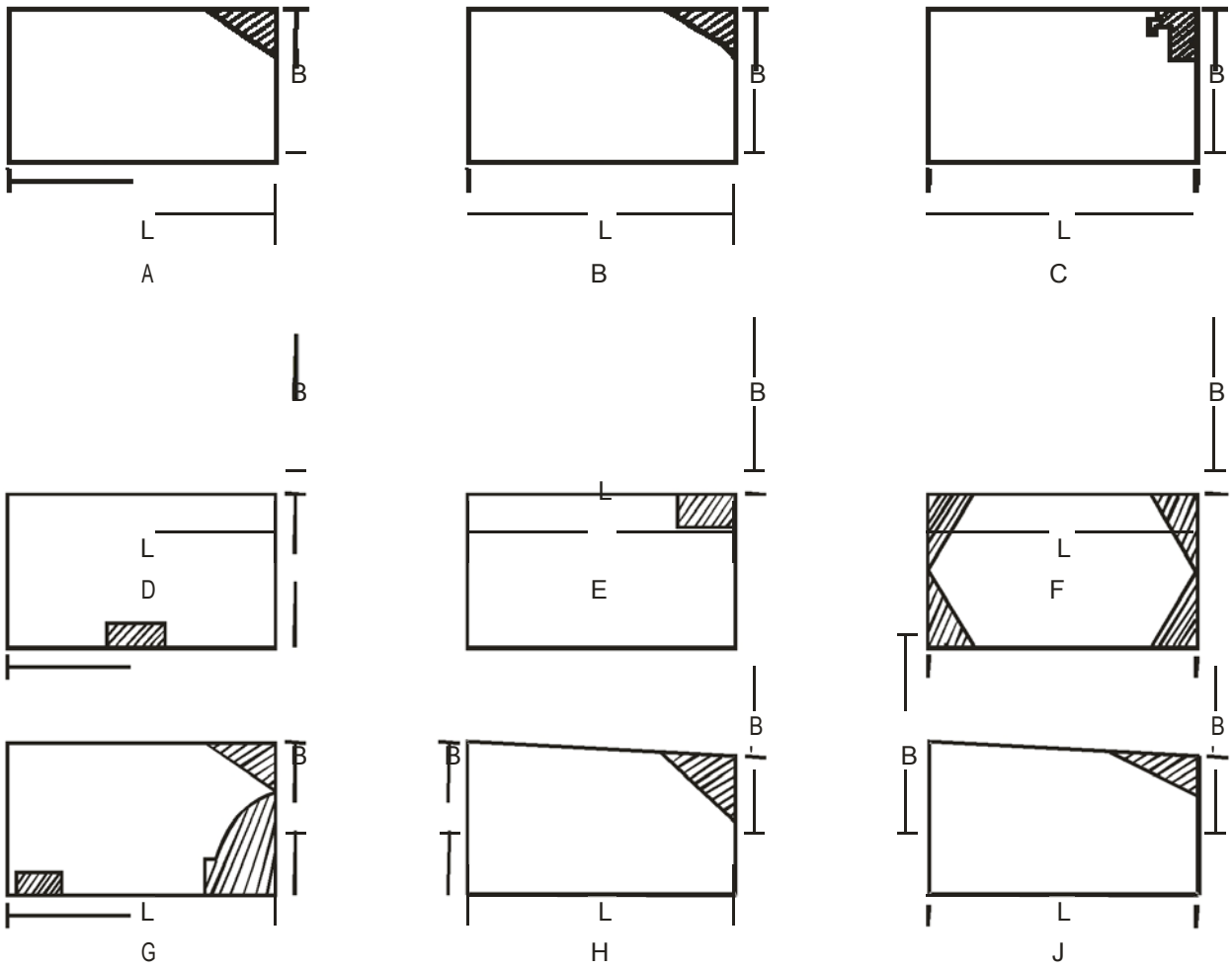
(a) Ends of dissimilar materials for example beams, posts, girders, rafters, purlins, trusses, corbels and steps upto 500 sq cm in cross sections.
(b) Opening upto 0.1 sq metre (1000 sq.cm)
(c) Volume occupied by pipes, conduits, sheathing etc. not exceeding 100 sq cm each in cross sectional areas.

(d) Small voids such as shaded portions in Figure A to J below when these do not exceed 40 sq cm each in cross section.

Note: In calculating area of opening, the thickness of any separate lintel or sill shall be included in the height. Nothing extra shall be payable for forming such openings or voids.

Area of Fig. A to G shall be = L x B

Area of Fig. H & J shall be = L x {Average of B and B'}



4.2.15.5 Cast-in-situ and precast concrete work shall be measured sperately.

4.2.15.6 Cast-in-situ concrete shall be classified and measured as follows:

(a) Foundation, footings, bases for columns
(b) Walls (any thickness) including attached pilasters, buttresses, plinth and string courses, fillets etc.
(c) Shelves
(d) Slabs
(e) Chajjas including portions bearing on the wall
(f) Lintels, beams and bressummers
(g) Columns, piers abutments, pillars, post and struts
(h) Stair case including stringer beams but excluding landings.
(i) Balustrades, newels and sailing
(j) Spiral staircase (including landings)
(k) Arches
(l) Domes, vaults
(m) Shell roof, arch ribs and folded piates
(n) Chimneys and shaft.
(o) Breast walls, retaining, walls, return walls
(p) Concrete filling to precast components
(q) Kerbs, steps and the like
(r) String or lacing courses, parapets, copings, bed block, anchor blocks, plain window sills and the like

(s) Cornices and moulded windows sills.
(t) Louvers, fins, facia.

4.2.15.7 Precast cement concrete solid article shall be measured separately and shall include use of moulds, finishing the top surfaces even and smooth with wooden trowel, before setting in position in cement mortar 1:2 (1 cement : 2 coarse sand). Plain and moulded work shall be measured separately and the work shall be classified and measured as under:

Classifications	*Method of measurement*
(a) Wall panels	In square meters stating the thickness.
(b) String or lacing courses, coping, bed plates, plain windows sills, shelves, louvers, steps etc.	In cubic meters.
(c) Kerbs, edgings etc.	In cubic metres.
(d) Solid block work	In square metres stating the thickness or in cubic meters.
(e) Hollow block work	In square metres stating the thickness or in cubic metres.
(f) Light weight partitions	In square metres stating the partition's thickness.

4.2.16 Rate

The rate is inclusive of the cost of labour and materials involved in all the operations described above.

4.3 *CEMENT- FLY ASH CONCRETE*

4.3.1 Fly ash concrete

Fly as concrete shall be prepared by mixing graded coarse aggregate of nominal size as specified with fine aggregate, ordinary Portland cement and fly ash in specified proportions with required quantity of water. The recommended composition of cement fly ash concrete is as under:

TABLE 4.12
Fly Ash Concrete Mixes

Composition (Dry Volume)	*Proportion (Dry Volume)*	*Compressive Strength at seven days*
Lean Concrete (1:5:10)		28 kg/cm^2
Cement (Ordinary Portland)	1.0	
Fly ash	2.5	
Sand	4.0	
Stone aggregate	11.0	
Lean Concrete (1:4:8)		37 kg/cm^2
Cement (Ordinary Portland)	1.0	
Fly ash	2.0	
Sand	3.5	
Stone aggregate	9.0	

Note: No fly ash is to be added to Portland Puzzolona cement in any case which itself contains fly ash.

4.3.2 Proportioning

Proportioning shall be done by volume. Boxes of suitable size shall be used for measuring fly ash, sand and aggregate. The internal dimensions of the boxes shall be generally 35x25x40 cm. deep or as otherwise approved by the Engineer -in-charge. The unit of measurement of cement shall be a bag of 50 kg. and this shall be taken as 0.035 cum. While measuring the aggregate, shaking, ramming or heaping shall not be done. The proportioning of sand shall be on the basis of its dry volume and in case of damp sand, allowances for bulkage shall be made as given in the chapter for mortar.

4.3.3 Mixing

Mixing shall be as specified in 4.2.5 except that the fly ash shall be placed in the hopper before cement in case of machine mixing.

4.3.4 Placing and compaction

Placing and Compaction shall be as specified in 4.2.6 and 4.2.7.

4.3.5 Curing

Curing shall be as specified in 4.2.10.

4.3.6 Form work

Form work shall be as specified in 4.2.12.

4.3.7 Measurements

Measurements shall be as specified in 4.2.15.

4.3.8 Rate

Rate shall include the cost of materials and labour involved in all the operations described above.

4.4 *DAMP PROOF COURSE*

4.4.1 Cement Concrete Layer

This shall consist of cement concrete of specified proportions and thickness. The surface of brick or stone masonry work shall be levelled and prepared before laying the cement concrete. Edge of damp proof course shall be straight, even and vertical. Side shuttering shall consist of steel forms and shall be strong and properly fixed so that it does not get disturbed during compaction and the mortar does not leak through. The concrete mix shall be of workable consistency and shall be tamped thoroughly to make a dense mass. When the sides are removed, the surface should come out smooth without honey-coming. Continuity shall be maintained while laying the cement concrete layer and laying shall be terminated only at the predetermined location where damp proof course is to be discontinued. There shall be no construction joints in the Damp Proof Course.

4.4.2 Curing

Damp proof course shall be cured for at least seven days, after which it shall be allowed to dry.

4.4.3 Application of Hot Bitumen

Where so directed, hot bitumen in specified quantity shall be applied over the dried up surface of cement concrete, properly cleaned with brushes and finally with a piece of cloth soaked in kerosene oil. Bitumen of penetration A 90 or equivalent where used shall be heated to a temperature of 160º ± 5ºC. The hot bitumen shall be applied uniformly all over, so that no blank spaces are left anywhere. It will be paid for separately.

4.4.4 Water Proofing Materials

Where so specified, water proofing material of approved quality shall be added to the concrete mixture in accordance with the manufacturer's specification stating the quantity of water proofing material in litres or kg per 50 kg or cement and will be paid for separately.

4.4.5 Measurements

The length and breadth shall be measured correct to a cm and its area shall be calculated in square metres correct to two places of decimal. The depth shall not be less than the specified thickness at any section.

4.4.6 Rate

The rate is inclusive of the cost of materials and labour involved in all the operations described above except for the applications of a coat of hot bitumen and addition of water proofing materials which shall be paid for separately, unless otherwise specified.

APPENDIX A

DETERMINATION OF PARTICLE SIZE
(Clause 4.1.2.3 & 4.1.2.5)

The apparatus, sample size and test procedure shall be same as specified in sub-head 'MORTARS'.

In order that the sieves shall not be overloaded, care must be taken to ensure that the maximum sieve loads shown in Table A-4.1 (below) are not exceeded at the completion of sieving.

TABLE A-4.1

I.S. Sieve Designation	*Maximum weight for*	
	45 cm dia sieve kg	*30 cm dia sieve kg*
45 mm	10	4.5
40 mm	8	3.5
31.5 mm or 22.1 mm	6	2.5
20 mm	4	2.0
16 mm or 12.5 mm	3	1.5
10 mm	2	1.0
5.6 mm	1.5	0.75
4.75 mm	1.0	0.50
3.35 mm	-	0.30

The sample weight taken will thus normally require several operations on each sieve. Each sieve should be taken separately over a clean tray or receiver until no more than a trace passes, but in any case for not less than two minutes. Materials should not be forced through the apertures but hand placing is permitted. A light brush should be used with fine sieves. The cumulative weight passing each sieve should be calculated as percentage of the total sample weight to the nearest whole number.

APPENDIX B

TEST FOR SURFACE MOISTURE
(Clause 4.1.1.5)

Take a sample of wet aggregate and weigh it (A). Then place it in a frying pan and gently apply heat, meanwhile stirring with a glass rod until the surface moisture disappears. This is apparent when the aggregate loses its shining wet appearance and becomes dull, or when it just attains a free funning condition. The saturated surface dry material is then weighed (B). Continue the heating thereafter until the moisture is evaporated and weigh the dry sample (C). The surface moisture is then calculated as follows:

$$\text{Surface moisture} = 100 \times \frac{A-B}{C}$$

It is expressed as a percentage of dry aggregate.

APPENDIX C

DETERMINATION OF TEN PER CENT FINE VALUE
(Clause 4.1.1.5)

Apparatus: The apparatus for the standard test shall consist of the following:

(a) A 15 cm diameter open-ended steel cylinder, with plunger and base-plate, as shown in Fig. in the end of this appendix. The surfaces in contact with the aggregate shall be machined and case hardened or otherwise treated so as to have a diamond (VH) pyramid hardness number of not less than 650 VH.

(b) A straight metal tamping rod of circular cross-section 16 mm in diameter and 45 to 60 cm long, rounded at one end.

(c) A balance of capacity 3 Kg, readable and accurate to one gram.

(d) I.S. Sieve of sizes 12.5, 10 and 2.36 mm.

(e) A compression testing machine capable of applying a load of 50 tonnes and which can be operated to give a uniform rate of loading so that the maximum load in any test is reached in 10 minutes. This load may vary from 0.5 to 50 tonnes.

(f) For measuring the sample, a cylindrical metal measure of sufficient rigidity to retain its form under rough usage and of the following internal dimensions:

Diameter	11.5 cm
Height	18.0 cm

(g) Means of measuring the reduction in the distance between the plates of the testing machine to the nearest one millimetre during the test (for example, dial gauge).

Test Sample: Material for the test shall consist of aggregate passing a 12.5 mm I.S. Sieve and retained on a 10 mm I.S. Sieve. The aggregate shall be tested in a surface dry condition. If dries by heating the period of drying shall not exceed four hours, the temperature shall be 100ºC to 110ºC and the aggregate shall be cooled to room temperature before testing.

The quantity of aggregate shall be such that the depth of material in the cylinder, after tamping as described below, shall be 10 cm.

The weight of material comprising the test sample shall be determined (weight A) and the same weight of sample shall be taken for the repeat test.

Note: About 6.5 kg of natural aggregate is required to provide the two test samoles. Less of light weight aggregate is required.

The measuring cylinder is filled in three layers of approximately equal depth with aggregate passing a 12.5 mm I.S. Sieve and retained on 10 mm I.S. Sieve. Each layer is subjected to 25 strokes from the tamping rod (16 mm dia and 45 to 60 cm long) rounded to one end, care being taken in case of weak materials not to break the particles. The surface of the aggregate shall be carefully levelled and the plunger inserted so that it rests horizontally on this surface.

Test Procedure: The apparatus, with the test sample and plunger in position, shall then be placed in the compression testing machine. The load shall be applied at a uniform rate so as to cause a total penetration of a plunger in 10 minutes of about: 15.0 mm for rounded or partially rounded aggregates

(for example uncrushed gravel) 20 mm for nominal crushed aggregate & 24 mm for honey combed aggregate (for example expanded shales and slags). These figures may be varied according to the extent of

the rounding or honey combing.

After reaching the required maximum penetration, the load shall be released and the whole of the material removed from the cylinder and sieved on a 2.36 mm I.S. Sieve. The fines passing the sieve shall be weighed, and this weight expressed as a percentage of the weight of the test sample. Normally, this percentage will fall within the range 7.5 to 12.5, but if it does not, a further test shall be made at a load adjusted appropriately, to bring the percentage fines within the range of 7.5 to 12.5.

A repeat test shall be made at the load that gives as percentage fines within the range 7.5 to 12.5.

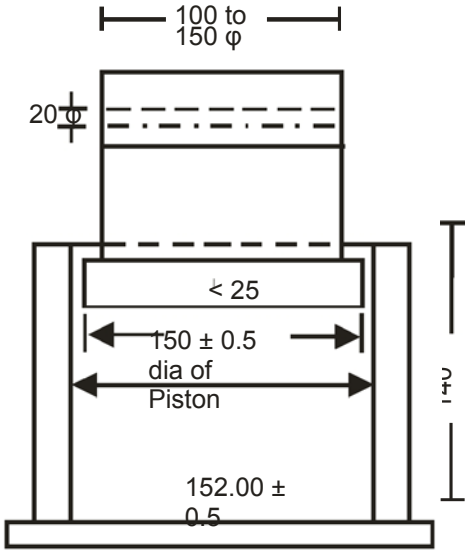
Calculations: The mean percentage fines from the two tests at this load shall be used in the following formula to calculate the load required to give 10 percentage fines.

$$\text{Load required for 10 percent fines} = \frac{14 \times X}{Y \times 4}$$

Where X = Load in tonnes and
Y= mean percentage fines from two test at X tonnes load.

Reporting of Results: The load required to produce 10 percent fines shall be reported to the nearest whole number for loads of 10 tonnes or more, the nearest 0.5 tonne for loads of less than 10 tonnes.

The value expressed to the nearest 0.5 tonne should be as follows:
(a) For normal concrete, not less than 5 tonnes.
(b) For wearing surfaces, not less than 10 tonnes.
(c) For granolithic concrete, not less than 15 tonnes.



APPENDIX D

SLUMP TEST
(Clause 4.2.2)

Apparatus: Mould shall consist of a metal frustum of cone having the following internal dimensions:

Bottom diameter……..20 cm

Top diameter……10 cm

Height……30 cm

The mould shall be of a metal other than brass and aluminium of at least 1.6 mm (or 16 BG) thickness. The top and bottom shall be open and at right angles to the axis of the cone. The mould shall have a smooth internal surface. It shall be provided with suitable foot pieces and handles to facilitate lifting it from the moulded concrete test specimen in a vertical direction as required by the test. A mould provided with a suitable guide attachment may be used.

Tamping rod shall be of steel or other suitable material 16 mm in diameter 60 mm long and rounded at one end.

Procedure: The internal surface of the mould shall be thoroughly cleaned and free form superfluous moisture and any set concrete before commencing the test. The mould shall be placed on a smooth horizontal, rigid and non- absorbent surface viz. levelled metal plate. The operator shall hold the mould firmly in place while it is being filled with test specimen of concrete. The mould shall be filled in four layers, each approximately one quarter of height of mould. Each layer shall be tamped with twenty five strikes of the rounded end of the tamping rod. The strokes shall be distributed in a uniform manner over the cross section of the mould and for the second and subsequent layers shall penetrate into the under-lying layer. The bottom layer shall be tamped through out its depth. After the top layer has been rodded, the concrete shall be struck off level with trowel or the tamping rod, so that the mould is exactly filled. Any mortar which shall leak out between the mould and the base plate shall be cleaned away. The mould shall be removed from the concrete immediately after filling by raising it slowly and carefully in a vertical direction. The moulded concrete shall then be allowed to subside and the slump shall be measured immediately by determining the difference between the height of the mould and that of the highest point of specimen.

The above operations shall be carried out at a place free from vibration or shock, and within a period of two minutes after sampling.

Result: The slump shall be recorded in terms of millimeters of subsidence of the specimen during the test. Any slump specimen which collapses or shears off laterally give incorrect result. If this occurs, the test shall be repeated with another sample.

The slump test shall not be used for very dry mixes as the results obtained are not accurate.

5 Specifications for Reinforced Cement Concrete Work

LIST OF MANDATORY TESTS

Material	*Clause*	*Test*	*Field/ labor-atory test*	*Test proce-dure*	*Min, quantity of material for carrying out the test*	*Frequency of testing*
1	*2*	*3*	*4*	*5*	*6*	*7*
Reinforced cement concrete (Nominal Mix)	5.4.1	(a) Slump test	Field/Lab	Appen-dix 'D' of Chapter 4	(i) 5 cum in case of column (ii) 20 cum for slabs, beams and connected columns (iii) 20 cum for other R.C.C. work for all other small items and where R.C.C. done in a day is less than 5 cum test may be carried out as required by Engineer-in-Charge	(i) Every 5 cum of part thereof (ii) Every 20 cum or part thereof (iii) -Do-
	5.4.9.1	(b) Cube Test	Lab	Appen-dix 'A'	(i) 5 cum in case of column (ii) 20 cum for slabs, beams and connected columns (iii) 20 cum for other R.C.C. work for all other small items and where R.C.C. done in a day is less than 5 cum test may be	(i) Every 5 cum or part thereof (ii) Every 20cum or part thereof (iii) -Do-

					carried out as required by Engineer-in-Charge	

1	*2*	*3*	*4*	*5*	*6*	*7*
Reinforced Cement Concrete (Design Mix)	Coarse Aggre-gates				50 cum or part thereof & also on each change of source	
	Fine Aggre-gates				50 cum or part thereof & also on each change of source	
	Cement				50 MT or on each change of source	
	Fresh Concrete	(a) Slump test	Field	Appen-dix 'D' of Chapter 4	10 cum	50 cum for R.C.C. work including in all other small location. R.C.C. done in a day is less than 50 cum test may be carried out as required by Engineer-in-Charge
	Fresh Concrete	(b) Cube Test	Lab	Appen-dix 'A'	10 cum or part thereof	50 cum or 10 batches of 5-7 cum each for R.C.C. work in all location taken together. R.C.C. done in a day is less than 50 cum test may be carried out as required by Engineer-in-Charge
Reinforced Cement Concrete (Ready Mix)	Coarse Aggre-gates				50 cum or part thereof & also on each change of source	
	Fine Aggre-gates				50 cum or part thereof & also on each change of source	
	Cement				50 MT or on each change of source	
	Fresh Concrete	(a) Slump test	Field/Lab	Appendix 'D' of Chapter 4	10 cum	50 cum for R.C.C. work including in all other small location. R.C.C. done in a day is less than 50 cum test may be carried

						out as required by Engineer-in-Charge

1	*2*	*3*	*4*	*5*	*6*	*7*	
	Fresh Concrete	(b) Cube Test	Lab	Appen-dix 'A'	10 cum or part thereof	50 cum or 10 batches of 5-7 cum each for R.C.C. work in all location - taken together. R.C.C. done in a day is less than 50 cum test may be carried out as required by Engineer-in-Charge	
Steel for Reinforced cement concrete	5.1.3	(A) Physical Test and chemical tests				(a) For consign-ment below 100 tonnes (i) under 10 mm dia, one sample for each 25 tonnes or part thereof (ii) 10 mm to 16 mm dia one sample for each 35 tonnes or part thereof (iii) over 16 mm dia one sample for each 45 tonnes or part thereof	(b) For consign-ment over 100 tonnes (i) Under 10 mm dia, one sample for each 40 tonnes or part thereof (ii) 10 mm to 16 mm, one sample for each 45 tonnes or part thereof (iii) over 16 mm dia, one sample for each 50 tonnes or part thereof

LIST OF BUREAU OF INDIAN STANDARDS CODES

Sl. No.	*I.S. No.*	*Subject*
1.	IS 226	Structural Steel
2.	IS 432 (Part I)	Specification for mild steel and medium tensile steel bars and hard drawn steel wire for concrete reinforcement part-I mild steel and medium tensile steel bars.
3.	IS 432 (Part II)	Specification for mild steel and medium tensile steel bars and hard drawn steel wire for concrete reinforcement – Part-II hard drawn steel wire.
4.	IS 456	Code of Practices for plain and Reinforced concrete.
5.	IS 516	Method of test for strength of concrete.
6.	IS 716	Specification for pentachlorophenol
7.	IS 1199	Method of sampling and analysis of concrete.
8.	IS 1200 (Part II)	Method of measurement of building and civil engineering work – concrete work
9.	IS 1200 (Part V)	Method of measurement of building and civil engineering work – concrete work (Part 5- Form work)
10.	IS 1566	Specification for hard drawn steel wire fabric for concrete requirement.
11.	IS 1599	Method for bend test
12.	IS 1343	Code of Practice for Prestressed Concrete
13.	IS 1608	Method for tensile testing of steel products
14.	IS 1786	Specification for high strength deformed steel and wires for concrete reinforcement.
15.	IS 1791	Specification for batch type concrete mixes
16.	IS 2502	Code of practice for bending and fixing of bars for concrete reinforcement.
17.	IS 2751	Recommended practice for welding of mild steel plain and deformed bars for reinforced construction.
18.	IS 4925	Batch plants specification for concrete batching and mixing plant
19.	IS 4926	Ready – Mixed Concrete
20.	IS 6523	Specification for precast reinforced concrete door, window frames

21.	IS 10262	Recommended guidelines for concrete mix design
22.	IS 13311 (Part I)	Indian standard for non-destructive testing of concrete. Method of test for ultrasonic pulse velocity
23.	IS 13311 (Part II)	Indian standard for non-destructive testing of concrete. Method of testing by rebound hammer.

5.0 *GENERAL*

Reinforced cement concrete work may be cast-in-situ or Precast as may be directed by Engineer-in-Charge according to the nature of work. Reinforced cement concrete work shall comprise of the following which may be paid separately or collectively as per the description of the item of work.

(a) Form work (Centering and Shuttering)

(b) Reinforcement

(c) Concreting: (1– Cast-in-situ), (2 – Precast)

5.1 *MATERIALS*

5.1.0 Materials

Water, cement, fine and coarse aggregate shall be as specified under respective clauses of chapter 03 mortars and chapter 04 concrete work as applicable.

5.1.1 Fly Ash admixed cement concrete (FACC) and fly ash Blended cements in Cement Concrete (PPCC) in RCC structures.

5.1.2.0 Fly ash Blended Cements conforming to IS 1489 (Part I) may be used in RCC structures as per guidelines given below :

5.1.2.1 ***General***

(i) IS 456- 2000 Code of Practice for Plain and Reinforced Concrete (as amended up to date) shall be followed in regard to Concrete Mix Proportion and its production as under :
   (a) The concrete mix design shall be done as “Design Mix Concrete” as prescribed in clause-9 of IS 456 mentioned above.
   (b) Concrete shall be manufactured in accordance with clause 10 of above mentioned IS 456 covering quality assurance measures both technical and organizational, which shall also necessarily require a qualified Concrete Technologist to be available during manufacture of concrete for certification of quality of concrete.

(ii) Minimum M -25 grade of concrete shall be used in all structural elements made with RCC both in load bearing and framed structure.

(iii) The mechanical properties such as modulus of elasticity, tensile strength, creep and shrinkage of fly ash mixed concrete or concrete using fly ash blended cements (PPCs) are not likely to be significantly different and their values are to be taken same as those used for concrete made with OPC.

(iv) To control higher rate of carbonation in early ages of concrete both in fly ash admixed as well as PPC based concrete, water/binder ratio shall be kept as low as possible, which shall be closely monitored during concrete manufacture.
If necessitated due to low water/binder ratio, required workability shall be achieved by use of chloride free chemical admixtures conforming to IS 9103. The compatibility of chemical admixtures and super plasticizers with each set OPC, fly ash and /or PPC received from different sources shall be ensured by trials.

(v) In environment subjected to aggressive chloride or sulphate attach in particular, use of fly ash admixed or PPC based concrete is recommended. In cases, where structural concrete is exposed to excessive magnesium sulphate, flyash substitution/content shall be limited to 18% by weight. Special type of cement with low C3A content may also be alternatively used. Durability criteria like minimum binder content and maximum water /binder ratio also need to be given due consideration in such environment.

Wet curing period shall be enhanced to a minimum of 10 days or its equivalent. In hot & arid regions, the minimum curing period shall be 14 days or its equivalent.

5.1.2.2 ***Use of Fly ash Admixed Cement Concrete (FACC) in RCC structures***

There shall be no bar on use of FACC in RCC structures subject to following additional conditions.

(i) Fly ash shall have its chemical characteristics and physical requirements etc. conforming to IS 3812 (part I & II) and shall be duly certified.

(ii) To ensure uniform blending of fly ash with cment in conformity with IS 456, a specific facility needs to be created at site with complete computerized automated process control to achieve design quality or with similar facility from Ready Mix Concrete (RMC) plants.

(iii) As per IS 1489 (Part-I) maximum 35% of OPC by mass is permitted to be substituted with fly ash conforming to IS 3812 (Part –I) and same is reiterated.

(iv) Separate storage for dry fly ash shall be provided. Storage bins or silos shall be weather proof and permit a free flow and efficient discharge of fly ash. The filter or dust control system provided in the bins or silos shall be of sufficient size to allow delivery of fly ash maintained at specified pressure to prevent undue emission of fly ash dust, which may interfere weighing accuracy.

5.1.2.3 ***Use of Fly Ash Blended Cements in Cement Concrete (PPCC) in RCC Structures***

(i) Subject to General Guidelines detailed out as above, PPC manufactured conforming to IS 1489 (Part-I) shall be treated at par with OPC for manufacture of Design Mix concrete for structural use in RCC.

(ii) Till the time, BIS makes it mandatory to print the %age of fly ash on each bag of cement, the certificate from the PPC manufacture indicating the same shall be insisted upon before allowing use of such cements in works.

(iii) While using PPC for structural concrete work, no further admixing of fly ash shall be permitted.

5.1.2 Steel for Reinforcement

5.1.3.1 The steel used for reinforcement shall be any of the following types:

(a) Mild steel and medium tensile bars conforming to IS 432 (Part I)

(b) High strength deformed steel bars conforming to IS 1786

(c) Hard drawn steel wire fabric conforming to IS 1566

(d) Structural steel conforming to Grade A of IS 2062

(e) Thermo-mechanically treated (TMT) Bars.

$\sqrt{}$

5.1.3.2 Elongation percent on gauge length is 5.65 A where A is the cross sectional areas of the test piece.

5.1.3.3 Mild steel is not recommended for the use in structures located in earthquake zone subjected to severe damage and for structures subjected to dynamic loading (other than wind loading) such as railway and highway bridges.

5.1.3.4 Welding of reinforcement bars covered in this specification shall be done in accordance with the requirements of IS 2751.

Nominal mass/weight : The tolerance on mass/ weight for round and square bars shall be the percentage given in Table 5.1 of the mass/ weight calculated on the basis that the masses of the bar/ wire of nominal diameter and of density 7.85 kg/ cm^3 or 0.00785 kg/mm^3.

TABLE 5.1
Tolerance on Nominal Mass

Nominal size in mm	*Tolerance on the Nominal Mass per cent*		
	Batch	*Individual sample +*	*Individual sample for coil (x)*
(a) Upto and including 10	±7	-8	±8
(b) Over 10, upto and including 16	±5	-6	±6
(c) Over 16	±3	-4	±4

\+ for individual sample plus tolerance is not specified
(x) for coil batch tolerance is not applicable
Tolerance shall be determined in accordance with method given in IS 1786.

5.1.3.5 High strength deformed bars & wires shall conform to IS 1786. The physical properties for all sizes of steel bars are mentioned below in Table 5.2.

TABLE 5.2

Sl. No	*Property*	*Fe 415*	*Fe 415 D*	*Fe 500 D*	*Fe 550 D*
(i)	0.2 Per cent Proof stress/ yield stress, Min, N/mm^2	415.0	415.0	500.0	550.0
(ii)	Elongation, per cent, Min. on gauge length 5.65 A , where A is the corss-sectional area of the test piece.	14.5	18.0	16.0	14.5
(iii)	Tensile strength, Min	10 Per cent more than the actual 0.2 per cent proof stress/ yield stress	12 Per cent more than the actual 0.2 per cent proof stress/yield stress but not	10 Per cent more than the actual 0.2 per cent proof stress/ yield stress	8 Per cent more than the actual 0.2 per cent proof stress/yield stress but not less than 600.0 N/mm^2

		but not less than 485.0 N/mm^2	less than 500.0 N/mm^2	but not less than 565.0 N/mm^2	
(iv)	Total elongation at maximum force, percent, Min on gauge length 5.65 $\sqrt{A}$, where A is the cross-sectional area of the test piece.	-	5	5	5

Tests: Selection and preparation of Test sample. All the tests pieces shall be selected by the Engineer-in-Charge or his authorized representative either-

(a) From cutting of bars
Or
(b) If he so desires, from any bar after it has been cut to the required or specified size and the test piece taken from and any part of it.

In neither case, the test pieces shall be detached from the bar or coil except in the presence of the Engineer-in-Charge or his authorized representative.

The test pieces obtained in accordance with as above shall be full sections of the bars as rolled and subsequently cold worked and shall be subjected to physical tests without any further modifications. No deduction in size by machining or otherwise shall be permissible. No test piece shall be enacted or otherwise subject to heat treatment. Any straightening which a test piece may require shall be done cold.

Tensile Test: 0.2% proof stress and percentage elongation –This shall be done as per IS 1608, read in conjunction with IS 226.

RE- test: This shall be done as per IS 1786.

Rebend test: This shall be done as per IS 1786.

5.1.3.6 Chemical composition of reinforcement bars shall be as per Table 5.3 as follows:-

TABLE 5.3

Constituent	*Maximum Per cent*			
	Fe 415	*Fe 415 D*	*Fe 500 D*	*Fe 550 D*
Carbon	0.30	0.25	0.25	0.25
Sulphur	0.060	0.045	0.040	0.040
Phosphorus	0.060	0.045	0.040	0.040
Sulphur and Phosphorus	0.110	0.085	0.075	0.075

5.1.3.7 Thermo Mechanically treated reinforcement bars:

(a) There is no BIS code for TMT bars. The available code BIS 1786 pertains to HSD Bars. Therefore there should be no stipulation that TMT bars should conform to relevant BIS code.

(b) The TMT bars are being produced under valid licence from either of the firms namely Tempcore, Thermex Evcon Turbo & Turbo Quench. These firms have acquired patents and are giving licences to various producers to produce TMT Bars.

(c) The TMT bars shall conform to IS 1786 pertaining to Fe 415 D or Fe 500 D or Fe grade of steel as specified.

(d) In design and construction of reinforced concrete building in seismic zone III and above, steel reinforcement of Grade Fe 415 D shall be used. However, high strength deformed steel bars, produced by thermo mechanical treatment process of grade Fe 415, Fe 500 and Fe 550 having elongation more than 14.5. % and conform to other requirements of Fe 415 D, Fe 500 D and Fe 550 D respectively of IS 1786 may also be used for reinforcement. In future, latest provision of IS 456 and IS 13920 or any other relevant code as modified from time to time shall be applicable.

5.1.3 Stacking and Storage

Steel for reinforcement shall be stored in such a way as to prevent distorting and corrosion. Care shall be taken to protect the reinforcement from exposure to saline atmosphere during storage,

fabrication and use. It may be achieved by treating the surface of reinforcement with cement wash or by suitable methods. Bars of different classifications, sizes and lengths shall be stored separately to facilitate issue in such sizes and lengths to cause minimum wastage in cutting from standard length.

5.1.4 Identification

Care shall also be taken to properly identify these bars at site. The staff shall be specially trained for looking for identification marks on these bars given by the manufacturers which are generally given colour code. It will be advisable to see that only one type/grade of bars are brought to site and used in the project after conducting tests for each lot.

5.2 *FORM WORK (CENTRING & SHUTTERING)*

5.2.0 Form Work

Form work shall include all temporary or permanent forms or moulds required for forming the concrete which is cast-in-situ, together with all temporary construction required for their support.

5.2.1 5.2.2 Design & Tolerance in Construction

Form work shall be designed and constructed to the shapes, lines and dimensions shown on the drawings with the tolerance given below.

(a) Deviation from specified dimension of cross section of columns and beams	+12 mm -6 mm
(b) Deviation from dimensions of footings	
(i) Dimension in Plan	(+ 50 mm (-12 mm
(ii) Eccentricity in plan	0.02 times the width of the footing in the direction of deviation but not more than 50 mm.
(iii) Thickness	± 0.05 times the specified thickness.

(**Note**- These tolerance apply to concrete dimensions only, and not to positioning of vertical steel or dowels).

5.2.2 General Requirement

It shall be strong enough to withstand the dead and live loads and forces caused by ramming and vibrations of concrete and other incidental loads, imposed upon it during and after casting of concrete. It shall be made sufficiently rigid by using adequate number of ties and braces, screw jacks or hard board wedges where required shall be provided to make up any settlement in the form work either before or during the placing of concrete.

Form shall be so constructed as to be removable in sections in the desired sequence, without damaging the surface of concrete or disturbing other sections, care shall be taken to see that no piece is keyed into the concrete.

5.2.3.1 ***Material for Form Work***

(a) *Propping and Centering* : All propping and centering should be either of steel tubes with extension pieces or built up sections of rolled steel.

5.2.3.2 (a) ***Centering/Staging :*** Staging should be as designed with required extension pieces as approved by Engineer-in-Charge to ensure proper slopes, as per design for slabs/ beams etc. and as per levels as shown in drawing. All the staging to be either of Tubular steel structure with adequate bracings as approved or made of built up structural sections made form rolled structural steel sections.

(b) In case of structures with two or more floors, the weight of concrete, centering and shuttering of any upper floor being cast shall be suitably supported on one floor below the top most floor already cast.

(c) Form work and concreting of upper floor shall not be done until concrete of lower floor has set at least for 14 days.

5.2.3.3 ***Shuttering:*** Shuttering used shall be of sufficient stiffness to avoid excessive deflection and joints shall be tightly butted to avoid leakage of slurry. If required, rubberized lining of material as approved by the Engineer-in-Charge shall be provided in the joints. Steel shuttering used or concreting should be sufficiently stiffened. The steel shuttering should also be properly repaired before use and
properly cleaned to avoid stains, honey combing, seepage of slurry through joints etc.

(a) *Runner Joists:* RSJ, MS Channel or any other suitable section of the required size shall be used as runners.

(b) Assembly of beam head over props. Beam head is an adopter that fits snugly on the head plates of props to provide wider support under beam bottoms.

(c) Only steel shuttering shall be used, except for unavoidable portions and very small works for which 12 mm thick water proofing ply of approved quality may be used.

5.2.3.4 Form work shall be properly designed for self weight, weight of reinforcement, weight of fresh concrete, and in addition, the various live loads likely to be imposed during the construction process (such as workmen, materials and equipment). In case the height of centering exceeds 3.50 metres, the prop may be provided in multi-stages. A typical detail of multistage shuttering is given in Fig. 5.9.

5.2.3.5 ***Camber:*** Suitable camber shall be provided in horizontal members of structure, especially in cantilever spans to counteract the effect of deflection. The form work shall be so assembled as to provide for camber. The camber for beams and slabs shall be 4 mm per metre (1 to 250) or as directed by the Engineer-in-Charge, so as to offset the subsequent deflection, For cantilevers the camber at free end shall be 1/50th of the projected length or as directed by the Engineer-in-Charge.

5.2.3.5.1 Typical arrangement of form work for 'beams, columns and walls' are shown in Figures 5.1 to 5.8 and form secured by wall ties is shown in Fig. 5.3.

5.2.3.6 ***Walls:*** The form faces have to be kept at fixed distance apart and an arrangement of wall ties with spacer tubes or bolts is considered best. A typical wall form with the components identified is given in Fig. 5.1, 5.2 & 5.3. The two shutters of the wall are to be kept in place by appropriate ties, braces and studs, some of the accessories used for wall form are shown in Fig. 5.3.

5.2.3.7 ***Removal of Form work (Stripping Time) :*** In normal circumstance and where various types of cements are used, forms, may generally be removed after the expiry of the following periods:

Type of Form work	*Minimum period Before Striking Form work for OPC 33 grade*	*Minimum period Before Striking Form work for OPC 43 grade*	*Minimum period Before Striking Form work for PPC*
(a) Vertical form work to columns, walls, beams	16-24 h	16-24 h	24-36 h

Type of Form work	*Minimum period Before Striking Form work for OPC 33 grade*	*Minimum period Before Striking Form work for OPC 43 grade*	*Minimum period Before Striking Form work for PPC*
(b) Soffit form work to slabs (Props to be refixed immediately after removal of formwork)	3 days	3 days	4 days
(c) Soffit form work to beams (Props to be refixed immediately after removal of formwork	7 days	7 days	10 days
(d) Props to slabs:			
(1) Spanning upto 4.5m	7 days	7 days	10 days
(2) Spanning over 4.5m	14 days	14 days	20 days
(e) Props to beams and arches:			
(1) Spanning upto 6m	14 days	14 days	20 days
(2) Spanning over 6m	21 days	21 days	30 days

Note 1: For other types of cement, the stripping time recommended for ordinary Portland cement may be suitably modified. Generally If Portland pozzolana or low heat cement or OPC with direct addition of fly ash has been used for concrete, the stripping time will be 10/7 of the period stated for OPC with 43 grade cement above.

Note 2: The number of props left under, their sizes and disposition shall be such as to be able to safely carry the full dead load of the slabs, beam or arch as the case may be together with any live load likely to occur during curing or further construction.

Note 3: For rapid hardening cement, 3/7 of above periods for OPC 33 grade will be sufficient in all cases except for vertical side of slabs, beams and columns which should be retained for at least 24 hours.

Note 4: In case of cantilever slabs and beams, the centering shall remain till structures for counter acting or bearing down have been erected and have attained sufficient strength.

Note 5: Proper precautions should be taken to allow for the decrease in the rate of hardening that occurs with all types of cement in cold weather and accordingly stripping time shall be increased.

Note 6: Work damaged through premature or careless removal of forms shall be reconstructed within 24 hrs.

5.2.3 Surface Treatment

5.2.4.1 *Oiling the Surface*: Shuttering gives much longer service life if the surfaces are coated with suitable mould oil which acts both as a parting agent and also gives surface protections.

A typical mould oil is heavy mineral oil or purified cylinder oil containing not less than 5% pentachlorophenol conforming to IS 716 well mixed to a viscosity of 70-80 centipoises.

After 3-4 uses and also in cases when shuttering has been stored for a long time, it should be recoated with mould oil before the next use.

The second categories of shuttering oils / leavening agents are Polymer based water soluble Compounds. They are available as concentrates and when used diluted with water in the ratio of 1:20 or as per manufacturer specifications. The diluted solution is applied by brush applications on the shuttering both of steel as well as ply wood. The solution is applied after every use.

5.2.4.2 The design of form work shall conform to sound Engineering practices and relevant IS codes.

5.2.4 Inspection of Form Work

The completed form work shall be inspected and approved by the Engineer-in-Charge before the reinforcement bars are placed in position.

Proper form work should be adopted for concreting so as to avoid honey combing, blow holes, grout loss, stains or discoloration of concrete etc. Proper and accurate alignment and profile of finished concrete surface will be ensured by proper designing and erection of form work which will be approved by Engineer-in-Charge.

Shuttering surface before concreting should be free from any defect/ deposits and full cleaned so as to give perfectly straight smooth concrete surface. Shuttering surface should be therefore checked for any damage to its surface and excessive roughness before use.

5.2.5.1 ***Erection of Form Work (Centering and shuttering):*** Following points shall be borne in mind while checking during erection.

(a) Any member which is to remain in position after the general dismantling is done, should be clearly marked.

(b) Material used should be checked to ensure that, wrong items/ rejects are not used.

(c) If there are any excavations nearby which may influence the safety of form works, corrective and strengthening action must be taken.

(d) (i) The bearing soil must be sound and well prepared and the sole plates shall bear well on the ground.
(ii) Sole plates shall be properly seated on their bearing pads or sleepers.
(iii) The bearing plates of steel props shall not be distorted.
(iv) The steel parts on the bearing members shall have adequate bearing areas.

(e) Safety measures to prevent impact of traffic, scour due to water etc. should be taken. Adequate precautionary measures shall be taken to prevent accidental impacts etc.

(f) Bracing, struts and ties shall be installed along with the progress of form work to ensure strength and stability of form work at intermediate stage. Steel sections (especially deep sections) shall be adequately restrained against tilting, over turning and form work should be restrained against horizontal loads. All the securing devices and bracing shall be tightened.

(g) The stacked materials shall be placed as catered for, in the design.

(h) When adjustable steel props are used. They should:
1. be undamaged and not visibly bent.
2. have the steel pins provided by the manufacturers for use. 3. be restrained laterally near each end.
4. have means for centralizing beams placed in the forkheads.

(i) Screw adjustment of adjustable props shall not be over extended.

(j) Double wedges shall be provided for adjustment of the form to the required position wherever any settlement/ elastic shorting of props occurs. Wedges should be used only at the bottom end of single prop. Wedges should not be too steep and one of the pair should be tightened/ clamped down after adjustment to prevent shifting.

(k) No member shall be eccentric upon vertical member.

(l) The number of nuts and bolts shall be adequate.

(m) All provisions of the design and/or drawings shall be complied with.

(n) Cantilever supports shall be adequate.

(o) Props shall be directly under one another in multistage constructions as far as possible.

(p) Guy ropes or stays shall be tensioned properly.

(q) There shall be adequate provision for the movements and operation of vibrators and other construction plant and equipment.

(r) Required camber shall be provided over long spans.

(s) Supports shall be adequate, and in plumb within the specified tolerances.

5.2.5 Measurements

5.2.6.1 ***General*** **:** The form work shall include the following:

(a) Splayed edges, notching, allowance for overlaps and passing at angles, sheathing battens, strutting, bolting, nailing, wedging, easing, striking and removal.

(b) All supports, struts, braces, wedges as well as mud sills, piles or other suitable arrangements to support the form work.

(c) Bolts, wire, ties, clamps, spreaders, nails or any other items to hold the sheathing together.

(d) Working scaffolds, ladders, gangways, and similar items.

(e) Filleting to form stop chamfered edges of splayed external angles not exceeding 20mm wide to beams, columns and the like.

(f) Where required, the temporary openings provided in the forms for pouring concrete, inserting vibrators, and cleaning holes for removing rubbish from the interior of the sheathing before pouring concrete.

(g) Dressing with oil to prevent adhesion and

(h) Raking or circular cutting

5.2.6.2 ***Classification of Measurements:*** Where it is stipulated that the form work shall be paid for separately, measurements shall be taken of the area of shuttering in contact with the concrete surface. Dimensions of the form work shall be measured correct to a cm. The measurements shall be taken separately for the following.

(a) Foundations, footings, bases of columns etc. and for mass concrete

(b) Walls (any thickness) including attached pilasters, buttresses, plinth and string courses etc.

(c) Suspended floors, roofs, landings, shelves and their supports and balconies.

(d) Lintels, beams, plinth beams, girders, bressummers and cantilevers.

(e) Columns, pillars, piers, abutments posts and struts.

(f) Stairs (excluding landings) except spiral staircase.

(g) Spiral staircases (including landings).

(h) Arches,Domes, vaults, shells roofs, arch ribs, curvilinear shaped folded plates

(i) Extra for arches, domes, vaults exceeding 6 m span other than curvilinear shaped

(j) Chimneys and shafts.

(k) Well steining.

(l) Vertical and horizontal fins individually or forming box, louvers and bands.facias and eaves board

(m) Waffle or ribbed slabs.

(n) Edges of slabs and breaks in floors and walls (to be measured in running metres where below 200 mm in width or thickness).

(o) Cornices and mouldings.

(p) Small surfaces, such as cantilevers ends, brackets and ends of steps, caps and boxes to pilasters and columns and the like.

(q) Chullah hoods, weather shades, chajjas, corbels etc. including edges and

(r) Elevated water reservoirs.

5.2.6.3 Centering, and shuttering where exceeding 3.5 metre height in one floor shall be measured and paid for separately.

5.2.6.4 Where it is not specifically stated in the description of the item that form work shall be paid for separately, the rate of the RCC item shall be deemed to include the cost of form work.

5.2.6.5 No deductions from the shuttering due to the openings/ obstructions shall be made if the area of each openings/ obstructions does not exceed 0.4 square metre. Nothing extra shall be paid for forming such openings.

5.2.6.6 Form work of elements measured under categories of arches, arch ribs, domes, spiral staircases, well steining, shell roofs, curvilinear folded plates & curvilinear eaves board, circular shafts & chimneys shall not qualify for extra rate for circular work.

5.2.6.7 Extra for circular work shall be admissible for surfaces circular or curvilinear in plan or in elevation beyond the straight edge of supporting beam in respective mode of measurement. However, there may be many different types of such structures. In such cases, extra payment shall be made judiciously after deducting areas where shuttering for circular form work is not involved.

5.2.6 Rate

The rate of the form work includes the cost of labour and materials required for all the operations described above.

5.3 *REINFORCEMENTS*

5.3.1 General Requirements

Steel conforming to para 5.1.3 for reinforcement shall be clear and free from loose mill scales, dust, loose rust, coats of paints, oil or other coating which may destroy or reduce bond. It shall be stored in such a way as to avoid distortion and to prevent deterioration and corrosion. Prior to assembly of reinforcement on no account any oily substance shall be used for removing the rust.

5.3.1.1 ***Assembly of Reinforcement:*** Bars shall be bent correctly and accurately to the size and shape as shown in the detailed drawing or as directed by Engineer-in-Charge. Preferably bars of full length shall be used. Necessary cutting and straightening is also included. Overlapping of bars, where necessary shall be done as directed by the Engineer-in-Charge. The overlapping bars shall not touch each other and these shall be kept apart with concrete between them by 25mm or $1^1/_4$ times the maximum size of the coarse aggregate whichever is greater. But where this is not possible, the overlapping bars shall be bound together at intervals not exceeding twice the dia. of such bars with two strands annealed steel wire of 0.90 mm to 1.6 mm twisted tight. The overlaps/ splices shall be staggered as per directions of the Engineer-in-Charge. But in no case the overlapping shall be provided in more than 50% of cross sectional area at one section.

5.3.1.2 ***Bonds and Hooks Forming End Anchorages:*** Reinforcement shall be bent and fixed in accordance with procedure specified in IS 2502, code of practice of bending and fixing of bars for concrete reinforcement. The details of bends and hooks are shown below for guidance.

(a) *U-Type Hook*

In case of mild steel plain bars standard U type hook shall be provided by bending ends of rod into semicircular hooks having clear diameter equal to four times the diameter of the bar.

Note: In case of work in seismic zone, the size of hooks at the end of the rod shall be eight times the diameter of bar or as given in the structural drawings.

(b) *Bends*

Bend forming anchorage to a M.S. plain bar shall be bent with and internal radius equal to two times the diameter of the bar with a minimum length beyond the bend equal to four times the diameter of the bar.

5.3.1.3 ***Anchoring Bars in Tension:*** Deformed bars may be used without end anchorages provided, development length equipment is satisfied. Hooks should normally be provided for plain bars in tension. Development length of bars will be determined as per IS: 456.

5.3.1.4 ***Anchoring Bars in Compression:*** The anchorage length of straight bar in compression shall be equal to the 'Development length' of bars in compression as specified in IS: 456. The projected length of hooks, bend and straight lengths beyond bend, if provided for a bar in compression, shall be considered for development length.

5.3.1.5 ***Binders, stirrups, links etc.:*** In case of binders, stirrups, links etc. the straight portion beyond the curve at the end shall be not less than eight times and nominal size of bar.

5.3.2 Welding of Bars

Wherever facility for electric **arc** welding **or gas pressure welding** is available, welding of bars shall be done in lieu of overlap. The location and type of welding shall be got approved by the Engineer-in-Charge. Welding shall be as per IS 2751 and 9417.

5.3.3 Placing in Position

5.3.3.1 Fabricated reinforcement bars shall be placed in position as shown in the drawings or as directed by the Engineer -in -charge. The bars crossing one another shall be tied together at every intersection with two strands of annealed steel wire 0.9 to 1.6 mm thickness twisted tight to make the skeleton of the steel work rigid so that the reinforcement does not get displaced during deposition of concrete. Tack welding in crossing bars shall also be permitted in lieu of binding with steel wire if approved by Engineer-in-Charge.

5.3.3.2 The bars shall be kept in correct position by the following methods:

(a) In case of beam and slab construction pre-cast cover blocks in cement mortar 1:2 (1 cement : 2 coarse sand) about 4x4 cm section and of thickness equal to the specified cover shall be placed between the bars and shuttering, so as to secure and maintain the requisite cover of concrete over reinforcements.

(b) In case of cantilevered and doubly reinforced beams of slabs, the vertical distance between the horizontal bars shall be maintained by introducing chairs, spacers or support bars of steel at 1.0 mere or at shorter spacing to avoid sagging.

(c) In case of columns and walls, the vertical bars shall be kept in position by means of timber templates with slots accurately cut in them: or with clock of cement mortar 1:2 (1 cement: 2 coarse sand) of required size suitable tied to the reinforcement to ensure that they are in correct position during concreting.

(d) In case of other R.C.C. structure such as arches, domes, shells, storage tanks etc. a combination of cover blocks, spacers and templates shall be used as directed by Engineer-in-Charge.

5.3.3.3 ***Tolerance on Placing of Reinforcement*****:** Unless otherwise specified by the Engineer-in-Charge, reinforcement shall be placed within the following tolerances:

	Tolerance in spacing
(a) For effective depth, 200 mm or less	+10 mm
(b) For effective depth, more than 200 mm	+ 15 mm

5.3.3.4 ***Bending at Construction Joints*** **:** Where reinforcement bars are bent aside at construction joints and afterwards bent back into their original position care should be taken to ensure that at no time the radius of the bend is less than 4 bar diameters for plain mild steel or 6 bar diameter for deformed bars. Care shall also be taken when bending back bars to ensure that the concrete around the bar is not damaged.

5.3.3.5 ***Cover :*** The minimum nominal cover to meet durability requirements shall be as under:-

Exposure	*Nominal Concrete cover in mm not less than*
Mild	20
Moderate	30
Severe	45
Very severe	50
Extreme	75

Notes:

1. For main reinforcement up to 12 mm diameter bar for mild exposure the nominal cover may be reduced by 5 mm.

2. Unless specified otherwise, actual concrete cover should not deviate from the required nominal cover by + 10 mm.

3. For exposure condition ‘severe’ and ‘very severe’ reduction of 5 mm may be made, where concrete grade is M35 and above.

4. Nominal cover to meet specified period of fire resistance shall not be less than as given in Table 16A of IS 456.

5.3.4 Measurement

Reinforcement including authorized spacer bars and lappages shall be measured in length of different diametre, as actually (not more than as specified in the drgs.) used in the work nearest to a centimetre and their weight calculated on the basis of standard weight given in Table 5.4 below. In case actual unit weight of the bars is less than standard unit weight, but within variation, in such cases weight of reinforcement shall be calculated on the basis of actual unit weight. Wastage and unauthorized overlaps shall not be paid for. Annealed steel wire required for binding or tack welding shall not be measured, its cost being included in the

rate of reinforcement.

Where tack welding is used in lieu of binding, such welds shall not be measured. Chairs separators etc. shall be provided as directed by the Engineer-in-Charge and measured separately and paid for.

TABLE 5.4
Cross Sections Area and Mass of Steel Bar

Nominal Size mm	*Cross sectional Area Sq.mm*	*Mass per metre Run Kg.*
6	28.3	0.222
8	50.3	0.395
10	78.6	0.617
12	113.1	0.888
16	201.2	1.58
20	314.3	2.47
25	491.1	3.85
28	615.8	4.83
32	804.6	6.31
36	1018.3	7.99
40	1257.2	9.86

Note: These are as per clause 6.2 of IS 1786.

5.3.2 Rate

The rate for reinforcement shall include the cost of labour and materials required for all operations described above such as cleaning of reinforcement bars, straightening, cutting, hooking bending, binding, placing in position etc. as required or directed including tack welding on crossing of bars in lieu of binding with wires.

5.4 *CONCRETING*

5.4.0 Concrete

Concrete shall be as specified under chapter 4 concrete work. The proportion by volume or by the weight of ingredients shall be as specified.

5.4.1 Consistency

The concrete which will flow sluggishly into the forms and around the reinforcement without any segregation of coarse aggregate from the mortar shall be used. The consistency shall depend on whether the concrete is vibrated on or hand tamped, it shall be determined by slump test as prescribed in sub-head “concrete” under workability – requirement.

5.4.2 Placing of Concrete

5.4.2.1 Concreting shall be commenced only after Engineer-in-Charge has inspected the centering, shuttering and reinforcement as placed and passed the same. Shuttering shall be clean and free from all shavings, saw dust, pieces of wood, or other foreign material and surfaces shall be treated as prescribed in 5.2.4.

5.4.2.2 In case of concreting of slab and beams, wooden plank or cat walks of chequerred MS plated or

bamboo chalies or any other suitable material supported directly on the centering by means of wooden blocks or lugs shall be provided to convey the concrete to the place of deposition without disturbing the reinforcement in any way. Labour shall not be allowed to walk over the reinforcement.

5.4.2.3 In case of columns and wall, it is desirable to place concrete without construction joints. The progress of concreting in the vertical direction, shall be restricted to one metre per hour.

5.4.2.4 The concrete shall be deposited in its final position in a manner to preclude segregation of ingredients. In deep trenches and footings concrete shall be placed through chutes or as directed by the Engineer-in-Charge. In case of columns and walls, the shuttering shall be so adjusted that the vertical drop of concrete is not more than 1.5 metres at a time.

5.4.2.5 During cold weather, concreting shall not be done when the temperature falls below 4.5^0C. The concrete placed shall be protected against frost by suitable covering. Concrete damaged by frost shall be removed and work redone.

5.4.2.6 During hot weather precaution shall be taken to see that the temperature of wet concrete does not exceed 38ºC. No concrete shall be laid within half an hour of the closing time of the day, unless permitted by the Engineer-in-Charge.

5.4.2.7 It is necessary that the time between mixing and placing of concrete shall not exceed 30 minutes so that the initial setting process is not interfered with.

5.4.3 Compaction

It shall be as specified in sub-head of Concrete Work of this specification.

5.4.3.1 Concrete shall be compacted into dense mass immediately after placing by means of mechanical vibrators designed for continuous operations complying with IS 2505, IS 2506, IS 2514 and IS 4656. The Engineer-in-Charge may however relax this condition at his discretion for certain items depending on the thickness of the members and feasibility of vibrating the same and permit hand compaction instead. Hand compaction shall be done with the help of tamping rods so that concrete is thoroughly compacted and completely worked around the reinforcement, embedded fixtures, and into corners of the form. The layers of concrete shall be so placed that the bottom layer does not finally set before the top layer is placed. The vibrators shall maintain the whole of concrete under treatment in an adequate state of agitation; such that de-aeration and effective compaction is attained at a rate commensurate with the supply of concrete from the mixers. The vibration shall continue during the whole period occupied by placing of concrete, the vibrators being adjusted so that the centre of vibrations approximates to the centre of the mass being compacted at the time of placing.

5.4.3.2 Concrete shall be judged to be properly compacted, when the mortar fills the spaces between the coarse aggregate and begins to cream up to form an even surface. When this condition has been attained, the vibrator shall be stopped in case of vibrating tables and external vibrators. Needle vibrators shall be withdrawn slowly so as to prevent formation of loose pockets in case of internal vibration. In case both internal and external vibrators are being used, the internal vibrator shall be first withdrawn slowly after which the external vibrators shall be stopped so that no loose pocket is left in the body of the concrete. The specific instructions of the makers of the particular type of vibrator used shall be strictly complied with. Shaking of reinforcement for the purpose of compaction should be avoided. Compaction shall be completed before the initial setting starts, i.e. with 30 minutes of addition of water to the dry mixture.

5.4.4 Construction joints

5.4.4.1 Concreting shall be carried out continuously upto the construction joints, the position and details of which shall be as shown in structural drawing or as indicated in Fig. 5.26 or as directed by Engineer-in-Charge. Number of such joints shall be kept to minimum. The joints shall be kept at places where the shear

force is the minimum. These shall be straight and shall be at right angles to the direction of main reinforcement. Construction joints should comply with IS 11817.

5.4.4.2 In case of columns the joints shall be horizontal and 10 to 15 cm below the bottom of the beam running into the column head. The portion of the column between the stepping off level and the top of the slab shall be concreted with the beam.

5.4.4.3 When stopping the concrete on a vertical plane in slabs and beams, and approved stop board (see Fig. 26C) shall be placed with necessary slots for reinforcement bars or any other obstruction to pass the bars freely without bending. The construction joints shall be keyed by providing a triangular or trapezoidal fillet nailed on the stopboard. Inclined or feather joints shall not be permitted. Any concrete flowing through the joints of stopboard shall be removed soon after the initial set. When concrete is stopped on a horizontal plane, the surface shall be roughened and cleaned after the initial set.

5.4.4.4 When the work has to be resumed, the joint shall be thoroughly cleaned with wire brush and loose particles removed. A coat of neat cement slurry at the rate of 2.75 kg of cement per square metre shall then be applied on the roughened surface before fresh concrete is laid.

5.4.5 Expansion Joints

Expansion joints shall be provided as shown in the structural drawings or as indicated in Fig. 5.10 to 5.25 or as directed by Engineer-in-Charge, for the purpose of general guidance. However it is recommended that structures exceeding 45 m in length shall be divided by one or more expansion joints. The filling of these joints with bitumen filler, bitumen felt or any such material and provision of copper plate, etc. shall be paid for separately in running metre. The measurement shall be taken two places of decimal stating the depth and width of joint.

5.4.6 Curing

After the concrete has begun to harden i.e. about 1 to 2 hours after its laying, it shall be protected from quick drying by covering with moist gunny bags, sand, canvass Hessian or any other material approved by the Engineer-in-Charge. After 24 hours of laying of concrete, the surface shall be cured by ponding with water for a minimum period of 7 days from the date of placing of concrete in case of OPC and at least 10 days where mineral admixtures or blended cements are used. The period of curing shall not be less than 10 days for concrete exposed to dry and hot weather condition.

5.4.7 Finishing

5.4.7.1 In case of roof slabs the top surface shall be finished even and smooth with wooden trowel, before the concrete begins to set. **Sprinkling of dry cement while finishing shall not be resorted to.**

5.4.7.2 Immediately on removal of forms, the R.C.C. work shall be examined by the Engineer-in-Charge, before any defects are made good.

(a) The work that has sagged or contains honey combing to an extent detrimental to structural safety or architectural concept shall be rejected as given in para 5.4.9.4 for visual inspection test.

(b) Surface defects of minor nature may be accepted. On acceptance of such a work by the Engineer-in-Charge, the same shall be rectified as follows:
   1. Surface defects which require repair when forms are removed, usually consist of bulged due to movement of forms, ridges at form joints, honey-combed areas, damage resulting from the stripping of forms and bolt holes, bulges and ridges are removed by careful chipping or tooling and the surface is then rubbed with a grinding stone. Honey-combed and other defective areas must be chipped out, the edges being cut as straight as possible and perpendicularly to the surface, or preferably slightly under cut to provide a key at the edge of the patch.
   2. Shallow patches are first treated with a coat of thin grout composed of one part of cement and

one part of fine sand and then filled with mortar similar to that used in the concrete. The mortar is placed in layers not more than 10mm thick and each layer is given a scratch finish to secure bond with the succeeding layer. The last layer is finished to match the surrounding concrete by floating, rubbing or tooling on formed surfaces by pressing the form material against the patch while the mortar is still plastic.

3. Large and deep patches require filling up with concrete held in place by forms. Such patches are reinforced and carefully dowelled to the hardened concrete.

4. Holes left by bolts are filled with mortar carefully packed into places in small amounts. The mortar is mixed as dry as possible, with just enough water so that it will be tightly compacted when forced into place.

5. Tiered holes extending right through the concrete may be filled with mortar with a pressure gun similar to the gun used for greasing motor cars.

6. Normally, patches appear darker than the surrounding concrete, possibly owing to the presence on their surface of less cement laitance. Where uniform surface colour is important, this defect shall be remedied by adding 10 to 20 percent of white Portland cement to the patching mortar, the exact quantity being determined by trial.

7. The same amount of care to cure the materials in the patches should be taken as with the whole structure. Curing must be started as soon as possible, after the patch is finished to prevent early drying. Damp Hessian may be used but in some locations it may be difficult to hold it in place. A membrane curing compound in these cases will be most convenient.

(c) The exposed surface of R.C.C. work shall be plastered with cement mortar 1:3 (1 cement : 3 fine sand) of thickness not exceeding 6 mm to give smooth and even surface true to line and form. Any RCC surface which remains permanently exposed to view in the completed structure, shall be considered exposed surfaced for the purpose of this specification.

Where such exposed surface exceeding 0.5 sqm in each location is not plastered with cement mortar 1:3 (1 cement : 3 fine sand) 6 mm thick, necessary deduction shall be made for plastering not done.

(d) The surface which is to receive plaster or where it is to be joined with brick masonry wall, shall be properly roughened immediately after the shuttering is removed, taking care to remove the laitance completely without disturbing the concrete. The roughening shall be done by hacking. Before the surface is plastered, it shall be cleaned and wetted so as to give bond between concrete and plaster.

RCC work shall be done carefully so that the thickness of plaster required for finishing the surface is not more than 6 mm.

(e) The surface of RCC slab on which the cement concrete or mosaic floor is to be laid shall be roughened with brushes while the concrete is green. This shall be done without disturbing the concrete.

5.4.8 Strength of Concrete

The compressive strength on the work tests for different mixed shall be as given in Table 5.5 below:-

TABLE 5.5

Concrete Mix (Nominal Mix on	*Compressive Strength in (Kg/ sq cm)*

Volume basis)		
	7 days'	*28 days'*
1:1:2	210	315
1:1.5:3	175	265
1:2:4	140	210

5.4.9 Testing of Concrete

5.4.9.0 Regular mandatory tests on the workability of the fresh concrete shall be done to achieve the specified compressive strength of concrete. These will be of two types

(a) Mandatory Lab, Test
(b) Mandatory Field Test

Results of Mandatory Field Test will prevail over mandatory Lab. Test.

5.4.9.1 ***Cube Test for Compressive Strength of Concrete - Mandatory Lab Test :*** Mandatory tests shall be carried out as prescribed in Appendix A of Chapter 5.

5.4.9.2 ***Additional Test*** *:* Additional test, if required, shall be carried out as prescribed in Appendix B of Chapter 5.

5.4.9.3 ***Slump Test :*** This test shall be carried out as prescribed in sub-head 4 of concrete.

5.4.9.4 ***Visual Inspection Test :*** The concrete will be inspected after removal of the form work as described in para 5.4.7.2 The question of carrying out mandatory test or other tests described in Appendix A and B (para 5.4.9.1 and 5.4.9.2) will arise only after satisfactory report of visual inspection.

The concrete is liable to be rejected if:

(i) It is porous or honeycombed as per para 5.4.7.2 (a).
(ii) Its placing has been interrupted without providing a proper construction joint.
(iii) The reinforcement has been displaced beyond tolerance specified or construction tolerances have not been met.

However, the hardened concrete may be accepted after carrying out suitable remedial measures to the satisfaction of the Engineer-in-Charge at the risk and cost of the contractor.

5.4.10 Standard of Acceptance – for Nominal Mix

5.4.10.1 ***Mandatory Lab. Test :*** For concrete sampled and tested as prescribed in Appendix A of Chapter 5, the following requirement shall apply.

5.4.10.2 Out of six sample cubes, three cubes shall be tested at 7 days and remaining three cubes at 28 days.

5.4.10.3 ***7 days' Tests***

Sampling: The average of the strength of three specimen shall be accepted as the compressive strength of the concrete provided the variation in strength of individual specimen is not more than ± 15% of the average. Difference between the maximum and minimum strength should not exceed 30% of average strength of three specimen. If the difference between maximum and minimum strength exceeds 30% of the average strength, then 28 days' test shall have to be carried out.

Strength: If the actual average strength of sample accepted in para 'sampling' above is equal to or higher than specified strength upto ±15% then strength of the concrete shall be considered in order.

In case the actual average strength of sample accepted in the above para is lower than the specified or higher by more than 15% then 28 days' test shall have to be carried out to determine the compressive

strength of concrete cubes.

5.4.10.4 ***28 days' Test***

(a) The average of the strength of three specimen be accepted as the compressive strength of the concrete provided the strength of any individual cube shall neither be less than 70% nor higher than 130% of the specified strength.

(b) If the actual average strength of accepted sample exceeds specified strength by more than 30% the Engineer-in-Charge, if he so desires, may further investigate the matter. However, if the strength of any individual cube exceeds more than 30% of specified strength, it will be restricted to 130% only for computation of strength.

(c) If the actual average strength of accepted sample is equal to or higher than specified strength upto 30% then strength of the concrete shall be considered in order and the concrete shall be accepted at full rates.

(d) If the actual average strength of accepted sample is less than specified strength but not less than 70% of the specified strength, the concrete may be accepted at reduced rate at the discretion of Engineer-in-Charge (see para 5.4.13.2).

(e) If the actual average strength of accepted sample is less than 70% of specified strength, the Engineer-in-Charge shall reject the defective portion of work represented by sample and nothing shall be paid for the rejected work. Remedial measures necessary to retain the structure shall be taken at the risk and cost of contractor. If, however the Engineer-in-Charge so desires, he may order additional tests (See Appendix B of Chapter 5) to be carried out to ascertain if the structure can be retained. All the charges in connection with these additional tests shall be borne by the contractor.

5.4.10.5 ***Acceptance Criteria of Field Test (Additional Test – Not Mandatory)***

(A) *Preparation of Standard Test Cubes for calibration of Rebound Hammer at site*

(a) In the beginning the standard test cubes of the specified mix shall be prepared by field units before undertaking any concrete work in each project.

(b) At least 18 standard cubes necessary for formation of one specimen of specified mix, shall be cast by site staff well in advance. From these 18 cubes any 3 cubes may be selected at random to be tested for crushing strength of 7 days. The crushing strength obtained should satisfy the specified strength for the mix as per specification or agreement. If the strength is satisfactory then the remaining cube will form the standard samples for calibration of rebound hammer. In case of failure, the site staff should totally reject the samples and remove them also and then make another set of samples by fresh mixing or alternatively, out of the remaining 15 cubes, 3 cubes will be tested on 28 days. If the 28 days' tests are found satisfactory then remaining 12 cubes will form the standard sample for calibration at 28 days' strength otherwise all samples shall be rejected and whole procedure repeated to form a fresh specimen. All the results shall be recorded in a register.

(c) No concreting will be allowed unless the standard specimen cubes are obtained.

The criteria for acceptance and calibration of hammer will be 28 days' strength. The 7 days' strength is only to facilitate the work to start.

(d) No work (for the concrete cast between 8th and 28th day) shall be allowed to be paid unless 28 days' cube strength is obtained. For the concrete cast between 8th and 28th day, the decision to make the payment may be taken by the Engineer-in-charge on the basis of existing criteria. Concrete work will be rejected if 28 days' strength falls short as per acceptance criteria. No further work will be allowed till the acceptable standard cubes are obtained.

(e) *Frequency*: it will be once in each quarter or as per the direction and discretion of Engineer-in-Charge. Whenever the acceptance criteria is changed or concrete mix or type of cement is changed or Engineer-in-Charge feels it necessary for recorded reasons with the approval of the authority

according to technical sanction, fresh specimen shall be prepared.

(B) Calibration of Hammer

(a) Simultaneously, same three cubes to be tested on 28 days as referred in para A (b) above shall be used to correlate the compressive strength of their concrete with rebound number as per procedure described in para 5.2 of the IS 13311 (Part 2) "Indian standard for non-destructive testing of concrete Method of test by rebound hammer which is given below in para B (b). The average of values of the rebound number (minimum readings) obtained in respect of same three cubes passing on 28 days' work test shall form the datum reference for remaining cubes for the strength of cubes.

(b) The concrete cubes specimens are held in a compression testing machine under a fixed load, measurements of rebound hammer taken and then compressive strength determined as per IS 516. The fixed load required is of the order of 7 N/mm^2 when the impact energy of the hammer is about 2.2 NM.

If the specimen are wet cured, they should be removed from wet storage & kept in the laboratory atmosphere for about 24 hours before testing.

Only the vertical faces of the cubes as cast should be tested for rebound number. At least nine readings should be taken on each of the three vertical faces accessible in the compression testing machine when using rebound hammers. The points of impact in the specimen must not be nearer than 20 mm from the edge & should not be less than 20 mm from each other. The same points must not be impacted more than once.

(c) The rebound number of hammer will be determined on each of the remaining (18-3-3=12) cubes. Whenever the rebound number of hammer of any individual cube varies by more than +25% form the datum readings referred to in para B (a) above, that cube will be excluded and will not be considered for standard specimen cubes for calibration. It must be ensured that at least 8 cubes out of 12 that is 66.67% are within the permissible range of variation of rebound number i.e. +25% or otherwise whole procedure shall have to be repeated and fresh specimen prepared.

These 8 cubes will form one standard sample in the beginning before commencement of work and shall be kept carefully for the visiting officers who will calibrate their hammers on these cubes.

(d) This calibration will be done by field staff with their hammer and then chart of calibration giving the details of the average readings, date & month of casting, mix of the concrete etc. shall be prepared and signed by Engineer-in-Charge and will be duly preserved for future reference as and when required.

(C) Preservation of Cubes at site

Standard sample cubes cast shall be carefully preserved at site under the safe custody of AE or his representative for making them available together with the charts, to the officers of QCTA/CTE or any other senior departmental officer, during their inspection of the work. They will calibrate their hammer on these cubes if required.

(D) Testing at Site

(D-1) Testing Equipments

(D-2) Testing will be done generally by non-destructive methods like rebound hammers etc. Each field Division/ Sub Division/ Unit will purchase rebound hammers and keep them in working order at work site. The testing will be done only by hammers which are duly calibrated.

(D-3) The relative strength of actual field work will be tested with reference to strength of these standard cubes and calibration charts of a hammer for determining the rebound number on the field work. The hammer will be used as per manufacturer's guidelines at various locations chosen at random. The number of location/reading on each wall, beam or column etc. shall not be less than 12. All the readings should be within the +25% range of values prescribed in calibration chart normally. However, reading indicating good strength will be when it is at per with calibrated value or between 100% & 125% and very good if more than 125% any value

between 100% & 75% of calibrated value shall be considered satisfactory. Values from 75% to 50% shall be considered for payment at rates reduced on prorate basis. The concrete indicating rebound number less than 50% of calibrated value shall be rejected and not paid for.

(E) Acceptance of Field Tests and Strength

If the relative strength of actual field work is found satisfactory considering the calibration charts with reference to the standard cube test kept at site, the representative work will be considered satisfactory. If the work is considered below satisfactory, the same will be dealt as stated in para D-3 above.

(F) 7 days' Strength in Rare Cases only

Normally cube crushing strength on 28 days' test shall form the basis of acceptance. However in rare cases of time bound projects/ urgent repairs 7 days' cube test strength criteria may be adopted on similar lines using 7 days' standard test cubes and calibration graphs/ curves/ charts for 7 days' in lieu of 28 days' and testing work done at 7 days'.

(G) Precautions

(G-1) The testing shall be done generally as per guidelines of manufacture of the apparatus and strictly in accordance with the procedure laid down in clause 6 of IS 13311 (Part 2): Indian Standard for Non-Destructive Testing of Concrete - Method of Test by Rebound Hammer.

(G-2) The rebound hammers are influenced by number of factor like type of cement aggregate, surface conditions, moisture content, age of concrete & extent of calibration of concrete etc. hence care shall be taken to compare the cement, aggregate etc. and tested under the similar surface conditions having more or less same moisture content and age. However effect of age can be ignored for concrete between 3 days & 3 months old.

5.4.11 Measurements

5.4.11.1 Dimensions shall be measured nearest to a cm except for the thickness of slab which shall be measured correct to 0.5 cm. The areas shall be worked out nearest to 0.01 Sq. mt. The cubical contents shall be worked out to nearest 0.01 cubic metre.

5.4.11.2 Reinforced cement concrete whether cast-in-situ or pre cast shall be classified and measured separately as follows.

(a) Raft, footing, bases of columns and mass concrete etc. all work up to plinth level, column up to plinth level, plinth beams.

(b) Wall (any thickness) including attached pilasters, buttresses plinth and string course, fillets, column, pillars, piers, abutments, post and struts etc.

(c) Suspended floors, roofs, landings and balconies.

(d) Shelves

(e) Chajjas

(f) Lintel, beams and bressummers.

(g) Columns, pillars, piers, abutments, posts and struts.

(h) Stair-cases including waist or waist less slab but excluding landing except in (i) below.

(i) Spiral stair-case (including landing).

(j) Arches, arch ribs, domes and vaults.

(k) Chimneys and shafts.

(l) Well steining.

(m) Vertical and horizontal fins individually or forming box, louvers and facias.

(n) Kerbs, steps and the like.

(o) String courses, bands, coping, bed plates, anchor blocks, plain window sills and the like.

(p) Mouldings as in cornices, window sills etc.

(q) Shell, dome and folded plates.

(r) Extra for shuttering in circular work in plan.

5.4.11.3 Work under the following categories shall be measured separately.
(a) Rafts, footings, bases of columns etc. and mass concrete.
(b) All other items upto floor two level.
(c) From floor two level to floor three level and so on.
(d) R.C.C. above roof level shall be measured along with R.C.C. Work in floor just below.

5.4.11.4 No deduction shall be made for the following:
(a) Ends of dis-similar materials (e.g. Joists, beams, post, griders, rafter, purlins, trusses, corbels steps etc.) upto 500 sq cm in cross-section.

(b) Opening upto 0.1. sqm.
Note: In calculating area of openings upto 0.1 sqm the size of opening shall include the thickness of any separate lintels or sills. No extra labour for forming such openings or voids shall be paid for.

(c) The volume occupied by reinforcement.

(d) The volume occupied by water pipes, conduits etc. not exceeding 25 sq cm each in cross sectional area. Nothing extra shall be paid for leaving and finishing such cavities and holes.

5.4.11.5 Measurement shall be taken before any rendering is done in concrete members. Measurement will not include rendering. The measurement of R.C.C. work between various units shall be regulated as below:

(a) Slabs shall be taken as running continuously through except when slab is monolithic with the beam. In that case it will be from the face to face of the beam.

(b) Beams shall be measured from face to face of columns and shall be including haunches, if any, between columns and beam. The depth of the beam shall be from the bottom of slab to the bottom of beam if beam and slab are not monolithic. In case of monolithic construction where slabs are integrally connected with beam, the depth of beam shall be from the top of the slab to the bottom of beam.

(c) The columns measurements shall be taken through.

(d) Chajjas along with its bearing on wall shall be measured in cubic metre nearest to two places of decimal. When chajjas is combined with lintel, slab or beam, the projecting portion shall be measured as chajjas, built in bearing shall be measured as per item of lintel, slab or beam in which chajja bears.

(e) Where the band and lintels are of the same height and the band serves as lintel the portion of the band to be measured as lintel shall be for clear length of opening plus twice the over all depth of band.

5.4.12 Tolerances

Subject to the condition that structural safety is not impaired and architectural concept does not hamper, the tolerances in dimensions of R.C.C. members shall be as specified in the drawings by the designer. Whenever these are not specified, the permissible tolerance shall be decided by the Engineer-in-Charge after consultations with the Designer, if necessary.

When tolerances in dimensions are permitted, following procedure for measurement shall apply.

(a) If the actual dimension of R.C.C. members do not exceed or decrease the design dimensions of the members plus or minus tolerance limit specified above, the design dimensions shall be taken for the purpose of measurement.

(b) If the actual dimensions exceed the design dimensions by more than the tolerance limit, the design dimensions only shall be measured for the purpose of payment.

(c) If the actual dimensions decrease more than the tolerance limit specified, the actual dimensions of the RCC members shall be taken for the purpose of measurement and payment.

(d) For acceptance of RCC members whose dimensions are not exactly as per design dimensions, the decision of Engineer-in-Charge shall be final. For the purpose of payment, however, the clarification as given in para a, b & c above shall apply.

5.4.13 Rate

5.4.13.1 The rate included the cost of materials and labour involved in all the operations described above except for the cost of centring and shuttering.

5.4.13.2 On the basis of mandatory lab tests, in case of actual average compressive strength being less than specified strength but upto 70% of specified strength, the rate payable shall be in the same proportion as actual average compressive strength bears to specified compressive strength.

Example:

1. Average compressive strength in 80% of specified strength. Rate payable shall be 80% of agreement rate.
2. In case average compressive strength is less than 70% of the specified strength, the work represented by the sample shall be rejected.
3. However, on the basis of mandatory field tests, where they prevail, the rates of the work represented by samples showing actual compressive strength less than specified strength shall be worked out as per para 5.4.10.5 (D-3) above. In addition, Engineer-in-charge may order for additional tests (see Appendix 'B' of chapter 5) to be carried out at the cost of contractor to ascertain if the portion of structure where in concrete represented by the samples had been used, can be retained on the basis of these tests. Engineer-in-Charge may take further remedial measured as necessary to retain the structure at the risk and cost of the contractor.

5.4.13.3 Where throating or plaster drip or moulding is not required to be provided in RCC chajjas, deduction for not providing throating or plaster drip or moulding shall be made from the item of R.C.C. in chajjas. The measurement for deduction item shall be made in running metres correct to a cm of the edge of chajja.

5.4.13.4 No extra payment for richer mix which projects into any member from another member during concreting of junctions of beams and columns etc. will be made except to the extent structurally considered necessary and when so indicated in the structural drawings. The payment for work done under items of different mixed shall be limited strictly to what is indicated in the structural drawings.

5.5 *ENCASING ROLLED STEEL SECTIONS*

5.5.1 General Requirements

Before concrete work is started, the Engineer-in-Charge shall check that all rolled steel sections to be encased, have been erected truly in position. The sections shall be unpainted and shall be wire brushed to remove the loose rust/ scales etc. Where so specified, ungalvanised metal, having mesh or perforations large enough to permit the free passage of 12.5 mm nominal size aggregate through them shall be wrapped round the section to be encased and paid for separately.

5.5.2 Wrapping

5.5.2.1 In case of columns, the wrapping shall be arranged as illustrated in Fig. 5.27 to pass through the centre of the concrete covering. The wrapping of the entire length of the columns be carried out in stages and no stage shall cover more than 1.5 metre of height of columns. Successive wrappings shall be carried out only after the immediate adjacent wrapping has been encased in concrete. The surface and edges of the flanges of the steel columns shall have a concrete cover of not less than 50mm. The wrappings of the successive stages shall be tied together.

5.5.2.2 In the case of beams and grillages, the wire mesh or expanded metal shall be wrapped round the lower flange of the beam as illustrated in Fig. 5.28 and the wrapping shall be suspended by wire hangers 5 mm diameter placed at about 1.2 metres centres. The surfaces and edges of the steel sections shall have a concrete cover of not less than 50mm. The wrapping shall pass through the centre of the concrete covering at the edges and soffits of the flanges.

5.5.3 Form Work shall be as prescribed in 5.2.

5.5.4 Concreting

Concrete shall consist of a mix of 1:2:4 (1 cement : 2 coarse and : 4 graded stone aggregate of 12.5 mm nominal size) unless a richer mix is specified. The mix shall be poured solidly around the steel sections and around the wrapping by vibrating the concrete into position. Consistency of concrete, Placing of concrete and its compaction, curing, finishing and strength of concrete shall be as described in 5.4.

5.5.5 Measurements

The length shall be measured correct to one cm and other dimensions correct of 0.5 cm. The cement concrete shall be measured as per gross dimensions of the encasing exclusive of the thickness of plaster. No deduction shall be made for the volume of steel sections, expanded metal, mesh or any other reinforcement used therein. However, in case of boxed stanchions or girders, the boxed portion only shall be deducted.
Fabric reinforcement such as expanded metal shall be measured separately in square metres stating the mesh and size of strands.

The description shall include the bending of the fabric as necessary, Racking or circular cutting and waste shall be included in the description.

5.5.6 Rate

The rate shall include the cost of materials and labour required for all the operations described above except the cost of fabric reinforcement. The cost of providing and erecting steel section and wire hangers shall be

paid for separately.

5.6 *PRECAST REINFORCED CONCRETE*

5.6.1 General Requirements

Precast reinforced concrete units such as columns, fencing posts, door and window frames, lintels, chajjas, copings, sills , shelves, slabs, louvers etc. shall be of grade of mix as specified and cast in forms or moulds. The forms/ moulds shall be of fiber glass or of steel sections for better finish. Provision shall be made in the forms and moulds to accommodate fixing devices such as nibs, clips, hooks, bolts and forming of notches and holes. The contractor may precast the units on cement or steel platform which shall be adequately oiled provided the surface finish is of the same standard as obtained in form. Each unit shall be cast in one operation.

5.6.2 Concrete

Concrete used for precasting the units should be well proportioned, mixed, placed and thoroughly compacted by vibrations or tamping to give a dense concrete free from voids and honey combing.

5.6.3 Precast articles

Precast articles shall have a dense surface finish showing no coarse aggregate and shall have not cracks or crevices likely to assist in disintegration of concrete or rusting of steel or other defects that would interfere with the proper placing of the units. All angle of the precast units with the exception of the angles resulting from the splayed or chamfered faces shall be true right angles. The arises shall be clean and sharp except those specified or shown to be rounded. The wearing surface shall be true to the lines. On being fractured, the interior of the units should present a clean homogeneous appearance.

5.6.4 Cover

The longitudinal reinforcement shall have a minimum cover of 12 mm or twice the diameter of the main bar, whichever is more, unless otherwise directed in respect of all items except fencing posts or electric posts where the minimum cover shall be 25 mm.

5.6.5 Curing

After having been cast in the mould or form the concrete shall be adequately protected during setting in the first stages of hardening from shocks and from harmful effects of frost, sunshine, drying winds and cold. The concrete shall be cured at least for 7 days from the date of casting.

5.6.6 Precast Articles:

The precast articles shall be matured for 28 days before erection or being built in so that the concrete shall have sufficient strength to prevent damage to units when first handled.

5.6.7 Marking

Precast units shall be clearly marked to indicate the top of member and its location and orientation in the structure.

5.6.8 Storage and Transportation

Precast units shall be stored, transported and placed in position in such a manner that they will not be overstressed or damaged.

5.7 *PRECAST CEMENT CONCRETE JALI*

5.7.0 General

The jali shall be of cement concrete 1:2:4 (1 cement 2 coarse sand:4 stone aggregate 6 mm nominal size) reinforced with 1.6 mm thick mild steel wire, unless otherwise specified.

5.7.1 Fixing

The jali shall be set in position true to plumb and level before the joints sills and soffits of the openings are plastered. It shall then be properly grouted with cement mortar 1:3 (1 cement :3 coarse sand) and rechecked for levels. Finally the jambs, sills and soffits shall be plastered embedding the jali uniformly on all sides.

5.7.2 Measurements

The jali shall be measured for its gross superficial area. The length and breadth shall be measured correct to a cm. The thickness shall not be less than that specified.

5.7.3 Rate

The rate shall be inclusive of materials and labour involved in all the operations described above except plastering of jambs, sills and soffits, which will be paid for under relevant items of plastering.

5.8 *DESIGN MIX*

5.8.0 Definition

Design mix concrete is that concrete in which the design of mix i.e. the determination of proportions of cement, aggregate & water is arrived as to have target mean strength for specified grade of concrete. The minimum mix of M25 shall be used in all structural elements in both load bearing & RCC framed construction.

5.8.1 Mix Design and Proportioning

5.8.1.1 Mix proportions shall be designed to ensure that the workability of fresh concrete is suitable for conditions of handling and placing, so that after compaction it surrounds all reinforcement and completely fills the formwork. When concrete is hardened, it shall have the stipulated strength, durability and impermeability.

5.8.1.2 Determination of the proportions by weight of cement, aggregates and water shall be based on design of the mix.

5.8.1.3 As a trial the manufacturer of concrete may prepare a preliminary mix according to provisions of SP: 23. Reference may also be made to ACI 211.1-77 for guidance.

5.8.1.4 Mix design shall be tried and the mix proportions checked on the basis of tests conducted at a recognized laboratory approved by the Engineer-in-Charge.

5.8.1.5 All concrete proportions for various grades of concrete shall be designed separately and the mix

proportions established keeping in view the workability for various structural elements, methods of placing and compacting.

5.8.1.6 Before using an admixture in concrete, its performance shall be evaluated by comparing the properties of concrete with the admixture and concrete without any admixture. Chloride content of admixture should be declared by the manufacturer of admixture and shall be within limits stipulated by IS:9103.

5.8.2 Standard Deviation

5.8.2.1 Standard deviation calculations of test results based on tests conducted on the same mix design for a particular grade designation shall be done in accordance with IS 456.

5.8.3 Acceptance Criteria

5.8.3.1 ***Compressive Strength:*** The concrete shall be deemed to comply with the strength requirements when both the following condition are met:

(a) The mean strength determined from any group of four consecutive test results complies with the appropriate limits in col 2 of Table 5.6.

(b) Any individual test result complies with the appropriate limits in col. 3 of Table 5.6.

5.8.3.2 ***Flexural Strength:*** When both the following conditions are met, the concrete complies with the specified flexural strength.

(a) The mean strength determined from any group of four consecutive test results exceeds the specified characteristic strength by at least 0.3 N/mm^2.

(b) The strength determined from any test result is not less than the specified characteristic strength/ 0.3 N/mm^2.

5.8.3.3 ***Quantity of Concrete Represented by Strength Test Results:*** The quantity of concrete represented by a group of four consecutive test results shall include the batches from which the first and last samples were taken together with all intervening batches.

For the individual test result requirements given in col 3 of Table 5.6 or in item (b) of 5.8.3.2. Only the particular batch from which the sample was taken shall be at risk.

Where the mean rate of sampling is not specified the maximum quantity of concrete that four consecutive test results represent shall be limited to 60 m^3.

5.8.3.4 If the concrete is deemed not to comply pursuant to 5.8.3 the structural adequacy of the parts affected shall be investigated and any consequential action as needed shall be taken.

5.8.3.5 Concrete of each grade shall be assessed separately.

5.8.3.6 Concrete is liable to be rejected if it is porous or honey-combed, its placing has been interrupted without providing a proper construction joint, the reinforcement has been displaced beyond the tolerances specified, or construction tolerances have not been met. However, the hardened concrete may be accepted after carrying out suitable remedial measured to the satisfaction of the Engineer-in-Charge.

5.8.4 Cement Content of Concrete

5.8.4.1 For all grades of concrete manufactured/produced, minimum cement content in the concrete shall be 330 kg per cubic metre of concrete. Also, irrespective of the grade of concrete the maximum cement content shall not be more than 500 kg per cubic metre of concrete. These limitations shall apply for all types of cements of all strengths.

5.8.4.2 Actual cement content in each grade of concrete for various conditions of variable shall be

established by design mixes within the limits specified in para 5.8.4.1 above.

5.8.5 Water Cement Ratio and Slump

5.8.5.1 In proportioning a particular mix, the manufacturer/ producer/ contractor shall give due consideration to the moisture content in the aggregates, and the mix shall be so designed as to restrict the maximum free water cement ratio to less than 0.5.

5.8.5.2 Due consideration shall be given to the workability of the concrete thus produced. Slump shall be controlled on the basis of placement in different situations. For normal methods of placing concrete, maximum slump shall be restricted to 100 mm when measured in accordance with IS 1199.

TABLE 5.6
Characteristic Compressive Strength Compliance Requirement
(Clause 5.8.3.1 and 5.8.3.3)

Specified Grade	*Mean of the Group of 4 Non-Overlapping Consecutive Test Results in N/mm^3*	*Individual Test Results in N/mm^3*
(1)	*(2)*	*(3)*
M15	≥ f_{ck} + 0.825 x established standard deviation (rounded off to nearest 0.5 N/mm^2) or f_{ck} +3 N/mm^2 Whichever is greater	≥ f_{ck}-3 N/mm^2
M20 or above	≥ f_{ck} + 0.825 x established standard deviation (rounded off to nearest 0.5 N/mm^2) or f_{ck} +4 N/mm^2, Whichever is greater	≥ f_{ck}-4 N/mm^2
NOTE – In the absence of established value of standard deviation, the values given in Table may be assumed, and attempt should be made to obtain results of 30 samples as early as possible to establish the value of standard deviation.		

5.8.6 Approval of Design Mix

5.8.6.1 The producer/ manufacturer/ contractor of concrete shall submit details of each trial mix of each grade of concrete designed for various workability conditions to the Engineer-in-Charge for his comments and approval. Concrete of any particular design mix and grade shall be produced/ manufactured for works only on obtaining written approval of the Engineer-in-Charge.

5.8.6.2 For any change in quality/ quantity in the ingredients of a particular concrete, for which mix has been designed earlier and approved by the Engineer-in-Charge, the mix has to be redesigned and approval obtained again.

5.9 *READY MIXED CONCRETE (as per IS 4926)*

5.9.1 Materials

5.9.1.1 ***Selection and Approval of Materials:*** Materials used should satisfy the requirements for the safety, structural performance durability and appearance of the finished structure, taking full account of the environment to which it will be subjected. The selection and use of materials shall be in accordance with IS 456. Materials used shall conform to the relevant Indian Standards applicable. Where materials are used which are not covered by the provisions of the relevant Indian Standard, there should be satisfactory data on their suitability and assurance of quality control. Records and details of performance of such materials should be maintained. Account should be taken of possible interactions and compatibility between IS 4926 and materials used. Also, prior permission of the purchaser shall be obtained before use of such materials.

5.9.1.2 ***Cement:*** Cement used for concrete shall be in accordance with the requirements of IS 456.

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5.9.1.3 ***Mineral Admixtures:*** Use of mineral admixtures shall be permitted in accordance with the provisions of IS 456.

5.9.1.4 ***Aggregates :*** Aggregates used for concrete shall be in accordance with the requirement of IS 456. Unless otherwise agreed testing frequencies for aggregates in plant shall be as given IS 4926.

5.9.1.5 ***Chemical Admixtures***

(i) Use of chemical admixtures shall be permitted in accordance, with the provisions of IS 456 and IS 9103.

(ii) It shall be the responsibility of the producer to establish compatibility and suitability of any admixture with the other ingredients of the mix and the determine the dosage required to give the desired effect.

(iii) Admixtures should be stored in a manner that prevents degradation of the product and consumed within the time period indicated by the admixture supplier. Any vessel containing an admixture in the plant or taken to site by the producer shall be clearly marked as to its content.

(iv) When offering or delivering a mix to a purchaser it should be indicated if such a mix contains an admixture or combination of admixtures or not. The admixtures may be identified generically and should be declared on the delivery ticket.

(v) The amount of admixture added to mix shall be recorded in the production record. In special circumstances, if necessary, additional dose of admixture may be added at project site to regain the workability of concrete with the mutual agreement between the producer and the purchaser.

5.9.1.6 ***Water:*** Water used shall be in accordance with the requirement of IS 456. Unless otherwise agreed, the testing frequencies for water shall be as given in Annex A.

The use of re-cycled water is encouraged as long as concrete of satisfactory performance can be produced and steps are taken to monitor the buildup of chlorides in any recirculated water and that any subsequent adjustments to the mix design are made to ensure that any overall limit on chloride contents is satisfied. The addition of any recycled water shall be monitored and controlled to meet these requirements.

The total amount of water added to the mix shall be recorded in the production record. The water content of concrete shall be regulated by controlling its workability or by measuring and adjusting the moisture contents of its constituent materials. The producer's production staff and truck -mixer, drivers shall be made aware of the appropriate responses to variations in concrete consistency of a particular mix caused by normal variations in aggregate moisture content or grading.

5.9.2 General Requirements

5.9.2.1 ***Basis of Supply:*** Ready-mixed concrete shall be supplied having the quality and the quantity in accordance with the requirement agreed with the purchaser or his agent. Notwithstanding this, the concrete supplied shall generally comply with requirements of IS 456.

All concrete will be supplied and invoiced in terms of cubic metres (full or part) of compacted fresh concrete. All proportioning is to be carried out by mass except water and admixture, which may be measured by volume.

5.9.2.2 ***Transport of Concrete:*** Ready-mixed concrete shall be transported from the mixer to the point of placing as rapidly as practicable by methods that will maintain the required workability and will prevent segregation, loss of any constituents or ingress of foreign matter or water. The concrete shall be placed as soon as possible after delivery, as close as is practicable to its final position to avoid re- handling or moving the concrete horizontally by vibration. If required by the purchaser the producer can utilize admixtures to slow down the rate of workability loss, however this does not remove the need for the purchaser to place the concrete as rapidly as possible. The purchaser should plan his arrangements so as to enable a full load of concrete to be discharged within 30 minutes of arrival on site.

Concrete shall be transported in a truck-mixer unless the purchaser agrees to the use of non-agitating vehicles. When non-agitating vehicles are used, the mixed concrete shall be protected from gain or loss of water.
The time of loading shall start from adding the mixing water to the dry mix of cement and aggregate or of adding the cement to the wet aggregate whichever is applicable.

Ready-mixed concrete plant shall have test facilities at its premises to carry out routine tests as per the requirement of the standard.

5.9.3 Sampling and Testing of Ready-Mixed Concrete

5.9.3.1 ***Point and Time of Sampling*** **:** For the assessment of compliance of ready-mixed concrete, the point and time of sampling shall be at discharge from the producer's delivery vehicle or from the mixer to the site or when delivered into the purchaser's vehicle. It is critical that the sampling procedure and equipment used enables as representative a sample as possible to be taken of the quantity of concrete delivered (see Annex A).

The sampling may be carried out jointly by the purchaser and the supplier with its frequency mutually agreed upon. However, it will not absolve the supplier of his responsibility from supplying in concrete as per the requirement given in this standard or otherwise agreed to where so permitted in the standard.

5.9.3.2 ***Workability:*** The test for acceptance is to be performed upon the producer's delivery vehicle discharge on site or upon discharge into the purchaser's vehicle. If discharge from the producers' vehicle is delayed on site due to lack of preparedness on behalf of the purchaser then the responsibility passes to the purchaser after a delay of more than 30 min.

The workability shall be within the following limits on the specified value as appropriate: Slump ± 25 mm or 1/3 of the specified value, whichever is less.

Compacting factor : ± 0.03, where the specified value is 0.90 or greater,
± 0.04, where the specified value is less than 0.90 but more than 0.80,
± 0.05, where the specified value is 0.80 or less.

Flow table test may be specified for concrete, for very high workability (see IS 9103) Acceptance criteria for spread (flow) are to be established between the supplier and the purchaser.

5.9.3.3 ***Specified Strength***

(i) Compliance shall be assessed against the requirements of IS 456 or other agreed Indian Standard. The purchaser may perform his sampling and testing or may enter into an arrangement with the producer to provide his testing requirements.

(ii) Unless otherwise agreed between the parties involved, the minimum testing frequency to

be applied by the producer in the absence of a recognized ready-mixed concrete industry method of production control should be one sample for every 50 m^3 of production or every 50 batches, whichever is the greater frequency. Three test specimens shall be made up for each sample for testing at 28 days (see also IS 456).
In order to get a relatively quicker idea of the quality of concrete, optional test on beams for modulus of rupture at 72 ± 2 h or at 7 days or compressive strength test at 7 days may be carried out in addition to 28 days compressive strength test. For this purpose the value should be arrived at based on actual testing. In all cases 28 days compressive strength shall alone be the criteria for acceptance or rejection of the concrete.

(iii) The purchaser shall inform the producer if his requirements for sampling and testing are higher than one sample every 50 m^3 or 50 batches, whichever is the greater frequency.

5.9.3.4 ***Additional Compliance Criteria:*** Any additional compliance criteria shall be declared to the producer by the purchaser prior to supply and shall be mutually agreed upon in terms of definition, tolerance frequency of assessment, method of test and significance result.

5.9.3.5 ***Non-Compliance:*** The action to be taken in case of non-compliance shall be declared and mutually agreed upon.

5.9.4 Information to be supplied by the Purchaser

5.9.4.1 The purchaser shall provide to the producer the details of the concrete mix or mixes required by him and all pertinent information on the use of the concrete and the specified requirements. Prior to supply taking place, it is recommended that a meeting is held between the purchaser and the producer. Its objective to clarify operational matters such as notice to be given prior to delivery, delivery rate, the name of the purchasers authorized representative who will coordinate deliveries, any requirements for additional services such as pumping, on site testing or training, etc.

5.9.4.2 ***Designed Mixes:*** Where the purchaser specifies a designed mix to be supplied it is essential that all relevant information is conveyed to the producer. In order to assist in this, the format given in Annex B may be completed and forwarded to the producer at the time of enquiry.

5.9.4.3 ***Prescribed Mixes:*** The concrete mix shall be specified by its constituent materials and the properties or quantities of those constituents to produce a concrete with the required performance. The assessment of the mix proportions shall form an essential part of the compliance requirements. The purchaser shall provide the producer with all pertinent information on the use of the concrete and the specified requirements. In order to assist in this, the format given in Annex B may be followed with suitable modifications as applicable to prescribed mixes.

5.9.5 Information to be supplied by the Producer

When requested, the producer shall provide the purchaser with the following information before any concretes is supplied:

(a) Nature and source of each constituent material,

(b) Source of supply of cement,

(c) Proposed proportions or quantity of each constituent/ m^3 of fresh concrete.

(d) Generic type(s) of the main active constituent(s) in the admixture;

(e) Whether or not the admixture contains chlorides and if so, the chloride content of the admixture expressed as a percentage of chloride ion by mass of admixture;

(f) Where more than one admixture is used, confirmation of their compatibility and

(g) Initial and final setting time of concrete when admixture is used at adopted dosage (tested as per IS 8142).

5.9.6 Production and Delivery

5.9.6.1 ***Materials Storage and Handling***

(i) *Cement:* Separate storage for Different types and grades of cement shall be provided. Containers may be used to store cement of different types provided these are emptied before loading new cement. Bins or silos shall be weatherproof and permit free flow and efficient discharge of the cement. Each silo or compartment of a silo shall be completely separate and fitted with a filter or alternative method of dust control. Each filter or dust control system shall be of sufficient size to allow delivery of cement to be maintained at a specified pressure, and shall be properly maintained and prevent undue emission of cement dust and prevent interference with weighing accuracy by buildup of pressure. Cement shall be stored and stacked in bags and shall be kept free from the possibility of any dampness or moisture coming in contact with them and where cement can be stored and retrieved without undue damage to the bags. The bags are to be protected from becoming damp either from the ground or the weather. The cement is to be used in the order it is delivered (see also IS 4082).
In case, the cement remains in storage for more than 3 months, the cement shall be retested before use and shall be rejected, if it fails to conform to any of the requirements given in the relevant Indian Standard.

(ii) *Dry Pulverized Fuel Ash and Other Mineral Admixtures :* Suitable separate arrangement for storage of pulverized fuel ash, silica fume, metakeolin, rice husk ash, ground granulated blast furnace slag such as for cement, shall be provided, in the plants utilizing these materials.

(iii) *Aggregates (Coarse and Fine):* Stockpiles shall be free draining and arranged to avoid contamination and to prevent intermingling with adjustment material. Handling procedures for loading and unloading aggregates shall be such as to reduce segregation to a minimum. Provision shall be made for separate storage for each nominal size and type of aggregate and the method of loading of storage bins shall be such as to prevent intermingling of different sizes and types. Fine aggregates shall be stacked in a place where loss due to the effect of wind is minimum (see also IS 4082 and IS 456).

(iv) *Water:* An adequate supply shall be provided and when stored on the plant such storage facilities shall be designed to minimize the risk of contamination.

(v) *Chemical Admixtures :* Tanks or drums containing liquid admixtures shall be clearly labeled for identification purposes and stored in such a way to avoid damage, contamination or the effects of prolonged exposure to sunlight (if applicable). Agitation shall be provided for liquid admixtures which are not stable solutions.

5.9.6.2 ***Batching Plants and Batching Equipment:*** Hoppers for weighing cement, mineral admixtures, aggregates and water and chemical admixture (if measured by mass) shall consist of suitable container freely suspended from a scale or other suitable load-measuring device and equipped with a suitable discharging mechanism. The method of control of the loading mechanism shall be such that, as the quantity required in the weighing hopper is approached the material may be added at controllable rate and shut off precisely within the weighing tolerances specified in Annex C. The weighing hoppers for cement, mineral admixtures aggregate shall be capable of receiving their rated load, without the weighed material coming into contact with the loading mechanism. Where the rated capacity of a batching plant mixing cycle is less than 2.0 m^3, additional precautions shall be taken to ensure that the correct number of batches is loaded into the truck mixer. The weighing hoppers shall be constructed so as to discharge efficiently and

prevent the buildup of materials. A tare adjustment, up to 10 percent of the nominal capacity of the weigh scale, shall be provided on the weighing mechanism so that the scale can be adjusted to zero at least once each day. Dust seals shall be provided on cement hoppers between the loading mechanism and the weigh hopper, and shall be fitted so as to prevent the emission of cement dust and not affect weighing accuracy. The hopper shall be vented to permit escape of air without emission of cement dust.

Vibrator or other attachment, where fitted, shall not affect the accuracy of weighing. There shall be sufficient protection to cement and aggregate weigh hoppers and weighing mechanisms to prevent interference with weighing accuracy by weather conditions or external build-up of materials.

Where chemical admixture dispensers are used, they shall be capable of measurement within the tolerance in annex C and calibrated container or weigh scales shall be provided to check the accuracy of measurement at least once a month.

Where a continuous mixer with ribbon loading is used the batching procedure specified by the manufacture of the plant shall be followed.

Each control on the batching console and weigh-dial or display shall be clearly labeled with its function and where concerned with the batching of materials, the materials type.

When more than one type or grade of cement is being used, the weighing device and discharge screw or other parts of the transfer system shall be empty before changing from on type of cement to another.

When more than one type or grade of cement is being used, the weighing devised and discharge screw or other parts of the transfer system shall be empty before changing from on type of cement to another.
When pulverized fuel ash and other mineral admixtures are batched through the cement weigh system, the weighing device and discharge screw or other parts of the transfer system shall be empty when the weighing system has returned to zero reading or completed the batch.
Where a back weigh system is utilized to weigh materials a system shall be in place so as to prevent materials being loaded during the process of weighing.

5.9.6.3 ***Measurement of Materials:*** Cement and mineral admixture materials shall be measured by mass in a hopper or compartment separate from those used for other materials and on a scale of appropriate sensitivity, measurement being taken from a zero reading. Aggregates shall be measured by mass, allowance being made for the free moisture content of the aggregates. The added water shall be measured by volume or by mass. Any liquid chemical admixture (or paste) shall be measured by volume or by mass and any solid admixture by mass. When weighing materials any build up in the hopper during the day must be tared out or allowed for in the batch weights. After measurement all materials shall be discharged into the mixer without loss.

The accuracy of the measuring equipment shall be within $\pm$ 2 percent of the quantity of cement and mineral admixtures being measured and within $\pm$ 3 percent of the quantity of aggregate, chemical admixture and water being measured. The plant operator shall be provided with a clear display of the quantities of materials to be batched for each mix and batch size with information identifying the display to be selected for each designed and prescribed mix to be produced. Analogue scale displays for the weighing of cement, mineral admixtures, aggregates and water shall be readily discernable from the operating position. For digital readouts the numerals shall be readily discernable from the operating position.

Fully automatic production systems shall be fitted with control equipment to allow the correct operation of the plant to be monitored during weighing and batching. Automatic control systems on batching plants shall not commence batching until all hoppers have been emptied and /or

tared and the scales zeroed unless such systems are designed to take account of buildup in their programming.

All scales shall be tested and calibrated as per Annex C.

5.9.6.4 ***Mixing***

(i) *Washing out Water:* Before loading concrete materials or mixed concrete into either a stationary mixer or truck mixer any water retained in the mixing drum for washing out purposes shall be completely discharged.

(ii) *Stationary or Central Mixers:* Stationary mixers shall not be loaded in excess of the manufacturer's rated capacity. The mixing time shall be measured from the time all the materials required for the batch, including water, are in the drum of the mixer. The mixing time shall not be less than that recommended by the manufacturer. Where a continuous mixing plant is used, the complete mixing time shall be sufficient to ensure that the concrete is of the required uniformity.

(iii) *Truck Mixers:* When a truck mixer is used for the partial or complete mixing of concrete, mixing shall be considered to commence from the moment when all the materials required for the batch, including water, are in the rotating drum of the mixer.

Truck or agitators shall not be loaded in excess of the manufacturer's rated capacity. In order to produce a satisfactory mix, and where there is no data available to establish different period and speed of revolutions, mixing shall continue for not less than 60 revolutions of the truck mixer drum at a rate of not less than 7 revolutions/min. All completely truck mixed concrete shall be visually inspected for uniformity prior to leaving the plant.

When a truck mixer or agitator is used for transporting concrete which has been mixed before leaving the plant, the concrete shall be agitated during transit and remixed at the site for at least 2 min so that the concrete is of the required uniformity.

Where water is added to the concrete in the truck mixer through the truck mixer water meter and when such water is being accounted for in the total water within the mix, it shall be ensured that the truck mixer water meter is in operational condition and properly calibrated. Where a water meter is not available, water must be measured in a suitable container before being added to the truck mixer.

(iv) *Condition of Mixers :* Stationary and truck mixers shall be maintained in an efficient and clean condition with no appreciable buildup of hardened concrete or cement in the mixing drum, on the mixing blades, or on the loading hopper or discharge chutes.

5.9.6.5 ***Delivery Ticket:*** Immediately before discharging the concrete at the point of delivery, the producer or his representative shall provide the purchaser with a preprinted delivery ticket for each delivery of concrete on which is printed, stamped or written the minimum information detailed invoicing as per Annex D.

5.9.7 Quality Control

Quality control of ready-mixed concrete may be divided into three components, forward control, immediate control and retrospective control.

5.9.7.1 ***Forward control:*** Forward control and consequent corrective action are essential aspects of quality control. Forward control includes the following.

(i) Control of purchased material Quality

(ii) Control of Materials storage

(iii) Mix design and mix design modification

(iv) *Transfer and Weighing Equipment:* The producer shall be able to demonstrate that a documented calibration procedure is in place. The use of electro- mechanical weighing and metering systems, that is, load cells, flow meters, magmeters, etc, is preferable over purely mechanical system, that is, knife edge and lever systems.

(v) Plant mixers where present and truck mixers used shall be in an operational condition.

5.9.7.2 ***Immediate Control:*** Immediate control is concerned with instant action to control the quality of the concrete being produced or that of deliveries closely following. It includes the production control and product control.

(i) *Production Control:* The production of concrete at each plant shall be systematically controlled. This is to ensure that all the concrete supplied shall be in accordance with these requirements and with the specifications that has formed the basis of the agreement between the producer and purchaser.

Each load of mixed concrete shall be inspected before dispatch and prior to discharge.

The workability of the concrete shall be controlled on a continuous basis during production and any corrective action necessary taken.

For each load, written, printed or graphical records shall be made of the mass of the materials batched, the estimated slump, the total amount of water added to the load, the delivery ticket number for that load, and the time the concrete was loaded into the truck.

Regular routine inspections shall be carried out on the condition of plant and equipment including delivery vehicles.

(ii) *Product Control:* Concrete mixes shall be randomly sampled and tested for workability and where appropriate, plastic density, temperature and air content. Where significant variations from target values are detected, corrective action shall be taken.

It is important to maintain the water cement ratio constant at its correct value. The amount of added water shall be adjusted to compensate for any observed variations in the moisture contents in the aggregates. Suitable adjustments should also be made in masses of the aggregates due to this variation (see IS 456). Any change in water content due to change in aggregate grading shall be taken care of by forward control by suitable modifications to mix design.

5.9.7.3 ***Retrospective Control:*** Retrospective control is concerned with those factors that influence the control of production. Retrospective control may cover any property of materials or concrete, such as aggregate grading, slump, or air content, but is particularly associated with 28-day cube strength because by its very nature it is not property which can be measured ahead of, or at the time of, manufacture.

5.9.7.4 ***Mix Performance:*** The producer shall be responsible for ensuring that suitable control procedures are in place ensure the following.

(i) *Design Mixes :* A quality control system shall be operated to control the strength of design mixes to the levels required as per IS 456 and shall be based on random tests of mixes which form the major proportion of production. The system shall include continuous

analysis of results from cube tests to compare actual with target values together with procedures for modifying mix proportions to correct for observed differences. Compressive strength testing shall be carried out using a machine that meets the requirements of IS 14858.

6 Specifications for Earth work:

Following codes shall be applicable

S. No	I.S. No.	Subject
	IS 1200 (Pt 1)	Gamma – BHC (Lindane) emulsifiable concentrates
	IS 1200 (Pt 1)	Method of measurement of earth work
	IS 632 Gamma	BHC (Lindane) emulsifiable concentrates Method of measurement of earth work
	IS 1200 (Pt-27)	Method of measurement of earth work (by Mechanical Appliances)
	IS 4081	Safety code for Blasting and related drilling operation
	IS 4988 (Part IV)	Excavators
	IS 6313 (pt-II)	Anti-Termite measures in buildings (pre -constructional)
	IS 6313(pt.-III)	Anti-Termite Measures in Buildings for existing buildings
	IS 6940	Methods of test for pesticides and their formulations
	IS 8944	Chlorpyrifos emulsifiable concentrates
	IS 8963	Chlorpyrifos – Technical specifications
	IS 12138	Earth moving Equipments

6.1 *Excavation in All Kinds of Soils*

All excavation operations manually or by mechanical means shall include excavation and 'getting out' the excavated materials. In case of excavation for trenches, basements, water tanks etc. 'getting out' shall include throwing the excavated materials at a distance of at least one metre or half the depth of excavation, whichever is more, clear off the edge of excavation. In all other cases 'getting out' shall include depositing the excavated materials as specified. The subsequent disposal of the excavated material shall be either stated as a separate item or included with the items of excavation stating lead.

During the excavation the natural drainage of the area shall be maintained. Excavation shall be done from top to bottom. Undermining or undercutting shall not be done.

In firm soils, the sides of the trenches shall be kept vertical up to a depth of 2 metres from the bottom. For greater depths, the excavation profiles shall be widened by allowing steps of 50 cms on either side after every 2 metres from the bottom. Alternatively, the excavation can be done so as to give slope of 1:4 (1 horizontal: 4 vertical). Where the soil is soft, loose or slushy, the width of steps shall be suitably increased or sides sloped or the soil shored up as directed by the Engineer-in-Charge. It shall be the responsibility of the contractor to take complete instructions in writing from the Engineer-in-Charge regarding the stepping , sloping or shoring to be done for excavation deeper than 2 metres.

The excavation shall be done true to levels, slope, shape and pattern indicated by the Engineer-in-Charge. Only the excavation shown on the drawings with additional allowances for centering and shuttering or as required by the Engineer-in-Charge shall be measured and recorded for payment.

In case of excavation for foundation in trenches or over areas, the bed of excavation shall be to the correct level or slope and consolidated by watering and ramming. If the excavation for foundation is done to a depth greater than that shown in the drawings or as required by the Engineer-in-Charge, the excess depth shall be made good by the contractor at his own cost with the concrete of the mix used for levelling/ bed concrete for foundations. Soft/defective spots at the bed of the foundations shall be dug out and filled with concrete (to be paid separately) as directed by the Engineer-in-Charge. 2.7.6 While carrying out the excavation for drain work care shall be taken to cut the side and bottom to the required shape, slope and gradient. The surface shall then be properly dressed. If the excavation is done to a depth greater than that shown on the drawing or as required by the Engineer-in-Charge, the excess depth shall be made good by the contractor at his own cost with stiff clay puddle at places where the drains are required to be pitched and with ordinary earth, properly watered and rammed, where the drains are not required to be pitched. In case the drain is required is to be pitched, the back filling with clay puddle, if required, shall be done simultaneously as the pitching work proceeds. The brick pitched storm water drains should be avoided as far as possible in filled-up areas and loose soils.

In all other cases where the excavation is taken deeper by the contractor, it shall be brought to the required level by the contractor at his own cost by filling in with earth duly watered, consolidated and rammed.

In case the excavation is done wider than that shown on the drawings or as required by the Engineer-in-Charge, additional filling wherever required on the account shall be done by the contractor at his own cost.

The excavation shall be done manually or by mechanical means as directed by Engineer-in-charge considering feasibility, urgency of work, availability of labour /mechanical equipment's and other factors involved. Contractor shall ensure every safety measures for the workers. Neither any deduction will be made nor any extra payment will be made on this account.

6.2 *Filling*

The earth used for filling shall be free from all roots, grass, shrubs, rank vegetation, brushwood, tress, sapling and rubbish.

Filling with excavated earth shall be done in regular horizontal layers each not exceeding 20 cm in depth. All lumps and clods exceeding 8 cm in any direction shall be broken. Each layer shall be watered and consolidated with steel rammer or ½ tonne roller. Where specified, every third and top must layer shall also be consolidated with power roller of minimum 8 tonnes. Wherever depth of filling exceeds 1.5 metre vibratory power roller shall be used to consolidate the filing unless otherwise directed by Engineer-in-charge. The top and sides of filling shall be neatly dressed. The contractor shall make good all subsidence and shrinkage in earth fillings, embankments, traverses etc. during execution and till the completion of work unless otherwise specified.

7 Cement Concrete Pipes (with and without Reinforcement) (Light Duty, Non-Pressure)

The pipes shall be with reinforcement and shall be of class NP3. These shall conform to IS 458 and shall be capable of withstanding a test pressure of 0.07 MPa (7 m head). The reinforced cement concrete pipes shall be manufactured by centrifugal (or spun) process while un-reinforced cement concrete pipes by spun or pressure process. All pipes shall be true to shape,

straight, perfectly sound and free from cracks and flaws. The external and internal surface of the pipes shall be smooth and hard. The pipes shall be free from defects resulting from imperfect grading of the aggregate mixing or moulding.

Concrete used for the manufacture of un-reinforced and reinforced concrete pipes and collars shall not be leaner than 1:2:4 (1 cement: 2 coarse sand: 4 graded stone aggregate). The maximum size of aggregate should not exceed one third of the thickness of the pipe or 20 mm whichever is smaller for pipes above 250 mm internal diameter. But for pipes of internal diameter 80 to 250 mm, the maximum size of aggregate should be 10mm. The reinforcement in the reinforced concrete pipes shall extend throughout the length of the pipe. The circumferential and longitudinal reinforcements shall be adequate to withstand the specified hydrostatic pressure and further bending stresses due to the weight of water when running full across a span equal to the length of pipe plus three times its own weight.

The minimum clear cover for reinforcement in pipes and collars shall be as given below

S. No.	Precast concrete pipe/collar	Minimum clear cover, mm
(i)	Barrel wall thickness	
(a)	Up to and including 75 mm	8
(b)	Over 75 mm	15
(ii)	At spigot steps	5
(iii)	At end of longitudinal	5

Note: An effective means shall be provided for maintaining the reinforcement in position and for ensuring correct cover during manufacture of the unit. Spacers for this purpose shall be of rust proof material or of steel protected against corrosion.

7.1 *Laying and Jointing Cement Concrete Pipes and Specials*

(i) Trenches: Trenches shall be as described in clause 18.4.4 volume 2 CPWD specifications. Where the pipes are to be bedded directly on soil, the bed shall be suitably rounded to fit the lower part of the pipe, the cost for this operation being included in the rate for laying the pipe itself.

(ii) Loading, transporting and unloading of concrete pipes shall be done with care. Handling shall be such as to avoid impact. Gradual unloading by inclined plane or by chain pulley block is recommended. All pipe sections and connections shall be inspected carefully before being laid. Broken or defective pipes or connections shall not be used. Pipes shall be lowered into the trenches carefully. Mechanical appliances may be used. Pipes shall be laid true to line and grade as specified. Laying of pipes shall proceed upgrade of a slope.

(iii) If the pipes have spigot and socket joints, the socket ends shall face upstream. In the case of pipes with joints to be made with loose collars, the collars shall be slipped on before the next pipe is laid. Adequate and proper expansion joints shall be provided where directed.

(iv) In case where foundation conditions are unusual such as in the proximity of trees or holes, under existing or proposed tracks manholes etc. the pipe shall be encased all-around in 15 cm thick cement concrete 1:5:10 (1 cement : 5 fine sand : 10 graded stone aggregate 40 mm nominal size) or compacted sand or gravel.

(v) In cases where the natural foundation is inadequate the pipes shall be laid either in concrete cradle supported on proper foundations or on any other suitably designed structure. If a concrete cradle bedding is used the depth of concrete below the bottom of the pipe shall be

at least 1/4th of the internal dia of the pipe subject to the min. of 10 cm and a maximum of 30 cm. The concrete shall extend up the sides of the pipe at least to a distance of 1/4th of the outside diameter of pipes 300 mm and over in dia. The pipe shall be laid in this concrete bedding before the concrete has set. Pipes laid in trenches in earth shall be bedded evenly and firmly and as far up the haunches of the pipe as to safely transmit the load expected from the backfill through the pipe to the bed. This shall be done either by excavating the bottom of the trench to fit the curve of the pipe or by compacting the earth under around the curve of the pipe to form an even bed. Necessary provision shall be made for joints wherever required.

(vi) When the pipe is laid in a trench in rock hard clay, shale or other hard material the space below the pipe shall be excavated and replaced with an equalizing bed of concrete, sand or compacted earth. In no place shall pipe be laid directly on such hard material.

(viii) When the pipes are laid completely above the ground the foundations shall be made even and sufficiently compacted to support the pipe line without any material settlement. Alternatively the pipe line shall be supported on rigid foundations at intervals. Suitable arrangements shall be made to retain the pipe line in the proper alignment, such as by shaping the top of the supports to fit the lower part of the pipe. The distance between the supports shall in no case exceed the length of the pipe. The pipe shall be supported as far as possible close to the joints. In no case shall the joints come in the centre of the span. Care shall be taken to see that super imposed loads greater than the total load equivalent to the weight of the pipe when running full shall not be permitted. Suitably designed anchor blocks at change of direction and grades for pressure lines shall be provided where required.

(ix) Jointing: Joints are generally of rigid type. Where specified flexible type joints may also be provided.

(a) Rigid Spigot and Socket Joint: The spigot of each pipe shall be slipped home well into the socket of the pipe previously laid and adjusted in the correct position. The opening of the joint shall be filled with stiff mixture of cement mortar in the proportion of 1:2 (1 cement: 2 fine sand) which shall be rammed with caulking tool. After a day's work any extraneous material shall be removed from the inside of the pipe and the newly made joint shall be cured.

(b) Rigid Collar Joint: The two adjoining pipes shall be butted against each other and adjusted in correct position. The collar shall then be slipped over the joint, covering equally both the pipes. The annular space shall be filled with stiff mixture of cement mortar 1:2 (1 cement: 2 fine sand) which shall be rammed with caulking fool. After a day's work any extraneous materials shall be removed from the inside of the pipe and the newly made joint shall be cured.

(c) Semi Flexible Spigot and Socket Joint: The joint is composed of specially shaped spigot and socket ends on the concrete pipes. A rubber ring shall be placed on the spigot which shall be forced into the socket of the pipe previously laid. This compresses the rubber ring as it rolls into the annular space formed between the two surfaces of the spigot and the socket, stiff mixture of cement mortar 1:2 (1 cement: 2 fine sand) shall then be filled into the remaining annular space and rammed with a caulking tool. After days work any extraneous materials shall be removed from the inside of the pipe and the newly made joint shall be cured.

(d) Semi Flexible Collar Joint: This is made up of a loose collar which covers two specially shaped pipe ends as shown in the Fig. 19.10. Each end shall be fitted with a rubber ring which when compressed between the spigot and the collar, seal the joint. Stiff mixture cement mortar 1:2 (1 cement: 2 fine sand), shall then be filled

into the remaining annular space and rammed with a caulking tool. After day's work, any extraneous material shall be removed from the inside of the pipe and the newly made joint shall be cured.

(e) Internal Flush Joint (Fig. 19.10): This joint is generally used for culvert pipe of 60 cm dia and over. The ends of the pipe are specially shaped to form a self-centering joint with an internal jointing space 1.3 cm wide the finished joint is flush with both inside and outside with the pipe wall as shown in Fig. 19.10. The jointing space is filled with cement mortar 1:2 (1 cement: 2 fine sand) mixed sufficiently dry to remain in position when forced with a trowel or rammer. After day's work, any extraneous material shall be removed from the inside of the pipe and the newly made joint shall be cured.

(f) External Flush Joint: This joint is suitable for pipes which are too small for jointing from inside. This joint is composed of specially shaped pipe ends as shown in. Each end shall be butted against each other and adjusted in correct position. The jointing space shall then be filled with cement mortar 1:2 (1 cement: 2 fine sand) sufficiently dry and finished off flush. Great care shall be taken to ensure that the projecting ends are not damaged as no repairs can be readily affected from inside the pipe.

(x) In all pressure pipe lines the recess at the end of the pipe line shall be filled with jute braiding dipped in hot bitumen or other suitable approved compound. Pipes shall be so jointed that the bitumen ring of one pipe shall set into the recess of the next pipe. The ring shall be thoroughly compressed by jacking or by any other suitable method. The number of pipes that shall be jacked together at a time shall depend on the diameter of the pipes and the bearing capacity of the soil, for small pipes up to 25 cm diameter, six pipes can be jacked together at a time. The quantity of jute and bitumen in the ring shall be just sufficient to fill the recess in the pipe when pressed hard by jacking or by any other suitable method. Before and during jacking care shall be taken to see that there is no offset at the joint.

(xi) Testing: For pressure pipes, the completed pipeline shall be tested for pressure (Known as site test pressure) which shall not be less than the maximum pipeline operating pressure plus the calculated surge pressure, but in no case shall it exceed the hydrostatic test pressure.

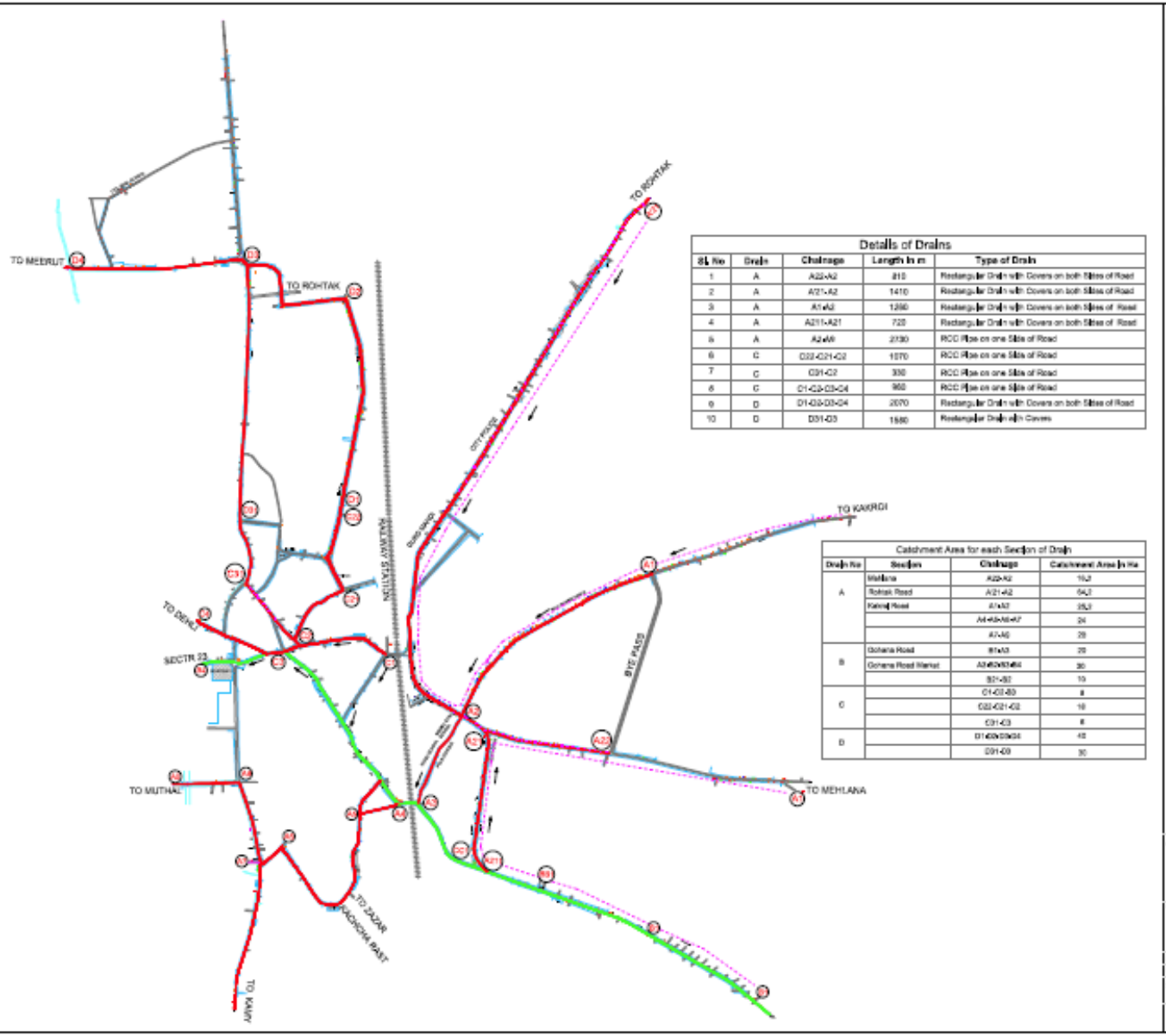
(xii) Refilling of Trenches: In case where pipes are not bedded on concrete special care shall be taken in refilling, trenches to prevent the displacement and subsequent settlement at the surface resulting in uneven street surfaces and dangers to foundations etc. The backfilling materials shall be packed by hand under and around the pipe and rammed with a shovel and light tamper. This method of filling will be continued up to the top of pipe. The refilling shall rise evenly on both sides of the pipe and continued up to 60 cm above the top of pipe so as not to disturb the pipe. No tamping shall be done within 15 cm of the top of pipe. The tamping shall become progressively heavier as the depth of the backfill increases.

(xiii) Measurements : The lengths of pipes shall be measured in running metres nearest to a cm as laid or fixed, from inside of one manhole to the inside of the other manhole. The length shall be taken along the centre line of the pipes over all fittings such as bends, collars, junctions, etc. which shall not be measured separately. Excavation, refilling, shoring and timbering in trenches, and cement concreting wherever required shall be measured separately under relevant items of work.

(xiv) Rate: The rate shall include the cost of materials and labor involved in all the operations described above.

8 Drawings and Figures

S.No	Drawing No.	Name of the Drawing
1	NCRPB-Sonipat-DR-01	Sonipath Layout Plan of Drainage
2	NCRPB-Sonipat-DR-01A	Sonipath Existing Drains
3	NCRPB-Sonipat-DR-02	Sonipath Cross Section of Drain
4	NCRPB-Sonipat-DR-03A	Typical detail of Manhole Type A for depth 0.91 to 1.65m
5	NCRPB-Sonipat-DR-03B	Typical detail of Manhole Type B for depth 1.66 to 2.3m
6	NCRPB-Sonipat-DR-03C	Typical detail of Manhole Type B for depth 2.3m above
7	NCRPB-Sonipat-DR-04	Box Girder of 6m width
8	NCRPB-Sonipat-DR-05A	Plan & Longitudinal Section from chainage 00m to 1260m (A1-A2)
9	NCRPB-Sonipat-DR-05B	Plan & Longitudinal Section from chainage 00m to 2730m (A2-A9)
10	NCRPB-Sonipat-DR-05C	Plan & Longitudinal Section from chainage 00m to 720m (A211-A21)
11	NCRPB-Sonipat-DR-05D	Plan & Longitudinal Section from chainage 00m to 810m (A22-A21-A2)
12	NCRPB-Sonipat-DR-05E	Plan & Longitudinal Section from chainage 00m to 1410m (A21-A2)
13	NCRPB-Sonipat-DR-06A	Plan & Longitudinal Section from chainage 00m to 1080m (C22-C21-C2)
14	NCRPB-Sonipat-DR-06B	Plan & Longitudinal Section from chainage 00m to 330m (C31-C2)
15	NCRPB-Sonipat-DR-06C	Plan & Longitudinal Section from chainage 00m to 960m (C1-C2-C3-C4)
16	NCRPB-Sonipat-DR-07A	Plan & Longitudinal Section from chainage 00m to 2070m (D1-D2-D3-D4)
17	NCRPB-Sonipat-DR-07B	Plan & Longitudinal Section from chainage 00m to 1590m (D1-D3)
18	Figure 1	Rainwater Harvesting structure of 3.0 m
19	Figure 2	Cross section of 3.0m Radius Injection Well
20	Figure 3	Foundation Dimensions



Details of Drains

SL No	Drain	Chainage	Length in m	Type of Drain
1	A	A22-A2	810	Rectangular Drain with Covers on both Sides of Road
2	A	A21-A2	1410	Rectangular Drain with Covers on both Sides of Road
3	A	A1-A2	1280	Rectangular Drain with Covers on both Sides of Road
4	A	A211-A21	720	Rectangular Drain with Covers on both Sides of Road
5	A	A2-A1	2130	RCC Pipe on one Side of Road
6	C	C22-C21-C2	1370	RCC Pipe on one Side of Road
7	C	C21-C2	330	RCC Pipe on one Side of Road
8	C	C1-C2-C3-C4	960	RCC Pipe on one Side of Road
9	D	D1-D2-D3-D4	2070	Rectangular Drain with Covers on both Sides of Road
10	D	D31-D3	1680	Rectangular Drain with Covers

Catchment Area for each Section of Drain

Drain No	Section	Chainage	Catchment Area in Ha
A	Mellana	A22-A2	10.2
	Rohtak Road	A21-A2	54.2
	Kakroi Road	A1-A2	35.3
		A4-A3-A2-A1	24
		A7-A6	28
B	Gohana Road	B1-A3	20
	Gohana Road Hamlet	A5-A4-A3-A2	30
		B21-B2	10
C		C1-C2-B2	8
		C22-C21-C2	10
		C31-C3	8
D		D1-D2-D3-D4	45
		D31-D3	30

Capcity Development of the NCRPB; Component B (ADB TA-7055)

Sonipath
Layout Plan of Drainage

Legend

- Road
- Railway Track
- Transformer
- Chimni
- Electric Pole
- Hand Pump
- Telephone Box
- Lamp Post
- Tree
- Tbm
- Temples
- Km Stone
- Man Hole
- Building
- Culvert

Overlay Legend

- Existing Drainage
- Proposed Drainage

Client:
Asian Development Bank
National Capital Region Planning Board

Consultant:
Wilbur Smith Associates

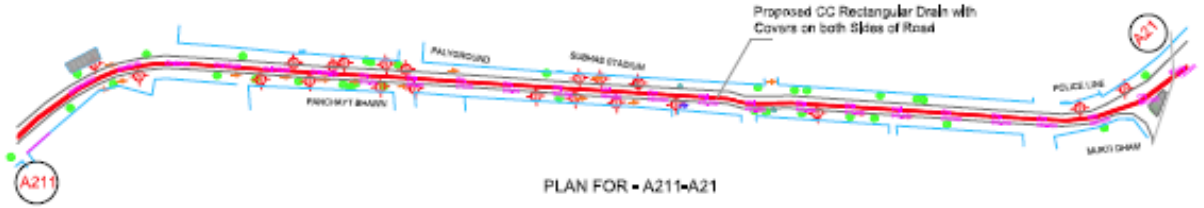
Drawn: SK | Checked: HVG
Date: Sept,2010 | Approved: NBB

Scale: 0 100 200 400 600 Metres

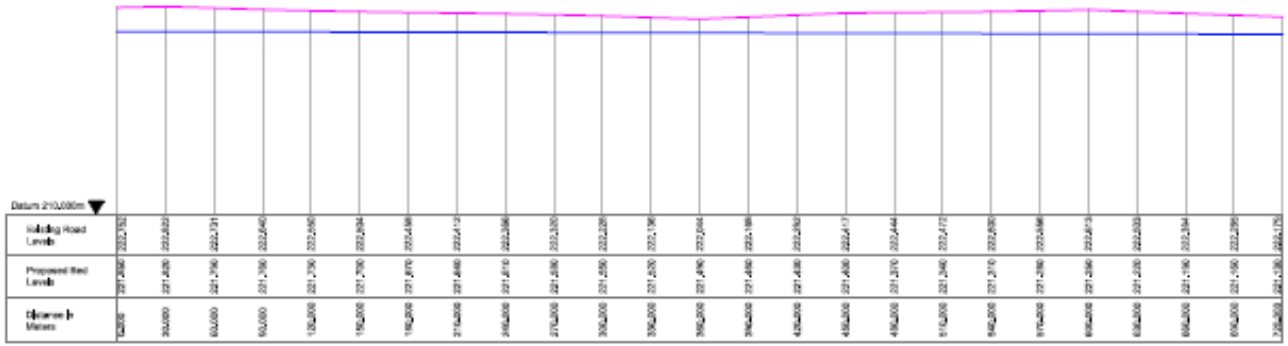
Drg. No.NCRPB-SON|PATH-DR-01

Capcity Development of the NCRPB: Component B (ADB TA-7055)

Sonipath
Plan &Longitudinal Section from Chainage 00 m to 720m (A211 - A21)



PLAN FOR - A211-A21



LONGITUDINAL SECTION FROM CHAINAGE 00m TO 720m
A211-A21

Legend

- Road
- Transformer
- Culvert
- Electric Pole
- Hand Pump
- Telephone Box
- Lamp Post
- Tree
- Tbm
- Temple
- Km Stone
- Man Hole
- Building
- Culvert

Overlay Legend

- Existing Road Level
- Proposed Bed Level

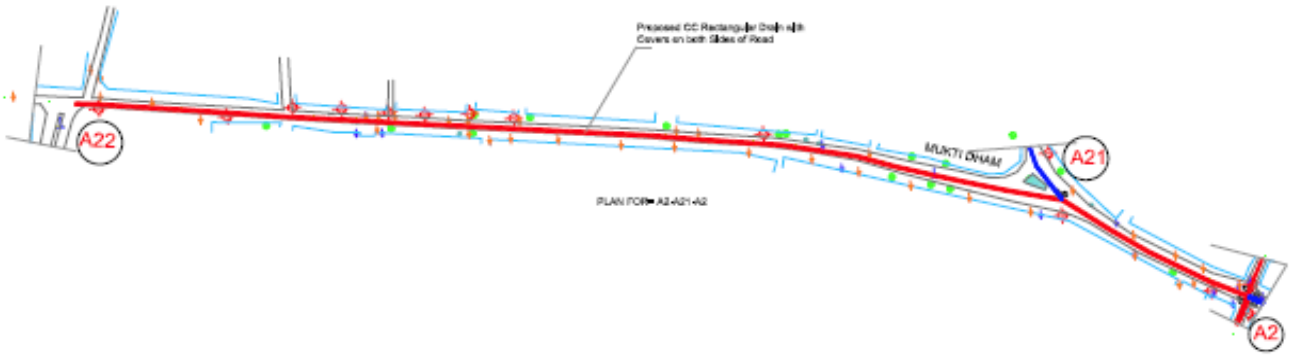
Client:
Asian Development Bank
National Capital Region Planning Board

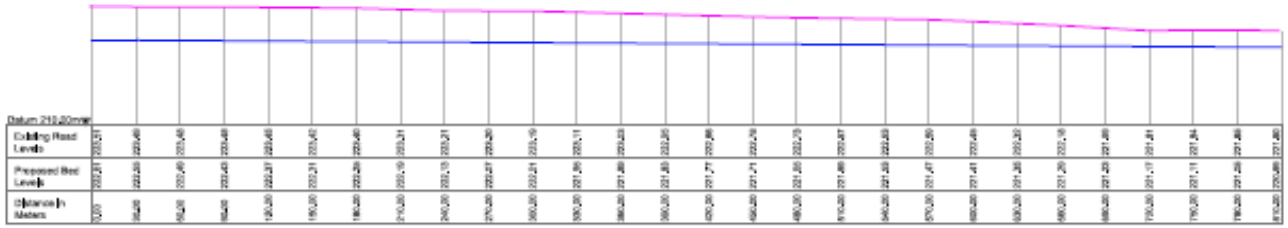
Consultant:
Wilbur Smith Associates

Drawn: BK	Checked: HVS
Date: Sept. 2010	Approved: NS

Scale: 10 20 40 60 80 Metres

Drg. No.NCRPB-SONIPATH-DR-05C





LONGITUDINAL SECTION FROM CHAINAGE 00m TO 810m
A22-A21-A2

Capcity Development of the NCRPB; Component B (ADB TA-7055)

Sonipath
Plan & Longitudinal Section from Chainage 00 m to 810m (A22 - A21-A2)

Legend

- Road
- Transformer
- Chinni
- Electric Pole
- Hand Pump
- Telephone Box
- Lamp Post
- Tree
- Tan
- Temple
- Km Stone
- Man Hole
- Building
- Culvert

Overlay Legend

- Existing Road Level
- Proposed Bed Level

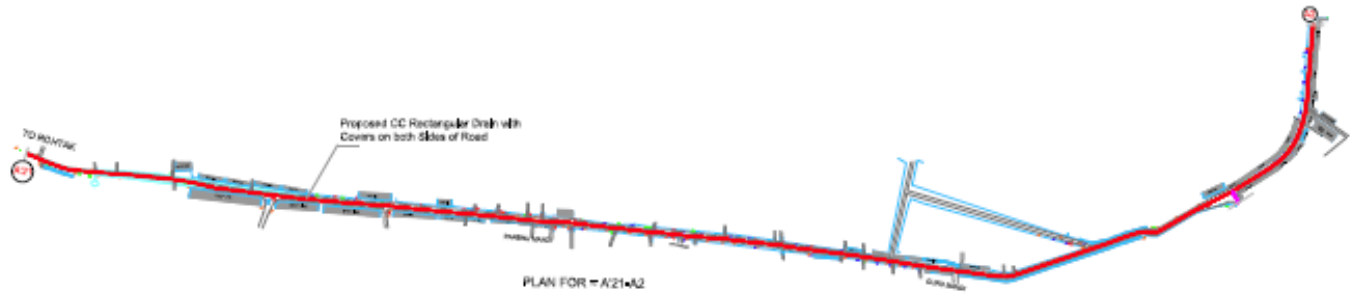
Client
Asian Development Bank
National Capital Region Planning Board

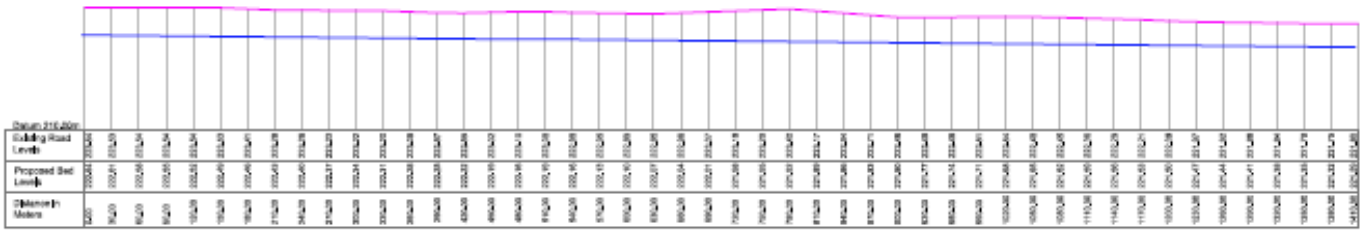
Consultant
Wilbur Smith Associates

Drawn: BK	Checked: HVS
Date: Sept, 2010	Approved: SS

Scale: 0 20 40 60 80 Metres

Drg. No.NCRPB-SON(PATH-DR-05D





LONGITUDINAL SECTION FROM CHAINAGE 00 m TO 1410 m
A'21-A2

Capcity Development of the NCRPB: Component B (ADB TA-7055)

Sonipath
Plan & Longitudinal Section from Chainage
00 m to 1410 m (A'21 - A2)

Legend

- Road
- Transformer
- Chimni
- Electric Pole
- Hand Pump
- Telephone Box
- Lamp Post
- Tree
- Tan
- Temples
- Km Stone
- Man Hole
- Building
- Culvert

Overlay Legend

- Existing Road Level
- Proposed Bed Level

Client:
Asian Development Bank
National Capital Region Planning Board

Consultant:
Wilbur Smith Associates

Drawn BK	Checked HVS
Date: Sept. 2010	Approved NS

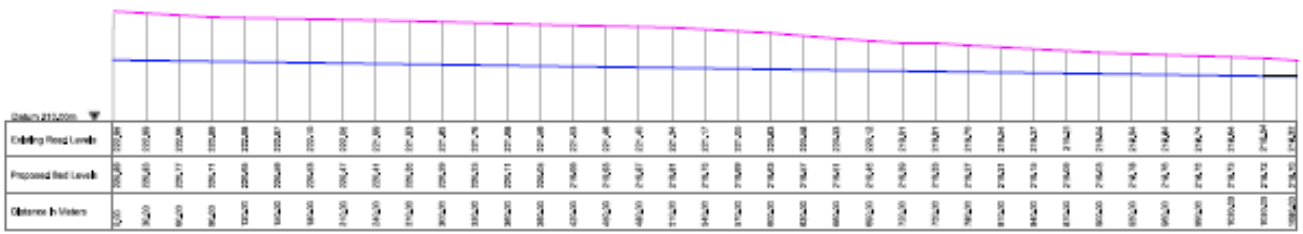
Scale:

Drg. No.NCRPB-SONIPATH-DR-05E

Capcity Development of the NCRPB: Component B (ADB TA-7055)

Sonipath
Plan & Longitudinal Section from Chainage 00 m to 1080 m (C22-C21-C2)

PLAN FOR C22-C21-C2



LONGITUDINAL SECTION FROM CHAINGE 00 m TO 1080.00 m
C22-C21-C2

Legend

- Road
- Transformer
- Chimni
- Electric Pole
- Hand Pump
- Telephone Box
- Lamp Post
- Tree
- Tbm
- Temple
- Km Stone
- Man Hole
- Building
- Culvert

Overlay Legend

- Existing Road Level
- Proposed Bed Level

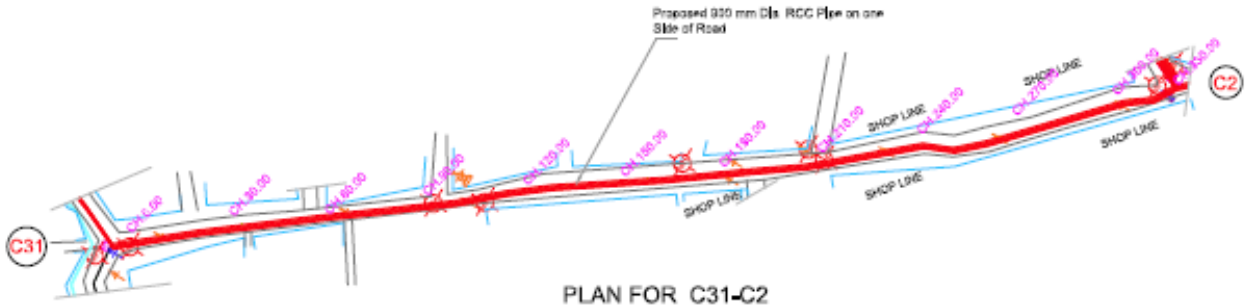
Client
Asian Development Bank
National Capital Region Planning Board

Consultant
Wilbur Smith Associates

Drawn | SK	Checked | HVS
Date: Sept, 2010	Approved | SS

Scale: 0 20 40 80 120 160 Metres

Drg. No.NCRPB-SONIPATH-DR-06A



PLAN FOR C31-C2

Datum 210.00m

Existing Road Levels	221.57	221.56	221.55	221.48	221.38	221.39	221.40	221.27	221.14	220.97	220.80	220.68
Proposed Bed Levels	219.57	219.51	219.45	219.39	219.33	219.27	219.21	219.15	219.09	219.03	218.97	218.91
Distance In Meters	0.00	30.00	60.00	90.00	120.00	150.00	180.00	210.00	240.00	270.00	300.00	330.00

LONGITUDINAL SECTION FROM CHAINGE 00 m TO 330.00 m
C31-C2

Capcity Development of the NCRPB: Component B (ADB TA-7055)

Sonipath
Plan & Longitudinal Section from Chainage 00 m to 330 m (C31 - C2)

Legend

- Road
- Transformer
- Chimney
- Electric Pole
- Hand Pump
- Telephone Box
- Lamp Post
- Tree
- Tank
- Temple
- Km Stone
- Man Hole
- Building
- Culvert

Overlay Legend

- Existing Road Level
- Proposed Bed Level

Client:
Asian Development Bank
National Capital Region Planning Board

Consultant:
Wilbur Smith Associates

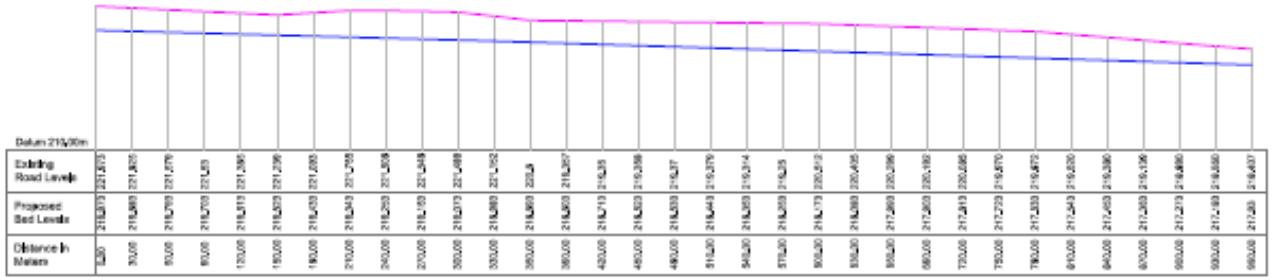
Drawing By: | Checked By: HVS
Date: Sept. 2010 | Approved By: SS
Scale: 00 15 30 45 60 Metres

Drg. No.NCRPB-SON|PATH-DR-06B

Capcity Development of the NCRPB: Component B (ADB TA-7055)

Sonipath
Plan & Longitudinal Section from Chainage 00 m to 960 (C1+C2+C3+C4)

PLAN FOR C1- C2- C3- C4



LONGITUDINAL SECTION FROM CHAINAGE 00 m TO 960 m
C1 • C2 • C3 • C4

Legend

- Road
- Railway Line
- Transformer
- Chimni
- Electric Pole
- Hand Pump
- Telephone Box
- Lamp Post
- Tree
- Tbm
- Temples
- Km Stone
- Man Hole
- Building
- Culvert

Overlay Legend

- Existing Road Level
- Proposed Bed Level

Client:
Asian Development Bank
National Capital Region Planning Board

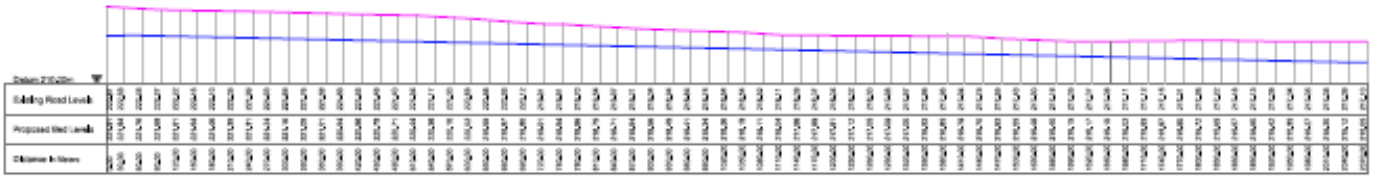
Consultant:
Wilbur Smith Associates

Drawn: SK	Checked: HVS
Date: Sept, 2010	Approved: HVS

Scale: 30 0 30 60 90 120 Meters

Drg. No. NCRPB/SONIPATH/DR-05C

PLAN FOR D1-D2-D3-D4



LONGITUDINAL SECTION FROM CHAINGE 00 m TO 2070.00 m
D1-D2-D3-D4

Capacity Development of the NCRPB: Component B (ADB TA-7055)

Sonipath
Plan & Longitudinal Section from Chainage 00 m to 2070m (D1-D2-D3-D4)

Legend

- Road
- Transformer
- Chimni
- Electric Pole
- Hand Pump
- Telephone Box
- Lamp Post
- Tree
- Tbm
- Temples
- Km Stone
- Man Hole
- Building
- Culvert

Overlay Legend

- Existing Road Level
- Proposed Bed Level

Client:
Asian Development Bank
National Capital Region Planning Board

Consultant
Wilbur Smith Associates

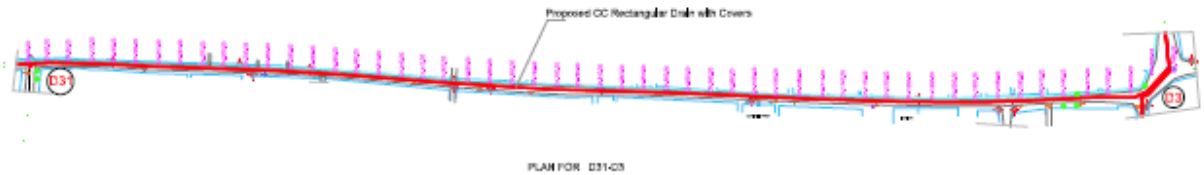
Drawn: SK	Checked: HVS
Date: Sept, 2010	Approved: SS

Scale: 0 75 150 225 300 Metres

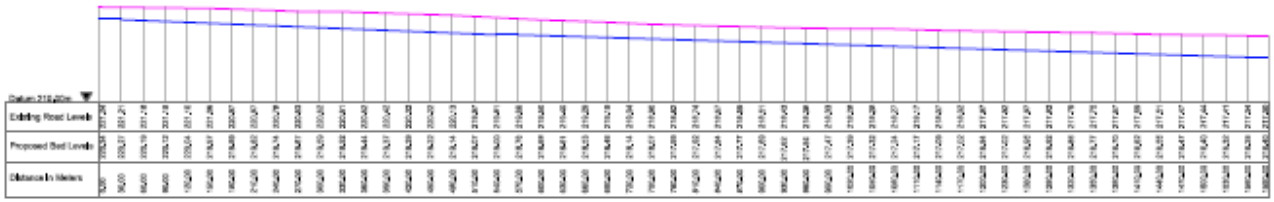
Drg. No.NCRPB-SONIPATH-DR-07A

Capcity Development of the NCRPB: Component B (ADB TA-7055)

Sonipath
Plan & Longitudinal Section from Chainage 00 m to 1590m (D31-03)



PLAN FOR D31-03



LONGITUDINAL SECTION FROM CHAINAGE 00m TO 1590m
D31-03

Legend

- Road
- Transformer
- Chimney
- Electric Pole
- Hand Pump
- Telephone Box
- Lamp Post
- Tree
- Tank
- Temples
- Km Stone
- Man Hole
- Building
- Culvert

Overlay Legend

- Existing Road Level
- Proposed Bed Level

Client:
Asian Development Bank
National Capital Region Planning Board

Consultant:
Wilbur Smith Associates

Drawn: SK	Checked: HVS
Dated: Sept, 2010	Approved: NRB

Scale: 00 75 150 225 300 Metres

Drg. No.NCRPB-SONIPATH-DR-07B

Capcity Development of the NCRPB: Component B (ADB TA-7055)

Sonipath
Existing Drains

Legend

- Road
- Railway Track
- Transformer
- Chimni
- Electric Pole
- Hand Pump
- Telephone Box
- Lamp Post
- Tree
- Tbm
- Temple
- Km Stone
- Man Hole
- Culvert

Overlay Legend

- Drain No.8
- Other Drains (1500 mm Dia Existing Pipe)

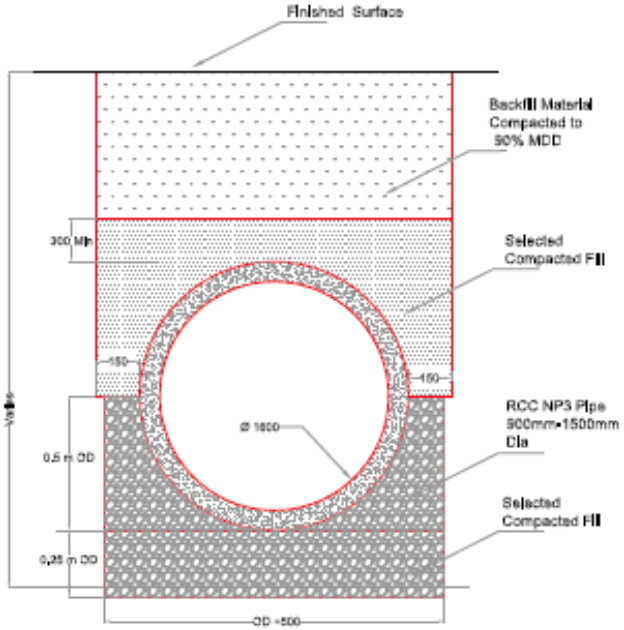
Client
Asian Development Bank
National Capital Region Planning Board

Consultant
Wilbur Smith Associates

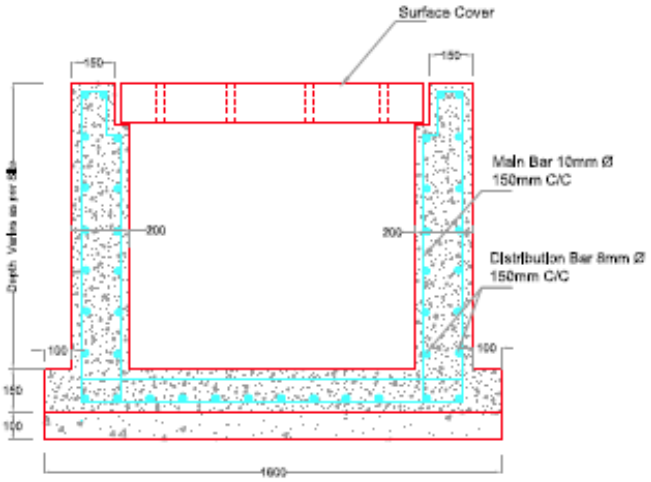
Drawn: SK	Checked: HVS
Date: [illegible] 2010	Approved: [illegible]

Scale: 0 100 200 400 600 Metres

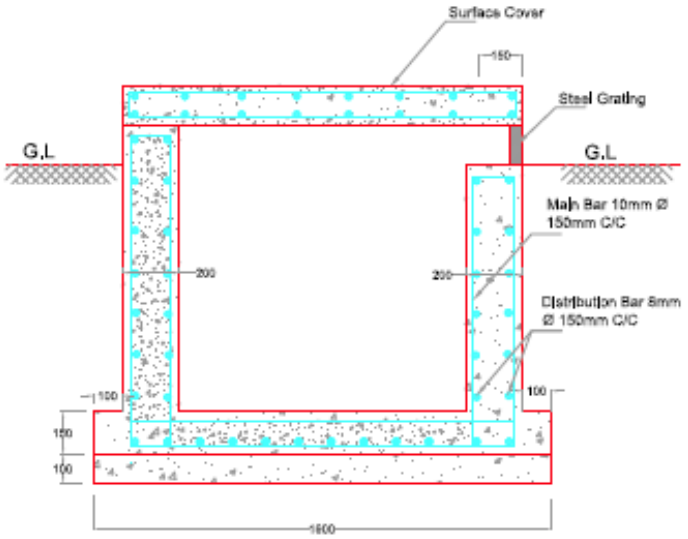
Drg. No.NCRPB-SONIPATH-DR-01 A



Cross Section of R.C.C Pipe Drain



Cross Section of Rectangular Drain



Cross Section of Rectangular Drain

Capcity Development of the NCRPB; Component B (ADB TA-7055)

Sonipath
Cross Section of Drain

Legend

OC - Outer Diameter
IC - Inner Diameter

Notes

1. All Dimensions are in Millimetres Unless Otherwise Noted
2. Add Extra Concrete for Raising the Top of Drain Wherever Necessary
3. Earthwork Excavation over and Above Standard Depths are to be Arrived for Level & Cut
4. In all Concrete Items Coarse Aggregate shall be 20mm.

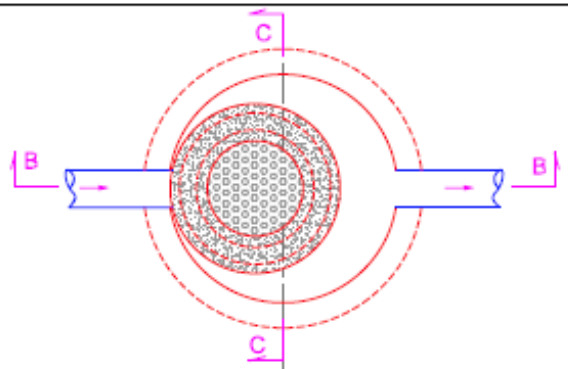
Client
Asian Development Bank
National Capital Region Planning Board

Consultant
Wilbur Smith Associates

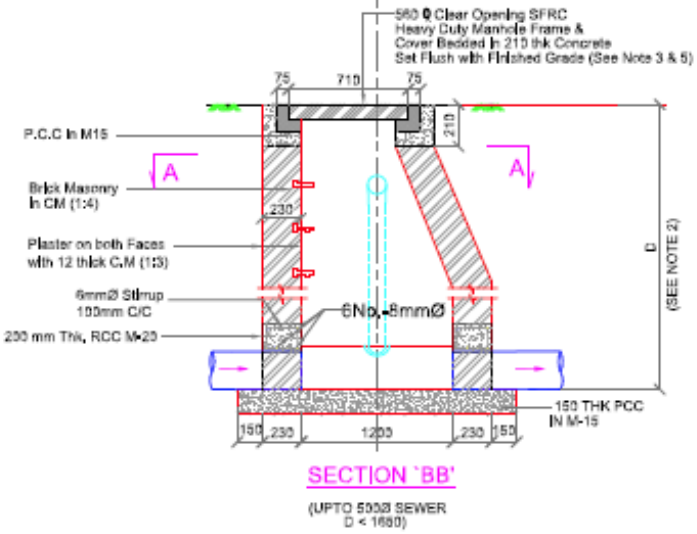
Drawn BK	Checked HVR
Date: Sept. 2010	Approved NSS

Scale: NTS

Drg. No. NCRPB/SONIPATH/DR-02



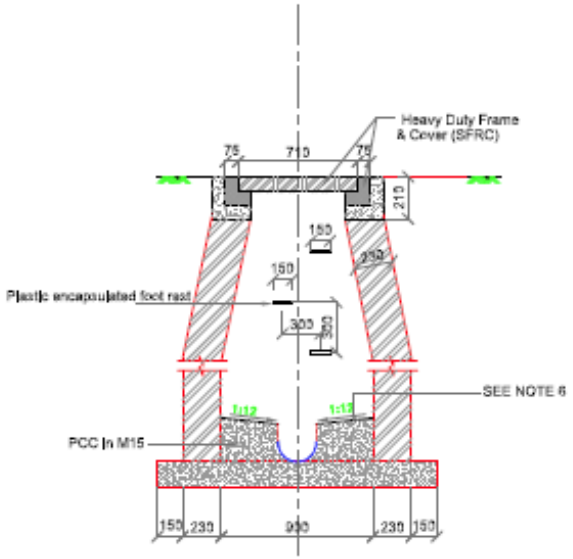
SECTION 'AA'



SECTION 'BB'

(UPTO 500Ø SEWER
D < 1600)

FOR R.C.C. PIPES



SECTION 'CC'

Capcity Development of the NCRPB; Component B (ADB TA-7055)

Sonipath
Typical Details of Manhole Type "A"
for Depth 0.91 to 1.85 m

Legend

THK	------	Thick
PCC	------	Plain Cement Concrete
EQ	------	Equal
SFRC	------	Steel Fibre Reinforced Concrete

Notes

1.All Dimensions are in mm.

2.'D' is The Depth from Ground Level to Lowest Sewer Invert Level in Manhole.

3.210 Thickness of Concrete Can be Varied to Flush Manhole Cover and Frame with Road Surface

4.SFRC Manhole Frame & Cover of Heavy Duty as Per I.S.12592 (Part I & II)

5.The Benching at the Side of the Channel Shall be at Least 50mm Above the Crown of the Pipe and then Rise with a Slope of 1 in 12 towards the Side of the Manhole. Semicircular Portion will be Achieved in Cement Concrete Finishing Itself.

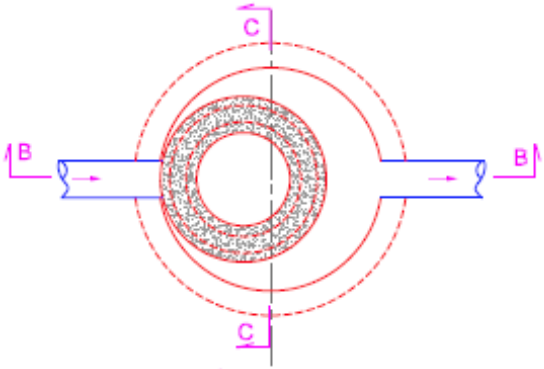
Client
Asian Development Bank
National Capital Region Planning Board

Consultant
Wilbur Smith Associates

Drawn BK	Checked MSS
Date: Sept. 2010	Approved: MSS

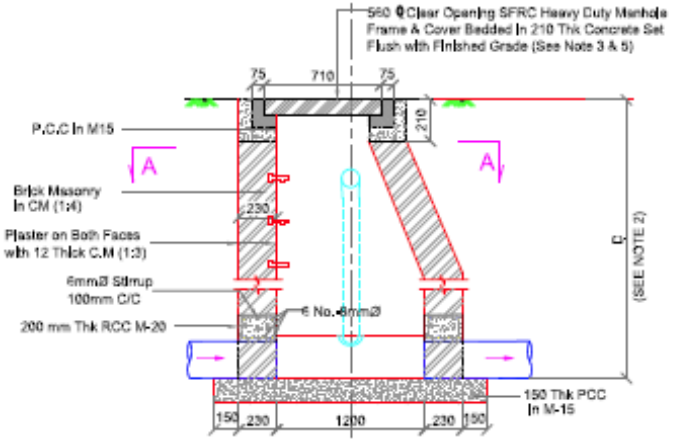
Scale: 0 300 600 900 1200 1500 mm

Drg. No. NCRPB/SONIPATH/DR-03A



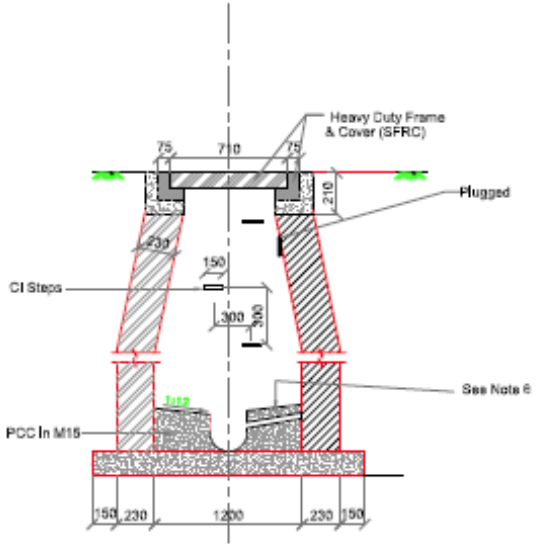
Section 'AA'

Sr No.	Type of Manhole	Depth(m)	Size of Manhole	Pipe Size
01	RaType	0.80	900x900	Upto 300Ø
02	A+Type	0.81-1.65	900mm Dia	Upto 500Ø
03	B-Type	1.66 to 2.30	1200mm Dia	Upto 600Ø
04	C+Type	2.31 to above	1500mm Dia	Upto 900Ø
05	D+Type	---	1800mm Dia	1000Ø to 1400Ø
06	E-Type	---	2400mm Dia	1600Ø to 1800Ø



Section 'BB'

(UPTO 600Ø Sewer
D = 1650 TO 2300)



Section 'CC'

For R.C.C. Pipes

Capacity Development of the NCRPB: Component B (ADB TA-7055)

Sonipath
Typical Details of Manhole Type "B" for Depth 1.66 to 2.30 m

Legend

THK	------	Thick
PCC	------	Plain Cement Concrete
EQ	------	Equal
SFRC	------	Steel Fibre Reinforced Concrete

Notes

1.All Dimensions are in mm.

2.'D' is The Depth from Ground Level to Lowest Sewer Invert Level in Manhole.

3.210 Thickness of Concrete Can be Varied to Flush Manhole Cover and Frame with Road Surface

4.SFRC Manhole Frame & Cover of Heavy Duty as Per I.S.12592 (Part I & II)

5.CI Step Fixed with Cement Concrete 1:2:4.

6.The Benching at the Side of the Channel Shall be at Least 50mm Above the Crown of the Pipe and then Rise with a Slope of 1 in 12 Towards the Side of the Manhole. Semicircular Portion will be Achieved in Cement Concrete Finishing Itself.

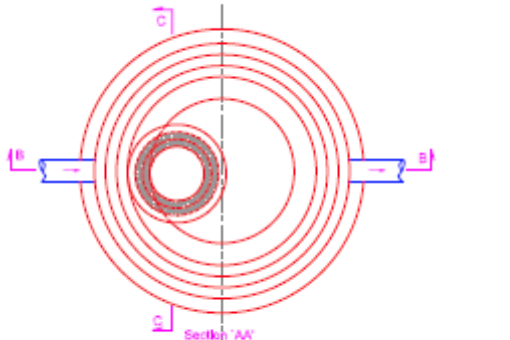
Client
Asian Development Bank
National Capital Region Planning Board

Consultant
Wilbur Smith Associates

Drawn: SK	Checked: MSS
Dated: Sept, 2010	Approved: MSS

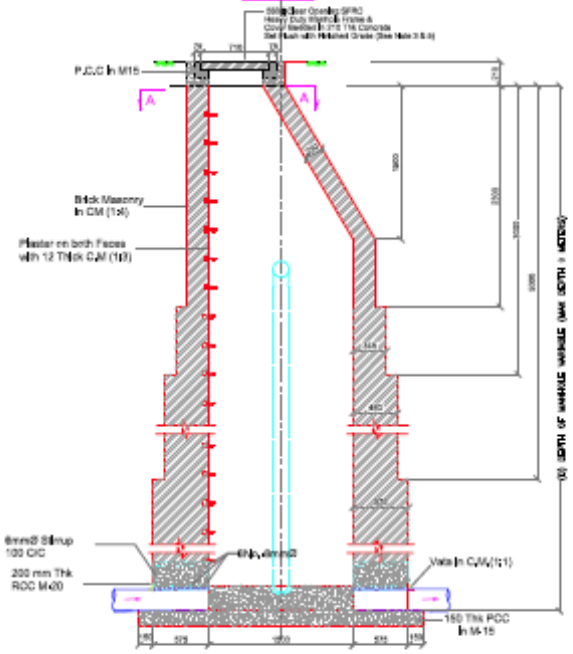
Scale:

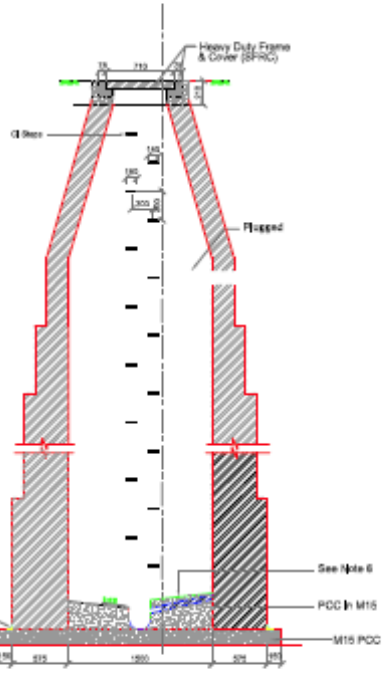
Drg. No. NCRPB/SON/PATH/DR-03B



Sr No.	Type of Manhole	Depth (m)	Size of Manhole	Pipe Size
01	A-Type	Upto 1.00	900x900	Upto 300Ø
02	B-Type	1.01 to 1.50	1200mm Dia	Upto 600Ø
03	B-Type	1.50 to 2.30	1200mm Dia	Upto 600Ø
04	C-Type	2.31 & above	1500mm Dia	Upto 900Ø
05	D-Type	---	1800mm Dia	1000Ø To 1400Ø
06	E-Type	---	2400mm Dia	1500Ø To 1800Ø

Section 'AA'





For R.C.C. Pipes

Capcity Development of the NCRPB: Component B (ADB TA-7055)

Sonipath
Typical Details of Manhole Type "C" for Depth 2.31m and Above

Legend

CI	———	Cast Iron
THK	———	Thick
PCC	———	Plain Cement Concrete
EQ	———	Equal
SFRC	———	Steel Fibre Reinforced Concrete

Notes

1. All Dimensions are in mm Except Otherwise Stated.
2. Vata in CM(1:1) Shall be Provided all Around the Pipe Entering and Leaving the Manhole and also at the Junction of Brick Masonry and Concrete Base Slab.
3. Manhole Located on Road Shall Have Manhole Cover Flush with Finished Road Surface.
4. At A Given Depth the Thickness of Brick Masonry Shall not be less than that Shown in the Drawing.
5. Thickness Specified for Brick Masonry is Excluding the Thickness of Cement Plaster on both Faces.
6. Channels for Manhole are to be Constructed Duly Considering the Direction of Flow as well as Alignment and Invert Level of Pipes Entering/ Leaving the Manhole and as Directed by Engineer
7. D is the Depth from Ground Level to Lowest Sewer Invert Level in Manhole.
8. CI Step Filled with Cement Concrete 1:2:4.

Client
Asian Development Bank
National Capital Region Planning Board

Consultant
Wilbur Smith Associates

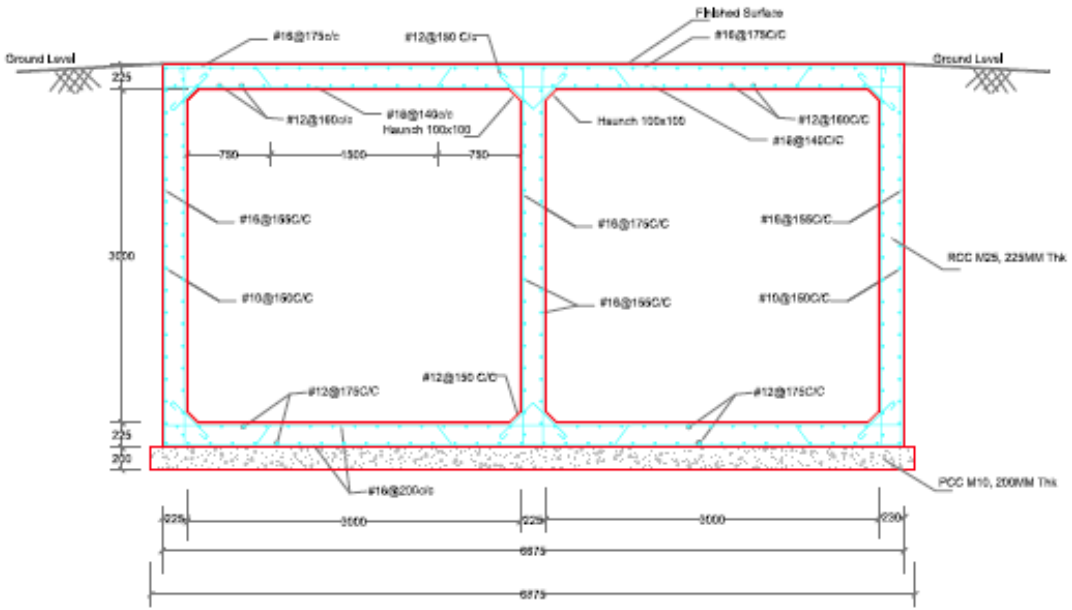
Drawn: BK	Checked: HSS
Date: Sept, 2013	Approved: HSS

Scale:

Drg. No. NCRPB/SONIPATH/DR-03C

Capc|ty Deve|opment of the NCRPB; Component B (ADB TA-7055)

Son|path
Box Girder of 6m Width



Box Girder 6.0m Width

Notes
1. All Dimensions are in mm Unless Mentioned Otherwise
2. Grade of Concrete P.C.C M15 R.C.C M25
3. Grade of Steel FE 415
4. Construction Shall Conform to Latested of I.S. 456-2000
5. Expansion Joint Provided 45m Interval
6. Clear Cover - 40mm for Slab, 45mm for RCC Wall, 50mm for Footing
7. Development Length - 50 Times of Dia of Bar

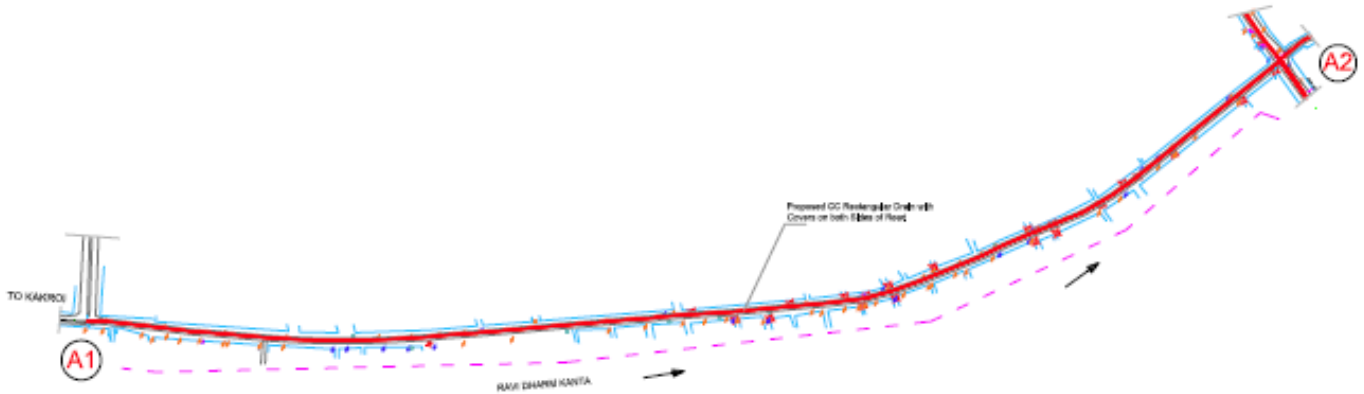
Client
Asian Development Bank
National Capital Region Planning Board

Consultant
Wilbur Smith Associates

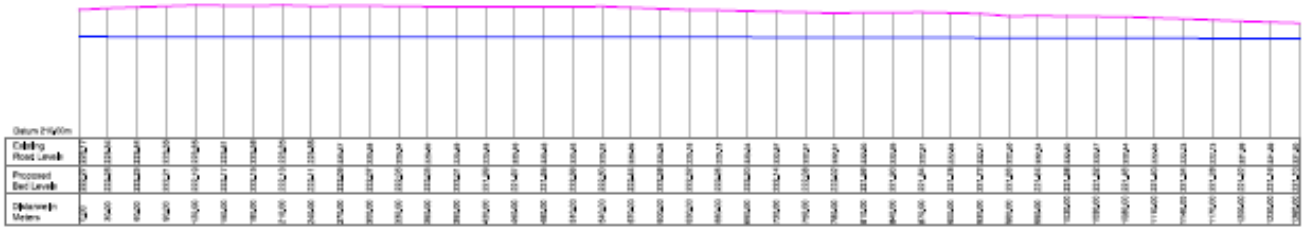
Drawn BK	Checked MSS
Date: Sep,2010	Approved MSS

Scale 1:50

Drg. No. NCRPB/SONIPATH/DR-04



PLAN FOR A1- A2



LONGITUDINAL SECTION FROM CHAINAGE 00 m TO 1260 m
A1- A2

Capcity Development of the NCRPB: Component B (ADB TA-7055)

Sonbath
Plan & Longitudinal Section from Chainage 00 m to 1260 (A1 - A2)

Legend

- Road
- Transformer
- Chimni
- Electric Pole
- Hand Pump
- Telephone Box
- Lamp Post
- Tree
- Tbm
- Temples
- Km Stone
- Man Hole
- Building
- Culvert

Overlay Legend

- Existing Road Level
- Proposed Bed Level

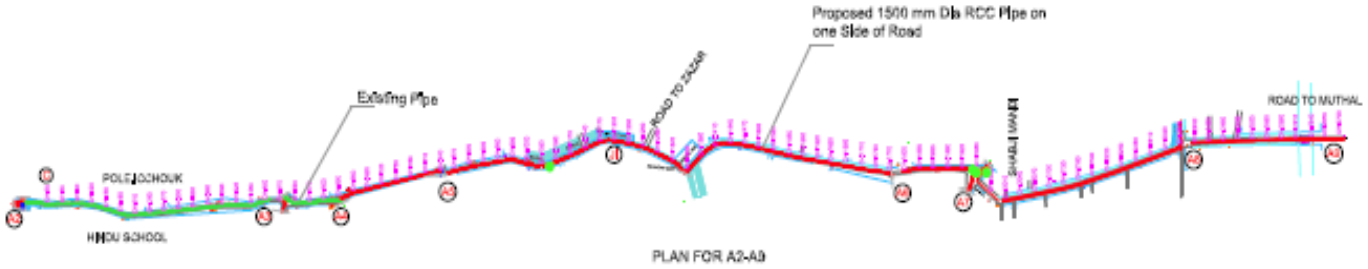
Client
Asian Development Bank
National Capital Region Planning Board

Consultant
Wilbur Smith Associates

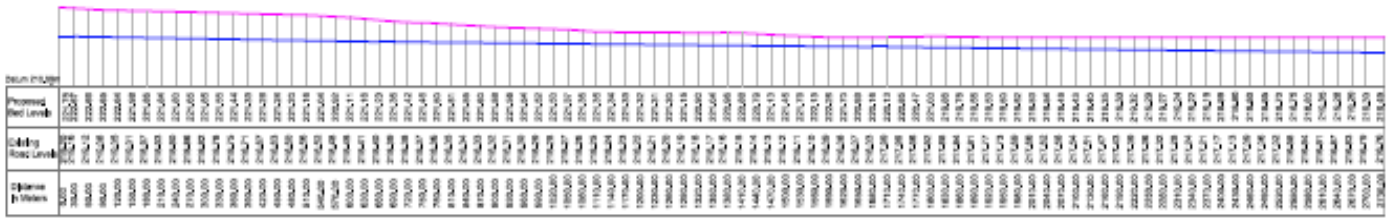
Drawn: SK	Checked: HVS
Date: Sept, 2010	Approved: SS

Scale: 0 20 40 60 120 Metres

Drg. No. NCRPB/SON/PATH/DR-05A



PLAN FOR A2-A9



LONGITUDINAL SECTION FROM CHAINGE 90 m TO 2730.00 m
A2-A9

Capcity Development of the NCRPB: Component B (ADB TA-7055)

Sonipath
Plan & Longitudinal Section from Chainage 90 m to 2730 (A2 - A9)

Legend

- Road
- Transformer
- Chapel
- Electric Pole
- Hand Pump
- Telephone Box
- Lamp Post
- Tree
- Tank
- Temples
- Km Stone
- Man Hole
- Building
- Culvert

Overlay Legend

- Existing Road Level
- Proposed Bed Level

Client
Asian Development Bank
National Capital Region Planning Board

Consultant
Wilbur Smith Associates

Drawn BK | Checked HVS
Date: Sept. 2013 | Approved MSS

Scale
0 60 120 180 240 Metres

Drg. No.NCRPB-SONIPATH-DR-05B

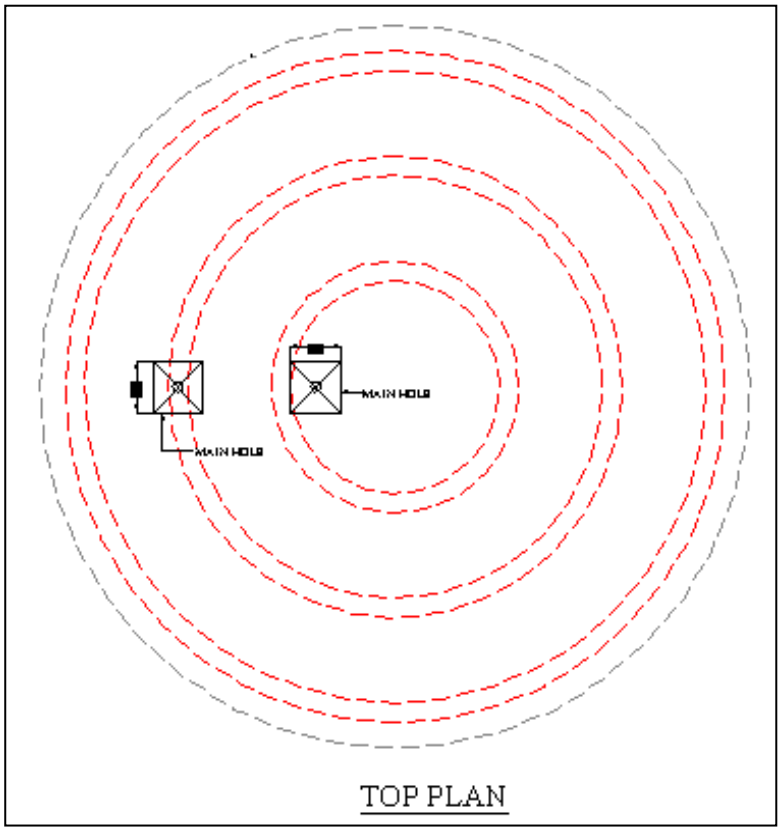
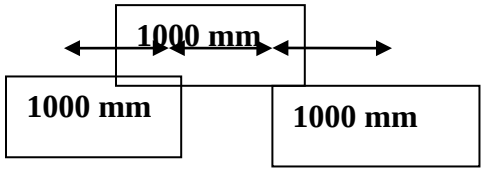


Figure1:- Figure showing dimensions of Rainwater Harvesting structure of 3.0 m

RADIUS



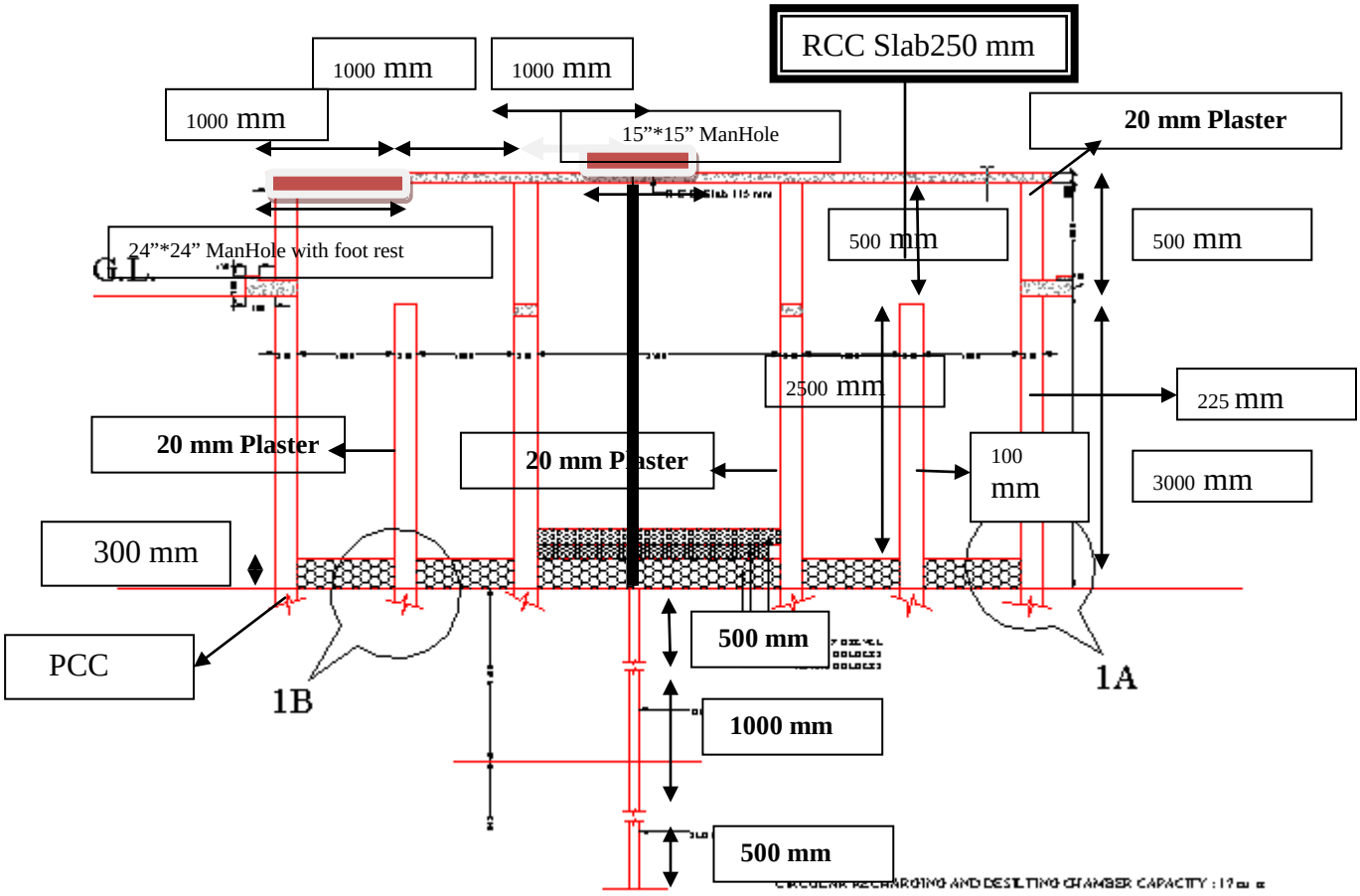


Figure 2:- Figure showing Cross section of 3.0mRadius Injection Well

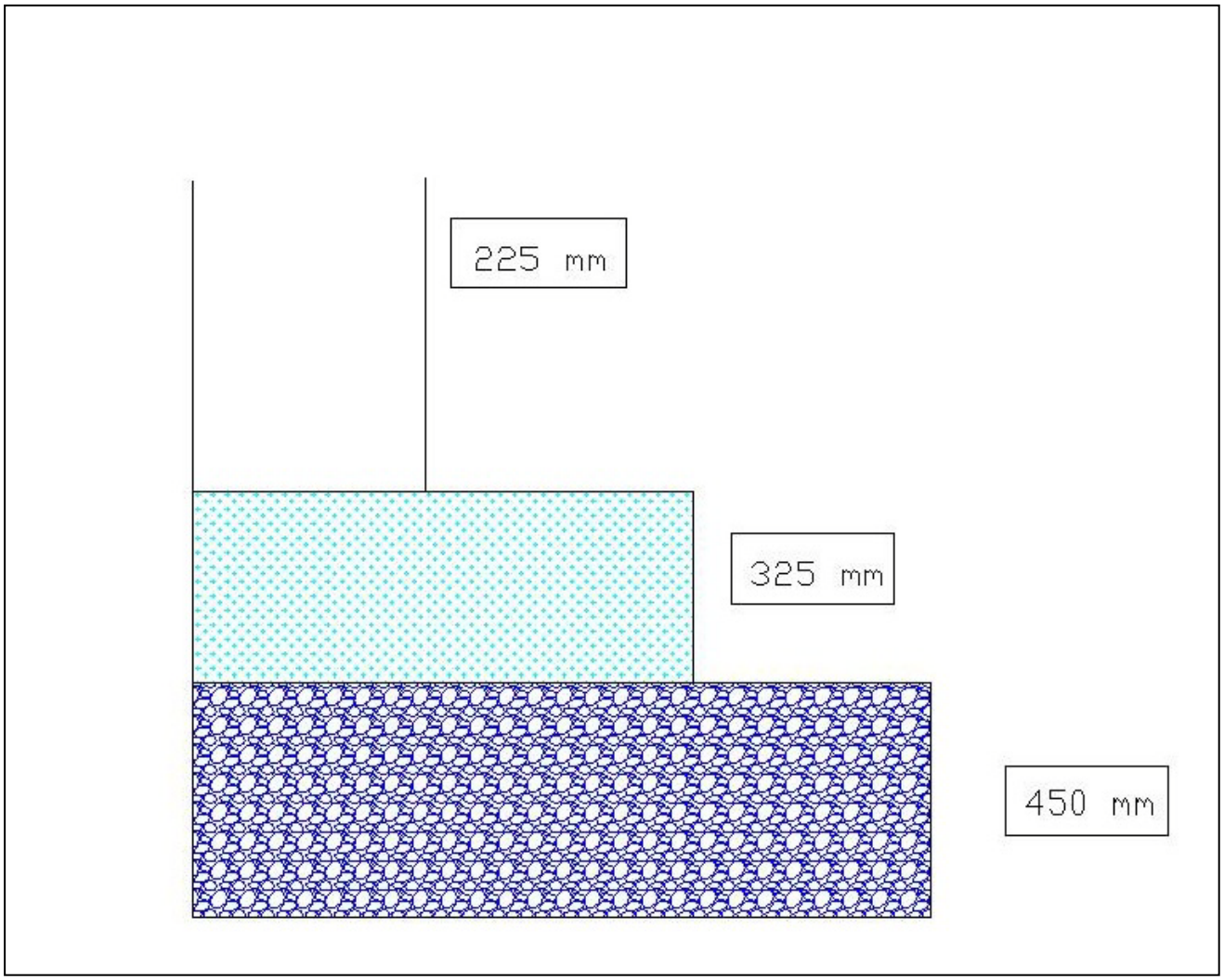


Figure 3:- Figure showing Foundation Dimensions

Public Health Engineering Department Haryana

NATIONAL CAPITAL REGION URBAN INFRASTRUCTURE FINANCING FACILITY

(ADB Loan No 2660 IND)

Bidding Document for Procurement of

Construction of storm water Drains in Sonepat Town

Single Stage Two Envelope Bidding Procedure under National Competitive Bidding on Item Rate Basis

Volume-1: Part III

Section 7: General Conditions of Contract

Section 7 - General Conditions of Contract

1. ***[Name of Employer]***

Engineer in Chief, Public Health Engineering Department, Government of Haryana, Bays 13 - 20, Sector - 4, Panchkula, Haryana Ph. 0172 – 2561672, 2564221 Ext 202 | Fax. 0172 - 2560237, eicwss@gmail.com

2. **[*Name of Contract*]**

Construction of Storm Water Drains in Sonepat

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General Conditions of Contract

A. General

1. Definitions 1.1 Boldface type is used to identify defined terms.

(a) The **Accepted Contract Amount** means the amount accepted in the Letter of Acceptance for the execution and completion of the Works and the remedying of any defects.

(b) The **Activity Schedule** is a schedule of the activities comprising the construction, installation, testing, and commissioning of the Works in a lump sum contract. It includes a lump sum price for each activity, which is used for valuations and for assessing the effects of Variations and Compensation Events.

(c) The **Adjudicator** is the person appointed jointly by the Employer and the Contractor to resolve disputes in the first instance, as provided for in GCC 23.1 hereunder.

(d) **Bill of Quantities** means the priced and completed Bill of Quantities forming part of the Bid.

(e) **Compensation Events** are those defined in GCC 41.1 hereunder.

(f) The **Completion Date** is the date of completion of the Works as certified by the Project Manager, in accordance with GCC 52.1.

(g) The **Contract** is the Contract between the Employer and the Contractor to execute, complete, and maintain the Works. It consists of the documents listed in GCC 2.3 below.

(h) The **Contractor** is the party whose Bid to carry out the Works has been accepted by the Employer.

(i) The **Contractor's Bid** is the completed bidding document submitted by the Contractor to the Employer.

(j) The **Contract Price** is the Accepted Contract Amount stated in the Letter of Acceptance and thereafter as adjusted in accordance with the Contract.

(k) **Days** are calendar days; months are calendar months.

(l) **Dayworks** are varied work inputs subject to payment on a time basis for the Contractor's employees and Equipment, in addition to payments for associated Materials and Plant.

(m) A **Defect** is any part of the Works not completed in accordance with the Contract.

(n) The **Defects Liability Certificate** is the certificate issued by Project Manager upon correction of defects by the Contractor.

(o) The **Defects Liability Period** is the period calculated from the Completion Date where the Contractor remains responsible for remedying defects.

(p) **Drawings** include calculations and other information provided

or approved by the Project Manager for the execution of the Contract.

(q) The **Employer** is the party who employs the Contractor to carry out the Works, as specified in the **PCC.**

(r) **Equipment** is the Contractor's machinery and vehicles brought temporarily to the Site to construct the Works.

(s) **Force Majeure** means an exceptional event or circumstance: which is beyond a Party's control; which such Party could not reasonably have provided against before entering into the Contract; which, having arisen, such Party could not reasonably have avoided or overcome; and, which is not substantially attributable to the other Party.

(t) The **Initial Contract Price** is the Contract Price listed in the Employer's Letter of Acceptance.

(u) The **Intended Completion Date** is the date on which it is intended that the Contractor shall complete the Works. The Intended Completion Date is specified in the **PCC**. The Intended Completion Date may be revised only by the Project Manager by issuing an extension of time or an acceleration order.

(v) **Letter of Acceptance** means the formal acceptance by the Employer of the Bid and denotes the formation of the Contract at the date of acceptance.

(w) **Materials** are all supplies, including consumables, used by the Contractor for incorporation in the Works.

(x) "**Party**" means the Employer or the Contractor, as the context requires.

(y) **PCC** means Particular Conditions of Contract

(z) **Plant** is any integral part of the Works that shall have a mechanical, electrical, chemical, or biological function.

(aa) The **Project Manager** is the person named in the **PCC** (or any other competent person appointed by the Employer and notified to the Contractor, to act in replacement of the Project Manager) who is responsible for supervising the execution of the Works and administering the Contract.

(bb) **Retention Money** means the aggregate of all monies retained by the Employer pursuant to GCC 45.1.

(cc) The **Site** is the area defined as such in the **PCC**.

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

(ee) **Specification** means the Specification of the Works included in the Contract and any modification or addition made or approved by the Project Manager.

(ff) The **Start Date** is given in the **PCC**. It is the latest date when the Contractor shall commence execution of the Works. It does not necessarily coincide with any of the Site Possession

Dates.

(gg) A **Subcontractor** is a person or corporate body who has a Contract with the Contractor to carry out a part of the work in the Contract, which includes work on the Site.

(hh) **Temporary Works** are works designed, constructed, installed, and removed by the Contractor that are needed for construction or installation of the Works.

(ii) A **Variation** is an instruction given by the Project Manager which varies the Works.

(jj) The **Works** are what the Contract requires the Contractor to construct, install, and turn over to the Employer, as defined in the **PCC.**

2. Interpretation

2.1 In interpreting these GCC, singular also means plural, male also means female or neuter, and the other way around. Headings have no significance. Words have their normal meaning under the language of the Contract unless specifically defined. The Project Manager shall provide instructions clarifying queries about these GCC.

2.2 If sectional completion is specified in the **PCC**, references in the GCC to the Works, the Completion Date, and the Intended Completion Date apply to any Section of the Works (other than references to the Completion Date and Intended Completion Date for the whole of the Works).

2.3 The documents forming the Contract shall be interpreted in the following order of priority:

(a) Agreement,

(b) Letter of Acceptance,

(c) Contractor's Bid,

(d) Particular Conditions of Contract,

(e) General Conditions of Contract,

(f) Specifications,

(g) Drawings,

(h) Bill of Quantities (or Schedules of Prices for lump sum contracts), and

(i) any other document listed in the **PCC** as forming part of the Contract.

3. Language and Law

3.1 The language of the Contract and the law governing the Contract are stated in the **PCC**.

4. Project Manager's Decisions

4.1 Except where otherwise specifically stated, the Project Manager shall decide contractual matters between the Employer and the Contractor in the role representing the Employer.

5. Delegation

5.1 The Project Manager may delegate any of his duties and responsibilities to other people, except to the Adjudicator, after notifying the Contractor, and may cancel any delegation after notifying the Contractor.

6. Communications

6.1 Communications between parties that are referred to in the Conditions shall be effective only when in writing. A notice shall be effective only when it is delivered.

7. Subcontracting

7.1 The Contractor may subcontract with the approval of the Project Manager, but may not assign the Contract without the approval of the Employer in writing. Subcontracting shall not alter the Contractor's obligations.

8. Other Contractors

8.1 The Contractor shall cooperate and share the Site with other contractors, public authorities, utilities, and the Employer between the dates given in the Schedule of Other Contractors, as **referred to in the PCC.** The Contractor shall also provide facilities and services for them as described in the Schedule. The Employer may modify the Schedule of Other Contractors, and shall notify the Contractor of any such modification.

9. Personnel and Equipment

9.1 The Contractor shall employ the key personnel and use the equipment identified in its Bid to carry out the Works, or other personnel and equipment approved by the Project Manager. The Project Manager shall approve any proposed replacement of key personnel and equipment only if their relevant qualifications or characteristics are substantially equal to or better than those proposed in the Bid.

9.2 If the Project Manager asks the Contractor to remove a person who is a member of the Contractor's staff or work force, stating the reasons, the Contractor shall ensure that the person leaves the Site within seven days and has no further connection with the work in the Contract.

10. Employer's and Contractor's Risks

10.1 The Employer carries the risks which this Contract states are Employer's risks, and the Contractor carries the risks which this Contract states are Contractor's risks.

11. Employer's Risks

11.1 From the Start Date until the Defects Liability Certificate has been issued, the following are Employer's risks:

(a) The risk of personal injury, death, or loss of or damage to property (excluding the Works, Plant, Materials, and Equipment), which are due to

(i) use or occupation of the Site by the Works or for the purpose of the Works, which is the unavoidable result of the Works or

(ii) negligence, breach of statutory duty, or interference with any legal right by the Employer or by any person employed by or contracted to him except the Contractor.

(b) The risk of damage to the Works, Plant, Materials, and Equipment to the extent that it is due to a fault of the Employer or in the Employer's design, or due to war or radioactive contamination directly affecting the country where the Works are to be executed.

11.2 From the Completion Date until the Defects Liability Certificate has been issued, the risk of loss of or damage to the Works, Plant, and

Materials is an Employer's risk except loss or damage due to

(a) a Defect which existed on the Completion Date,

(b) an event occurring before the Completion Date, which was not itself an Employer's risk, or

(c) the activities of the Contractor on the Site after the Completion Date.

12. Contractor's Risks

12.1 From the Starting Date until the Defects Liability Certificate has been issued, the risks of personal injury, death, and loss of or damage to property (including, without limitation, the Works, Plant, Materials, and Equipment) which are not Employer's risks are Contractor's risks.

13. Insurance

13.1 The Contractor shall provide, in the joint names of the Employer and the Contractor, insurance cover from the Start Date to the end of the Defects Liability Period, in the amounts and deductibles stated in the **PCC** for the following events which are due to the Contractor's risks:

(a) loss of or damage to the Works, Plant, and Materials;

(b) loss of or damage to Equipment;

(c) loss of or damage to property (except the Works, Plant, Materials, and Equipment) in connection with the Contract; and

(d) personal injury or death.

13.2 Policies and certificates for insurance shall be delivered by the Contractor to the Project Manager for the Project Manager's approval before the Start Date. All such insurance shall provide for compensation to be payable in the types and proportions of currencies required to rectify the loss or damage incurred.

13.3 If the Contractor does not provide any of the policies and certificates required, the Employer may effect the insurance which the Contractor should have provided and recover the premiums the Employer has paid from payments otherwise due to the Contractor or, if no payment is due, the payment of the premiums shall be a debt due.

13.4 Alterations to the terms of an insurance shall not be made without the approval of the Project Manager.

13.5 Both parties shall comply with any conditions of the insurance policies.

14. Site Investigation Reports

14.1 The Contractor, in preparing the Bid, shall rely on any Site Investigation Reports referred to in the **PCC,** supplemented by any information available to the Bidder.

15. Contractor to Construct the Works

15.1 The Contractor shall construct and install the Works in accordance with the Specifications and Drawings.

16. The Works to Be Completed by the Intended Completion

16.1 The Contractor may commence execution of the Works on the Start Date and shall carry out the Works in accordance with the Program submitted by the Contractor, as updated with the approval of the Project Manager, and complete them by the Intended Completion

Date Date.

17. Designs by Contractor and Approval by the Project Manager

17.1 The Contractor shall carry out design to the extent specified in the **PCC**. The Contractor shall promptly submit to the Employer all designs prepared by him. Within 14 days of receipt, the Employer shall notify any comments. The Contractor shall not construct any element of the permanent work designed by him within 14 days after the design has been submitted to the Employer or where the design for that element 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.

17.2 The Contractor shall be responsible for design of Temporary Works.

17.3 The Contractor shall submit Specifications and Drawings showing the proposed Temporary Works to the Project Manager, who is to approve them if they comply with the Specifications and Drawings.

17.4 The Project Manager's approval shall not alter the Contractor's responsibility for design of the Temporary Works.

17.5 The Contractor shall obtain approval of third parties to the design of the Temporary Works, where required.

17.6 All Drawings prepared by the Contractor for the execution of the temporary or permanent Works, are subject to prior approval by the Project Manager before this use.

18. Safety

18.1 The Contractor shall be responsible for the safety of all activities on the Site.

19. Discoveries

19.1 Anything of historical or other interest or of significant value unexpectedly discovered on the Site shall be the property of the Employer. The Contractor shall notify the Project Manager of such discoveries and carry out the Project Manager's instructions for dealing with them.

20. Possession of the Site

20.1 The Employer shall give possession of all parts of the Site to the Contractor. If possession of a part is not given by the date stated in the **PCC,** the Employer shall be deemed to have delayed the start of the relevant activities, and this shall be a Compensation Event.

21. Access to the Site

21.1 The Contractor shall allow the Project Manager and any person authorized by the Project Manager access to the Site and to any place where work in connection with the Contract is being carried out or is intended to be carried out.

22. Instructions, Inspections and Audits

22.1 The Contractor shall carry out all instructions of the Project Manager which comply with the applicable laws where the Site is located.

22.2 The Contractor shall permit the ADB to inspect the Contractor's accounts, records and other documents relating to the submission of bids and contract performance and to have them audited by auditors appointed by the ADB. The Contractor shall maintain all documents and records related to the Contract for a period of three (*3*) years after completion of the Works. The Contractor shall provide any documents

necessary for the investigation of allegations of fraud, collusion, coercion, or corruption and require its employees or agents with knowledge of the Contract to respond to questions from the ADB.

23. Appointment of the Adjudicator

23.1 The Adjudicator shall be appointed jointly by the Employer and the Contractor, at the time of the Employer's issuance of the Letter of Acceptance. If, in the Letter of Acceptance, the Employer does not agree on the appointment of the Adjudicator, the Employer will request the Appointing Authority **designated in the PCC**, to appoint the Adjudicator within 14 days of receipt of such request.

23.2 Should the Adjudicator resign or die, or should the Employer and the Contractor agree that the Adjudicator is not functioning in accordance with the provisions of the Contract, a new Adjudicator shall be jointly appointed by the Employer and the Contractor. In case of disagreement between the Employer and the Contractor, within 30 days, the Adjudicator shall be designated by the Appointing Authority at the request of either party, within 14 days of receipt of such request.

24. Procedure for Disputes

24.1 If the Contractor believes that a decision taken by the Project Manager was either outside the authority given to the Project Manager by the Contract or that the decision was wrongly taken, the decision shall be referred to the Adjudicator within 14 days of the notification of the Project Manager's decision.

24.2 The Adjudicator shall give a decision in writing within 28 days of receipt of a notification of a dispute.

24.3 The Adjudicator shall be paid by the hour at the rate specified in the **PCC,** together with reimbursable expenses of the types specified in the **PCC**, and the cost shall be divided equally between the Employer and the Contractor, whatever decision is reached by the Adjudicator. Either party may refer a decision of the Adjudicator to an Arbitrator within 28 days of the Adjudicator's written decision. If neither party refers the dispute to arbitration within the above 28 days, the Adjudicator's decision shall be final and binding.

24.4 The arbitration shall be conducted in accordance with the arbitration procedures published by the institution named and in the place specified in the **PCC**.

B. Time Control

25. Program

25.1 Within the time stated in the **PCC**, after the date of the Letter of Acceptance, the Contractor shall submit to the Project Manager for approval a Program showing the general methods, arrangements, order, and timing for all the activities in the Works. In the case of a lump sum contract, the activities in the Program shall be consistent with those in the Activity Schedule.

25.2 An update of the Program shall be a program showing the actual progress achieved on each activity and the effect of the progress achieved on the timing of the remaining work, including any changes to the sequence of the activities.

25.3 The Contractor shall submit to the Project Manager for approval an updated Program at intervals no longer than the period stated in the

PCC. If the Contractor does not submit an updated Program within this period, the Project Manager may withhold the amount stated in the **PCC** from the next payment certificate and continue to withhold this amount until the next payment after the date on which the overdue Program has been submitted. In the case of a lump sum contract, the Contractor shall provide an updated Activity Schedule within 14 days of being instructed to by the Project Manager.

25.4 The Project Manager's approval of the Program shall not alter the Contractor's obligations. The Contractor may revise the Program and submit it to the Project Manager again at any time. A revised Program shall show the effect of Variations and Compensation Events.

26. Extension of the Intended Completion Date

26.1 The Project Manager shall extend the Intended Completion Date if a Compensation Event occurs or a Variation is issued which makes it impossible for Completion to be achieved by the Intended Completion Date without the Contractor taking steps to accelerate the remaining work, which would cause the Contractor to incur additional cost.

26.2 The Project Manager shall decide whether and by how much to extend the Intended Completion Date within 21 days of the Contractor asking the Project Manager for a decision upon the effect of a Compensation Event or Variation and submitting full supporting information. If the Contractor has failed to give early warning of a delay or has failed to cooperate in dealing with a delay, the delay by this failure shall not be considered in assessing the new Intended Completion Date.

27. Acceleration

27.1 When the Employer wants the Contractor to finish before the Intended Completion Date, the Project Manager shall obtain priced proposals for achieving the necessary acceleration from the Contractor. If the Employer accepts these proposals, the Intended Completion Date shall be adjusted accordingly and confirmed by both the Employer and the Contractor.

27.2 If the Contractor's priced proposals for an acceleration are accepted by the Employer, they are incorporated in the Contract Price and treated as a Variation.

28. Delays Ordered by the Project Manager

28.1 The Project Manager may instruct the Contractor to delay the start or progress of any activity within the Works.

29. Management Meetings

29.1 Either the Project Manager or the Contractor may require the other to attend a management meeting. The business of a management meeting shall be to review the plans for remaining work and to deal with matters raised in accordance with the early warning procedure.

29.2 The Project Manager shall record the business of management meetings and provide copies of the record to those attending the meeting and to the Employer. The responsibility of the parties for actions to be taken shall be decided by the Project Manager either at the management meeting or after the management meeting and stated in writing to all who attended the meeting.

30. Early Warning

30.1 The Contractor shall warn the Project Manager at the earliest opportunity of specific likely future events or circumstances that may adversely affect the quality of the work, increase the Contract Price, or delay the execution of the Works. The Project Manager may require

the Contractor to provide an estimate of the expected effect of the future event or circumstance on the Contract Price and Completion Date. The estimate shall be provided by the Contractor as soon as reasonably possible.

30.2 The Contractor shall cooperate with the Project Manager in making and considering proposals for how the effect of such an event or circumstance can be avoided or reduced by anyone involved in the work and in carrying out any resulting instruction of the Project Manager.

C. Quality Control

31. Identifying Defects

31.1 The Project Manager shall check the Contractor's work and notify the Contractor of any Defects that are found. Such checking shall not affect the Contractor's responsibilities. The Project Manager may instruct the Contractor to search for a Defect and to uncover and test any work that the Project Manager considers may have a Defect.

32. Tests

32.1 If the Project Manager instructs the Contractor to carry out a test not specified in the Specification to check whether any work has a Defect and the test shows that it does, the Contractor shall pay for the test and any samples. If there is no Defect, the test shall be a Compensation Event.

33. Correction of Defects

33.1 The Project Manager shall give notice to the Contractor of any Defects before the end of the Defects Liability Period, which begins at Completion, and is defined in the **PCC.** The Defects Liability Period shall be extended for as long as Defects remain to be corrected.

33.2 Every time notice of a Defect is given, the Contractor shall correct the notified Defect within the length of time specified by the Project Manager's notice.

34. Uncorrected Defects

34.1 If the Contractor has not corrected a Defect within the time specified in the Project Manager's notice, the Project Manager shall assess the cost of having the Defect corrected, and the Contractor shall pay this amount.

D. Cost Control

35. Contract Price

35.1 In the case of an admeasurement contract, the Bill of Quantities shall contain priced items for the Works to be performed by the Contractor. The Bill of Quantities is used to calculate the Contract Price. The Contractor will be paid for the quantity of the work accomplished at the rate in the Bill of Quantities for each item.

35.2 In the case of a lump sum contract, the Activity Schedule shall contain the priced activities for the Works to be performed by the Contractor. The Activity Schedule is used to monitor and control the performance of activities on which basis the Contractor will be paid. If payment for Materials on Site shall be made separately, the Contractor shall show

delivery of Materials to the Site separately on the Activity Schedule.

36. Changes in the Contract Price

36.1 In the case of an admeasurement contract:

(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 Project Manager shall adjust the rate to allow for the change.

(b) The Project Manager 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 Employer.

(c) If requested by the Project Manager, the Contractor shall provide the Project Manager with a detailed cost breakdown of any rate in the Bill of Quantities.

36.2 In the case of a lump sum contract, the Activity Schedule shall be amended by the Contractor to accommodate changes of Program or method of working made at the Contractor's own discretion. Prices in the Activity Schedule shall not be altered when the Contractor makes such changes to the Activity Schedule.

37. Variations

37.1 All Variations shall be included in updated Programs, and, in the case of a lump sum contract, also in the Activity Schedule, produced by the Contractor.

37.2 The Contractor shall provide the Project Manager with a quotation for carrying out the Variation when requested to do so by the Project Manager. The Project Manager shall assess the quotation, which shall be given within seven (7) days of the request or within any longer period stated by the Project Manager and before the Variation is ordered.

37.3 If the Contractor's quotation is unreasonable, the Project Manager may order the Variation and make a change to the Contract Price, which shall be based on the Project Manager's own forecast of the effects of the Variation on the Contractor's costs.

37.4 If the Project Manager decides that the urgency of varying the work would prevent a quotation being given and considered without delaying the work, no quotation shall be given and the Variation shall be treated as a Compensation Event.

37.5 The Contractor shall not be entitled to additional payment for costs that could have been avoided by giving early warning.

37.6 In the case of an admeasurement contract, if the work in the Variation corresponds to an item description in the Bill of Quantities and if, in the opinion of the Project Manager, the quantity of work above the limit stated in GCC 36.1 or the timing of its execution do not cause the cost per unit of quantity to change, the rate in the Bill of Quantities shall be used to calculate the value of the Variation. If the cost per unit of

quantity changes, or if the nature or timing of the work in the Variation does not correspond with items in the Bill of Quantities, the quotation by the Contractor shall be in the form of new rates for the relevant items of work.

38. Cash Flow Forecasts

38.1 When the Program, or, in the case of a lump sum contract, the Activity Schedule, is updated, the Contractor shall provide the Project Manager with an updated cash flow forecast. The cash flow forecast shall include different currencies, as defined in the Contract, converted as necessary using the Contract exchange rates.

39. Payment Certificates

39.1 The Contractor shall submit to the Project Manager monthly statements of the estimated value of the work executed less the cumulative amount certified previously.

39.2 The Project Manager shall check the Contractor's monthly statement and certify the amount to be paid to the Contractor.

39.3 The value of work executed shall be determined by the Project Manager.

39.4 The value of work executed shall comprise:

(a) In the case of an admeasurement contract, the value of the quantities of work in the Bill of Quantities that have been completed; or

(b) In the case of a lump sum contract, the value of work executed shall comprise the value of completed activities in the Activity Schedule.

39.5 The value of work executed shall include the valuation of Variations and Compensation Events.

39.6 The Project Manager 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.

40. Payments

40.1 Payments shall be adjusted for deductions for advance payments and retention. The Employer shall pay the Contractor the amounts certified by the Project Manager within 28 days of the date of each certificate. If the Employer makes a late payment, the Contractor shall be paid interest on the late payment in the next payment. Interest shall be calculated from the date by which the payment should have been made up to the date when the late payment is made at the prevailing rate of interest for commercial borrowing for each of the currencies in which payments are made.

40.2 If an amount certified is increased in a later certificate or as a result of an award by the Adjudicator or an Arbitrator, the Contractor shall be paid interest upon the delayed payment as set out in this clause. Interest shall be calculated from the date upon which the increased amount would have been certified in the absence of dispute.

40.3 Unless otherwise stated, all payments and deductions shall be paid or charged in the proportions of currencies comprising the Contract Price.

40.4 Items of the Works for which no rate or price has been entered in shall not be paid for by the Employer and shall be deemed covered by other rates and prices in the Contract.

41. Compensation Events

41.1 The following shall be Compensation Events:

(a) The Employer does not give access to a part of the Site by the Site Possession Date pursuant to GCC 20.1.

(b) The Employer modifies the Schedule of Other Contractors in a way that affects the work of the Contractor under the Contract.

(c) The Project Manager orders a delay or does not issue Drawings, Specifications, or instructions required for execution of the Works on time.

(d) The Project Manager instructs the Contractor to uncover or to carry out additional tests upon work, which is then found to have no Defects.

(e) The Project Manager unreasonably does not approve a subcontract to be let.

(f) Ground conditions are substantially more adverse than could reasonably have been assumed before issuance of the Letter of Acceptance from the information issued to bidders (including the Site Investigation Reports), from information available publicly and from a visual inspection of the Site.

(g) The Project Manager gives an instruction for dealing with an unforeseen condition, caused by the Employer, or additional work required for safety or other reasons.

(h) Other contractors, public authorities, utilities, or the Employer does not work within the dates and other constraints stated in the Contract, and they cause delay or extra cost to the Contractor.

(i) The advance payment is delayed.

(j) The effects on the Contractor of any of the Employer's Risks.

(k) The Project Manager unreasonably delays issuing a Certificate of Completion.

41.2 If a Compensation Event would cause additional cost or would prevent the work being completed before the Intended Completion Date, the Contract Price shall be increased and/or the Intended Completion Date shall be extended. The Project Manager shall decide whether and by how much the Contract Price shall be increased and whether and by how much the Intended Completion Date shall be extended.

41.3 As soon as information demonstrating the effect of each Compensation Event upon the Contractor's forecast cost has been provided by the Contractor, it shall be assessed by the Project Manager, and the Contract Price shall be adjusted accordingly. If the Contractor's

forecast is deemed unreasonable, the Project Manager shall adjust the Contract Price based on the Project Manager's own forecast. The Project Manager shall assume that the Contractor shall react competently and promptly to the event.

41.4 The Contractor shall not be entitled to compensation to the extent that the Employer's interests are adversely affected by the Contractor's not having given early warning or not having cooperated with the Project Manager.

42. Tax

42.1 The Project Manager shall adjust the Contract Price if taxes, duties, and other levies are changed between the date 28 days before the submission of bids for the Contract and the date of the last Completion certificate. The adjustment shall be the change in the amount of tax payable by the Contractor, provided such changes are not already reflected in the Contract Price or are a result of GCC 44.1.

43. Currencies

43.1 Where payments are made in currencies other than the currency of the Employer's country specified in the **PCC,** the exchange rates used for calculating the amounts to be paid shall be the exchange rates stated in the Contractor's Bid.

44. Price Adjustment

44.1 Prices shall be adjusted for fluctuations in the cost of inputs only if provided for in the **PCC.** If so provided, the amounts certified in each payment certificate, before deducting for Advance Payment, shall be adjusted by applying the respective price adjustment factor to the payment amounts due in each currency. A separate formula of the type indicated below applies to each Contract currency:

$$\mathbf{P_c = A_c + B_c\ Imc/Ioc}$$

where:

P_c is the adjustment factor for the portion of the Contract Price payable in a specific currency "c."

A_c and B_c are coefficients specified in the **PCC,** representing the nonadjustable and adjustable portions, respectively, of the Contract Price payable in that specific currency "c;" and

Imc is a consolidated index prevailing at the end of the month being invoiced and Ioc is the same consolidated index prevailing 28 days before Bid opening for inputs payable; both in the specific currency "c."

44.2 If the value of the index is changed after it has been used in a calculation, the calculation shall be corrected and an adjustment made in the next payment certificate. The index value shall be deemed to take account of all changes in cost due to fluctuations in costs.

45. Retention

45.1 The Employer shall retain from each payment due to the Contractor the proportion stated in the **PCC** until Completion of the whole of the Works.

45.2 Upon the issue of a Certificate of Completion of the Works by the Project Manager, in accordance with GCC 52.1, half the total amount retained shall be repaid to the Contractor and half when the Defects

Liability Period has passed and the Project Manager has certified that all Defects notified by the Project Manager to the Contractor before the end of this period have been corrected. The Contractor may substitute retention money with an "on demand" bank guarantee.

46. Liquidated Damages

46.1 The Contractor shall pay liquidated damages to the Employer at the rate per day stated in the **PCC** for each day that the Completion Date is later than the Intended Completion Date. The total amount of liquidated damages shall not exceed the amount defined in the **PCC.** The Employer may deduct liquidated damages from payments due to the Contractor. Payment of liquidated damages shall not affect the Contractor's liabilities.

46.2 If the Intended Completion Date is extended after liquidated damages have been paid, the Project Manager shall correct any overpayment of liquidated damages by the Contractor by adjusting the next payment certificate. The Contractor shall be paid interest on the overpayment, calculated from the date of payment to the date of repayment, at the rates specified in GCC 40.1.

47. Bonus

47.1 The Contractor shall be paid a Bonus calculated at the rate per calendar day stated in the **PCC** for each day (less any days for which the Contractor is paid for acceleration) that the Completion is earlier than the Intended Completion Date. The Project Manager shall certify that the Works are complete, although they may not be due to be complete.

48. Advance Payment

48.1 The Employer shall make advance payment to the Contractor of the amounts stated in the **PCC** by the date stated in the **PCC,** against provision by the Contractor of an unconditional bank guarantee in a form and by a bank acceptable to the Employer in amounts and currencies equal to the advance payment. The guarantee shall remain effective until the advance payment has been repaid, but the amount of the guarantee shall be progressively reduced by the amounts repaid by the Contractor. Interest shall not be charged on the advance payment.

48.2 The Contractor is to use the advance payment only to pay for Equipment, Plant, Materials, and mobilization expenses required specifically for execution of the Contract. The Contractor shall demonstrate that advance payment has been used in this way by supplying copies of invoices or other documents to the Project Manager.

48.3 The advance payment shall be repaid by deducting proportionate amounts from payments otherwise due to the Contractor, following the schedule of completed percentages of the Works on a payment basis. No account shall be taken of the advance payment or its repayment in assessing valuations of work done, Variations, price adjustments, Compensation Events, Bonuses, or Liquidated Damages.

49. Securities

49.1 The Performance Security shall be provided to the Employer no later than the date specified in the Letter of Acceptance and shall be issued in an amount specified in the **PCC,** by a bank acceptable to the Employer, and denominated in the types and proportions of the currencies in which the Contract Price is payable. The Performance

Security shall be valid until a date 28 days from the date of issue of the Certificate of Completion in the case of a bank guarantee.

50. Dayworks

50.1 If applicable, the Dayworks rates in the Contractor's Bid shall be used for small additional amounts of work only when the Project Manager has given written instructions in advance for additional work to be paid for in that way.

50.2 All work to be paid for as Dayworks shall be recorded by the Contractor on forms approved by the Project Manager. Each completed form shall be verified and signed by the Project Manager within two days of the work being done.

50.3 The Contractor shall be paid for Dayworks subject to obtaining signed Dayworks forms.

51. Cost of Repairs

51.1 Loss or damage to the Works or Materials to be incorporated in the Works between the Start Date and the end of the Defects Correction periods shall be remedied by the Contractor at the Contractor's cost if the loss or damage arises from the Contractor's acts or omissions.

E. Finishing the Contract

52. Completion

52.1 The Contractor shall request the Project Manager to issue a certificate of Completion of the Works, and the Project Manager shall do so upon deciding that the work is completed.

53. Taking Over

53.1 The Employer shall take over the Site and the Works within seven days of the Project Manager's issuing a certificate of Completion.

54. Final Account

54.1 The Contractor shall supply the Project Manager with a detailed account of the total amount that the Contractor considers payable under the Contract before the end of the Defects Liability Period. The Project Manager shall issue a Defects Liability Certificate and certify any final payment that is due to the Contractor within 56 days of receiving the Contractor's account if it is correct and complete. If it is not, the Project Manager shall issue within 56 days a schedule that states the scope of the corrections or additions that are necessary. If the Final Account is still unsatisfactory after it has been resubmitted, the Project Manager shall decide on the amount payable to the Contractor and issue a payment certificate.

55. Operating and Maintenance Manuals

55.1 If "as built" Drawings and/or operating and maintenance manuals are required, the Contractor shall supply them by the dates stated in the **PCC.**

55.2 If the Contractor does not supply the Drawings and/or manuals by the dates **stated in the PCC** pursuant to GCC 55.1**,** or they do not receive the Project Manager's approval, the Project Manager shall withhold the amount **stated in the PCC** from payments due to the Contractor.

56. Termination

56.1 The Employer or the Contractor may terminate the Contract if the other party causes a fundamental breach of the Contract.

56.2 Fundamental breaches of Contract shall include, but shall not be limited to, the following:

(a) the Contractor stops work for 28 days when no stoppage of work is shown on the current Program and the stoppage has not been authorized by the Project Manager;

(b) the Project Manager instructs the Contractor to delay the progress of the Works, and the instruction is not withdrawn within 28 days;

(c) the Employer or the Contractor is made bankrupt or goes into liquidation other than for a reconstruction or amalgamation;

(d) a payment certified by the Project Manager is not paid by the Employer to the Contractor within 84 days of the date of the Project Manager's certificate;

(e) the Project Manager gives Notice that failure to correct a particular Defect is a fundamental breach of Contract and the Contractor fails to correct it within a reasonable period of time determined by the Project Manager;

(f) the Contractor does not maintain a Security, which is required; and

(g) the Contractor has delayed the completion of the Works by the number of days for which the maximum amount of liquidated damages can be paid, as defined in the **PCC.**

(h) if the Contractor, in the judgment of the Employer has engaged in corrupt or fraudulent practices in competing for or in executing the Contract, pursuant to GCC 57.1.

56.3 When either party to the Contract gives notice of a breach of Contract to the Project Manager for a cause other than those listed under GCC 56.2 above, the Project Manager shall decide whether the breach is fundamental or not.

56.4 Notwithstanding the above, the Employer may terminate the Contract for convenience.

56.5 If the Contract is terminated, the Contractor shall stop work immediately, make the Site safe and secure, and leave the Site as soon as reasonably possible.

57. Fraud and Corruption

57.1 ADB requires that Borrowers (including beneficiaries of ADB loans), as well as Contractors, Subcontractors, manufacturers, and Consultants under ADB-financed contracts, observe the highest standard of ethics during the procurement and execution of such contracts. In pursuit of this policy, the ADB:

(a) defines, for the purposes of this provision, the terms set forth below as follows:

(i) "corrupt practice" means the offering, giving, receiving, or soliciting, directly or indirectly, anything of value to influence improperly the actions of another party;

(ii) "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;

(iii) "coercive practice" means impairing or harming, or threatening to impair or harm, directly or indirectly, any party or the property of the party to influence improperly the actions of a party;

(iv) "collusive practice" means an arrangement between two or more parties designed to achieve an improper purpose, including influencing improperly the actions of another party;

(b) will cancel the portion of the financing allocated to a contract if it determines at any time that representatives of the borrower or of a beneficiary of ADB-financing engaged in corrupt, fraudulent, collusive, or coercive practices during the procurement or the execution of that contract, without the borrower having taken timely and appropriate action satisfactory to ADB to remedy the situation; and

(c) will sanction a firm or an individual, at any time, in accordance with ADB's Anticorruption Policy and Integrity Principles and Guidelines (both as amended from time to time), including declaring ineligible, either indefinitely or for a stated period of time, to participate in ADB-financed or ADB-administered activities or to benefit from an ADB-financed or ADB-administered contract, financially or otherwise, if it at any time determines that the firm or individual has, directly or through an agent, engaged in corrupt, fraudulent, collusive, or coercive or other prohibited practices.

58. Payment upon Termination

58.1 If the Contract is terminated because of a fundamental breach of Contract by the Contractor, the Project Manager shall issue a certificate for the value of the work done and Materials ordered less advance payments received up to the date of the issue of the certificate and less the percentage to apply to the value of the work not completed, as indicated in the **PCC.** Additional Liquidated Damages shall not apply. If the total amount due to the Employer exceeds any payment due to the Contractor, the difference shall be a debt payable to the Employer.

58.2 If the Contract is terminated for the Employer's convenience or because of a fundamental breach of Contract by the Employer, the Project Manager shall issue a certificate for the value of the work done, Materials ordered, the reasonable cost of removal of Equipment, repatriation of the Contractor's personnel employed solely on the Works, and the Contractor's costs of protecting and securing the Works, and less advance payments received up to the date of the certificate.

59. Property

59.1 All Materials on the Site, Plant, Equipment, Temporary Works, and Works shall be deemed to be the property of the Employer if the Contract is terminated because of the Contractor's default.

60. Release from Performance

60.1 If the Contract is frustrated by the outbreak of war or by any other event entirely outside the control of either the Employer or the Contractor, the Project Manager shall certify that the Contract has been frustrated. The Contractor shall make the Site safe and stop work as quickly as possible after receiving this certificate and shall be paid for all work carried out before receiving it and for any work carried out afterwards to which a commitment was made.

61. Suspension of ADB Loan or Credit

61.1 In the event that the ADB suspends the Loan or Credit to the Employer, from which part of the payments to the Contractor are being made:

(a) The Employer is obligated to notify the Contractor, with copy to the Project Manager, of such suspension within 7 days of having received the ADB's suspension notice.

(b) If the Contractor has not received sums due it within the 28 days for payment provided for in GCC 40.1, the Contractor may immediately issue a 14-day termination notice.

62. Eligibility

62.1 The Contractor shall have the nationality of an ADB member country. The Contractor shall be deemed to have the nationality of a country if the Contractor is a citizen or is constituted, or incorporated, and operates in conformity with the provisions of the laws of that country. This criterion shall also apply to the determination of the nationality of proposed subcontractors or suppliers for any part of the Contract including related services.

62.2 The materials, equipment and services to be supplied under the Contract shall have their origin in eligible source countries and all expenditures under the Contract will be limited to such materials, equipment, and services. At the Employer's request, the Contractor may be required to provide evidence of the origin of materials, equipment and services.

62.3 For purposes of GCC 62.2, "origin" means the place where the materials and equipment are mined, grown, produced or manufactured, and from which the services are provided. Materials and equipment are produced when, through manufacturing, processing, or substantial or major assembling of components, a commercially recognized product results that differs substantially in its basic characteristics or in purpose or utility from its components.

Public Health Engineering Department Haryana

NATIONAL CAPITAL REGION URBAN INFRASTRUCTURE FINANCING FACILITY
(ADB Loan No 2660 IND)

Bidding Document for Procurement of

Construction of storm water Drains in Sonepat Town

Single Stage Two Envelope Bidding Procedure under National Competitive Bidding on Item Rate Basis

Volume-1: Part III

Section 8: Particular Conditions of Contract

Section 8 - Particular Conditions of Contract

The following Particular Conditions of Contract (PCC) shall supplement the General Conditions of Contract (GCC). Whenever there is a conflict, the provisions herein shall prevail over those in the GCC.

A. General	
GCC 1.1 (q)	The Employer is, Public Health Engineering Department, Bays 13 - 20, Sector - 4, Panchkula, Ph. 0172 – 2561672, 2564221 ext 202 Fax. 0172 - 2560237, eicwss@gmail.com
GCC 1.1 (u)	The Intended Completion date for the completion of physical works shall be 24 months from the start date.
GCCs 1.1 (aa) & 4.1	The Project Manager is Executive Engineer, Public Health Engineering Department, Division No.2, Sonepat Distt. Sonepat – 131001 Ph. 0130-2220254, ee2sonepat@gmail.com, Fax Number: 0130 – 2220254 Design and Supervision consultant to be nominated on award of work and Assistant Engineer PHED Division 2 Sonepat will be the authorized representative of the Project Manager
GCC 1.1 (cc)	The Site is located in Sonepat town in district Sonepat, Haryana and are shown in drawings No. 1
GCC 1.1 (ff)	The Start Date shall be within 14 days from the letter of acceptance.
GCC 1.1 (jj)	The works consist of construction of channel, pipe drains and rain water harvesting structures as per scope of work described in section 6 of this bid document.
GCC 2.2	Sectional Completions are: Not Applicable
GCC 2.3(i)	The following documents also form part of the Contract: a) Initial Environmental Examination Report b) Environmental Management Plan; and Environmental Monitoring Plan attached hereto as Appendix 1 and Appendix 2
GCC 3.1	The language of the contract is English The law that applies to the Contract is the law of India and laws of Haryana state. The laws of Haryana state will prevail in case of conflict.
GCC 8.1	Schedule of other contractors: Not Applicable
GCC 13.1	The minimum insurance amounts and deductibles shall be: (a) for the Works, Plant and Materials: Full replacement cost . (b) For loss or damage to Equipment: Full replacement/repair cost (c) for loss or damage to property (except the Works, Plant, Materials, and Equipment) in connection with Contract: Full replacement/repair cost (d) for personal injury or death:

	(i) of the Contractor's employees: Rs 5 lacs per occurrence with the number of occurrences limited to four. (ii) of other people: (5 lacs for each occurrence)
GCC 14.1	Site Investigation Reports are: (i) The various Data available with the Employer for this contract are: (a) Survey maps of existing water supply pipelines with ground levels; (b) Hydraulic analyses and design report for the proposed water supply pipelines under the contract; (c) Project reports of PHED.
GCC 17.1	The Contractor shall undertake topographical survey of proposed drain alignment and carry out hydraulic design of various drains
GCC 20.1	The Site Possession Date(s) shall be: 15 days of issue of notice to proceed
GCC 23.1	Appointing Authority for the Adjudicator: The Executive Committee, Institution of Engineers, Haryana Centre
GCC 24.3	The Adjudicator shall be paid by the days at the rate of: Rs. 15000 (Rupees fifteen thousand only) per day of hearing and the cost shall be divided equally between the Employer and the Contractor. The reimbursable expenses are: as per actuals
GCC 24.4	Institution whose arbitration procedures shall be used **Contracts with foreign contractors:** International arbitration shall be conducted in accordance with the rules of Arbitration of the International Chamber of Commerce (ICC) by one or more arbitrators appointed in accordance with said Rules. Arbitration shall be administered by International Chamber of Commerce. The Place of Arbitration shall be : to be determined during contract award **Contracts with domestic contractors:** Arbitration shall be conducted in accordance with the laws applicable in India
B. Time Control	
GCC 25.1	The Contractor shall submit for approval a Program for the Works within 30 (thirty) days from the date of the Letter of Acceptance.
GCC 25.3	The period between Program updates is 90 (Ninety) days. The amount to be withheld for late submission of an updated Program is Rs. 10000
C. Quality Control	
GCC 33.1	The Defects Liability Period is: 365 days.

D. Cost Control	
GCC 42.2	Sales Tax, Income Tax and Cess charges shall be deducted from contractor's each bills as per Central/ State Government Rules. Royalties on the excavated material at site as applicable as per State Government Rules shall be recovered from the Contractor.
GCC 42.3	Project Manager will issue essentiality certificate under GOI notification No. 108/95 (Appendix 3) and 84/97 (Appendix 4) (or any other applicable notification) which will assist the Contractor to obtain any lawful exemptions from payment of Excise Duty or Import Duty on Plant and Materials, which are to be incorporated as a part of the Permanent Works. The Certificate will be issued in the format indicated in Section 9, which certifies the estimated quantities of materials that are to be incorporated into the permanent works. The responsibility for obtaining any such exemptions from Competent Authority will remain with the supplier/ Contractor and the employer shall not in any way be responsible for admissibility of the claims or eligibility of the supplier/ Contractor
GCC 43.1	The currency of the Employer's country is: Indian Rupees
GCC 44.1	Prices payable to the Contractor, in accordance with the Contract, shall be subject to adjustment during performance of the Contract to reflect changes in the cost of labor and material components, in accordance with the following formula: Increase or decrease in the cost of labor/material shall be calculated quarterly. The first statement of price adjustment shall be prepared at the end of three months in which the work was awarded and the work done from the date of start to the end of this period shall be taken into account. For subsequent statement, cost of work done during every quarter shall be taken into account. At the completion of work, the work done during the last quarter or fraction, thereof, shall be taken into account. For the purpose of reckoning the work done during any period, the bills prepared during the period shall be considered. The dates of recording measurements in the Measurement Book by the Employer's Representative shall be the guiding factor to decide the bills relevant to any period. The date of completion, as finally recorded by the Employer's Representative in the Measurement Book, shall be the criterion. The index relevant to any quarter, for which such compensation is paid, shall be the arithmetical average of the indices relevant of the calendar month. (A) **LABOR** $V_L = 0.85 \times P_L / 100 \times R \times (I_{L1} - I_{L0}) / I_{L0}$ V_L Increase or decrease in the cost of work during the quarter under consideration due to change in rates for labour. R The value of the work done in rupees during the quarter under consideration excluding the cost of materials supplied by the department and excluding other items as mentioned in this Clause. I_{L0} The average consumer price index for industrial workers (wholesale prices) applicable on base date as published in Labour Bureau Simla, for the area Delhi. I_{L1} The average consumer price index for industrial workers (wholesale prices for the quarter of calendar year under consideration as published in Labour Bureau Simla for the area Delhi. P_L Percentage of labour components as indicated in table below.

Note: In case of revision of minimum wages by the Government or other competent authority, nothing extra would be payable except the price escalation permissible under this Clause).

(B) **Material**

$$V_M = 0.85 \times P_M / 100 \times R \times (L_{M1} - L_{M0}) / L_{M0}$$

V_M	Increase or decrease in the cost during the quarter under consideration due to change in rates of material.
R	The value of the work done in rupees during the quarter under consideration excluding the cost of materials supplied by the department and excluding other items as mentioned in this Clause.
L_{M0}	The average wholesale price Index (all commodities) applicable on the base date as published by Economic Adviser to Govt. of India, Ministry of Industries, for the area.
L_{M1}	The average wholesale price index (all commodities) for the quarter under consideration as published by Economic Adviser to Govt. of India, Ministry of Industries, for the area).
P_M	Percentage of material components as specified in the table below.

Base Date: The base date shall be the date thirty (30) days prior to the Bid closing date.

The following conditions shall apply:
(a) No price increase will be allowed beyond the original delivery date unless covered by an extension of time awarded by the Employer under the terms of the Contract. No price increase will be allowed for periods of delay for which the Contractor is responsible. The Employer will, however, be entitled to any price decrease occurring during such periods of delay.
(b) If the currency in which the Contract price, P0, is expressed is different from the currency of the country of origin of the labor and/or materials indices, a correction factor will be applied to avoid incorrect adjustments of the Contract price. The correction factor shall correspond to the ratio of exchange rates between the two currencies on the base date and the date for adjustment as defined above.
(c) No price adjustment shall be payable on the portion of the Contract price paid to the Contractor as an advance payment.

Table showing percentage of material and labor component

Adjustments for Changes in Cost	**Items**	**Percentage of various components**
civil works	Labor, Material	P_L = 30%, P_M = 70%

GCC 45.1	The proportion of payments retained is: 5% (five percent) shall be retained from each of the bill
GCC 46.1	The liquidated damages for the whole of the Works are 0.1% of the final Contract Price per day. The maximum amount of liquidated damages for the whole of the Works is 10% of the final Contract Price.
GCC 47.1	The Bonus for the whole of the Works is NIL per day. The maximum amount of Bonus for the whole of the Works is NIL of the final Contract Price.
GCC 48.1	The Advance Payments shall be: 10 % of the Initial contract value and shall be paid to the Contractor no later than 21 days after receiving the necessary Bank Guarantee as security for advance payment

GCC 49.1	The Performance Security amount is 10 percent of the Contract Price. In case the institution issuing the security is located outside India, it shall have a correspondent financial institution located in India to make it enforceable.
E. Finishing the Contract	
GCC 55.1	The date by which "as built" drawings are required is within one month of completion of the physical work or along with the submission of the final invoice of the contractor, whichever is earlier.
GCC 55.2	The amount to be withheld for failing to produce "as built" drawings by the date required in GCC 55.1 is 0.03% of contract amount.
GCC 56.2 (g)	The maximum number of days is 100.
GCC 56.2 (h)	(h) Breach if any of the applicable national and state labor laws and those specified in GCC Clause 64.
GCC 58.1	The percentage to apply to the value of the work not completed, representing the Employer's additional cost for completing the Works, is 25 %
GCC 62.1	Not Applicable

Add following new Clauses

GCC 63: Environmental Mitigation measures: Site Environmental Plan (SEP)

The Contractor shall prepare a detailed Site Environmental Plan (SEP) for the work site, base camp, etc., showing arrangements for disposal of sanitary and other waste, location of fuel, oil and lubricant depots, sheds for equipment, labor and housing facilities, etc., prior to the construction for approval of the Project Manager.

The contractors SEP shall also take into account implementation of all measures stated in Environmental Management Plan attached hereto as Appendix 1 giving potential negative impacts and mitigation measures to reduce impacts.

GCC 64: The Contractor shall follow all applicable national and state labor laws and shall in effect (i) carry out HIV/AIDS awareness programs for labor and disseminate information at worksites on risks of sexually transmitted diseases and HIV/AIDS as part of health and safety measures for those employed during construction; (ii) shall not employ children in the implementation of this contract; and (iii) follow legally mandated provisions of labor (including equal pay for equal work), health, safety, sanitation, welfare and working conditions.

GCC 65: Safety, Security and Protection of the Environment: The Contractor shall take all necessary precautions against pollution or interference with the supply, or obstruction of the flow of, surface or underground water. These precautions shall include but not be limited to physical measures such as earth bunds of adequate capacity around fuel, oil and solvent storage tanks and stores, oil and grease traps in drainage systems from workshops, vehicle and plant washing facilities and service and fuelling areas and kitchens, the establishment of sanitary solid and liquid waste disposal systems, the maintenance in effective condition of these measures, the establishment of emergency response procedures for pollution events, and dust suppression, all in accordance with

normal good practice and to the satisfaction of the Engineer. Should any pollution arise from the Contractor's activities he shall clean up the affected area immediately at his own cost and to the satisfaction of the Engineer, and shall pay full compensation to any affected parties?

GCC 66: Protection of Trees and Vegetation: The Contractor shall ensure that no trees or shrubs or waterside vegetation are felled or harmed except for those required to be cleared for execution of the Works. The Contractor shall protect trees and vegetation from damage to the satisfaction of the Engineer. No tree shall be removed without the prior approval of the Engineer and any competent authorities. Should the Contractor become aware during the period of the Contract that any tree or trees designated for clearance have cultural or religious significance he shall immediately inform the Engineer and await his instructions before proceeding with clearance. In the event that trees or other vegetation not designated for clearance are damaged or destroyed, they shall be repaired or replaced to the satisfaction of the Engineer, who shall also impose a penalty to twice the commercial value of any timber affected, as assessed by the Engineer.

GCC 67: Use of Wood as Fuel: The Contractor shall not use wood as a fuel for the execution of any part of the Works, including but not limited to the manufacture of bricks for use in the Works, and to the extent practicable shall ensure that fuels other than wood are used for cooking, and water heating in all his camps and living accommodations.

GCC 68: First-Aid Services: The Contractor shall, at his own expense, provide first aid equipment at all camps and work sites to the satisfaction of the Engineer, and shall ensure that at all work sites where 40 or more persons are engaged on the Works there shall at all times be a person qualified in first-aid with access to appropriate first-aid equipment. A first-aid post shall be established at each base camp comprising a suitable room with two beds, washing and examination facilities, appropriate medical supplies, and staffed on a full-time basis by a qualified paramedical attendant.

GCC 69: Health and Pests: The Contractor shall at his own expense and throughout the period of the Contract ensure that suitable arrangements are made for the prevention of epidemics and for all necessary welfare and hygiene requirements for his staff and labor, and shall comply with all the regulations and requirements of the local health authorities with respect to disease prevention and control. He shall warn his staff and labor of the dangers of communicable diseases including those transmitted by insects, water, fecal / oral contact and sexual activity. The Contractor shall take the precautions necessary to protect all staff and labor employed on the Site from insect nuisance, rats and other pests and minimizes the dangers to health and the general nuisance caused by the same. Should malaria or other insect-borne diseases be prevalent in the area, he shall provide his staff and labor with suitable prophylactics, equip living accommodation with screens and bed-nets, and carry out spraying with approved insecticides, as appropriate and to the Engineer's satisfaction.

GCC 70: **Supply of Drinking Water, Sanitation:** The Contractor shall so far is reasonable, having regard to local conditions, provide on the Site and at his expense an adequate supply of drinking water for the use of Contractor’s staff and work people, together with sanitary facilities (portable toilets or latrines), to the satisfaction of the Project Manager

Appendix 1: Environmental Management Plan

Potential Negative Impacts	Mitigation measures	Responsibility
Tree Cutting *Description*: 122 trees are falling in the alignment of drains. However, with slight changes in alignment locally during construction, most can be saved.	• Fine tune the alignment during construction to avoid tree cutting • Obtain necessary approvals from Forest Department/Sonipat Municipality) • Implement compensatory measures as suggested by such competent authority • Plant and maintain three trees for each tree felled	Contractor
Excavation will produce large quantity of waste soil, which needs proper disposal. *Description*. Excavation for drain construction will produce an estimated 41,343 m3 of waste soil.	• Utilize waste soil in construction work; Provide surplus soil to HUDA for utilizing in land development and formation of housing/industrial areas in and around Sonipat; HUDA requires significant quantities of soilfor formation of new areas (called as Sectors), which is under full swing in Sonipat.	Contractor
Dust nuisance due to construction *Description*. Due to dry weather conditions dust generation from construction activities will be significant. Since the project is located within an urban area with large scale development, the impact due to dust could be significant. .	• Cover or damp down by water spray on the excavated mounds of soil to control dust generation; • Bring the material (aggregate) as and when required; • Ensure speedy completion of work – trench excavation, drain constriction and refilling, to remove surplus soil as soon as possible; • Use tarpaulins to cover loose material/soil that is transported to and from the site by truck • Soil shall be damped down sufficiently while using for leveling the ground • Control dust generation while unloading the material (particularly aggregate) at the site by sprinkling water and unloading an a barricaded area • Sprinkle water in truck after downloading material; or cover it with tarpaulin to avoid dust raging from the truck while it is moving	Contractor
Generation of noise and other construction related disturbances *Description*. Since the project is located within an urban area with large scale development, the nuisance and disturbance to community may be considerable.	• Consult the local community to inform them of the nature, duration and likely effects of the construction work, and the mitigation measures in place • Proper planning of the work programme; schedule noisy or otherwise invasive activities to avoid sensitive times; • Avoid noise-generating activities at night; • Implementing the measures to reduce dust; • Utilizing modern vehicles and equipment with the requisite adaptations to limit noise and exhaust emissions	Contractor
Impacts due to improper mining for construction materials	• Ensure that construction materials (sand, aggregate and gravel) are obtained from	Contractor

Potential Negative Impacts	Mitigation measures	Responsibility
Description. Large quantities of construction material like sand and aggregate will be required for construction work. Souce of material is: Sand - Panchkula (Yamuna River), and aggregate Panchkula and Bhiwani District	quarries licensed by Geology and Mining Department of Government Haryana	
Shops and other business may loose income if costumer's access is impeded *Description*. Presence of trenches in front of shops and establishments, and construction work may affect the business activity	• Inform all residents and businesses about the nature and duration of any work well in advance to make preparations if necessary; • Leave spaces for access between mounds of excavated soil and other stored materials and machinery, and provide footbridges so that people can cross open trenches • Control dust generation • Increase workforce to complete the work in a short period, especially in commercial areas like bus stand road, railway road, Kakroi Road, Meerut and and Jhajjar Rohtak Road	Contractor
Hindrance to traffic due to construction work *Description*. Construction work on narrow roads where the piped drains are proposed to be laid within the carriage way and construction of box culverts at road crossing will disturb the traffic	• Conduct work during light traffic; explore night working schedule ensuring workers and public safety • Do not close the road completely; conduct the work in minimum possible area and allow the traffic to move on the remaining carriageway • Provide alternative traffic arrangement/detours and ensure that public is informed about such traffic diversions • Allow smooth traffic movement by confining and barricading the construction area; • Provide necessary personnel to guide and control the traffic • Provide information to the public through media – daily newspapers and local cable television (TV) services, about the need and schedule of work, and alternative routes • At work site, public information/caution boards shall be provided - information shall inter-alia include: project name, cost and schedule; executing agency and contractor details; nature and schedule of work at that road/locality; traffic diversion details, if any; entry restriction information; competent official's name and contact for public complaints • Control & regulate the movement of vehicles and pedestrian Barricade the site near the site properly; avoid accidental entry of traffic (pedestrian/vehicular) into site	Contractor
Excavation could damage existing infrastructure/utilities	• Notify the respective agencies (PHED, SM,	Contractor and respective agency

Potential Negative Impacts	Mitigation measures	Responsibility
Description. There are various utilities (electric poles, transformers, telephone cables, water lines and sewers) within the ROW. Depending on the finalized alignment, the need for relocation may occur, however it appears minimal	BSNL and HSEB) in advance • Coordinate with respective agencies and provide prior information to public about the disruption in services during construction • Alternative arrangement for disrupted services such as water supply based on the necessity and duration of disruption	(BSNL, UP Electricity Board, GNN)
Increase in traffic due to trucks carrying construction material and heavy equipment	• Plan routes to avoid narrow streets, congested roads, and places of religious importance • Plan work to avoid peak traffic hours	Contractor
Workers and public at risk from accidents on site *Description*. Excavation of trenches in busy roads may enhance the risk of accidents	• Follow standard and safe construction practices • Exclude the public from the site – enclosing and regulating the construction area, providing warning boards and sign boards • Ensure that all workers are provided with and use appropriate Personal Protective Equipment (helmet, hand gloves, boots, masks, etc); • Follow standard practices of safety checks as prescribed before use of equipment's; • Report accidents to the authorities promptly, and maintain records	Contractor
Economic benefits for people employed in workforce	• Ensure that most of the unskilled workforce is from local communities	Contractor

Appendix 2: Environmental Monitoring Plan

Mitigation measures	Monitoring Method & Parameters	Monitoring Frequency	Responsible for monitoring
Pre-Construction			
• Inform squatters/vendors about work & temporary relocation • Provide an alternative temporary site in the vicinity • Provide prior public information	Records review; interview with APs	As needed	Environment Social Monitoring Cell
• Fine tune the alignment to avoid tree cutting • Obtain necessary approvals for tree cutting • Plant and maintain three tree for each tree felled	Records review; on site-observation	As needed	Sonepat Municipality/PHED
• Notify the respective agencies for shifting of utilities • Inform public about the likely disruption of services • Ensure alternate arrangements during the relocation	Observations on- -site; CC records; consult respective agencies; informal public interviews	Weekly	Sonepat Municipality/PHED
• Procure construction material only from licensed quarries	Records review	As needed	Sonepat Municipality/PHED
Construction			
• Utilize the waste soil in construction work • Provide surplus soil to HUDA • Cover or damp down by water spray control dust • Bring the material (aggregate, sand) as & when required • Ensure speedy completion of work • Use tarpaulins to cover loose material/soil in transport • Damp down soil while using for ground leveling • Control dust generation while unloading the material • Sprinkle water in truck after downloading material • Consult the local community and inform about the work	Observations on-site/off-site; CC records; informal public interviews	Weekly	Sonepat Municipality/PHED
• Avoid scheduling noisy activities in sensitive times • Avoid noise-generating activities at night • Implement measures to reduce dust • Utilize modern vehicles and equipment • Ensure construction materials obtained licensed quarries	Observations on-site/off-site; CC records; informal public interviews	Weekly	Public Health Engineering Department

Mitigation measures	Monitoring Method & Parameters	Monitoring Frequency	Responsible for monitoring
• Inform all residents and businesses about the work • Leave spaces for access and provide footbridges • Control dust generation • Increase workforce to complete the work quickly • Do not close the road completely • Provide alternative traffic arrangement/detours • Allow smooth traffic movement • Provide personnel to guide and control the traffic • Provide information to the public through media • Provide public information/caution boards at site • Notify & coordinate with other agencies • Provide alternative arrangements for disrupted services • Plan routes to avoid sensitive roads • Plan work to avoid peak traffic hours • Follow standard and safe construction practices • Exclude the public from the site • Ensure that all workers are provided with and use PPE • Follow standard practices of safety checks • Report accidents to the authorities, and maintain records • Ensure that most of the unskilled workforce is from local			
Ambient air quality and monitoring	3 locations in the town SPM, and RSPM, NOx, CO	Quarterly	Contractor

Goods supplied to UN or an International Organisation

Notification No. 108/95-C.E., dated 28-8-1995

In exercise of the powers conferred by sub-section (1) of section 5A of the Central Excises and Salt Act, 1944 (1 of 1944), read with sub-section (3) of section 3 of the Additional Duties of Excise (Goods of Special Importance) Act, 1957 (58 of 1957), the Central Government, being satisfied that it is necessary in the public interest so to do, hereby exempts all goods falling under the Schedule to the Central Excise Tariff Act, 1985 (5 of 1986) (hereinafter referred to as the said goods) when supplied to the United Nations or an international organization for their official use or supplied to the projects financed by the said United Nations or an international organization and approved by the Government of India, from the **whole of -**

(i) **the duty of excise** leviable thereon under section 3 of the Central Excise Act, 1944 (1 of 1944); and

(ii) **the additional** duty **of excise** leviable thereon under sub-section (1) of section 3 of the Additional Duties of Excise (Goods of Special Importance) Act, 1957 (58 of 1957):

Provided that before clearance of the said goods, the manufacturer produces before the Assistant Commissioner of Central Excise having jurisdiction over his factory,-

(a) in case the said goods are intended for the official use by the United Nations or an international organization, a certificate from the United Nations or that international organization that the said goods are intended for such use;

(b) in case the said goods are -

(i) supplied to an international organisation listed in the Annexure appended to this notification for use in a project that has been approved by the Government of India and financed (whether by a loan or a grant) by such an organisation, a certificate from such an organisation that the said goods are required for the execution of the said project and that the said project has duly been approved by the Government of India; or

(ii) supplied to a project that has been approved by the Government of India and financed (whether by a loan or a grant) by an international organization listed in the said Annexure, a certificate from an officer not below the rank of Deputy Secretary to the Government of India, in the Ministry of Finance (Department of Economic Affairs) that the said goods are required for the execution of the said project and that the said project has duly been approved by the Government of India.

(c) in case the said goods are intended to be supplied to a project financed (whether by a loan or a grant) by the World Bank, the Asian Development Bank or any international organization other than those listed in the Annexure, and

(i) if the said project has been approved by the Government of India, a certificate from the executive head of the Project Implementing Authority and countersigned by an officer not below the rank of a Joint Secretary to the Government of India, in the concerned Line Ministry in the Government of India, that the said goods are required for the execution of the said project and that the said project has duly been approved by the Government of India, and

(ii) if the said project has been approved by the Government of India for implementation by the Government of a State or a Union Territory, a certificate from-the executive head of the Project Implementing Authority and countersigned by the Principal Secretary or the Secretary (Finance), as the case may be, in the concerned State Government or the Union Territory, that the said goods are required for the execution of the said project, and that the said project has duly been approved by the Government of India for implementation by the concerned State Government.

Explanation. - For the purposes of this notification,-

(a) "international organization" means an international organization to which the Central Government has declared, in pursuance of section 3 of the United Nations (Privileges and Immunities) Act, 1947 (46 of 1947), that the provisions of the Schedule to the said Act shall apply;

(b) "Line Ministry" means a Ministry in the Government of India, which has been so nominated with respect to a project, by the Government of India, in the Ministry of Finance (Department of Economic Affairs).

ANNEXURE

1. United Nations Development Programme,

2. United Nations International Children's Fund,

3. Food and Agricultural Organisation,

4. International Labour Organisation,

5. World Health Organisation,

6. United Nations Population Fund.

7. United Nations World Food Programme.

8. United Nations Industrial Development Organisation.

Notification No. 108/95-C.E., dated 28-8-1995 as amended by Notifications No. 7/98-C.E., dated 2-6-1998; No. 33/98-C.E., dated 13-10-1998; No. 4/99-C.E., dated 11-2-1999, No. 40/99-C.E., dated 2-11-1999, No. 36/2001-C.E., dated 6-7-2001 and No. 50/2001-C.E., dated 12-10-2001.

Back

Seeks to Exempt Imports by United Nations or International organisation for execution of projects in India.

11-11-1997

Notification No. 84/97-Customs

In exercise of the powers conferred by sub-section (1) of section 25 of the Customs Act, 1962 (52 of 1962), read with sub-section (4) **of** section 68 of the Finance (No. 2) Act, 1996 (33 of 1996), the Central Government, being satisfied that it is necessary in the public interest so to do, hereby exempts all the **goods imported into India for execution of projects financed by the United Nations or an International Organisation** and approved by the Government of India, from the **whole of the duty of customs** leviable thereon under First Schedule to the Customs Tariff Act, 1975 (51 of 1975), the **whole of the additional duty of customs** leviable thereon under section 3 of the said Customs Tariff Act and the **whole of the special duty of customs** leviable under section 68 of the Finance (No. 2) Act 1996 (33 of 1996):

Provided that the importer, at the time of clearance of the goods, produces before the Assistant Commissioner of Customs or Deputy Commissioner of Customs, as the case may be, having jurisdiction, -

(i) in case the said goods are -

(a) Imported by an international organisation listed in the Annexure appended to this notification and intended to be used in a project that has been approved by the Government of India and financed (whether by a loan or a grant) by such an organisation, a certificate from such organisation that the said goods are required for the execution of the said project and that the said project has duly been approved by the Government of India; or

(b) imported for use in a project that has been approved by the Government of India and financed (whether by a loan or a grant) by an international organisation listed in the said Annexure, a certificate from an officer not below the rank of Deputy Secretary to the Government of India, in the Ministry of Finance (Department of Economic Affairs) that the said goods are required for the execution of the said project and that the said project has duly been approved by the Government of India;

(ii) in case the said goods are intended to be used in a project financed (whether by a loan or a grant) by the World Bank, the Asian Development Bank or any other international organisation other than those listed in the Annexure, and the said project has been approved by the Government of India, a certificate from the executive head of the Project Implementing Authority and countersigned by an officer not below the rank of a Joint Secretary to the Government of India, in the concerned Line Ministry in the Government of India, that the said goods are required for the execution of the said project and that the said project has duly been approved by the Government of India, and

(iii) in case the said goods are intended to be used in a project financed (whether by a loan or a grant) by the World Bank, the Asian Development Bank or any other international organisation, other than those listed in the Annexure and the said project has been approved by the Government of India for implementation by the Government of a State or a Union Territory, a certificate from the executive head of the Project Implementing Authority and countersigned by the Principal Secretary or the Secretary (Finance), as the case may be, in the concerned State Government or the Union Territory, that the said goods are required for the execution of the said project, and that the said project has duly been approved by the Government of India for implementation by the concerned State Government.

Explanation. - For the purposes of this notification, -

(a) "international organisation" means an international organisation to which the Central Government has declared, in pursuance of section 3 of the United Nations (Privileges and Immunities) Act, 1947 (46 of 1947), that the provisions of the Schedule to the said Act shall apply;

(b) "Line Ministry" means a Ministry in the Government of India, which has been so nominated with respect to a project, by the Government of India, in the Ministry of Finance (Department of Economic Affairs).

ANNEXURE

1. United Nations Development Programme,

2. United Nations International Childrens' Fund,

3. Food and Agricultural Organisation,

4. International Labour Organisation,

5. World Health Organisation,

6. United Nations Population Fund.

7. United Nations World Food Programme.

8. United Nations Industrial Development Organisation.

Notification No. 84/97-Cus.,dated 11-11-1997 as amended by Notification No. 85/99-Cus.,dated 6-7-1999 and No.119/99-Cus.,dated 2-11-1999.and Notification No.75/2001 dt.0-07-01 and Notification No. 107/2001-Cus.,dated 12.10.2001.

Public Health Engineering Department Haryana

NATIONAL CAPITAL REGION URBAN INFRASTRUCTURE FINANCING FACILITY

(ADB Loan No 2660 IND)

Bidding Document for Procurement of

Construction of storm water Drains in Sonepat Town

Single Stage Two Envelope Bidding Procedure under National Competitive Bidding on Item Rate Basis

Volume-1: Part III

Section 9: Contract Forms

Section 9 - Contract Forms

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Letter of Acceptance

[on letterhead paper of the Employer]

. . . . . ***date***. . . . . .

To: . . . . . ***name and address of the Contractor*** . . . . . .

Subject: . . . . . ***Notification of Award Contract No.*** . . . . . .

This is to notify you that your Bid dated . . . . ***date*** . . . . Consisting of the Technical and Price Bids for execution of the . . . . . ***.name of the contract and identification number, as given in the Contract Data*** . . . . . for the Accepted Contract Amount of the equivalent of . . . . . ***.amount in numbers and words and name of currency*** . . . . . ., as corrected and modified in accordance with the Instructions to Bidders is hereby accepted by our Agency.

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

Authorized Signature: .....

Name and Title of Signatory: .....

Name of Agency: .....

Attachment: Contract Agreement

Contract Agreement

THIS AGREEMENT made the . . . . . .day of . . . . . ., ..., between . . . . . ***name of the Employer***. . . . . (hereinafter "the Employer"), of the one part, and . . . . . ***name of the Contractor***. . . . . .(hereinafter "the Contractor"), of the other part:

WHEREAS the *Employer* desires that the Works known as . . . . . ***name of the Contract***. . . . .should be executed by the Contractor, and has accepted a Bid by the Contractor for the execution and completion of these Works and the remedying of any defects therein,

The Employer and the Contractor agree as follows:

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

2. The following documents shall be deemed to form and be read and construed as part of this Agreement. This Agreement shall prevail over all other Contract documents.

   - the Letter of Acceptance
   - the Letters of Technical Bid and Price Bid
   - the Addenda Nos . . . . . ***insert addenda numbers if any***. . . . .
   - the Particular Conditions
   - the General Conditions;
   - the Specification
   - the Drawings*;* and
   - the completed Schedules,

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

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

IN WITNESS whereof the parties hereto have caused this Agreement to be executed in accordance with the laws of . . . . . ***name of the borrowing country***. . . . .on the day, month and year indicated above.

Signed by	Signed by .....
for and on behalf of the Employer in the presence of	for and on behalf the Contractor in the presence of
Witness, Name, Signature, Address, Date	Witness, Name, Signature, Address, Date

Performance Security

.....*Bank's Name, and Address of Issuing Branch or Office* .....

Beneficiary: .....*Name and Address of Employer* .....

Date:.....

Performance Guarantee No.: .....

We have been informed that . . . . . ***name of the Contractor***. . . . . (hereinafter called "the Contractor") has entered into Contract No. . . . . ***reference number of the Contract***. . . . . dated . . . . . .with you, for the execution of . . . . . ***name of contract and brief description of Works***. . . . . (hereinafter called "the Contract").

Furthermore, we understand that, according to the conditions of the Contract, a performance guarantee is required.

At the request of the Contractor, we . . . . . ***name of the Bank***. . . . . hereby irrevocably undertake to pay you any sum or sums not exceeding in total an amount of . . . . . ***name of the currency and amount in figures****. . . . . (. . . . . ***amount in words***. . . . .) such sum being payable in the types and proportions of currencies in which the Contract Price is payable, upon receipt by us of your first demand in writing accompanied by a written statement stating that the Contractor is in breach of its obligation(s) under the Contract, without your needing to prove or to show grounds for your demand or the sum specified therein.

This guarantee shall expire, no later than the . . . . . Day of . . . . . , ... **, and any demand for payment under it must be received by us at this office on or before that date.

This guarantee is subject to the Uniform Rules for Demand Guarantees, ICC Publication No. 458, except that subparagraph (ii) of Sub-article 20(a) is hereby excluded.

. . . . . .

Seal of Bank and Signature(s)

- Note -

All italicized text is for guidance on how to prepare this demand guarantee and shall be deleted from the final document.

[1] The Guarantor shall insert an amount representing the percentage of the Contract Price specified in the Contract and denominated either in the currency(ies) of the Contract or a freely convertible currency acceptable to the Employer. If the bank issuing the performance security is located outside the country of the Employer, it shall have a correspondent financial institution located in the country of the Employer.

[2] Insert the date twenty-eight days after the expected completion date. The Employer should note that in the event of an extension of the time for completion of the Contract, the Employer would need to request an extension of this guarantee from the Guarantor. Such request must be in writing and must be made prior to the expiration date established in the guarantee. In preparing this guarantee, the Employer might consider adding the following text to the form, at the end of the penultimate paragraph: "The Guarantor agrees to a one-time extension of this guarantee for a period not to exceed [six months][one year], in response to the Employer's written request for such extension, such request to be presented to the Guarantor before the expiry of the guarantee."

Advance Payment Security

..... ***Bank's Name, and Address of Issuing Branch or Office*** .....

Beneficiary: ..... ***Name and Address of Employer*** .....

Date: .....

Advance Payment Guarantee No.: .....

We have been informed that . . . . . ***name of the Contractor***. . . . . (hereinafter called "the Contractor") has entered into Contract No. . . . . ***reference number of the Contract***. . . . . dated . . . . . .with you, for the execution of . . . . . ***name of contract and brief description of Works***. . . . . (hereinafter called "the Contract").

Furthermore, we understand that, according to the Conditions of the Contract, an advance payment in the sum . . . . . ***name of the currency and amount in figures****. . . . . (. . . . . ***amount in words***. . . . .) is to be made against an advance payment guarantee.

At the request of the Contractor, we . . . . . ***name of the Bank***. . . . . hereby irrevocably undertake to pay you any sum or sums not exceeding in total an amount of . . . . . ***name of the currency and amount in figures****. . . . . (. . . . . ***amount in words***. . . . .) upon receipt by us of your first demand in writing accompanied by a written statement stating that the Contractor is in breach of its obligation under the Contract because the Contractor used the advance payment for purposes other than the costs of mobilization in respect of the Works.

It is a condition for any claim and payment under this guarantee to be made that the advance payment referred to above must have been received by the Contractor on its account number . . . . . ***Contractor's account number***. . . . . at . . . . . ***name and address of the Bank***. . . . . .

The maximum amount of this guarantee shall be progressively reduced by the amount of the advance payment repaid by the Contractor as indicated in copies of interim statements or payment certificates which shall be presented to us. This guarantee shall expire, at the latest, upon our receipt of a copy of the interim payment certificate indicating that eighty (80) percent of the Contract Price has been certified for payment, or on the . . day of . . . . . ., . . .****, whichever is earlier. Consequently, any demand for payment under this guarantee must be received by us at this office on or before that date..

This guarantee is subject to the Uniform Rules for Demand Guarantees, ICC Publication No. 458.

. . . . . .

Seal of Bank and Signature(s)

- Note -

All italicized text is for guidance on how to prepare this demand guarantee and shall be deleted from the final document.

[1] The Guarantor shall insert an amount representing the amount of the advance payment denominated either in the currency(ies) of the advance payment as specified in the Contract, or in a freely convertible currency acceptable to the Employer.

[2] Insert the expected expiration date of the Time for Completion. The Employer should note that in the event of an extension of the time for completion of the Contract, the Employer would need to request an extension of this guarantee from the Guarantor. Such request must be in writing and must be made prior to the expiration date established in the guarantee. In preparing this guarantee, the Employer might consider adding the following text to the form, at the end of the penultimate paragraph: "The Guarantor agrees to a one-time extension of this guarantee for a period not to exceed [six months][one year], in response to the Employer's written request for such extension, such request to be presented to the Guarantor before the expiry of the guarantee.

Essentiality Certificate

TO WHOMSOEVER IT MAY CONCERN

This is to certify that the work of "Storm Water Drains in Sonepat", Package No.----------has been awarded to _____(Name of Contractor) for amount of Rs._____(Amount of Contract Agreement) only by the Public Health Engineering Department, Government of Haryana and that this project has been approved under National Capital Region Urban infrastructure Financing Facility under ADB line of Credit. Thus the project is funded by----------. The project is being implemented by Public Health Engineering Department of Government of Haryana from -------- to ----------.

It is certified that M/S_____ (Name of Contractor) _____ for the above project requires to purchase _____ (Quantity of Material and name of material) _____under above mentioned work.

It is further certified that the aforesaid material is required for incorporation in the execution of the said project.

(Name)
Project Manager,
Project Implementation Unit,
PHED– Sonepat

(Name)
Engineer in Chief
Public Health Engineering Department
Government of Haryana, Panchkula

Countersigned
(Name)
Secretary, Finance Department
Government of Haryana

Public Health Engineering Department Haryana

NATIONAL CAPITAL REGION URBAN INFRASTRUCTURE FINANCING FACILITY

(ADB Loan No 2660 IND)

Bidding Document for Procurement of

Detail Project Report for construction of storm water Drains in Sonepat Town

Single Stage Two Envelope Bidding Procedure under National Competitive Bidding on Item Rate Basis

Volume-2

Section 4B: Bidding Forms Financial

Issued on :

Invitation for Bids No.:

NCB No. :

Employer: **:** Public Health Engineering Department,

Employers Representative: Executive Engineer, Public Health Engineering Department, Division No.2, Sonepat Distt. Sonepat – 131001 Ph. 0130-2220254
ee2sonepat@gmail.com, Fax Number: 0130 – 2220254

Section 4B – Bidding Forms-Financial

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Letter of Price Bid

Date: .....

NCB No.: .....

Invitation for Bid No.: .....

To:

The Executive Engineer,
Public Health
Engineering Division No. 2,
Sonipat, Haryana

We, the undersigned, declare that:

(a) We have examined and have no reservations to the Bidding Documents, including Addenda issued in accordance with Instructions to Bidders (ITB) 8;

(b) We offer to execute in conformity with the Bidding Documents the following Works:
Construction of storm water Drains in Sonepat Town

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

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

(e) Our Bid shall be valid for a period of 120 days from the date fixed for the bid submission deadline in accordance with the Bidding Documents, and it shall remain binding upon us and may be accepted at any time before the expiration of that period;

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

(g) We have paid, or will pay the following commissions, gratuities, or fees with respect to the bidding process or execution of the Contract: **

Name of Recipient	Address	Reason	Amount
.....	.....	.....	.....
.....	.....	.....	.....

(h) We understand that this bid, together with your written acceptance thereof included in your notification of award, shall constitute a binding contract between us, until a formal contract is prepared and executed; and

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

(j) We agree to permit ADB or its representative to inspect our accounts and records and other documents relating to the bid submission and to have them audited by auditors appointed by ADB.

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

Name .....

In the capacity of .....

Signed .....

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

Date .....

***** If none has been paid or is to be paid, indicate "none"***

Bill of Quantities

Schedule 1:- Drain Work

S. No.	Description	Qty.	Unit	Rate in Rs	Total in Rs
1	2	3	4	5	6
1	Earth work in excavation in foundation of underground structures sullage drains etc. and similar works in ordinary soil including dressing and disposal of surplus soil as directed within a lead of 30 mtrs. For depth up to 2 mtrs. Below ground level.	29640	Cum		
2	Cement concrete 1: 4: 8 with Stone aggregate 40 mm Nominal size in foundation and plinth.	2115	Cum		
3	Cement concrete 1:2:4 with stone aggregate 20 mm nominal size for reinforced concrete work but excluding steel reinforcement centering and shuttering Laid in Position Complete **in Bed**	2861	Cum		
4	Cement concrete 1:2:4 with stone aggregate 20mm nominal size for reinforcement concrete work in slab with inclination not exceeding 25 degree with horizontal excluding steel reinforcement but including centering and shuttering laid In position, complete in all respect. **Covered Slab**	1904	Cum		
5	Cement concrete 1:2:4 with stone aggregate 20mm Nominal size for reinforcement concrete work for walls (10cm to 20cm) thickness straight and curved excluding steel reinforcement but including centering and laid in position, complete in all respect. **Wall**	4662	Cum		
6	Fe- 500 EQR for T.M.T for steel bars for R.C.C. works was not Included in the complete rate of RCC including bending, binding and placing in position complete.	6566	Qtl		
7	Excavation, of trenches in streets, lanes or in open areas for storm sewer, sewers running by gravity and manholes to full depths as shown in drawings including shoring, timbering of poling boards, frame system type. And removal of surplus soil, from site of work up to a lead of 1 km in ordinary soil				
a	For depths of excavation not exceeding 3 mtr below ground level	20850	cum		
b	For depths of excavation exceeding 3 mtr but not exceeding 4.5mtr	2000	cum		
8	Dismantling concrete (Cement Concrete Plain 1:2:4 mix)	660	cum		
9	Cement concrete 1:4:8 with stone aggregate 20mm nominal size in foundation and plinth	100	cum		
10	Cement concrete 1:2:4 with stone aggregate 20mm nominal size in foundation and plinth.	400	cum		

11	Cement concrete 1:2:4 with stone aggregate 20mm nominal size for reinforced concrete work in slab With inclination not exceeding 25 degree with horizontal excluding steel reinforcement but including centering & shuttering laid in position, complete in all respect	100	Cum		
12	First class brick work laid in cement sand mortar 1:5 in foundation and plinth.	675	Cum		
13	12mm thick cement plaster 1:2	2550	Sqm		
14	Cement rendering on plaster 1 mm thick.	2550	Sqm		
15	Fe- 500 EQR for T.M.T for steel bars for R.C.C. works was not Included in the complete rate of RCC including bending, binding and placing in position complete.	90	Qtl.		
16	Dismantling of road including soling and wiring coat, screening and stacking of old serviceable material, complete in all respect.	1400	Sqm		
17	Extra over the rate for cement concrete work for making and finishing benching and complicated floor work in manholes.	550	Per Sqm benc hing		
18	Providing and fixing SFRC Main hole cover and frame making with IS: 12592 including setting the same to correct line and levels in 1:2 cement send motor over main hole including carriage, loading, unloading, stacking, handling, rehandling etc. complete in all respects to the satisfaction of Engineer in Charge. (EHD-35) 560MM CLEAR OPENING	150	No.		
19	Proof & fixing Steel bar embedded plastic steps of size 263mm x 165 mm of orange color, conforming to specifications, in pump chamber, manholes etc. having minimum 3mm thick polypropylene polymer confirming to Is 10910 encapsulated on 12mm dia ribbed steel bars per IS 1786 The rate including cost of setting	700	No.		
20	Providing, lowering, jointing and testing sulphate resistant RCC pipe class NP-3 as per IS 458-2003 with spigot and socketed joints manufactured with ISI marked sulphate resistance cement as per ISI 12330 with rubber ring ISI marked, anti-termite as required at site, specials in to trenches for all depth and laying out the same to correct alignment, gradients and levels including all dressing and side of trenches, if required jointing with rubber rings in trenches and jointing with 1:1.5 cement sand mortar and with end dowels filled 1:1.5 cement sand mortar and finishing the joints at an angle of 45 degree with faces of spigot of socket joints cutting and finishing the cut surface at a uniform finish etc. as fully described in HSR item no. 29.38, 29.44, 29.45 & 29.46 including cartage, loading and unloading complete in all respects				
a	**900 mm i/d**	330	mtr		

b	**1200 mm i/d**	1070	mtr		
c	**1500 mm i/d**	3690	mtr		
21	Cement concrete 1: 4: 8 with Stone aggregate 40 mm Nominal size in foundation and plinth.	986	Cum		
22	Cement concrete 1:2:4 with stone aggregate 20 mm nominal size for reinforced concrete work but excluding steel reinforcement centering and shuttering Laid in Position Complete **in Bed**	1480	Cum		
	Total of Schedule 1 (carried forward to Grand Summary, p----)		Rs.		

Schedule 2:-Rain Water Harvesting Structure

Schedule 2A: Construction of Injection Wells for Harvesting Rainwater (3m Radius)

S.No	Description of Item	Quantity	Unit	Unit Rate	Amount
1	Earthwork in excavation over areas (exceeding 30 cms in depth as well as sq.m on plan) including disposal of excavated soil as directed within a lead of 50 m, and lift up to 1.5 m disposed earth to be levelled and neatly dressed. In all types of soil (excluding rock)	339.12	cu.m		
2	Providing and laying in position specified grade of reinforced cement concrete excluding the cost of controlling shuttering, finishing and reinforcement- All works up to plinth level 1:1.5:3 (1 cement:1.5 coarse sand: 3 graded stone aggregate 20 mm nominal size)	28.24	cu.m		
3	Brick work with bricks of class designation 100 in foundation and plinth with cement mortar 1:6 (1 cement: 6 coarse sand)	86.6	cu.m		
4	Centring and shuttering including strutting, propping etc and removal of form for suspended floors, roofs, landings, balconies and access platform	113.04	sq.m		
5	Reinforcement for RCC work including cutting, cleaning, straightening bending, binding, placing in position complete (including cost of binding wire) at all level and heights, cold twisted bars	3040.76	kg		
6	Providing and fixing Ms. foot rests including fixing in chamber with 20x20x10 cm concrete blocks 1:3:6 (1 cement :3 coarse sand : 6 graded stone aggregate 20 mm nominal size) as per standard design with 20x20 mm square bar	24	No		
7	Supplying and fixing in position precast R.C.C. manhole cover and frame of required shape and approved quality Square shape 500 mm internal dia.	12	No		

8	Disposing of available excavated earthwork by mechanical means including loading, unloading and stacking earth (5 Km)	271.28	cum		
9	15mm Cement Plaster of mix 1:6 (1 Cement :6 C. Sand) on rough side of wall	452.16	sq.m		
10	Providing and filling washed Boulders of 100-200 mm nominal size in structure.	56.52	cu.m		
11	Providing and filling washed Gravels of 5-10 mm nominal size in structure.	6.28	cum		
12	Providing and filling washed Pea Gravels of 2-6 mm nominal size in structure.	6.28	cum		
	Total of Schedule 2A (carried forward to Grand Summary, p----)		Rs.		

Schedule 2B: Construction of 20 Bore Wells

S.No	Description of Item	Quantity	Unit	Unit Rate	Amount
1	Drilling of 200 mm hole by combination rig up to 60 m depth below ground level as per direction of site engineer	1200	m		
2	Making of ancillary well for water supply for drilling purpose and refilling the same after completion of work of size 5mx5mx1.2m	20	no.		
3	Supplying/lowering/fixing in position 100 mm dia PVC plain pipe with compatible fittings (6 kg/cm^2)	200	m		
4	Supplying/lowering/fixing in position 100 mm dia PVC slotted pipes with compatible fittings (6 kg/cm^2)	200	m		
5	Supplying and fitting bail plug suitable for suitable for 100 mm dia PVC pipe	20	no.		
6	Supply of pipe cap suitable for 100 mm dia PVC pipes	20	no.		
7	Supplying and laying of pipe suitable for 25 mm dia PVC pipe for vent	80	m		
8	Carrying out geochemical Treatment for incoming water	20	No.		
9	Aquifer Test	1	No		
10	Carrying out geophysical logging	20	No.		
11	Gravel Packing	20	No.		
	Total of Schedule 2B (carried forward to Grand Summary, p----)		Rs.		

Schedule 2C: Construction of Network Connection pipes

S.No	Description of Item	Quantity	Unit	Unit Rate	Amount

1	Excavating trenches of required width for pipes, cables	540	m		
2	Providing and laying 300 mm dia cement concrete pipe the injection wells	540	m		
3	Providing and laying in position cement concrete of specified grade excluding cost of centering and shuttering-all works up to plinth level 1:5:10 (1 cement: 5 sand: 10 graded stone aggregate 40 mm nominal size) for pipe encasing	70	cu.m		
4	Providing and Laying 375 mm x 375 mm Man Hole	15	No.		
	Total of Schedule 2C (carried forward to Grand Summary, p----)		Rs.		

Grand Summary

Schedule	Amount in Rs
Schedule 1: Drains	
Schedule 2A:	
Schedule 2B	
Schedule 2C	
Grand Total Carried forward to letter of price bid in Figures	
Grand Total Carried forward to letter of price bid in words	

Tables of Adjustment Data

Table A- Local Currency

Index Code	Index Description	Source of Index	Base Value and Date	Bidder's Local Currency Amount	Bidder's Proposed Weighting
000	Nonadjustable	—	—	—	A: 0.15
001	Labor (local)	The average consumer price index for industrial workers (wholesale prices) as published in Labor Bureau Simla for the area Delhi.	28 days prior to deadline of Bid submission		B:
002	Cement	All India average wholesale price index for cement as published by Economic Adviser to Govt. of India, Ministry of Industries, for the area.	28 days prior to deadline of Bid submission		C:
003	Steel	The average wholesale price Index for steel reinforcement as published by Economic Adviser to Govt. of India, Ministry of Industries, for the area.	28 days prior to deadline of Bid submission		D:
004	DI Pipe	The average wholesale price Index for pig iron as published by Economic Adviser to Govt. of India, Ministry of Industries, for the area.	28 days prior to deadline of Bid submission		E:
			Total		

Additional Price for withdrawal of Deviations

Deviation in specifications, Design parameters, Capacities etc. shall be clearly brought out in this schedule with additional price. The contents of the schedule shall be exactly identical to the one described in Section – 4 (A) Volume – I and additional price for withdrawing the deviations shall be given below:

S. No.	Clause Reference and section of bid document	As proposed in Bid document	As proposed by Bidder	Additional Price
1	2	3	4	5

We hereby undertake that the bid is strictly in conformity with the bid document except for the deviations mentioned above. Deviations, if any, found elsewhere in our bid, will be withdrawn without any implications.

Bidder

Name of Bidder

Signature of Bidder