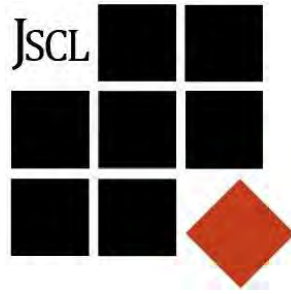


# Jaipur Smart City Limited



## INVITATION FOR BID (IFB)

**Bid Reference No. JSCL/Smart City Works/16/2017-18**

### RFP for Redevelopment of Talkatora Lake

November - 2017

### Jaipur Smart City Limited

JMC Building, Pt. Deendayal Upadhyay Bhawan, Lal Kothi, Tonk Road, Jaipur-302016  
Phone No. 0141-2741346/2741347, E-Mail ID: jscljaipur@gmail.com

# **Bid Reference No. JSCL/Smart City**

## **Works/16/2017**

### **Bidding Document**

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## **DISCLAIMER**

This request for proposal (RFP) contains brief information about the Project, Qualification Requirements, Eligibility Criteria and the Selection process for the successful bidder. The purpose of this RFP documents is to provide bidders with information to assist in the formulation of their proposal ('proposal').

The information ('Information') contained in this RFP document or subsequently provided to interested parties (the bidder(s)), in writing by or on behalf of Jaipur Smart City Limited (JSCL) is provided to Bidder(s) on the terms and conditions set out in this RFP documents and any other terms and conditions subject to which such information is provided. This RFP document does not purport to contain all their information each Bidder may require. This RFP document may not be appropriate for all persons, and it is not possible for JSCL, their employees or advisors to consider the investment objectives, financial situation and particular needs of each party who reads or uses this RFP document. Certain Bidders may have a better knowledge of the proposed Project than others. Each Bidder should conduct its own investigations and analysis and should check the accuracy, reliability and completeness of the information in this RFP document and obtain independent advice from appropriate sources.

JSCL, their employees and advisors make no representation or warranty and shall incur no liability under any law, statute, rules or regulations as to the accuracy; reliability or completeness of the RFP document and information provided hereunder is only to the best of the knowledge of JSCL.

Intimation of discrepancies in the RFP, if any, should be given to the office of the JSCL immediately by the Bidder. If JSCL receives no written communication, it shall be deemed that the Bidders are satisfied that the RFP document is complete in all respects.

This RFP, along with its Annexures, is not transferable and will be issued only to the interested Bidding Company or the Lead Member of the interested Bidding Consortium. The RFP and the information contained therein are to be used only by the person to whom it is issued. It may not be copied or distributed by the recipient to third parties (other than in confidence to the recipient's professional advisors). In the event that the recipient does not continue with its involvement in the Project in accordance with this RFP, this RFP must be kept confidential.

This RFP document is not an agreement and is not an offer or invitation by JSCL to any other party. The terms on which the Project is to be developed and the right of the successful bidder shall be as set out in separate agreement contained herein. JSCL reserves the right to accept or reject any or all proposals without giving any reasons thereof. JSCL will not entertain any claim for expenses in relation to the preparation of RFP submissions.

Neither Jaipur Smart City Limited, nor its employees and advisors/consultants will have any liability to any Bidder or any other person under the law of contract, tort, the principles of restitution or unjust enrichment or otherwise for any loss, expense or damage which may arise from or be incurred or suffered in connection with anything contained in this RFP, any matter deemed to form part of this RFP, the award of the Project, the information supplied by or on behalf of JSCL or its employees, any advisors/consultants or otherwise arising in any way from the selection process for the said Project.

The purchaser of the RFP, which may be the Bidder or the lead Member of the Bidding Consortium and on behalf of each Member of such Consortium, shall be deemed to have confirmed that the Bidders are fully satisfied with the process of evaluation of the Responses and the JSCL's decision regarding the qualification or disqualification or short listing of the Bidders. The Bidders hereby expressly waive any and all objections or claims in respect thereof.

This RFP may be withdrawn or cancelled by JSCL at any time without assigning any reasons thereof. JSCL further reserves the right, at its complete discretion to reject any or all of the Bids without assigning any reasons whatsoever.

# Jaipur Smart City Limited

JMC Building, Pt DeendayalUpadhyay Bhawan,  
LalKothi, Tonk Road, Jaipur – 302016  
E-Mail ID: jscljaipur@gmail.com

## SHORT NOTICE INVITING BID Bid Reference No. JSCL/Smart City Works/16/2017-18

Jaipur Smart City Limited (JSCL), Jaipur invites online e-bids from reputed contracting firms who have experience in multidisciplinary urban Infrastructure Projects for the following work.

Sl. No.	Name of Work	Estimated Project Cost	Earnest Money deposit(Rs.)	Tender document Fee	Bid processing fee	Period of Completion
1	Redevelopment of Talkatora Lake	Rs. 16.14 Crore (Rupees Sixteen Crore fourteen Lakhs)only	Rs. 32.28 Lakh (Rupees thirty two Lakh twenty eight thousand )only	Rs.20,000.00 (Rupees Twenty Thousands) Only	Rs. 1000.00 (Rupees One Thousand) Only	24 Months (Twenty Four Months)

### Salient date

(i)	Bid document Downloading and Submission Start Date and time	24 <sup>th</sup> November, 2017 at 11:00 am
(ii)	Bid document Downloading End Date and time	13 <sup>th</sup> December, 2017 at 5 :00 PM
(iii)	Pre-bid Meeting	5 <sup>th</sup> November,, 2017 at 11:00 AM
(iv)	Venue of Pre-bid meeting	Jaipur Smart City Limited JMC Building, Pt DeendayalUpadhyay Bhawan, LalKothi, Tonk Road, Jaipur – 302016
(v)	Last date and time of Online submission of technical proposal and financial proposal	13 <sup>th</sup> December, 2017 at 5:00 PM
(vi)	Last date and time of Physical submission of EMD, Bid document fee Bid processing fee & Power of Attorney	14 <sup>th</sup> December, 2017 at 5:00 PM
(vii)	Opening of bid online (Technical proposal only)	15 <sup>th</sup> December, 2017 at 5:00 PM

### Terms:

- Demand draft of EMD and Bid Cost are to be submitted in favour of Chief Executive Officer, Jaipur Smart City Limited, Jaipur & Bid Processing fee in favour of Managing Director, RISL, Jaipur.
- This notice and bid documents are available on following internet site address for e tender [www.eproc.rajasthan.gov.in](http://www.eproc.rajasthan.gov.in) or <http://sppp.rajasthan.gov.in>
- A complete set of bid documents can be downloaded from above websites.
- Bids shall remain valid for 120 days (one hundred and twenty days) from the date of submission of the bid
- Any bid not accompanied by Bid document fee, Bid processing fee and Earnest Money as in the NIT will be rejected as nonresponsive.
- Complete e-Tender must be submitted on-line on [www.eproc.rajasthan.gov.in](http://www.eproc.rajasthan.gov.in)
- Any addendum, clarification to the bidder's queries and corrigendum will be published on the [www.eproc.rajasthan.gov.in](http://www.eproc.rajasthan.gov.in) or <http://sppp.rajasthan.gov.in> and will not be published in the Newspapers.

**Chief Executive Officer  
Jaipur Smart City Limited**



**VOLUME -1**

**SECTION – I**

**INSTRUCTION TO BIDDERS**

## SECTION-I: INSTRUCTION TO BIDDERS

**Important Instruction:-** The Law relating to procurement “The Rajasthan Transparency in Public Procurement Act, 2012” [hereinafter called the Act] and the “Rajasthan Public Procurement Rules, 2012” [hereinafter called the Rules] under the said Act have come into force which are available on the website of State Public Procurement Portal <http://sppp.raj.nic.in>. Therefore, the Bidders are advised to acquaint themselves with the provisions of the Act and the Rules before participating in the Bidding process. If there is any discrepancy between the provisions of the Act and the Rules and this Bidding Document, the provisions of the Law shall prevail.

1. General			
1.1	Scope of Bid	1.1.1	In support of the Invitation to Bid indicated in the Bid Data Sheet (BDS), the Procuring Entity as indicated in the BDS, issues this Bidding Document for the procurement of works as named in the BDS and as specified in Section V, Procuring Entity's Requirements.
1.2	Interpretation	1.2.1	Throughout this Bidding Document: The term “in writing” means communicated in written form through letter, fax, e-mail etc. with proof of receipt. If the context so requires, singular means plural and vice versa; and “Day” means calendar day.
1.3	Code of Integrity	1.3.1	Any person participating in the procurement process shall, - i. not offer any bribe, reward or gift or any material benefit either directly or indirectly in exchange for an unfair advantage in procurement process or to otherwise influence the procurement process; ii. not misrepresent or omit that misleads or attempts to mislead so as to obtain a financial or other benefit or avoid an obligation; iii. not indulge in any collusion, bid rigging or anti-competitive behavior to impair the transparency, fairness and progress of the procurement process; iv. not misuse any information shared between the Procuring Entity and the Bidders with an intent to gain unfair advantage in the procurement process; v. not indulge in any coercion including impairing or harming or threatening to do the same, directly or indirectly, to any party or to its property to influence the procurement process; vi. not obstruct any investigation or audit of a procurement process; vii. disclose conflict of interest, if any; and viii. Disclose any previous transgressions with any Entity in India or any other country during the last three years or any debarment by any other Procuring Entity.
		1.3.2	Conflict of Interest: A conflict of interest is considered 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. A Bidder may be considered to be in conflict of interest with one or more parties in this bidding process if, including but not

			<p>limited to:</p> <ul style="list-style-type: none"> <li>i. have controlling partners/ shareholders in common; or</li> <li>ii. receive or have received any direct or in direct subsidy from any of them;or</li> <li>iii. have the same legal representative for purposes of this Bid; or</li> <li>iv. have a relationship with each other, directly or through common third parties, that puts them in a position to have access to information about or influence on the Bid of another Bidder, or influence the decisions of the Procuring Entity regarding this bidding process; or</li> <li>v. The 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 Bidder 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</li> <li>vi. the Bidder or any of its affiliates participated as a consultant in the preparation of the design or technical specifications of the Works that are the subject of the Bid; or</li> <li>vii. The Bidder or any of its affiliates has been hired (or is proposed to be hired) by the Procuring Entity as Engineer-in-charge/ consultant for the Contract.</li> </ul>
		1.3.3	The Bidder shall have to give a declaration regarding compliance of the Code of Integrity prescribed in the Act, the Rules and stated above in this Clause along with its Bid, in the format specified in Section IV, Bidding Forms.
		1.3.4	Breach of Code of Integrity by the Bidder: - Without prejudice to the provisions of Chapter IV of the Rajasthan Transparency in Public Procurement Act, in case of any breach of the Code of Integrity by a Bidder or prospective Bidder, as the case may be, the Procuring Entity may take appropriate action in accordance with the provisions of sub-section (3) of section 11 and section 46 of the Act.
1.4	Eligible Bidders	1.4.1	A Bidder may be a natural person, private Entity, government-owned Entity or, where permitted in the Bidding documents, 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], Consortium or Association. In the case of a Joint Venture, Consortium or Association: -all parties to the Joint Venture, Consortium or Association shall sign the Bid and they shall be jointly and severally liable; and a Joint Venture, Consortium or Association 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 Joint Venture, Consortium or Association during the Bidding process. In the event the Bid of Joint Venture, Consortium or Association is accepted, either they shall form a registered Joint Venture, Consortium or Association as company/firm or otherwise all the parties to Joint Venture, Consortium or Association shall sign the Agreement.
		1.4.2	A Bidder, and all parties constituting the Bidder, shall have the nationality of India. In case of International Competitive Bidding or Joint Venture, Consortium or Association [where

			permitted], the nationality of the Bidder and all parties constituting the Bidder shall be of India or an eligible country declared as such by Government of India. A Bidder shall be deemed to have nationality of a country if the Bidder is a citizen or 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 Sub-Contractors or suppliers for any part of the Contract including related services.
		1.4.3	A Bidder should not have a conflict of interest in the procurement in question as stated in the Rule 81 and this Bidding document.
		1.4.4	A Bidder debarred under section 46 of the Act shall not be eligible to participate in any procurement process undertaken by any Procuring Entity, if debarred by the State Government; and a Procuring Entity, if debarred by such Procuring Entity.
		1.4.5	The Bidder must be a registered enlisted Contractor in appropriate class with the Department/ Organization. He shall furnish necessary proof for the same.
		1.4.6	<ul style="list-style-type: none"> <li>i Any change in the constitution of the firm, etc., shall be notified forth with by the Bidder in writing to the Procuring Entity and such change shall not relieve any former partner/ member of the firm, etc from any liability under the Contract.</li> <li>ii No new partner/partners shall be accepted in the firm by the Bidder in respect of the contract unless he/they agree to abide by all its terms, conditions and deposit with the Procuring Entity a written agreement to this effect. The Bidder's receipt for acknowledgement or that of any partners subsequently accepted as above shall bind all of them and will be sufficient discharge for any of the purpose of the Contract.</li> <li>iii The status of the lead partner/ representative of the Joint Venture, Consortium or Association as a major stake holder shall not change without the consent of the Procuring Entity. New major stake holder must agree to abide by all terms and conditions of the Contract.</li> </ul>
		1.4.7	Bidders shall provide such evidence of their continued eligibility satisfactory to the Procuring Entity, should the Procuring Entity request.
		1.4.8	In case a prequalification or empanelment or registration process has been conducted prior to the bidding process, this bidding shall be open only to the pre-qualified, empanelled or registered Bidders.
		1.4.9	Each Bidder shall submit only one Bid except in case of alternative bids, if permitted.
		1.4.10	Bidder who is not registered under the Sales Tax Act prevalent in the State of Rajasthan can bid, however selected bidder shall have to be got registered with the Sales Tax department of the state government and submit the proof of registration before signing the Contract agreement. He is also required to provide proof of Permanent Account Number (PAN) given by Income Tax Department.
<b>2. Contents of Bidding Document</b>			
2.1	Sections of the Bidding Document	2.1.1	The Bidding Document consists of Parts I, II, and III, which include all the Sections indicated below, and should be read

			<p>in conjunction with any Addenda issued in accordance with ITB Clause 2.3 [Amendment of Bidding Document].</p> <p><b>Part I: Bidding Procedures</b> Section I. Instructions to Bidders (ITB) Section II. Bid Data Sheet (BDS) Section III. Evaluation and Qualification Criteria Section IV. Bidding Forms</p> <p><b>Part II: Requirements</b> Section V. Procuring Entity's Requirements.</p> <p><b>Part III: Contract</b> Section VI A. General Conditions of Contract [GCC] Section VI B. Special Conditions of Contract [SCC] Section VI C. Contract Forms</p>
		2.1.2	The Invitation for Bids (NIB) issued by the Procuring Entity is also part of the Bidding Document.
		2.1.3	i. The Bidding Document shall be uploaded on the e-procurement portal, <a href="http://eproc.raj.nic.in">eproc.raj.nic.in</a> along with the Notice Inviting Bids. The complete Bidding Document shall also be placed on the State Public Procurement Portal, <a href="http://sppp.raj.nic.in">sppp.raj.nic.in</a> . The prospective Bidders may download the bidding document from these portals. The price of the Bidding Document and processing fee of e-bid shall have to be paid to the Procuring Entity in the amount and manner as specified in Bid Data Sheet and e-procurement portal.
		2.1.4	The Procuring Entity is not responsible for the completeness of the Bidding Document and its addenda, if they were not downloaded correctly from the e-procurement portal or the State Public Procurement Portal.
		2.1.5	The Bidder is expected to examine all instructions, forms, terms and specifications in the Bidding Document. Failure to furnish all information or authentic documentation required by the Bidding Document may result in the rejection of the Bid.
2.2	Clarification of Bidding Document and Pre-Bid Conference	2.2.1	The Bidder shall be deemed to have carefully examined the conditions, specifications, size, make and drawings, etc. of the Works and Related Services to be provided. If any Bidder has any doubts as to the meaning of any portion of the conditions or of the specifications, drawings etc., it shall, before submitting the Bid, refer the same to the Procuring Entity and get clarifications. A Bidder requiring any clarification of the Bidding Document shall contact the Procuring Entity in writing or e-mail at the Procuring Entity's address indicated in the BDS. The Procuring Entity will respond in writing or e-mail to any request for clarification, within seven days provided that such request is received no later than twenty-one (21) days prior to the deadline for submission of Bids as specified in ITB Sub-Clause 4.2.1[Deadline for Submission of Bids].The clarification issued, including a description of the inquiry but without identifying its source shall also be placed on the State Public Procurement Portal and should the Procuring Entity deem it necessary to amend the Bidding Document as a result of a clarification, it shall do so following the procedure under ITB Clause 2.3 [Amendment of Bidding Document] through an addendum which shall form part of the Bidding Document.
		2.2.2	The Bidder or his authorized representative is invited to attend the Pre- Bid Conference, if provided for in the BDS. The purpose of the Pre- Bid Conference will be to clarify issues and to answer questions on any matter related to this procurement that may be raised at that stage. If required, a conducted site visit may be arranged by the Procuring Entity.

		2.2.3	The Bidder is requested, to submit questions in writing, to reach the Procuring Entity not later than one week before the date of Pre-Bid Conference.
		2.2.4	Minutes of the Pre-Bid Conference, including the text of the questions raised, and the responses given, without identifying the source, will be transmitted promptly to all Bidders who attended the Pre-Bid Conference and shall also be placed on the State Public Procurement Portal and the e-procurement portal. Any modification to the Bidding Document that may become necessary as a result of the Pre-Bid Conference shall be made by the Procuring Entity exclusively through the issue of an addendum (part of Bid document) and not through the minutes of the Pre-Bid Conference.
		2.2.5	At any time prior to the deadline for submission of the Bids, the Procuring Entity, suo-moto, may also amend the Bidding Document, if required, by issuing an addenda which will form part of the Bidding Document.
		2.2.6	Non-attendance at the Pre-Bid Conference will not be a cause for disqualification of a Bidder.
2.3	Amendment of Bidding Document	2.3.1	Any addendum issued shall be part of the Bidding Document and shall be uploaded on the State Public Procurement Portal and the e-procurement portal.
		2.3.2	To give prospective Bidders reasonable time in which to take an addendum into account in preparing their Bids, the Procuring Entity may, at its discretion, extend the deadline for the submission of the Bids, pursuant to ITB Sub-Clause 4.2 [Deadline for Submission of Bids], under due publication on the State Public Procurement Portal and the e-procurement portal and newspapers.
<b>3. Preparation of Bids</b>			
3.1	Cost of Bidding	3.1.1	The Bidder shall bear all costs associated with the preparation and submission of its Bid, and the Procuring Entity shall not be responsible or liable for those costs, regardless of the conduct or outcome of the bidding process.
		3.1.2	The Bidder shall furnish the scanned attested copies of following documents with its Bid: - i. Partnership Deed and valid registration certificate with the Registrar of Firms in case of Partnership Firms. Power of Attorney in favor of the partner signing/submitting the Bid, authorizing him to represent all partners of the firm. ii. GST/VAT/ Sales Tax registration certificate and GST/VAT/Sales Tax clearance certificate from the concerned Commercial Taxes Officer and Permanent Account Number (PAN) given by the Income Tax Department. iii. Address of residence and office, telephone numbers e-mail address in case of sole Proprietorship. iv. Certificate of Registration and Memorandum of Association issued by Registrar of Companies in case of a registered company and in case of any other statutory or registered body, certificate of incorporation or registration issued by concerned authorities. Power of attorney in favor of the person signing the Bid. v. Where permitted to bid as Joint Venture, Consortium or

			Association, letter of formal intent to enter in to an agreement or an existing agreement in the form of a Joint Venture, Consortium or Association.
3.2	Language of Bid	3.2.1	The Bid, as well as all correspondence and documents relating to the Bid exchanged by the Bidder and the Procuring Entity, shall be written in English/ Hindi or a 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 duly accepted by the Bidder in English/ Hindi or the language specified in the BDS, in which case, for purposes of interpretation of the Bid, such translation shall govern.
3.3	Documents Comprising the Bid	3.3.1	The Bid shall comprise of two covers, one containing the Technical Bid/ Proposal and the other the Financial or Price Bid/ Proposal. One more cover containing scanned copies of proof of payment in form specified in Bid Data Sheet, of the price of Bidding Document, processing fee and Bid Security/ Bid Securing Declaration shall be enclosed separately.
		3.3.2	The Technical Bid/ Proposal shall contain the following: i. Technical Bid/ Proposal Submission Sheet and Technical Bid containing the filled up Bidding Forms and Declarations related to Technical Bid and Code of Integrity given in Section IV [Bidding Forms]; ii. proof of payment of price of Bidding Document, processing fee, Bid Security, in accordance with ITB Clause 3.10; iii. written confirmation authorizing the signatory of the Bid to commit the Bidder, in accordance with ITB Clause 3.11; iv. documentary evidence in accordance with ITB Clause 3.7 establishing the Bidder's eligibility to bid; v. documentary evidence in accordance with ITB Clause 3.8 establishing the Bidder's qualifications to perform the contract if its Bid is accepted; vi. Drawings/ designs in support of the Works to be executed; vii. the Notice Inviting Bids; viii. any other document required in the BDS; and ix. Others considered necessary to strengthen the Bid submitted.
		3.3.3	The Financial Bid/ Price Proposal shall contain the following: Financial Bid/ Price Proposal Submission Sheet and the applicable Price Schedules, in accordance with ITB Clauses 3.4, 3.5; Any other document required in the BDS.
3.4	Bid Submission Sheets and Price Schedules	3.4.1	The Bidder shall submit the Technical Bid and Financial Bid using the Bid Submission Sheets provided in Section IV [Bidding Forms]. These forms must be completed without any alterations to their format, and no substitutes shall be accepted. All blank spaces shall be filled in with the information requested.
		3.4.2	The Bidder shall submit as part of the Financial Bid, the Price Schedules for Works, using the forms provided in Section IV [Bidding Forms].
3.5	Bid Prices	3.5.1	i. In case of Item Rate 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

			<p>by the Procuring Entity but will have to be executed and shall be deemed covered by the rates for other items and prices in the Bill of Quantities.</p> <p>ii. In case of Percentage Rate Contracts, combined single percentage above or below must be quoted by the Bidder for all items of the Bill of Quantities.</p> <p>iii. In case of Lump Sum Contracts, only Total Price which the Bidder wants to charge for the entire Works with all its contingencies in accordance with drawings and specifications shall be quoted by the Bidder. A Schedule of Rates shall be specified in the Bid Data Sheet in order to regulate the amount to be added to or deducted from the fixed sum on account of additions and alterations not covered by the Contract. Payments shall be linked to various stages of completion of the Works specified in Activity Schedule given in Bid Data Sheet.</p>
		3.5.2	<p>Prices quoted by the Bidder shall be fixed during the Bidder's Performance of the Contract and not subject to variation on any account, unless otherwise specified in the BDS. A Bid submitted with an adjustable price quotation shall be treated as non-responsive and shall be rejected, pursuant to ITB Clause 5.7 [Responsiveness of Bids]. However, if in accordance with the BDS, prices quoted by the Bidder shall be subject to adjustment during the performance of the Contract, a Bid submitted with a fixed price quotation shall not be rejected, but the price adjustment shall be treated as zero.</p>
		3.5.3	<p>All duties, taxes and other levies payable by the Bidder under the contract, or for any other cause, shall be included in the rates and prices, and the total Bid Price submitted by the Bidder.</p>
3.6	Currencies of Bid.	3.6.1	<p>The unit rates and the prices shall be quoted by the Bidder entirely in Indian Rupees unless otherwise specified in BDS. All payments shall be made in Indian Rupees only, unless otherwise specified in the BDS.</p>
3.7	Documents Establishing the Eligibility of the Bidder	3.7.1	<p>To establish their eligibility in accordance with ITB Clause 1.4 [Eligible Bidders], Bidders shall:</p> <p>complete the eligibility declarations in the Bid Submission Sheet and Declaration Form included in Section IV [Bidding Forms];</p> <p>if the Bidder is an existing or intended Joint Venture [JV], Consortium or Association in accordance with ITB Sub-Clause 1.4.1, shall submit a copy of the Agreement, or a letter of intent to enter into such Agreement.</p> <p>The respective document shall be signed by all legally authorized signatories of all the parties to the existing or intended JV, Consortium or Association as appropriate; and the existing or intended JV / Consortium shall authorize an individual/ partner in one of the firms as lead partner of the JV / Consortium to act and commit all the partners of JV / Consortium for the Bid.</p>
3.8	Documents Establishing the Qualifications of the Bidder	3.8.1	<p>To establish its qualifications to perform the Contract, the Bidder shall submit as part of its Technical Proposal the documentary evidence indicated for each qualification criteria specified in Section III, [Evaluation and Qualification Criteria].</p>



3.9	Period of Validity of Bids	3.9.1	Bids shall remain valid for 90 days or the period specified in the BDS after the Bid submission deadline date as specified by the Procuring Entity. A Bid valid for a shorter period shall be rejected by the Procuring Entity as non-responsive.
		3.9.2	In exceptional circumstances, prior to the expiration of the Bid validity period, the Procuring Entity may request Bidders to extend the period of validity of their Bids. The request and the responses shall be made in writing. The Bid Security or a Bid Securing Declaration in accordance with ITB Clause 3.10 [Bid Security] shall also be got extended for thirty days beyond the dead line of the extended validity period. A Bidder may refuse the request without forfeiting its Bid Security or a Bid Securing Declaration. A Bidder granting the request shall not be permitted to modify its Bid.
3.10	Bid Security	3.10.1	Unless otherwise specified in the BDS, the Bidder shall furnish as part of its Bid, a Bid Security for the amount specified in the BDS.
		3.10.2	Bid Security shall be 2% of the value of the Works indicated in the NIB. For bidders registered with the Procuring Entity, the bid security shall be 0.5% of the value of works indicated in the NIB. The bid security shall be in Indian Rupees, if not otherwise specified in the BDS.
		3.10.3	The Bid Security may be given in the form of a banker's cheque or demand draft or bank guarantee of a Scheduled Bank in India, in specified format, or deposited through eGRAS/ net-banking, if permitted.
		3.10.4	In lieu of Bid Security, a Bid Securing Declaration shall be taken from Government Departments and State Government Public Sector Enterprises, Autonomous bodies, Registered Societies, Cooperative Societies which are owned or controlled or managed by the State Government, Public Sector Enterprises of Central Government. For the Bid Securing Declaration the Bidder shall use the form included in Section IV [Bidding Forms].
		3.10.5	Scanned copy of Bid Security instrument or a Bid Securing Declaration shall necessarily accompany the sealed Bid. Any Bid not accompanied by Bid Security or Bid Securing Declaration, if not exempted, shall be liable to be rejected.
		3.10.6	Bid Security of a Bidder lying with the Procuring Entity in respect of other Bids awaiting decision shall not be adjusted towards Bid Security for this Bid. The Bid Security originally deposited may, however be taken into consideration in case Bids are re-invited.
		3.10.7	The issuer of the Bid Security and the confirmer, if any, of the Bid Security, as well as the form and terms of the Bid Security, must be acceptable to the Procuring Entity.
		3.10.8	Prior to submitting its Bid, a Bidder may request the Procuring Entity to confirm the acceptability of a proposed issuer of a Bid Security or of a proposed confirmer, if different than as specified in ITB Clause 3.10.3. The Procuring Entity shall respond promptly to such a request.

		3.10.9	The bank guarantee presented as Bid Security shall be got confirmed from the concerned issuing bank. However, the confirmation of the acceptability of a proposed issuer or of any proposed confirmer does not preclude the Procuring Entity from rejecting the Bid Security on the ground that the issuer, or the confirmer, as the case may be, has become insolvent or is under liquidation or has otherwise ceased to be creditworthy.
		3.10.10	The Bid Security of unsuccessful Bidders shall be refunded soon after final acceptance of successful Bid and signing of Contract Agreement and submitting Performance Security by successful Bidder pursuant to ITB Clause 6.4 [Performance Security].
		3.10.11	The Bid Security taken from a Bidder shall be forfeited in the following cases, namely:- i. when the Bidder withdraws or modifies his Bid after opening of Bids; or ii. when the Bidder does not execute the agreement in accordance with ITB Clause 6.3 [Signing of Contract] after issue of letter of acceptance/ placement of Work order within the specified time period; or iii. when the Bidder fails to commence the Works as per Work Order within the time specified; or iv. when the Bidder does not deposit the Performance Security in accordance with ITB Clause 6.4 [Performance Security]; in the prescribed time limit after the work order is placed; v. if the Bidder breaches any provision of the Code of Integrity prescribed for Bidders in the Act and Chapter VI of the Rules or as specified in ITB Clause 1.3 [Code of Integrity]; or vi. if the Bidder does not accept the correction of its Bid Price pursuant to ITB Sub-Clause 5.5 [Correction of Arithmetical Errors].
		3.10.12	In case of the successful bidder, the amount of Bid Security may be adjusted in arriving at the amount of the Performance Security, or refunded if the successful bidder furnishes the full amount of Performance Security. No interest will be paid by the Procuring Entity on the amount of Bid Security.
		3.10.13	The Procuring Entity shall promptly refund the Bid Security of the Bidders at the earliest of any of the following events, namely:- i. the expiry of validity of Bid Security; ii. the execution of agreement for procurement and Performance Security is furnished by the successful bidder; iii. the cancellation of the procurement process; or iv. the withdrawal of Bid prior to the deadline for presenting bids, unless the Bidding Document stipulates that no such withdrawal is permitted.

		3.10.14	The Bid Security of a Joint Venture, Consortium or Association must be in the name of the Joint Venture, Consortium or Association that submits the Bid. If the Joint Venture, Consortium or Association has not been legally constituted at the time of Bidding, the members of the proposed consortium or JV shall enter in to an Agreement to form a legally constituted JV / Consortium after the issue of Letter of Acceptance / Letter of Intent to them and also declare a partner as the lead partner in whose name the Bid Security may be submitted.
3.11	Format and Signing of Bid	3.11.1	All pages of the Technical and Financial Bid shall be digitally signed by the Bidder or authorized signatory 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. In case of a Joint Venture, Consortium or Association, if the Joint Venture, Consortium or Association has not been legally constituted at the time of Bidding, all the members of the proposed Joint Venture, Consortium or Association shall digitally sign the Bid.
<b>4. Submission and Opening of Bids</b>			
4.1	Sealing and Marking of Bids	4.1.1	Bidders shall submit their Bids to the Procuring Entity electronically only on the e-procurement portal, eproc.raj.nic.in. In submission of their Bids, the Bidders should follow the step by step instructions given on the e-procurement portal.
		4.1.2	The Bidder shall enclose the Technical Bid and the Financial Bid in separate covers. The proof of payment of price of Bidding Document, processing fee and Bid Security shall be enclosed in third cover. The price of Bidding Document and Bid Security shall be paid in the name of the Procuring Entity and the processing fee shall be paid in the name of RISL.
4.2	Deadline for Submission of Bids	4.2.1	Bids shall be submitted electronically only upto the time and date specified in the Notice Inviting Bids and BDS or an extension issued thereof.
4.3	Withdrawal, Substitution and Modification of Bids	4.3.1	A Bidder may withdraw, substitute or modify its Bid after it has been submitted by submitting electronically on the e-procurement portal a written Withdrawal/ Substitutions/ Modifications etc. Notice on the e-procurement portal, duly digitally signed by the Bidder or his authorized representative, and shall include a copy of the authorization in accordance with ITB Sub-Clause 3.11.1 [Format and Signing of Bid]. The corresponding Withdrawal, Substitution or Modification of the Bid must accompany the respective written Notice. All Notices must be received by the Procuring Entity on the e-procurement portal prior to the deadline specified for submission of Bids in accordance with ITB Sub-Clause 4.2. [Deadline for Submission of Bids].
		4.3.2	No Bid shall be withdrawn, substituted or modified in the interval between the deadline for submission of the Bid and the expiration of the period of Bid validity specified in ITB Clause 3.9.[Period of Validity of Bids] or any extension thereof.

4.4	Bid Opening	4.4.1	The electronic Technical Bids shall be opened by the Bids opening committee constituted by the Procuring Entity at the time, date and place specified in the Bid Data Sheet in the presence of the Bidders or their authorized representatives, who choose to be present.
		4.4.2	The Bids opening committee may co-opt experienced persons in the committee to conduct the process of Bid opening.
		4.4.3	The Bidders may choose to witness the electronic Bid opening procedure online.
		4.4.4	The Financial Bids shall be kept unopened until the time of opening of the Financial Bids. The date, time, and location of electronic opening of the Financial Bids shall be intimated to the bidders who are found qualified by the Procuring Entity in evaluation of their Technical Bids.
		4.4.5	The Bids opening committee shall prepare a list of the Bidders or their representatives attending the opening of Bids and obtain their signatures on the same. The list shall also contain the representative's name and telephone number and corresponding Bidders' names and addresses. The authority letters brought by the representatives shall be attached to the list. The list shall be signed by all the members of Bids opening committee with date and time of opening of the Bids.
		4.4.6	<ul style="list-style-type: none"> <li>i. First, covers marked as "WITHDRAWAL" shall be opened, read out, and recorded and the covers containing the corresponding Technical Bids and Financial Bids shall not be opened. No Bid shall be permitted to be withdrawn unless the corresponding withdrawal notice contains a valid authorization to request the withdrawal and is readout and recorded at Bid opening. If the withdrawal notice is not accompanied by the valid authorization, the withdrawal shall not be permitted and the corresponding Technical Bid shall be opened.</li> <li>ii. Next, covers marked as "SUBSTITUTION Technical Bid" shall be opened, read out, recorded. The covers containing the Substitution Technical Bids and/ or Substitution Financial Bids shall be exchanged for the corresponding covers being substituted. Only the Substitution Technical Bids shall be opened, read out, and recorded. Substitution Financial Bids will remain unopened in accordance with ITB Sub-Clause 4.4.4. No Bid 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.</li> <li>iii. Covers marked as "MODIFICATION Technical Bid" shall be opened thereafter, read out and recorded with the corresponding Technical Bids. No Technical Bid and/ or Financial Bid shall be modified unless the corresponding modification notice contains a valid authorization to request the modification and is read out and recorded at opening of Technical Bids. Only the Technical Bids, both Original as well as Modifications to be opened, read out, and recorded at the opening. Financial Bids, both Original as well as Modification, will remain unopened in accordance with ITB Sub-Clause 4.4.4.</li> </ul>

		4.4.7	<p>All other covers containing the Technical Bids shall be opened one at a time and the following read out and recorded-</p> <ol style="list-style-type: none"> <li>i. the name of the Bidder;</li> <li>ii. whether there is a modification or substitution;</li> <li>iii. whether proof of payment of Bid Security or Bid Securing Declaration, if required, payment of price of the Bidding Document and processing fee have been enclosed;</li> <li>iv. Any other details as the Bids opening committee may consider appropriate.</li> </ol> <p>After all the Bids have been opened, their hard copies shall be printed and shall be initialed and dated on the first page and other important papers of each Bid by the members of the Bids opening committee.</p>
		4.4.8	<p>Only Technical Bids shall be read out and recorded at the bid opening and shall be considered for evaluation. No Bid shall be rejected at the time of opening of Technical Bids except Alternative Bids (if not permitted) and Bids not accompanied with the proof of payment of the required price of Bidding Document, processing fee and Bid Security.</p>
		4.4.9	<p>The Bids opening committee shall prepare a record of opening of Technical Bids that shall include, as a minimum: the name of the Bidder and whether there is a withdrawal, substitution, modification, or alternative offer (if they were permitted), any conditions put by Bidder and the presence or absence of the price of Bidding Document, processing fee and Bid Security. The Bidders or their representatives, who are present, shall sign the record. The members of the Bids opening committee shall also sign the record with date.</p>
		4.4.10	<p>After completion of the evaluation of the Technical Bids, the Procuring Entity shall invite Bidders who have submitted substantially responsive Technical Bids and who have been determined as being qualified to attend the electronic opening of the Financial Bids. The date, time, and location of the opening of Financial Bids will be intimated in writing by the Procuring Entity. Bidders shall be given reasonable notice of the opening of Financial Bids.</p>
		4.4.11	<p>The Procuring Entity shall notify Bidders in writing whose Technical Bids have been rejected on the grounds of being substantially non-responsive and not qualified in accordance with the requirements of the Bidding Document.</p>
		4.4.12	<p>The Bids opening committee shall conduct the electronic opening of Financial Bids of all Bidders who submitted substantially responsive Technical Bids and have qualified in evaluation of Technical Bids, in the presence of Bidders or their representatives who choose to be present at the address, date and time specified by the Procuring Entity.</p>

		4.4.13	<p>All covers containing the Financial Bids shall be opened one at a time and the following read out and recorded-</p> <ol style="list-style-type: none"> <li>i. the name of the Bidder;</li> <li>ii. whether there is a modification or substitution;</li> <li>iii. the Bid Prices;</li> <li>iv. any other details as the Bids opening committee may consider appropriate.</li> </ol> <p>After all the Bids have been opened, their hard copies shall be printed and shall be initialed and dated on the first page of the each Bid by the members of the Bids opening committee. All the pages of the Price Schedule and letters, Bill of Quantities attached shall be initialed and dated by the members of the committee. Key information such as prices, completion period, etc. shall be encircled and unfilled spaces in the Bids shall be marked and signed with date by the members of the Bids opening committee.</p>
		4.4.14	<p>The Bids opening committee shall prepare a record of opening of Financial Bids that shall include as a minimum: the name of the Bidder and whether there is a withdrawal, substitution, or modification, the Bid Price, any conditions, any discounts and alternative offers (if they were permitted). The Bidders or their representatives, who are present, shall sign the record. The members of the Bids opening committee shall also sign the record with date.</p>
<b>5.Evaluation and Comparison of Bids</b>			
5.1	Confidentiality	5.1.1	<p>Information relating to the examination, evaluation, comparison, and post-qualification 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.</p>
		5.1.2	<p>Any attempt by a Bidder to influence the Procuring Entity in its examination of qualification, evaluation, comparison of the Bids or Contract award decisions may resulting in the rejection of its Bid, in addition to the legal action which may be taken by the Procuring Entity under the Act and the Rules.</p>
		5.1.3	<p>Notwithstanding ITB Sub-Clause 5.1.2 [Confidentiality], from the time of opening the Bid to the time of Contract award, if any Bidder wishes to contact the Procuring Entity on any matter related to the Bidding process, it shall do so in writing.</p>
		5.1.4	<p>In addition to the restrictions specified in section 49 of the Act, the Procuring Entity, while procuring a subject matter of such nature which requires the procuring Entity to maintain confidentiality, may impose condition for protecting confidentiality of such information.</p>
5.2	Clarification of Technical or Financial Bids	5.2.1	<p>To assist in the examination, evaluation, comparison and qualification of the Technical or Financial Bids, the Bid evaluation committee may, at its discretion, ask any Bidder for a clarification regarding his Bid. The committee's request for clarification and the response of the Bidder shall be in writing.</p>

		5.2.2	Any clarification submitted by a Bidder with regard to his Bid that is not in response to a request by the Bid evaluation committee shall not be considered.
		5.2.3	No change in the prices or substance of the Bid shall be sought, offered, or permitted, except to confirm the correction of arithmetical errors discovered by the Bid evaluation committee in the evaluation of the financial Bids.
		5.2.4	No substantive change to qualification information or to a submission, including changes aimed at making an unqualified Bidder, qualified or an unresponsive submission, responsive shall be sought, offered or permitted.
5.3	Deviations, Reservations and Omissions in Technical or Financial Bids	5.3.1	During the evaluation of Technical or Financial Bids, the following definitions apply: <ul style="list-style-type: none"> <li>i. "Deviation" is a departure from the requirements specified in the Bidding Document;</li> <li>ii. "Reservation" is the setting of limiting conditions or withholding from complete acceptance of the requirements specified in the Bidding Document; and</li> <li>iii. "Omission" is the failure to submit part or all of the information or documentation required in the Bidding Document.</li> </ul>
5.4	Nonmaterial Non conformities in Technical or Financial Bids	5.4.1	Provided that a Technical or Financial Bid is substantially responsive, the Procuring Entity may waive any non-conformities (with recorded reasons) in the Bid that do not constitute a material deviation, reservation or omission.
		5.4.2	Provided that a Technical or Financial Bid is substantially responsive, the Procuring Entity may request the Bidder to submit the necessary information or documentation, within a reasonable period of time, to rectify nonmaterial nonconformities or omissions in the Bid related to documentation requirements. Request for information or documentation on such nonconformities shall not be related to any aspect of the Financial Proposal of the Bid. Failure of the Bidder to comply with the request may result in the rejection of its Bid.
		5.4.3	* Provided that a Technical or Financial Bid is substantially responsive, the Procuring Entity will rectify nonmaterial nonconformities or omissions (with recorded reasons). To this effect, the Bid Price shall be adjusted during evaluation of Financial Proposals for comparison purposes only, to reflect the price of the missing or non- conforming item or component. The adjustment shall be made using the method indicated in Section III, Evaluation and Qualification Criteria. <b>* [This ITB Sub-Clause should be kept only when considered necessary]</b>
5.5	Correction of Arithmetical Errors in Financial Bid	5.5.1	Provided that a Financial Bid is substantially responsive, the Bid evaluation committee shall correct arithmetical errors during evaluation of Financial Bid on the following basis: <ul style="list-style-type: none"> <li>i. 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 Procuring Entity 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;</li> <li>ii. 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</li> </ul>

			iii. 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 (i) and (ii) above.
		5.5.2	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 shall be forfeited or its Bid Securing Declaration shall be executed.
5.6	Preliminary Examination of Technical or Financial Bids	5.6.1	The Procuring Entity shall examine the Technical or Financial Bids to confirm that all documents and technical documentation requested in ITB Sub-Clause 3.3 [Documents Comprising the Bid] have been provided, and to determine the completeness of each document submitted.
		5.6.2	The Procuring Entity shall confirm, following the opening of the Technical or Financial Bids, that the following documents and information have been provided: <ul style="list-style-type: none"> <li>i. Bid is signed, as per the requirements listed in the Bidding documents;</li> <li>ii. Bid has been sealed as per instructions provided in the Bidding documents;</li> <li>iii. Bid is valid for the period, specified in the Bidding documents;</li> <li>iv. Bid is accompanied by Bid Security or Bid securing declaration;</li> <li>v. Bid is unconditional and the Bidder has agreed to give the required performance Security;</li> <li>vi. Price Schedules in the Financial Bids are in accordance with ITB Clause 3.4 [Bid Submission Sheets and Price Schedules];</li> <li>vii. written confirmation of authorization to commit the Bidder;</li> <li>viii. Declaration by the Bidder in compliance of Section 7 and 11 of the Act; and</li> <li>ix. Other conditions, as specified in the Bidding Document are fulfilled.</li> </ul>
5.7	Responsiveness of Technical or Financial Bids	5.7.1	The Procuring Entity's determination of the responsiveness of a Technical or Financial Bid is to be based on the contents of the Bid itself, as defined in ITB Sub-Clause 3.3 [Documents Comprising the Bid].
		5.7.2	A substantially responsive Technical or Financial Bid is one that meets without material deviation, reservation, or omission to all the terms, conditions, and specifications of the Bidding Document. A material deviation, reservation, or omission is one that: <ul style="list-style-type: none"> <li>(a) if accepted, would- <ul style="list-style-type: none"> <li>i. affect in any substantial way the scope, quality, or performance of the Goods and Related Services specified in Section V, Schedule of Supply; or</li> <li>ii. limits in any substantial way, inconsistent with the Bidding Document, the Procuring Entity's rights or the Bidder's obligations under the proposed Contract; or</li> </ul> </li> </ul>



			iii. if rectified, would unfairly affect the competitive position of other Bidders presenting substantially responsive Bids.
		5.7.3	The Procuring Entity shall examine the technical aspects of the Bid in particular, to confirm that requirements of Section V, Procuring Entity's Requirements have been met without any material deviation, reservation, or omission.
		5.7.4	If a Technical or Financial Bid is not substantially responsive to the Bidding Document, it shall be rejected by the Procuring Entity and may not subsequently be made responsive by the Bidder by correction of the material deviation, reservation, or omission.
5.8	Examination of Terms and Conditions of the Technical or Financial Bids	5.8.1	The Procuring Entity shall examine the Bids to confirm that all terms and conditions specified in the GCC and the SCC have been accepted by the Bidder without any material deviation or reservation.
		5.8.2	The Procuring Entity shall evaluate the technical aspects of the Bid submitted in accordance with ITB Clauses 3.3 [Documents Comprising the Bid] and to confirm that all requirements specified in Section V [Procuring Entity's Requirements] of the Bidding Document and all amendments or changes requested by the Procuring Entity in accordance with ITB Clause 2.3 [Amendment of Bidding Document] have been met without any material deviation or reservation.
5.9	Evaluation of Qualification of Bidders in Technical Bids	5.9.1	The determination of qualification of a Bidder in evaluation of Technical Bids shall be based upon an examination of the documentary evidence of the Bidder's qualifications submitted by the Bidder, pursuant to ITB Clause 3.8 [Documents Establishing the Qualifications of the Bidder] and in accordance with the qualification criteria indicated in Section III [Evaluation and Qualification Criteria]. Factors not included in Section III, shall not be used in the evaluation of the Bidder's qualification.
5.10	Evaluation of Financial Bids	5.10.1	The Procuring Entity shall evaluate each Financial Bid, the corresponding Technical Bid of which has been determined to be substantially responsive
		5.10.2	To evaluate a Financial Bid, the Procuring Entity shall only use all the criteria and methodologies defined in this Clause and in Section III, Evaluation and Qualification Criteria. No other criteria or methodology shall be permitted.
		5.10.3	To evaluate a Financial Bid, the Procuring Entity shall consider the following: <ul style="list-style-type: none"> <li>i. the Bid Price quoted in the Financial Bid;</li> <li>ii. price adjustment for correction of arithmetical errors in accordance with ITB Clause 5.5 [Correction of Arithmetical Errors];</li> <li>iii. Adjustment of bid prices due to rectification of nonmaterial nonconformities or omissions in accordance with ITB Sub Clause 5.4.3 [Nonmaterial Nonconformities in Bids], if applicable.</li> </ul>

		5.10.4	If the Bid, which results in the lowest evaluated Bid Price, is considered to be seriously unbalanced, or front loaded, in the opinion of the Procuring Entity, the Procuring Entity may require the Bidder to produce detailed rate analysis for any or all items of the Bill of Quantities, to demonstrate the internal consistency of those rates with the construction methods and schedule proposed. After evaluation of the rate analysis, taking into consideration, the schedule of estimated Contract payments, the Procuring Entity may require that the amount of the Performance security be increased at the cost of the Bidder to a level sufficient to protect the Procuring Entity against financial loss in the event of default of the successful Bidder under the Contract.
5.11	Comparison of Bids	5.11.1	The Procuring Entity shall compare all substantially responsive Financial Bids to determine the lowest-evaluated Financial Bid in accordance with ITB Sub-Clause 5.10 [Evaluation of Financial Bids].
5.12	Negotiations	5.12.1	To the extent possible, no negotiations shall be conducted after the pre-Bid stage. All clarifications needed to be sought shall be sought in the pre-Bid stage itself.
		5.12.2	Negotiations may, however, be undertaken only with the lowest Bidder under the following circumstances- i. when ring prices have been quoted by the Bidders for the subject matter of procurement; or  ii. When the rates quoted vary considerably and considered much higher than the prevailing market rates.
		5.12.3	The Bid evaluation committee shall have full powers to undertake negotiations. Detailed reasons and results of negotiations shall be recorded in the proceedings.
		5.12.4	The lowest Bidder shall be informed about negotiations in writing either through messenger or by registered letter and e-mail (if available). A minimum time of seven days shall be given for calling negotiations. In case of urgency, the Bid evaluation committee, after recording reasons, may reduce the time, provided the lowest Bidder has received the intimation and consented to holding of negotiations.
		5.12.5	Negotiations shall not make the original offer made by the Bidder inoperative. The Bid evaluation committee shall have option to consider the original offer in case the Bidder decides to increase rates originally quoted or imposes any new terms or conditions.
		5.12.6	In case of non-satisfactory achievement of rates from lowest Bidder, the Bid evaluation committee may choose to make a written counter offer to the lowest Bidder and if this is not accepted by him, the committee may decide to reject and re-invite Bids or to make the same counter-offer first to the second lowest Bidder, then to the third lowest Bidder and so on in the order of their initial standing in the bid evaluation and work order be awarded to the Bidder who accepts the counter-offer.
		5.12.7	In case the rates even after the negotiations are considered very high, fresh Bids shall be invited.

5.13	Procuring Entity's Right to Accept Any Bid, and to Reject Any or All Bids	5.13.1	The Procuring Entity 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 assigning any reasons thereof and without there by incurring any liability to the Bidders.
<b>6. Award of Contract</b>			
6.1	Procuring Entity's Right to Vary Quantities	6.1.1	If the Procuring Entity does not procure any subject matter of procurement or procures less than the quantity specified in the Bidding Document due to change in circumstances, the Bidder shall not be entitled for any claim or compensation except otherwise provided in the Bidding Document.
		6.1.2	Order for additional quantity of an item of the Works upto 50 percent of the original quantity of that item in the Bill of Quantities and for extra items not provided for in the Bill of Quantities may be given but the amount of the additional quantities and extra items, taken together, shall not exceed 50 percent of the Contract Price.
6.2	Acceptance of the successful Bid and award of contract	6.2.1	The Procuring Entity after considering the recommendations of the Bid Evaluation Committee and the conditions of Bid, if any, financial implications, samples, test reports, etc., shall accept or reject the successful Bid.
		6.2.2	Before award of the Contract, the Procuring Entity shall ensure that the price of successful Bid is reasonable and consistent with the required specifications.
		6.2.3	A Bid shall be treated as successful only after the competent authority has approved the procurement in terms of that Bid.
		6.2.4	The Procuring Entity shall award the contract to the Bidder whose offer has been determined to be the lowest in accordance with the evaluation criteria set out in the Bidding Document if the Bidder has been determined to be qualified to perform the contract satisfactorily on the basis of qualification criteria fixed for the Bidders in the Bidding Document for the subject matter of procurement.
		6.2.5	Prior to the expiration of the period of validity of Bid, the Procuring Entity shall inform the successful Bidder in writing, by registered post or email, that its Bid has been accepted.
		6.2.6	If the issuance of formal letter of acceptance (LOA) is likely to take time, in the meanwhile a Letter of Intent (LOI) may be sent to the Bidder. The acceptance of an offer is complete as soon as the letter of acceptance or letter of intent is posted and/ or sent by email (if available) to the address of the Bidder given in the Bidding Document.
6.3	Signing of Contract	6.3.1	In the written intimation of acceptance of its Bid sent to the successful Bidder, it shall also be requested to execute an agreement in the format given in the Bidding Document on a non-judicial stamp of requisite value at his cost and deposit the Performance Security or a Performance Security Declaration, if applicable, within a period specified in the BDS or where the period is not specified in the BDS, then within fifteen days from the date on which the LOA or LOI is dispatched to the Bidder. In case the successful bidder is a JV / Consortium still to be legally constituted, all parties to the JV / Consortium shall sign the Agreement.

		6.3.2	If the Bidder, whose Bid has been accepted, fails to sign a written procurement contract or fails to furnish the required Performance Security or Performance Security Declaration within the specified time period, the Procuring Entity shall forfeit the Bid Security of the successful bidder / execute the Bid Securing Declaration and take required action against it as per the provisions of the Act and the Rules.
		6.3.3	The Bid Security, if any, of the Bidders whose Bids could not be accepted shall be refunded soon after the contract with the successful Bidder is signed and his Performance Security is obtained. Until a formal contract is executed, LOA or LOI shall constitute a binding contract.
6.4	Performance Security	6.4.1	Performance Security shall be solicited from the successful Bidder except State Govt. Departments and undertakings, corporations, autonomous bodies, registered societies, co-operative societies which are owned or controlled or managed by the State Government and undertakings of Central Government. However, a Performance Security Declaration shall be taken from them. The State Government may relax the provision of Performance Security in particular procurement.
		6.4.2	<ul style="list-style-type: none"> <li>i. The amount of Performance Security shall be ten percent, or as specified in the BDS, of the amount of the Work Order. The currency of Performance Security shall be Indian Rupees, if otherwise not specified in BDS.</li> <li>ii. If the Bid, which results in the lowest evaluated bid price, is seriously unbalanced or front loaded in the opinion of the Procuring Entity, the Procuring Entity may require the Bidder to produce detailed price analysis 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 analysis, taking into consideration the schedule of estimated Contract payments, the Procuring Entity may require that the amount of the performance security be increased (to a maximum of 20% of the bid value of such items) at the expense of the Bidder to a level sufficient to protect the Procuring Entity against financial loss in the event of default of the successful Bidder under the Contract.</li> </ul>
		6.4.3	<ul style="list-style-type: none"> <li>i. Performance Security shall be furnished in one of the following forms as applicable-</li> <li>ii. Deposit through eGRAS; or</li> <li>iii. Bank Draft or Banker's Cheque of a Scheduled Bank in India; or</li> <li>iv. National Savings Certificates and any other script/ instrument under National Savings Schemes for promotion of small savings issued by a Post Office in Rajasthan, if the same can be pledged under the relevant rules. They shall be accepted at their surrender value at the time of Bid and formally transferred in the name of the Procuring Entity with the approval of Head Post Master; or</li> <li>v. Bank guarantee. It shall be got verified from the issuing bank. Other conditions regarding bank guarantee shall be same as specified in ITB Sub-Clause 3.10 [Bid Security]; or</li> </ul>

			<ul style="list-style-type: none"> <li>vi. Fixed Deposit Receipt (FDR) of a Scheduled Bank. It shall be in the name of the Procuring Entity on account of Bidder and discharged by the Bidder in advance. The Procuring Entity shall ensure before accepting the Fixed Deposit Receipt that the Bidder furnishes an undertaking from the bank to make payment/ premature payment of the Fixed Deposit Receipt on demand to the Procuring Entity without requirement of consent of the Bidder concerned. In the event of forfeiture of the Performance Security, the Fixed Deposit shall be forfeited along with interest earned on such Fixed Deposit.</li> <li>vii. The successful Bidder at the time of signing of the Contract agreement, may submit option for deduction of Performance Security from his each running and final bill @ 10% of the amount of the bill.</li> </ul>
		6.4.4	Performance Security furnished in the form of a document mentioned at options (a) to (e) of Sub-Clause 6.4.3 above, shall remain valid for a period of sixty days beyond the date of completion of all contractual obligations of the Bidder, including operation and / or maintenance and defect liability period, if any.
		6.4.5	Failure of the successful Bidder to submit the above-mentioned Performance Security or sign the Contract shall constitute sufficient grounds for the annulment of the award and forfeiture of the Bid Security. In that event the Procuring Entity may either cancel the procurement process or if deemed appropriate, award the Contract at the rates of the lowest Bidder, to the next lowest evaluated Bidder whose offer is substantially responsive and is determined by the Procuring Entity to be qualified to perform the Contract satisfactorily.
		6.4.6	<p>Forfeiture of Performance Security: Amount of Performance Security in full or part may be forfeited in the following cases:-</p> <ul style="list-style-type: none"> <li>i. when the Bidder does not execute the agreement in accordance with ITB Clause 6.3 [Signing of Contract] within the specified time; after issue of letter of acceptance; or</li> <li>ii. when the Bidder fails to commence the Works as per Work order within the time specified; or</li> <li>iii. when the Bidder fails to complete Contracted Works satisfactorily within the time specified; or</li> <li>iv. when any terms and conditions of the contract is breached; or</li> <li>v. to adjust any established dues against the Bidder from any other contract with the Procuring Entity; or</li> <li>vi. if the Bidder breaches any provision of the Code of Integrity prescribed for the Bidders specified in the Act, Chapter VI of the Rules and this Bidding Document.</li> <li>vii. Notice of reasonable time will be given in case of forfeiture of Performance Security. The decision of the Procuring Entity in this regard shall be final.</li> </ul>
<b>7. Redressal of Grievances during Procurement Process (Appeals)</b>			

7	Grievance handling procedure during procurement process	7.1	Any grievance of a Bidder pertaining to the procurement process shall be by way of filing an appeal to the First or Second Appellate Authority, as the case may be, as specified in the BDS, in accordance with the provisions of chapter III of the Act and chapter VII of the Rules and as given in Appendix A to these ITB.
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## Appendix A:

### Grievance Handling Procedure during Procurement Process (Appeals)

**1) Filing an appeal.-** If any Bidder or prospective Bidder is aggrieved that any decision, action or omission of the Procuring Entity is in contravention to the provisions of the Act or the Rules or the Guidelines issued there under, he may file an appeal to First or Second Appellate Authority, as the case may be, as may be designated for the purpose, within a period of ten days or such other period as may be specified in the pre-qualification documents, Bidder registration documents or Bidding documents, as the case may be, from the date of such decision or action, omission, as the case may be, clearly giving the specific ground or grounds on which he feels aggrieved:

Provided that after the declaration of a Bidder as successful in terms of section 27 of the Act, the appeal may be filed only by a Bidder who has participated in procurement proceedings:

Provided further that in case a Procuring Entity evaluates the technical Bid before the opening of the financial Bid, an appeal related to the matter of financial Bid may be filed only by a Bidder whose technical Bid is found to be acceptable.

**2) Appeal not to lie in certain cases. -**No appeal shall lie against any decision of the Procuring Entity relating to the following matters, namely:-

- a) determination of need of procurement;
- b) provisions limiting participation of Bidders in the Bid process;
- c) the decision of whether or not to enter into negotiations;
- d) cancellation of a procurement process;
- e) applicability of the provisions of confidentiality.

**3) Form of Appeal.-**

- a) An appeal under sub-section (1) or (4) of section 38 shall be in the annexed Form along with as many copies as there are respondents in the appeal.
- b) Every appeal shall be accompanied by an order appealed against, if any affidavit verifying the facts stated in the appeal and proof of payment of fee.
- c) Every appeal may be presented to First Appellate Authority or Second Appellate Authority, as the case may be, in person or through registered post or authorized representative.

**4) Fee for filing Appeal.-**

- a) Fee for first appeal shall be rupees two thousand five hundred and for second appeal shall be rupees ten thousand, which shall be non-refundable.
- b) The fee shall be paid in the form of bank demand draft or banker's Cheque of a Scheduled Bank payable in the name of Appellate Authority concerned.

**5) Procedure for disposal of Appeals.-**

- a) The First Appellate Authority or Second Appellate Authority, as the case may be, upon filing of appeal, shall issue notice accompanied by copy of appeal, affidavit and documents, if any, to the respondents and fix date of hearing.
- b) On the date fixed for hearing, the First Appellate Authority or Second Appellate Authority, as the case may be, shall,-
  - (i) hear all the parties to appeal present before him; and
  - (ii) peruse or inspect documents, relevant records or copies thereof relating to the matter.
- c) After hearing the parties, perusal or inspection of documents and relevant records or copies thereof relating to the matter, the Appellate Authority concerned shall pass an order in writing and provide the copy of order to the parties to appeal free of cost.
- d) The order passed under sub-clause (c) above shall be placed on the State Public Procurement Portal.

**Annexure**

**FORM No. 1**

**[See rule 83]**

**Memorandum of Appeal under the Rajasthan Transparency in Public Procurement Act, 2012**

Appeal No .....of .....

Before the ..... (First / Second Appellate Authority)

1. Particulars of appellant:

- (a) Name of the appellant:
- (b) Official address, if any:
- (c) Residential address:

2. Name and address of the respondent(s):

- (a)
- (b)
- (c)

3. Number and date of the order appealed against name and designation of the officer / authority who passed the order (enclose copy), or a statement of a decision, action or omission of the Procuring Entity in contravention to the provisions of the Act by which the appellant is aggrieved:

4. If the Appellant proposes to be represented by a representative, the name and postal address of the representative:

5. Number of affidavits and documents enclosed with the appeal:

6. Grounds of appeal:

.....  
.....  
.....  
..... (Supported by an affidavit)

7. Prayer:

.....  
.....  
.....

Place .....

Date.....

Appellant's Signature



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**SECTION-II**

**BIDDING DATA SHEET**

## SECTION-II: BIDDING DATA SHEET

The following specific data for the works shall complement, amend, or supplement the provisions in Instructions to Bidders – Section I. Whenever there is a conflict, the provisions herein shall prevail over those in the Instructions to Bidders.

### INSTRUCTIONS TO BIDDERS CLAUSE REFERENCE

#### A. Introduction

ITB. 1.1.1	The Number of the Invitation for Bids (NIT) is: <b>JSCL/Smart City -Works/16/2017 - 18</b> The Procuring Entity is: <b>Jaipur Smart City Limited, Rajasthan</b> Name of Work: <b>Development of Talkotara Lake</b> (Detailed Scope of work has been defined in Section V: Procuring Entity's Requirement)
1.1.2	<b>Period of Completion:</b> The Physical Works shall be completed in its entirety within <b>24 (twenty four)</b> the Start Date, which shall be the date of issue of the Notice to proceed or such other Start Date as may be specified in the Notice to proceed. The Defect Liability Period for the project is one year.
1.1.3	<b>Estimated Cost of work is: Rs. 16.14Crores.</b>
ITB 1.4.1	Joint Ventures / Consortium are permitted comprising not more than <b>3 (three)</b> firms/companies. <b>The minimum equity under JV / Consortium of lead firm should be min 51% and other firm min 20% each.</b>
ITB 1.4.2	<b>"Bidders of Indian Nationality"</b> are only permissible.
ITB 1.4.5	The Bidder must be a enlisted Contractor of Class AA with Rajasthan Public Works Department or equivalent with other Government / Organisation. He shall furnish necessary proof for the same.
ITB 1.4.8	The bidding process is open to bidders who fulfil the prescribed eligibility criteria.
ITB 1.4.9	Each bidder shall upload on-line / submit only one bid for one work. A bidder who submits or participates in more than one bid for the particular Works will be disqualified.

#### B. Bidding Documents

ITB 2.1.3	This is an "on-line tender". Therefore, tender documents in physical form shall not be available for sale but can be downloaded from the website and pay cost (Rs 20,000/-) while submitting the filled-up Bidding document to the Procuring Entity along with the processing fee of Rs 1,000/- separately in favour of RISL, Jaipur.  The bidder should submit, by date & time specified in bid document, in original, hard copies of (i) cost of bid document as Rs. 20,000/- for each work in the form of DD/Banker's Cheque of a scheduled bank in India or eGRAS in the name of Chief Executive Officer, Jaipur Smart City Limited payable at Jaipur; (ii) Bid processing fee of Rs. 1,000/- for each work in the form of DD in the name of Managing Director, RISL, Jaipur payable at Jaipur; (iii) Bid Security as per RTPP; (iv) Letter of Technical Bid; (v) Power of Attorney; and (vi) Joint Venture Agreement, if applicable. The bidder should upload scanned copies of these documents on e-procurement web-site along with their technical bids.
ITB 2.2.1	For Clarification purposes only, the Procuring Entity's address is: <b>OFFICE OF THE CHIEF EXECUTIVE OFFICER</b> <b>Jaipur Smart City Limited.</b> JMC Building, Pt. Deendayal Upadhyay Bhawan, LalKothi, Tonk Road, Jaipur-302016 Phone No. 0141-2741346/2741347, E-Mail ID: <a href="mailto:jscljaipur@gmail.com">jscljaipur@gmail.com</a>

ITB 2.2.2	<p>A <b>Pre-bid Meeting</b> will take place at the JMC Building,Pt. Deendayal Upadhyay Bhawan,LalKothi,Tonk Road,Jaipur-302016.on:</p> <p><b>Date: 5<sup>th</sup> December, 2017</b></p> <p><b>Time:11 AM.</b></p> <p>No Site visit shall be organised by the procuring entity. However, bidders are advised to visit the sites at their own expenses and if any support is required, shall be provided by the Executive Officer/Engineer.</p>
ITB 2.2.3	<p>The Bidders are requested, to submit questions in writing, to reach the Procuring Entity preferably not later than one week before the Pre-bid Meeting. However, Department may also consider questions / queries raised in writing only, during the Pre-bid Meeting.</p>
ITB 2.3.1	<p>Any addendum issued shall be part of the Bidding Document and shall be uploaded on the State Public Procurement Portals <a href="http://sppp.rajasthan.gov.in/">http://sppp.rajasthan.gov.in/</a> and <a href="http://eproc.rajasthan.gov.in">http://eproc.rajasthan.gov.in</a></p>
ITB 2.3.2	<p>To give prospective Bidders reasonable time in which to take an addendum into account in preparing their Bids, the Procuring Entity may, at its discretion, extend the deadline for the submission of the Bids, pursuant to ITB Sub-Clause 4.2 [Deadline for Submission of Bids], under due intimation to the Bidders by uploading it on the State Public Procurement Portal and its e-procurement portal.</p>

### C. Preparation of Bids

ITB 3.2.1	<p>The language of the bid shall be: <b>English</b></p>
ITB 3.3.1	<p>The online Bid shall comprise of two parts submitted simultaneously, one containing the Technical Bid/ Proposal and the other the Financial or Price Bid/ Proposal.</p>
ITB 3.3.2	<p>The Bidder shall submit the forms, declarations and documents, as specified in Section IV of Bid Document, with the Technical Bid:</p>
ITB 3.3.3	<p>The Bidder shall upload the following documents with its Financial Bid:</p> <ol style="list-style-type: none"> <li>i. Financial Proposal Submission</li> <li>ii. Bill of Quantities</li> <li>iii. And other details as mentioned in Sec IV of Vol-1</li> </ol>
ITB 3.5.1	<p>Add following:</p> <ol style="list-style-type: none"> <li>a) The type of Contract will be lumpsum.</li> </ol>
ITB 3.5.2	<p>The Prices quoted by the Bidder shall be fixed.</p>
ITB 3.5.3	<p>All variations in taxes and duties shall be borne as per relevant clause of the Section VI B: SCC</p>
ITB 3.9.1	<p>The Bid validity period shall be <b>120 (One hundred and twenty days)</b> days from deadline for submission of bids.</p>
ITB 3.10.2	<p>Add following:</p> <p>Bid security shall be <b>of the value Rs. 32.28 Lakh (Rupees Thirty-Two Lakh Twenty-Eight Thousand only), as indicated in NIT for all bidders.</b></p>
ITB 3.10.3	<p>A Bid Security shall be provided as a part of the bid in the form of a Banker's Cheque</p>

	or Demand Draft or Bank Guarantee of a Scheduled Bank in India, in specified format which shall remain valid for a period of 45(forty-five) days beyond the validity of the bid.
ITB 3.11.1	Only Digital signed copy shall be submitted through e-procurement website.
ITB 3.11.2	The written confirmation of authorization to sign on behalf of the Bidder shall consist of: Power of Attorney

#### D. Submission and Opening of Bids

ITB 4.1.1	<p>For bid submission purposes only, the Procuring Entity's address is:</p> <p><b>OFFICE OF THE CHIEF EXECUTIVE OFFICER</b> Jaipur Smart City Limited. JMC Building,Pt.Deendayal Upadhyay Bhawan, Lalkothi,Tonk Road,Jaipur-302016 Phone No. 0141-2741346/2741347E-Mail ID: jscjjaipur@gmail.com</p> <p><b>Bidders shall submit their Bids electronically only.</b></p> <p>The Bidders shall submit the Bid online with all pages numbered serially and by giving an index of submissions. Each page of the submission shall be initialled by the Authorised Representative of the Bidder as per the terms of the tender. The Bidder shall be responsible for documents accuracy and correctness as per the version uploaded by the Procuring Entity and shall ensure that there are no changes caused in the content of the downloaded document. The bidder shall follow the following instructions for online submission:</p> <ol style="list-style-type: none"> <li>Bidder who wants to participate in bidding will have to procure digital certificate as per IT Act to sign their electronic bids. Offers which are not digitally signed will not be accepted. Bidder shall submit their offer in electronic format on above mentioned website after digitally signing the same.</li> <li>Cost of bid document is <b>Rs.20,000/-</b> per tender should be deposited by Non-Refundable Demand Draft drawn in favor of Chief Executive Officer, Jaipur Smart City Limited, Jaipur payable at Jaipur, whereas the Processing fee <b>Rs. 1,000/-</b> should be deposited by Non-Refundable Demand Draft drawn in favour of MD, RISL, Jaipur payable at Jaipur. <b>Original documents along with above mentioned fees and other documents as per bid conditions, has to be deposited up to 05.00 PM on 14<sup>th</sup> December, 2017 before opening of technical bid.</b></li> <li>The Procuring Entity will not be responsible for any mistake occurred at the time of uploading of bid or thereafter.</li> <li>If holiday is declared on submission &amp; opening date of tender the scheduled activity will take place on next working day.</li> </ol>
ITB 4.1.2	Bids are required to be submitted in Electronic Format, it shall be submitted on the e-procurement portal: <a href="http://eproc.rajasthan.gov.in">http://eproc.rajasthan.gov.in</a>
ITB 4.2.1	<p>The Deadline for electronic Bid submission is</p> <p><b>Date: 13<sup>th</sup> December, 2017</b></p> <p><b>Time: 05:00 PM</b></p>
ITB 4.4.1,4.4.5	<p>The online Bid opening shall take place at:</p> <p><b>OFFICE OF THE CHIEF EXECUTIVE OFFICER</b> <b>Jaipur Smart City Limited.</b> JMC Building,Pt.Deendayal Upadhyay Bhawan Lalkothi,Tonk Road,Jaipur-302016 Phone No. 0141-2741346/2741347E-Mail ID: jscjjaipur@gmail.com</p>

	The tendering process shall be conducted online only; DD/BG tender fee, processing fee and Bid Security shall be submitted physically up to deadline described in tender document.
ITB 4.4.13,4.4.15	The Procuring Entity will open the Financial proposal as per e-tendering procedure.

### E. Award of Contract

ITB 6.3.1	The period within which the Performance Security is to be submitted by the successful Bidder and the Contract Agreement is to be signed by him from the date of issue of Letter of Acceptance is 30 Days.
ITB 6.3.3	The procuring entity shall promptly return the bid security after the earliest of the following events, namely: <ul style="list-style-type: none"> <li>i. The expiry of validity of bid security</li> <li>ii. The execution of agreement for procurement and performance security is furnished by the successful bidder;</li> <li>iii. The cancellation of the procurement process; or</li> <li>iv. The withdrawal of bid prior to the deadline for presenting bids, unless the bidding documents stipulate that no such withdrawal is permitted.</li> </ul>
ITB 6.4.2, 6.4.3, 6.4.4  Replace with following	Performance Security amounting to total 10% of contract value and provisional sum) shall be submitted / deducted as follows: <ul style="list-style-type: none"> <li>i. Contractor shall submit Performance Security @ 10% in advance at the time of signing of agreement in form of Bank Guarantee as per latest rules under RTTPP act. The Bank Guarantee should be issued by any nationalized/ schedule bank and shall remain valid up to 60 days beyond defect liability period. Bank Guarantee submitted against the performance guarantee, shall be unconditional and en-cashable/ invokable at Town for which tenders are invited, or at Jaipur.</li> <li>ii. If there is no reason to retain the Performance Security, it shall be returned back to the contractor within 60 days after the satisfactory completion of the defect liability period.</li> <li>iii. Refer Clause 49 of Special Conditions of Contract.</li> </ul>
7.1	First Appellate Authority shall be: Dy. Secretary/Joint secretary, LSGD, Rajasthan Second Appellate Authority shall be: Secretary/Principal Secretary, LSGD, Rajasthan

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**SECTION III**

**EVALUATION**

**AND**

**QUALIFICATION CRITERIA**

## SECTION III: EVALUATION AND QUALIFICATION CRITERIA

### A. Evaluation Criteria

1.1 The successful Bid will be the lowest evaluated responsive Bid, which qualifies technical evaluation.

1.2 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.

1.3 Quantifiable Nonconformities, Errors and Omissions.

The evaluated cost of quantifiable non-conformities, errors and/or omissions is determined as follows:

"Pursuant to ITB Clause 5.4, the cost of all quantifiable nonmaterial nonconformities or omissions shall be evaluated. The Procuring Entity will make its own assessment of the cost of any nonmaterial nonconformities and omissions for the purpose of ensuring fair comparison of bids."

*[For guidance: The cost of minor omissions or missing items should be added to the Bid Price to allow for bid comparison on an equal basis. The price adjustment should be based on a reasonable estimate of the cost by the executing agency, engineer, consultant or bid evaluation committee, taking into consideration the corresponding quoted prices from other conforming bids. The price adjustment may be based on the price of the item quoted by the next lowest qualified bidder].*

### Qualification Criteria:

#### 1. Eligibility:

	Criteria	Compliance Requirements				Documents Submission Requirements
		Single Entity	Joint Venture / Consortium			
	Requirement		All Partners Combined	Each Partner	One partner	
<b>i) Nationality</b>	Nationality with accordance with ITB sub Clause 1.4.2	Must meet requirement	Must meet requirement	Must meet requirement	Not Applicable	As per forms ELI 1, ELI 2 with attachment
<b>ii) Conflict of Interest</b>	No conflicts of interest in accordance with ITB Sub-clause 1.4.3	Must meet requirement	Must meet requirement	Must meet requirement	Not Applicable	Letter of Bid
<b>iii) Debarment/ Transgression by any Procuring Entity</b>	Must declare	Must meet requirement	Must meet requirement	Must meet requirement	Not Applicable	Declaration form given in the Bidding Document as per Form 4.15

**2. Pending Litigation:**

<b>Pending Litigation</b>	All pending litigation shall be treated as resolved against the Bidder and so shall in total not represent more than <b>50</b> percent of the Bidder's net worth.	Must meet requirement by itself or as partner to past or existing JV / Consortium	Not Applicable	Must meet requirement by itself or as partner to past or existing JV / Consortium	Not Applicable	Form LIT 1
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**NOTE:** CA certificate clearly mentioning with calculation that pending litigation in total not more than 50% of Bidder's net worth.

**3. Financial Situation:**

Criteria	Compliance Requirements			Documents Submission Requirements	
	Single Entity	Joint Venture / Consortium(permitted)			
Requirement		All Partners Combined	Lead Member	Each Member	

**3.1 Historical Financial Performance**

Net Worth					
Net Worth for the Financial Year 2016-17 (from latest audited balance sheet) should be positive. (Certificate of Chartered Accountant showing calculation of Net Worth must be enclosed)	Must meet requirement	Not Applicable	Must meet requirement	Must meet requirement	Form FIN 1 with attachment
Construction Turnover					
Average Annual Construction Turnover of <b>last three financial years</b> should be equal to or more than (1.5x cost of work/time period in years <i>i.e.</i> <b>Rs121 Lakh</b> ).	Must meet requirement	Must meet requirement	Must meet 51% (percent) of the requirement	Must meet 20%(percent) of the requirement	Form FIN 2

**NOTE:** Audited Balance Sheets of all the three financial years must be submitted in support, without which the bid may not be considered. The calculation sheet for annual average construction turnover shall be certified by a Chartered Accountant.

Working Capital					
Working Capital based on the current assets and current liabilities (including the short term loan repayments due in current years) should be minimum of 25% of the estimated cost of bid.  (Available Working Capital shall be evaluated as Current Assets + Revolving Line of Credit – Current Liabilities (including loan repayment due within one year)	Must meet requirement	Must meet requirement	Must meet 51% (percent) of the requirement	Must meet 20% (percent) of requirement	

**NOTE:** Certificate of CA must be submitted indicating clearly that the working capital is as per formula given in tender document and clearly stating the individual components. CA must also clearly mention



*that he has gone through the Revolving line of credit which is issued by scheduled Bank and Bank's commitment is project specific, assured and without any ambiguity and shall be available till final completion of project, otherwise bid shall not be considered. For revolving line of credit bank's letter should be attached. The bank issuing revolving line of credit has to be scheduled Bank as per format, otherwise it shall not be considered.*

### 3.2 Bid Capacity (Financial Resources)

Bid Capacity: The bid capacity of the bidder shall not be less than the estimated cost of the bid. The formula for calculating Bid capacity is given here	Must meet requirement	Must meet requirement	Lead member must meet 51% (percent) of the requirement	Must meet 20% (percent) of requirement	Form FIN 3
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Bid Capacity =  $(2 \times A \times N) - B$

Where A= Maximum value of Annual Turnover from urban infrastructure works executed in any one year during the last four years (2013-14, 2014-15, 2015-16, 2016-17) (updated to present price level) taking in to account the completed as well as works in progress (including current year, if opted by the bidder),

N=Prescribed completion period of the work for which bids are invited in years,

B= Value at present price level (2016-17) of existing commitments and ongoing works to be completed during N period i.e., the period of completion of works for which bids are invited.

*NOTE: The certificate of CA regarding Bid Capacity must be submitted otherwise bid shall not be considered. The certificate should clearly show the calculation how the Bid Capacity is calculated as per formula given in tender. The contractor should submit an undertaking on stamp paper of Rs. 500 that he has mentioned all projects necessary for calculation of B value for the calculation of Bid Capacity*

**4. Experience:**

Criteria	Compliance Requirements				Documents Submission Requirements
	Single Entity	Joint Venture / Consortium			
		All Partners Combined	Each Partner	One partner	
Requirement					
<b>4.1 General Construction Experience:</b>					
Experience of construction contracts - At least the last 5 Years prior to the Bid submission deadline. (2012-13 to 2016-17 and current year)	Must meet requirement	Not Applicable	Must meet requirement	Not Applicable	Form EXP 1
<i>NOTE: Certificate of Chartered Accountant must be submitted, clearly indicating construction experience based on construction turnover of the firm.</i>					
<b>4.2 Specific Construction Experience</b>					
<i>The bidder should have experience of the following in last five financial years (2012-13 to 2016-17); experience in current year shall also be counted up to deadline for submission of bid.</i>					
Should have substantially completed (as per definition given below) (i) At least two numbers of not less than six storey buildings with Mechanical, Electrical and Plumbing work complete, with total Project cost of not less than Rs.11.50 Crore and (ii) Construction of Road Embankment work having Project cost of not less than 65.00 Lakh.	Must meet requirement	Must meet requirement	Not Applicable	Not Applicable	Form EXP 2a
<b>OR</b>					
Should have substantially completed (as per definition given below) (i) At least three numbers of not less than four storey buildings with Mechanical, Electrical and Plumbing work complete with total Project cost of not less than Rs. 9.00 Crore and (ii) Construction of Road Embankment work having Project cost of not less than 65.00 Lakh.	Must meet requirement	Must meet requirement	Not Applicable	Not Applicable	Form EXP 2a

**Note:**

- (i) *The bidder should submit the following documents to substantiate his bid:*
1. *The bidder shall submit copies of work order, completion and satisfactory performance certificates in support of their experience claims.*
  2. *The works which have been completed during the period mentioned above, though may have commenced earlier shall be considered for experience purpose.*
- (ii) *Clients certificate of experience must clearly indicate whether*
1. *Completed and commissioned; or*
  2. *Substantially completed as per definition given.*

**4.3 Construction Experience in Key Activities in last 5 years**

Should have substantially completed (as per definition given below) (i) At least two numbers of not less than six storey buildings with Mechanical, Electrical and Plumbing work complete, with built up area of not less than 2500 square meter each and (ii) Construction of Road Embankment work having Project cost not less than 150 Meter.	Must meet requirement	Must meet requirement	Not Applicable	Not Applicable	Form EXP 2b
<b>OR</b>					
Should have substantially completed (as per definition given below) (i) At least three numbers of not less than four storey buildings with Mechanical, Electrical and Plumbing work complete with built up area of not less than 1500 square meter each and (ii) Construction of Road Embankment work having Project cost not less than 150 Meter.	Must meet requirement	Must meet requirement	Not Applicable	Not Applicable	Form EXP 2b

*Note: - Substantially completed means that the Contractor has completed and commissioned the work, at least of the amount required for qualification, out of a large size contract. The commissioning of the work is essentially required and any hindrance in commissioning whether within or beyond control of the contractor would not be acceptable.*

**Note: For 4.2 & 4.3**

- i) *The Bidder shall submit copies of Work Orders, Completion and satisfactory performance Certificates in support of their experience claims. Only works of Govt/PSU/Autonomous bodies under Govt. Sector of any country shall be considered.*
- ii) *The works which have been completed during the period mentioned above, though may have commenced earlier, and shall be considered for experience purposes.*
- iii) *For considering experience of the bidder, out of its experience as JV / Consortium, its own works in the JV / Consortium shall be considered with relevant evidence/certificates.*
- iv) *JV / Consortium shall comprise of not more than three firms/companies. The minimum equity under JV / Consortium of lead firm should be min 51% and other firm min 20% each.*

NOTE:

The present price level for turnover and cost of completed work of similar nature, the previous years' value shall be given weight age of 10% per year as follows:

Sr. No	Financial Year	Weight age
(i)	2016-17	1.00
(ii)	2015-16	1.00
(iii)	2014-15	1.10
(iv)	2013-14	1.21
(v)	2012-13	1.33
(vi)	2011-12	1.46

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**Section IV**

**Bidding Forms**

## Section IV: Bidding Forms

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#### **4.1 TECHNICAL PROPOSAL [WITH REFERENCE TO SECTION III] CHECK LIST**

In addition to the forms given in this section, a Technical Proposal must necessarily contain the following, otherwise the bid shall be considered incomplete and may lead to non- responsive:

1. Notice Inviting Tender
2. CA's certificates
3. Bank's letter as required in Tender Document (if applicable).
4. GST / Sales Tax Registration in State of Rajasthan
5. GST / VAT / Sales Tax Clearance Certificate
6. GST / Service Tax Registration, as required per law
7. Proof of payment of Bid Security
8. Proof of Cost of bidding document or receipt of such cost.
9. Proof of Bid processing fee as specified.
10. Bid capacity stipulations as required in Tender Document.
11. Completion Certificates of works which have been cited in support of fulfillment of eligibility criteria as specified in Tender Document.
12. Work orders of works which have been cited in support of fulfillment of eligibility criteria as specified in Tender Document.
13. Drawings / designs / technical documents (if required) in support of works to be executed
14. Any modifications or withdrawal.
15. Other documents considered necessary to strengthen the bid.
16. JV / Consortium agreement against which experience for eligibility is claimed to demonstrate clearly the JV / Consortium members work in that JV / Consortium.
17. Registration certificate of each bidder / JV / Consortium Partner in class AA or equivalent in any State / Central / PSU / in India.
18. Self-Declaration by Bidder: No Blacklisting
19. Certificate of Conformity / No Deviation
20. Check Points and Self-Appraisal sheet

## 4.2 Letter of Technical Bid

### Technical Bid Submission Sheet (In Bidder's Own Letterhead)

Date: \_\_\_\_\_ NIT No.: \_\_\_\_\_

To: \_\_\_\_\_

Sir,

We, the undersigned, declare that:

- a) We have examined and have no reservations to the Bidding Document, including Addenda No. \_\_\_\_\_
- b) We offer to execute in conformity with the Bidding Document the following Works:  
\_\_\_\_\_
- c) 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 Document, and it shall remain binding upon us and may be accepted at any time before the expiration of that period;
- d) If our Bid is accepted, we commit to obtain a Performance Security in the amount of \_\_\_\_\_ percent of the Contract Price or Performance Security Declaration, as the case may be, for the due performance of the Contract;
- e) Our firm, including any subcontractors or suppliers for any part of the Contract, have nationalities from the eligible countries;
- f) We are not participating, as Bidder, in more than one Bid in this bidding process, other than alternative offers, if permitted, in the Bidding Document;
- g) Our firm, its affiliates or subsidiaries, including any subcontractors or suppliers has not been debarred by the State Government or the Procuring Entity;
- 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;
- 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 Government of Rajasthan or the Procuring Entity or their representatives to inspect our accounts and records and other documents relating to the bid submission and to have them audited by auditors appointed by the Procuring Entity;
- k) We have paid, or will pay the following commissions, gratuities, or fees, if any, with respect to the bidding process for execution of the Contract:

Name of Recipient	Address	Reason	Amount

- l) We declare that we have complied with and shall continue to comply with the provisions of the Code of Integrity including Conflict of Interest as specified for Bidders in the Rajasthan Transparency in Public Procurement Act, 2012, the Rajasthan Transparency in Public Procurement Rules, 2013 and this Bidding Document during this procurement process and execution of the Works as per the Contract;

m) Other comments, if any:

Yours faithfully,

Signature:

Name/ address: \_\_\_\_\_

In the capacity of: \_\_\_\_\_

Signed: \_\_\_\_\_

Duly authorised to sign the Bid for and on behalf of: \_\_\_\_\_

Date: \_\_\_\_\_

Tel: \_\_\_\_\_ Fax: \_\_\_\_\_ E-mail: \_\_\_\_\_



#### 4.3.1 Bid Security (Bank Guarantee Unconditional) \*

**Form of Bid Security**  
***[insert Bank's Name, and Address of Issuing Branch or Office]***

**Beneficiary: *[Chief Executive Officer, JSCL, RAJSATHAN]***

**Date: *[insert date]***

**BID GUARANTEE No.: *[insert number]***

We have been informed that ***[insert name of the Bidder]*** (hereinafter called "the Bidder") has submitted to you its bid dated ***[insert date]*** (hereinafter called "the Bid") for the execution of ***[insert name of contract]*** under Notice Inviting Tender No. ***[insert NIT number]*** ("the NIT").

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

At the request of the Bidder, we ***[insert name of Bank]*** hereby irrevocably undertake to pay you any sum or sums not exceeding in total an amount of ----- ***[insert amount in figures]*** ***[insert amount in words]*** upon receipt by us of your first demand in writing accompanied by a written statement Bidder 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 Letter of Technical Bid; or
- (b) having been notified of the acceptance of its Bid by the *Procuring Entity* during the period of bid validity,
  - (i) fails or refuses to execute the Contract Agreement,
  - (ii) fails or refuses to furnish the performance security, in accordance with the Instructions to Bidders (hereinafter "the ITB"),
- (c) has not accepted the correction of mathematical errors in accordance with the ITB, or
- (d) has breached a provision of the Code of Integrity specified in the ITB;

This guarantee will expire: (a) if the Bidder is the successful Bidder, upon our receipt of copies of the contract 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 of your notification to the Bidder of the name of the successful Bidder; or (ii) thirty days after the expiration of the validity 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.

Signed: \_\_\_\_\_

***[Insert signature of person whose name and capacity are shown]***

***NOTE: \* - Scheduled Bank Only***

Name: \_\_\_\_\_

***[insert complete name of person signing the Bid Security]***

In the capacity of: \_\_\_\_\_

***[insert legal capacity of person signing the Bid Security]***

Duly authorized to sign the Bid Security for and on behalf of \_\_\_\_\_

***[insert name of the Bank]***

Dated on            day of ,

***[insert date of signing]***

Bank's Seal \_\_\_\_\_

***[affix seal of the Bank]***

***[Note: In case of a Joint Venture, the Bid-Security must be in the name of all partners to the Joint Venture/Lead bidder that submits the bid.]***

### 4.3.2 Bid Securing Declaration

#### Form of Bid Securing Declaration

Date: ***[insert date (as day, month and year)]***

Bid No.: ***[insert number of bidding process]***

Alternative No, if permitted: ***[insert identification No if this is a Bid for an alternative]***

To: ***[Chief Executive Officer, JSCL, RAJASTHAN]***

We, the undersigned, declare that:

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

We accept that we will automatically be suspended from being eligible for bidding in any contract with you, the Procuring Entity for the period of time of ***[insert number of months or years, as required by the Procuring Entity]*** starting on ***[insert date]***, if we are in breach of our obligation(s) under the bid conditions, because we:

- i. Withdraw our Bid during the period of bid validity specified in the Letter of Bid; or
- ii. Do not accept the correction of errors in accordance with the Instructions to Bidders (hereinafter "the ITB"); or
- iii. Having been notified of the acceptance of our Bid by you, the Procuring Entity, during the period of bid validity, (i) fail or refuse to sign the Contract, if required, or (ii) fail or refuse to furnish the Performance Security Declaration, in accordance with the ITB; or
- iv. Breach any provisions of the Code of Integrity as specified in the ITB;

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

Signed: \_\_\_\_\_

***[insert signature of person whose name and capacity are shown]***

Name: \_\_\_\_\_

***[insert complete name of person signing the Bid-Securing Declaration]***

In the capacity of: \_\_\_\_\_

***[insert legal capacity of person signing the Bid-Securing Declaration]***

Duly authorized to sign the bid for and on behalf of: \_\_\_\_\_

***[insert complete name of Bidder]***

Dated on \_\_\_\_\_ day of,

***[insert date of signing]***

Corporate Seal \_\_\_\_\_

***[affix corporate seal of the bidder]***

***[Note: In case of a Joint Venture, the Bid-Securing Declaration must be in the name of all partners to the Joint Venture/ Lead bidder that submits the bid.]***

#### 4.4 Bidder's Qualification

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

##### 4.4.1 Form ELI - 1: Bidder's Information Sheet

<b>BIDDER'S INFORMATION</b>	
Bidder's legal name	
In case of JV/Consortium, legal name of each partner	
Bidder's /all JV/Consortium partners country of constitution.	
Bidder's /all JV/Consortium partners year of constitution	
Bidder's /all JV/Consortium partners legal address in country of constitution	
Bidder's /all JV/Consortium partners authorized representative (name, address, telephone numbers, fax numbers, e-mail address)	
Attached are self-attested copies of the following original documents: <ol style="list-style-type: none"><li>1. In case of single entity, certificate of registration/ incorporation and memorandum of association or constitution of the legal entity named above.</li><li>2. Authorization to represent the firm or JV / Consortium named in above.</li><li>3. In case of JV / Consortium, letter of intent to form JV / Consortium or JV / Consortium agreement.</li><li>4. In case of Consortium, letter of intent to form Consortium or JV Consortium.</li></ol>	

**4.4.2 Form ELI – 2: JV / Consortium Information Sheet**

Attach the Letter of Intent to form JV / Consortium or certificate of registration/ incorporation and memorandum of association or constitution of the legal entity, if JV / Consortium is already in existence.

**(Each member of a JV / Consortium / must fill in this form)**

<b>JV /Consortium/ SPECIALIST CONTRACTOR’S INFORMATION</b>	
Bidder’s legal name	
JV /Consortium Partner’s or Subcontractor’s legal name	
JV /Consortium Partner’s financial share in the JV	
JV /Consortium Partner’s or Subcontractor’s country of constitution	
JV /Consortium Partner’s or Subcontractor’s year of constitution	
JV /Consortium Partner’s or Subcontractor’s legal address in country of constitution	
JV /Consortium Partner’s or Subcontractor’s authorized representative information(name, address, telephone numbers, fax numbers, e-mail address)	
<p>Attached are attested copies of the following original documents:</p> <ol style="list-style-type: none"> <li>1. Certificate of registration/ incorporation and memorandum of association or constitution of the legal entity named above.</li> <li>2. Authorization to represent the firm named above.</li> </ol>	

**4.4.3 Form LIT 1- Pending Litigation**

**(Each Bidder or member of a JV / Consortium / must fill in this form to be certified by the Statutory Auditors of the Bidder)**

<b>Pending Litigation</b>			
<input type="radio"/> No pending litigation in accordance with Section III (Evaluation and Qualification Criteria).			
<input type="radio"/> Pending litigation in accordance with Section III (Evaluation and Qualification Criteria)			
Year	Matter in Dispute	Value of Pending Claim in INR	Value of Pending Claim as a Percentage of Net Worth

**4.4.4 Form FIN 1 – Financial Situation**

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

***(To be certified by the statutory auditors of the Bidder)***

Financial Data for past ..... years in Rupees				
Years /Items	Year 1:	Year 2 :	Year 3:	Year 4:

**Information from Balance Sheet in Rupees**

(in case of bidders and JV / Consortium partners from outside India, data to be converted at the exchange rate prevailing 28 days prior to the deadline of submission of the bids)

Total Assets				
Total Liabilities				
Net Worth				
Current Assets				
Current Liabilities				
Others as required				

**Information from Profit & Loss Account/ Income & Expenditure Statement**

Total Operating Revenues/ Income				
Profit/ Excess of Income over Expenditure before Taxes				
Profit/ Excess of Income over Expenditure after Taxes				
Others as required				

Attached are attested copies of audited financial statements (balance sheets including all related notes, and Profit & Loss Account/ Income & Expenditure Statement) for the last ..... years, as indicated above, complying with the following conditions:

- All such documents reflect the financial situation of the Bidder or partner to a JV / Consortium, and not sister or parent companies.
- Historic financial statements must be audited by a chartered 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).

Signature of the statutory auditors

Signature of Authorised Signatory

**4.4.5 Form FIN 2 Average Annual Construction Turnover in Rupees**

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

**(To be certified by the statutory auditors of the Bidder)**

Annual Turnover Data for the last.....years ( <i>Construction works only</i> )	
Year	Amount-Rupees
Average Annual Construction Turnover	
The information supplied should be the Annual Turnover of the Bidder or each member of a JV / Consortium in terms of the amounts billed to clients for each year for work in progress or completed, at the end of the period reported. For JV / Consortium partners from other countries, the conversion to Rupees shall at the rates prevailing on the 31st. March of that year.	
Signature of the statutory auditors	Signature of Authorised Signatory

NOTE:

[To bring the earlier year's amount to the last financial year's level the following multiplier may be applied.]

The present price level for turnover and cost of completed work of similar nature, the previous years' value shall be given weight age of 10% per year as follows:

Sr. No	Financial Year	Weight age
(i)	2016-17	1.00
(ii)	2015-16	1.00
(iii)	2014-15	1.10
(iv)	2013-14	1.21
(v)	2012-13	1.33
(vi)	2011-12	1.46



**4.4.6 Form FIN 3 Financial Resources - Rupees**

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 as indicated in Section III (Evaluation and Qualification Criteria).

<b>FINANCIAL RESOURCES</b>		
<b>S.No</b>	<b>Source of Financing</b>	<b>Amount in Rupees</b>

Signature of Authorised Signatory

**4.4.7 Form FIN 4 Current Contract Commitments / Works in Progress**

Bidders and each partner to a JV / Consortium 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.

<b>CURRENT CONTRACT COMMITMENTS</b>					
S.No.	Name of Contract	Procuring Entity's Contact Address, Tel., Mobile, Fax, e-mail id	Value of Outstanding work in Rupees	Estimated Completion Date	Average Monthly Invoicing during Last 6 months (Rupees per month)

Signature of Authorised Signatory

**4.5 Form EXP – 1: General Experience**

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

<b>GENERAL EXPERIENCE</b>				
Starting Month Year	Ending Month Year	Years	Contract Identification and Name Name and Address of Procuring Entity Brief Description of the Works Executed by the Bidder	Role of Bidder

Bidder Must Enclose:

1. Certificate of CA mentioning the construction turnover as per relevant clause.

**4.6 Form EXP – 2(a): Specific Experience**

**Note:** Please fill up one sheet per contract

<b>CONTRACT OF SIMILAR SIZE AND NATURE</b>		
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 / Consortium or subcontractor, specify participation of total	Percent of Total	Amount
Procuring Entity's Name, Address, Telephone Number, Fax Number, E-mail address		

Bidder Must Enclose:

1. Work order.
2. Experience certificate as per relevant clause from an officer not below the rank of executive Engineer or Equivalent.

**4.7 Form EXP – 2(b): Experience in Key Activities**

Fill up one (1) form per contract

<b>CONTRACT WITH SIMILAR KEY ACTIVITIES</b>			
<b>Contract No. . . . .of. . . . .</b>		<b>Contract Identification</b>	
<b>Award Date</b>		<b>Completion Date</b>	
<b>Total Contract Amount</b>		-----Equivalent INR -----	
<b>If partner in a JV / Consortium or subcontractor, specify participation of total contract amount</b>		<b>Percent of Total</b>	<b>Amount</b>
<b>Employer's Name</b>			
<b>Address</b>			
<b>Telephone Number</b>			
<b>Fax Number</b>			
<b>E-mail</b>			
<b>Description of the key activities in accordance with Criteria.</b>			
Should have substantially completed ( <a href="#">as per definition given below</a> ) / completed and commissioned one single work of Sports Complex which includes Construction of indoor and outdoor sports facilities and at least two works out of following (i) Construction/ renovation of cycle velodrom of perimeter 330m (ii) Construction of tensile fabric roofing with supporting structure and foundations covering an area of 1800 sqm ( iii) Construction of international level championship tennis court			
<b>OR</b>			
Should have substantially completed ( <a href="#">as per definition given below</a> ) / completed and commissioned two single work of construction of Sports Complex which includes Construction of indoor and outdoor sports facilities and at least two works out of following (i) Construction/ renovation of cycle velodrom of perimeter 330m (ii) Construction of tensile fabric roofing with supporting structure and foundations covering an area of 1800 sqm ( iii) Construction of international level championship tennis court			

**4.8 Form: Assured Revolving Line of Credit Facility.**

(To be submitted by a Scheduled Bank on the Bank's Letter head)

**Date:** (Insert Date)

**To: Chief Executive Officer**

JMC Building, Pt Deendayal Upadhyay Bhawan  
LalKothi, Tonk Road, Jaipur-302016

**Subject: Letter of Assurance for Revolving line of credit facility for INR ----**

Dear Sir,

---

**WHEREAS** \_\_\_\_\_ [name and address of Bidder] (hereinafter called the "Bidder") intends to submit a bid for----- (name of contract package) -----" under the Jaipur Smart City Limited (JSCL) (hereinafter called the "Employer") in response to the Invitation for Bids issued by the JSCL through NIB no. -----; and

**WHEREAS** the Bidder has requested that an assured revolving line of credit be provided to it for executing the ----- (name of contract package) -----In the event that the Contract is awarded to it; then

**KNOW ALL THESE PEOPLE** by these presents that We \_\_\_\_\_ [name of Bank] of \_\_\_\_\_ [name of Country] having our registered office at \_\_\_\_\_ [address of registered office] are willing to provide to \_\_\_\_\_ (the Bidder) a sum of up to \_\_\_\_\_ [amount of guarantee in figures and words] as an assured revolving line of credit for executing the Works under ----- (name of contract package) -----should the Bidder be awarded the contract based on its tendered prices.

We understand that this assurance may be taken into consideration by the Employer during evaluation of the Bidder's financial capabilities, and further assure that we intend to maintain this revolving line of credit until such time as the Works are completed and taken over by the Employer.

**SEALED** with the Common Seal of the said Bank on the \_\_\_\_ day of \_\_\_\_\_, 2017

Date: \_\_\_\_\_ Signature of the Bank: \_\_\_\_\_

Witness: \_\_\_\_\_ Seal: \_\_\_\_\_

[Signature, name and address]

#### **4.9 Declaration by the Bidder in compliance of Section 7 & 11 of the Act**

##### **Declaration by the Bidder/ JV / Consortium**

**(To be prepared and submitted in 100 rupees Non Judicial Stamp Paper)**

In relation to our Bid submitted to ..... *[enter designation and address of the procuring entity]* for procurement of ..... *[insert name of the Works]* in response to their Notice Inviting Bids No..... Dated ..... we hereby declare under Section 7 and 11 of the Rajasthan Transparency in Public Procurement Act, 2012, that;

1. We possess the necessary professional, technical, financial and managerial resources and competence required by the Bidding Document issued by the Procuring Entity;
2. We have fulfilled our obligation to pay such of the taxes payable to the Central Government or the State Government or any local authority, as specified in the Bidding Document;
3. We are not insolvent, in receivership, bankrupt or being wound up, not have my/our affairs administered by a court or a judicial officer, not have my/our business activities suspended and are not the subject of legal proceedings for any of the foregoing reasons;
4. We do not have, and our directors and officers not have, been convicted of any criminal offence related to our professional conduct or the making of false statements or misrepresentations as to our qualifications to enter into a procurement contract within a period of three years preceding the commencement of this procurement process, or not have been otherwise disqualified pursuant to debarment proceedings;
5. We do not have a conflict of interest as specified in the Rajasthan Transparency in Public Procurement Act, the Rajasthan Transparency in Public Procurement Rules and this Bidding Document, which materially affects fair competition;
6. We have complied and shall continue to comply with the Code of Integrity as specified in the Rajasthan Transparency in Public Procurement Act, the Rajasthan Transparency in Public Procurement Rules and this Bidding Document, till completion of all our obligations under the Contract.

Date:

Signature of Bidder

Place:

Name:

Designation:

Address:

**4.10 Letter of Financial Bid**

**Financial Bid Submission Sheet**

***(To be submitted with financial bid under Vol 2: BoQ only)***

Date: \_\_\_\_\_

NIT No.: \_\_\_\_\_

To: \_\_\_\_\_

Sir,

We, the undersigned, declare that:

- a) We have examined and have no reservations to the Bidding Document, including Addenda No.: \_\_\_\_\_
- b) We offer to execute in conformity with the Bidding Document the following Works:  
\_\_\_\_\_
- c) The total Price for our Bid, excluding any discounts offered, if permitted, in item (d) below is:  
\_\_\_\_\_
- d) The discounts offered, if permitted, and the methodologies for their application are:  
\_\_\_\_\_
- e) 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.
- f) We understand that you are not bound to accept the lowest evaluated bid or any other bid that you may receive.
- g) Other comments, if any:

Yours faithfully,

Signature:

Name/ address: \_\_\_\_\_

In the capacity of: \_\_\_\_\_

Signed: \_\_\_\_\_

Duly authorised to sign the Bid for and on behalf of: \_\_\_\_\_

Date: \_\_\_\_\_

Tel: \_\_\_\_\_ Fax: \_\_\_\_\_

E-mail: \_\_\_\_\_



**4.11 POWER OF ATTORNEY (TO BE PREPARED AND SUBMITTED IN RS. 100.00 NON JUDICIAL STAMP PAPER)**

Power of Attorney for Authorized Representative

The firm M/s.....authorize the following Representative to sign and submit the tender document, negotiate terms and conditions for the contract, to sign the contract, to deal with the \_\_\_\_\_, to issue and receive correspondence related to all matters of the bid "-----". We / M/s \_\_\_\_\_ undertake the responsibility due to any act of the representative appointed hear by.

**For Partnership Firm's**

S. No.	Name of the All Partner	Signature of Partner with Seal
1.		
2.		
3.		
4.	Name and Designation of the person Authorized	
5.	Attested Signature of the Authorized Representative	

**For Limited Firm's**

Name and Designation of the person Authorized	
Firm	
Address	
Telephone No.	
Fax No.	
Telex No.	
Authority By which the Powers is delegated	
Attested Signature of the Authorized Representative	
Name and Designation of person attesting the signatures	

#### 4.12 Joint Venture Agreement (Among Three Firms)

(On Rs 1000/- Non-judicial Stamp Paper)

##### Memorandum of Understanding for

##### **JOINT VENTURE**

This Memorandum of Understanding (hereinafter referred to as "MOU") is made and entered into this ----- ("Effective Date").

##### **BETWEEN**

**M/s.** \_\_\_\_\_, a company incorporated, and having its registered office at \_\_\_\_\_.

(Hereinafter referred to as the "**First Party**"/ "**One Partner**");

**M/s.** \_\_\_\_\_) a company incorporated, and having Registered office at \_\_\_\_\_.

(Hereinafter referred to as the "**Second Party**"/ "**Each Partner**");

Hereinafter jointly referred to as the "**Parties**" and individually as "**Each Party**" or "**a Party**" as the case may be.

WHEREAS,

A) **The Government of Rajasthan, JAIPUR SMART CITY LIMITED. Jaipur Rajasthan (hereinafter referred to as the JSCL or procuring entity) invited bid for**

\_\_\_\_\_  
\_\_\_\_\_

(B) The **Parties** hereto formed a Joint Venture or will form a joint venture (hereinafter referred to as the "**JV**") to jointly execute the above project in all respect

**NOW THEREFORE IT IS HERE BY AGREED** as follows

##### **ARTICLE 1: JOINT VENTURE:**

1.1. The Parties hereto agree to form the Joint Venture with \_\_\_\_\_ designated as the **One Partner and First Partner.**

1.2. \_\_\_\_\_ shall be the **Second Member – or Second Partner**

1.3. \_\_\_\_\_ shall be the **Third Member – or Third Partner (insert more lines if more partners)**

##### **ARTICLE 2: JOINT VENTURE NAME:**

2. The JV shall do business in the name of "**\_\_\_\_\_ Joint Venture**".

##### **ARTICLE 3: JOINT AND SEVERAL LIABILITY:**

3. The **Parties** hereto shall, for the above-referred **Projects**, be jointly and severally liable to the **Employer** for the execution of the Projects in accordance with the **Contract** till the actual completion of Contract including defect liability period and operation & maintenance as per bid conditions.

**ARTICLE 4: PROPORTIONATE SHARE:**

4.1 Each member of the Joint Venture agrees to place at the disposal of the Joint Venture, the benefit of all its experience, technical knowledge and skill, and shall in all respects bear its share of responsibility and burden of completing the contract. The parties herein shall be responsible for physical and financial distribution of work as under.

**Lead Partner:** Financial responsibility: -----

Physical responsibility: -----

**Other Partners:** Financial responsibility: -----

Physical responsibility: -----

**Other Partners:** Financial responsibility: -----

Physical responsibility: -----

4.2 All rights, interests, liabilities, obligations, risks, costs, expenses and pecuniary obligations and all net profits or net losses arising out of the **Contract** shall be shared or borne by the **Parties** in the above **Proportions**.

4.3 The members in the proportion as mention in article 4.1, shall contribute sufficient Initial fixed capital for timely execution of the project including commissioning & operating period as per the contract.

**ARTICLE 5: JOINT EFFORT AND MANAGEMENT:**

5.1 The **Parties** shall participate as a **JV** in the submission of bids and further negotiations with the **Employer** and shall co-operate and contribute their respective expertise and resources to secure and execute the **Projects**.

5.2 On award of **Projects**, the **First Partner** in consultation with the other members of JV will decide on the final management structure for the successful execution of the **Projects** as per the terms of **Contract**.

5.3 All the **Parties** hereby agree to pool in their financial, administrative, managerial, technical and material resources for execution of the **Projects**, including commissioning & operation for the period as stipulated in the contract. The share of interest of the **JV** shall be as per the mutual understanding for the successful completion of the project.

**ARTICLE 6: EXCLUSIVITY:**

6.1 The co-operation between the **Parties** hereto shall be mutually exclusive i.e. none of them shall without the other **Party's** consent & prior approval of **JSCL**, approach or cooperate with any other parties in respect of the Project.

6.2 In the course of working as associates, the parties to the JV will be sharing information with each other which may be proprietary /confidential information /knowledge acquired by each other. It is hereby agreed that the parties will maintain complete secrecy regarding such information / knowledge and will not divulge to any party for any other purpose except for the success of the joint execution of the contract. All parties will also indemnify each other against any claim that may arise out of using information, which are being claimed proprietary.

**ARTICLE 7: Memorandum of Understanding:**

7.1 This **Memorandum of Understanding** shall be terminated:-

a. if the **Parties** mutually confirm that the **JV's** bid proposal has not been finally accepted by **Employer** and all rights and obligations of the **Parties** under or in connection with this **Memorandum of Understanding** have ceased, or

b. after successful completion of the project including commissioning & operation and defect liability period from the date of this **Memorandum of Understanding** unless extended for a further period on demand of **JSCL** & mutual consent of the Parties, or

7.2 The **Memorandum of Understanding** can be modified by mutual consent of the Parties to suit the efficient and expeditious execution of Projects including commissioning & operation of Plant or to make this agreement more meaningful to suit the requirements of Employer **after the consent of the Employer**.

**ARTICLE 8: ARBITRATION:**

8.1 Any dispute resulting from this Agreement shall be settled amicably by mutual Consultation by the Managing Directors/Chairman of \_\_\_\_\_ & \_\_\_\_\_. In the event that an amicable settlement is not reached within 60 days in any particular case, the dispute shall be referred to arbitration and shall be resolved in accordance with and subject to the provisions of the \_\_\_\_\_ and any statutory modifications and enactment hereof for the time being in force. The decision of the arbitrators shall be final and binding upon both parties. The venue of arbitration will be \_\_\_\_\_.

**ARTICLE 9: GOVERNING LAWS:**

9.1 This Agreement shall in all respects be governed by and interpreted in accordance with the \_\_\_\_\_ Laws.

**ARTICLE 10: CONFIDENTIALITY:**

10.1 No Party hereto shall disclose to any other party any information of a confidential nature including but not limited to trade secrets, know-how acquired from any Party in connection with the subject matter of this Agreement.

**ARTICLE 11: ADDRESS OF Consortium:**

Any and all correspondence from the Employer to the **JV** shall be addressed to **(name of JV)** at the address stated herein below—(any one of the partners). The address of the Consortium office of the partner companies will be deemed to be the address for the purpose of communication.

The notice, if any required to be served on the party by the other party, will be deemed to be served, if the said notice / communication is delivered by Registered Post at the respective address **(name of JV)**

\_\_\_\_\_  
\_\_\_\_\_

**ARTICLE 12: Authorized Representative:**

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.

Authorized Representative of JV: \_\_\_\_\_

**ARTICLE 13: ASSIGN ABILITY:**

13.1 The interests and rights of a Party in the Contract and as a Party of the Joint Venture shall not be transferable or assignable without the written consent of the Employer & other party.

**ARTICLE 14: INTERPRETATION OF HEADINGS:**

14. The headings of each of the Articles herein contained are inserted merely for convenience of reference and shall be ignored in the interpretation and construction of any of the provisions herein contained.

**ARTICLE 15: OTHERS**

15.1 Any other matters not contained in this Agreement shall be discussed and amicably agreed upon by the Parties in the spirit of mutual trust and cooperation for timely completion of project including commissioning & operation of project. Notwithstanding anything above all the Parties are severally and jointly responsible to the Employer for execution of the Contract:

**IN WITNESS WHEREOF** the Parties hereto have caused this Agreement to be executed by each of the duly authorized representatives as appearing below:-

Signed by )  
For and on behalf of )  
\_\_\_\_\_ )

in the presence of: )  
\_\_\_\_\_ )

Name:  
Designation:

Signed by )  
For and on behalf of )  
\_\_\_\_\_ )

in the presence of: )  
\_\_\_\_\_ )

Name:  
Designation:

\_\_\_\_\_

Name:  
Designation:

\_\_\_\_\_

Name :  
Designation:

\*Similar Consortium Agreement to be signed in case of a Consortium

**4.13 STATEMENT FOR WORK IN HAND (for calculation of value of Bid Capacity)**

This is to certify that the status of the present works in hand as on **date of publication of NIT** of order value more than Rs. 10.00 lacs for which either order are received or the work is under execution but which are still not completed is as under:

*Amount in Lacs of Rupees.*

Sl. No	Brief Description of Work	Stipulated Date of Start	Stipulated Date of Completion	Time left for execution after <b>date of publication of NIT</b> , in months	Cost of awarded work	Cost of work executed up to <b>date of publication of NIT</b>	Balance Cost of un-executed work as on <b>date of publication of NIT in 30 month from and date of submission</b>
1	2	3	4	5	6	7	8=6-7

1. If the value of Balance work goes beyond 30 months from the date of bid submission then client certificate mentioning the amount of work to be executed beyond 30 months, otherwise full balance work shall be accounted for calculation of 'B' value.

2. This is certified that this is true in all respect and can be used for calculation of the bidding capacity as per the formula given in ITB. This is also certified that other orders under execution by the firm shall not materially affect the bidding capacity of the firm as required in this tender. **(Format should be on Rs 500/= stamp paper)**

**Signatures with Seal of Authorized Signatory for tender**

#### **4.14 Calculation of Available Bid Capacity**

*[Using the following formula the Bidder must calculate his available Bid Capacity: -]*

**Assessed Available Bid Capacity:  $(A*N*2 - B)$**

*Where*

*A= Maximum value of works executed in any one year during the last five years (updated to the current price level) taking into account the completed as well as works in progress;*

*N = Number of years prescribed for completion of the works for which bids are invited, and*

*B = Value at current price level of the existing commitments and ongoing works to be completed during the next ----- years (period of completion of the work for which bids have been invited)*

**Signature of Authorized Signatory**

**4.15 Self-Declaration by Bidder: No Blacklisting**

In relation to our Bid submitted to ..... *[enter designation and address of the procuring entity]* for procurement of ..... *[insert name of the Works]* in response to their Notice Inviting Bids No..... Dated ..... we hereby declare that;

We do hereby affirm that we have not been blacklisted. by any Government agency or Public Sector Undertakings, either in the bidding stage or during the execution stage of any contract. in which we participated

Date:  
Place:

Signature of Bidder  
Name:

Designation:

Address:



**4.17 Self-Declaration by Bidder: Certificate of Conformity / No Deviation**

In relation to our Bid submitted to..... [enter designation and address of the procuring entity]  
for procurement of ..... [insert name of the Works] in response to their Notice  
Inviting Bids No..... Dated ..... we hereby declare that;

We do hereby affirm that we have complied and shall continue to comply with the all the terms and conditions as specified in this Bidding Document, including technical specification and schedule of supply, quantity of Goods to be procured, payment conditions, till completion of all our obligations under the Contract.

Date:  
Place:

Signature of Bidder  
Name:

Designation:  
Address:

**4.16 Check Points**  
**(Must be filled by Bidder)**

<b>S. No.</b>	<b>Page No. of Bidding Document</b>	<b>Requirements / Documents required to be submitted</b>	<b>Check Points</b>	<b>Yes / No</b>	<b>Enclosed at page no. of bid and any other detail as required</b>
		<b>GENERAL</b>			

**4.16 Self Appraisal Sheet**

**(To Be Filled by The Bidder for Determination of Responsiveness)**

<b>S. No.</b>	<b>Page No. of Bidding Document</b>	<b>Requirements as per bid document</b>	<b>Check points</b>	<b>Tick the correct option or fill in information</b>	<b>Enclosed at page no. of bid and any other detail as required</b>
1					
2					
3					
4					
5					
6					

# **VOLUME - I**

## **Section V**

### **Procuring Entity's Requirement**

## **PROJECT: REDEVELOPMENT OF TALKATORA LAKE**

### **Brief Description of Work**

Talkatora Lake is a significant man-made water body (about 246m X 246m of size) in the Walled City of Jaipur situated on the most important urban axis of the city. Historically, the lake was an important component of water catchment systems and landscape design of the city. It has also been used for festival activities. But the lake is presently in a poor condition after the natural water networks feeding it have been ruptured due to unchecked building activities and unimaginative development around the precinct. The lake water stinks with solid waste being dumped into it. "Smart City Proposal– Jaipur City (SCP)" document, prepared in December 2015, recognizes the immense potential of the lake in contributing to positive open spaces in the city.

Amidst the dense Walled City area, along with Jaleb Chowk and Jai Niwas Bagh, Talkatora Lake has the potential to become an open space for reflection, repose and recreation. The lake can become a potential tourist spot and public place for the residents where water recreational activities with musical fountain, light and sound show, boating facilities, and cultural performance can imbue a unique combination to create an attractive place.

Core Objectives of the Project are:

- To improve overall physical environment
- To revive the connection between the lake as a source of water and the water landscape systems in the nearby gardens like, Jai Niwas Bagh and Pondrick Park
- To make a popular tourist spot showcasing cultural heritage of Jaipur
- To create a public open place in a lake ambience that is culturally and socially active for different age-groups by incorporating
  - Water recreational facilities with musical fountains and light
  - Activities like classical music recital, dance or other performing arts
  - Small-scale social and religious gatherings, discourses and discussions

Presently, the Talkatora Lake is holding around 5.0 meter deep water. The lake will be emptied by another agency and then handed over to the Contractor to carry out his work. The bed material apparently comprises silt /soil /solid waste /sewage deposits. Under water plants are also reported to be present in the lake bed. In September 2017, free-board is around 2.4 and the Invert Level of inlet is only 100mm above Still Water Level (SWL). The lake does not have any overflow system. The source of lake water is the untreated sewage water of a part of the city. A Sewage Treatment Plant (STP) is coming up that will direct the treated water into the lake.

For construction purposes, there are two entry points to approach the lake. One is a 35 m wide on the northern side of the lake and the other is at south-western corner of the lake.

It is proposed to rejuvenate the lake with an aim to make it an accessible public place where visitors can sit, move around and enjoy the water. For that purpose, a 3.50 m wide Causeway shall be constructed all around the lake. The SWL of the Lake shall be maintained at a fix level. The excess water (due to rain or from continuous inflow from STP) shall be utilised in three ways. A part of water shall be diverted to the Pondrick Park fountain system lying across the road. Some part will be diverted to the Jai Niwas Bagh fountain system as make up water and the surplus third part will be disposed of to the nearby drain.

### **Drawings:**

The architectural drawings for the proposed project are given in Annexure 1. The Contractor shall design & construct the structures & their foundations including all components associated with the project viz., causeway entrance lobby, approach jetty, planter, gardening support system etc. complete as shown in those drawings and as per scope of work.

### **Scope of Work**

The broad scope of work shall include but not limited to those given below.

The Contractor shall undertake the following:

#### Investigation Work:

1. Carry out Topographical Survey for preparation of basic layout drawing of the lake, indicating location of various water inlets from surrounding building structures, establishing the bed level of lake, invert level of inlet pipes, existing road level at the northern end and at the south-west corner, ground level elevations at locations of 3 terminal points, pipe route survey for carrying water from lake to Jai Niwas fountain area, location of nearest storm water drain and its invert level etc.
2. Carry out sub-soil Investigation, laboratory testing of soil/rock samples. There will be minimum 3 number of bore holes up to 15 m below bed level and in case, the rock encountered earlier, rock drilling will be upto 3 m into the rock level.
3. Prepare and submit reports, documents and drawings of all investigations reports and surveys for approval.
4. Collect information from appropriate authority as to the discharge level of STP to fill the tank and quality report of discharged water for record/ approval.
5. Prepare Civil GA drawings for the Causeway along with its substructure and foundation etc. in line with the Architectural drawings as given in Tender Drawings and obtain approval. The civil GA drawing shall indicate arrangements for the provision of all services and utility ducts like irrigation pipes for plantation, conduits and fixtures for electrical and Instrumentation cables and fittings, in-situ RCC walls for overhead and causeway level planters, as required.
6. Prepare Structural design documents and reports, Construction drawings including BBS etc. complete and obtain approval.
7. Submit As built Drawings after completion of works.

#### Preparatory Work:

8. Develop site offices, labour camp at locations as provided by the owner.
9. Carry out all site preparation and clearance of all water plants & bushes from the lake bed.
10. Dismantling of existing jetty, stone wall etc. near entrance area.
11. Grading and levelling of the lake bed: This shall be carried out before taking up civil construction work and shall be maintained in neat & proper manner throughout the progress of the work till completion.
12. Provide temporary approaches of adequate width to all site facilities & construction site etc... for inspection and for free & smooth movement of traffic & construction equipment etc. The approach shall be maintained in a neat & proper manner till completion of work.
13. Closure of all Sewerage discharge inlets from adjoining buildings.

#### Construction Work

14. Construct all civil and structural components viz., the Causeway and its supporting structures and foundations, entrance lobby and all approaches etc. complete as per technical specification and approved drawings. All electrical items like conduits, inserts, junction boxes etc. to be concealed in RCC shall be provided by the Contractor. This work shall be carried out in coordination with the Electrical and musical fountain Vendor.
15. Carry out all architectural finish works, horticulture, landscape & signage's. This shall be done in line with the GFC drawings to be issued during progress of work. The broad scope of works involved along with material and work specification etc. shall be as given in Tender Drawing. Minor variation from the details given in the these drawings is possible during execution of work.
16. Design, supply and install an automated pumping system for overflow disposal. The work involves pumping out water accumulated above SWL due to continuous discharge from STP or from rainfall. Adequate stand-by arrangement shall be made for pumps and important equipment. This shall be done as per design criterion given hereinafter. The bidder shall collect all basic discharge from STP and rainfall data and shall design the system so as to maintain the SWL of the lake to (+/-) 50 mm. The storm water entering the Lake shall pass through Siltation Tank/sto prevent excess silt from entering the lake.
17. Design, supply, install and commission pumps and accessories with electrical works complete as required for water cascades (1) near entrance area and (2) at the south east corner.
18. Design all associated civil structures for housing of all mechanical and electrical equipment along with necessary foundations, supports etc. complete.
19. Prepare design & drawings of underground piped water disposal system from the lake to 3 terminal points.
20. Construct all civil and architectural works associated with the above overflow disposal system. The work shall be carried out as per approved drawings.
21. Supply & install 10 numbers of 60 liters capacity Dust Bins, 12 number of 40 liters capacity Twin Litter Bins, one number of Hand Carts with 4 nos. of 60 liters capacity dustbins, 12 numbers of 1100 liters capacity Refuse compactor bin.
22. Supply and install all types of signage, glow-signs, name plate with necessary support and make provision for electrical connection for glow signs as required.

## Design Criteria

### 1. Loads:

- a) The dead loads shall be as per actual for material densities as per IS 875 Part I. The unit weight of soil for gardening shall be considered as 20 KN/cu-m.
- b) A superimposed dead load of 1.5 KN /m for hand rails and 3 KN /m for water pipes & cables shall be considered as line load on the appropriate edges of the cause way.
- c) An accidental lateral load of 10 KN concentrated shall be considered for design of column and its foundation. This need not be combined with seismic forces.
- d) The Live loads of 10 KN/sq-m shall be on causeways & approaches.
- e) An Importance Factor of 1.75 shall be considered for evaluation of Seismic forces.
- f) The foundations shall be designed such that no tension is developed in any portion of the foundation base. The causeway shall be an independent structural assembly without transmitting any load on to the adjoining stone wall structure.
- g) Temporary approach roads to the lake base shall be designed for adequate volume of vehicular traffic and shall have bituminous topping. The sides of this approach road shall have boulder pitching. All precaution shall be taken to keep the surrounding environment dust free specially caused by vehicular movements within the lake base area.

- h) Clear cover: The following clear covers shall be maintained in all sides of RCC structural components:
- Slab 25 mm
  - Beams 30 mm
  - Column 40 mm
  - Footing 75 mm

### **Major Material Specification**

1. All materials shall conform to IS codes of Practices and as per Technical Specification.
2. Only OPC grade 43/53 shall be used in construction.
3. Reinforcement shall be of grade Fe 415/500 as per IS 1786
4. The expansion joints shall be non-bitumen type and shall be as approved by the owner.
5. The design mix concrete of minm grade M 30 shall be used in all RCC components for cause way and its supporting structures.
6. The PCC below foundation, grade slab shall be of 100 mm thick nominal mix 1:3:6 .
7. The grade of concrete in PCC fill shall be of nominal M20 grade.
8. The RCC grade slab shall be of minimum 150 mm thickness with nominal reinforcement in each direction of both top & bottom surfaces totalling not less than minimum 55 Kg/cu-m of concrete volume at any section.

### **Electrical**

1. 3 nos. of 150 mm diameter PVC conduits shall run all along the periphery of causeway with manholes @10m approximately or at location of junction box.
2. All cables, induction motor, electrical panels and accessories shall be of technical / RUIDP specification.
3. Separate multi-core cables shall run from pumps at South West corner to control room near entrance area for indicating ON/ OFF status of motor.

### **Design Considerations for Automated Pumping System**

It is proposed to install **three pumps** of adequate capacities: one near the entrance area of the lake and two on the south-west corner of the lake. The first pump will dispose of lake water to the Pond rick Park (for the fountain system in the park) which lies opposite to the entrance to lake. The terminal point of the discharge pipe will be up to a distance of 3 meters inside the Pondrick Park boundary just after crossing the road. Out of the two pumps on south-west corner, one will be used for throwing out the accumulated excess water to the nearest storm-water drain and the other will be used for make-up water of the Jai Niwas Bagh fountain system.

### **Submission of Documents:**

The contractor shall submit his QAP for approval within 15 days of letter of Acceptance (LoA)



# **SPECIFICATIONS**

## **Section VA:**

# **Technical Specification for Civil & Architectural works**

1. **GENERAL:**

This section deals with specification of only a few civil & architectural works which are relevant to the scope of works under the Contract. For all other civil & architectural works not given herein but are required for successful completion of works , the work shall generally be carried out as per RUIDP technical specification for civil, architectural & Heritage works or as per instruction of the Engineer.

2. **GENERAL**

**2.2 Preamble – Deleted**

**2.3 Inclusive Documents – Deleted**

**2.4 Order of Precedence, Clarifications and Interpretation**

1. When the various Specifications and codes referred to in preceding portion are at variance with these Specifications and with each other, the following order of precedence will generally be accepted.
  1. Written instructions of the Engineer.
  2. Special Conditions of Contract, Item wise Technical Specifications, if provided, and Execution Drawings.
  3. Provisions of General Specifications.
  4. I.S. Codes.
  5. IRC Codes, M.O.S.T., Specifications, etc.
2. The attention of the Contractor is drawn to those Clauses of IS codes which require either Specification by Engineer or the mutual agreement between the supplier and purchaser. In such cases it is the responsibility of the Contractor to seek clarification on any uncertainty and obtain prior approval of the Engineer before taking up the supply/construction.

**2.5 Measurement and Payments - Deleted**

**2.6 Unacceptable Work**

1. All defective Works are liable to be demolished, rebuilt and defective materials replaced by the Contractor at his own cost. In the event of such Works being accepted by carrying out repairs etc. as specified by the Engineer, the cost of repairs will be borne by the Contractor.
2. In the event of the work being accepted by giving 'Design Concession', arising out of but not limited to under sizing, under strength, shift in location and alignment, etc. and accepting design stresses in members which are higher than those provided for in the original design or by accepting materials not fully meeting the Specifications, etc. the Contractor will be paid for the Works actually carried out by him at the suitable reduced rate of the tendered rates for the portion of the work thus accepted.

**2.7 Water Supply and Sanitary Works–**

1. All items covered under the above head shall conform to the detailed Specifications given for each of the items in addition to the by-laws of the local bodies within whose jurisdiction the Works are executed. The Works shall be carried out as per the relevant IS Codes and as per the instructions of the Engineer.

## **2.8 Floor and Levels**

### **1. Building**

2.8.1.1 Floor I is the lowest floor above the ground level in the building unless otherwise specified in a particular case. The floors above Floor I shall be numbered in sequence as Floor 2, Floor 3 and so on. The number shall increase upwards.

2.8.1.2 Floor level: For floor 1, top level of finished floor shall be the floor level and for all other floors above floor 1, top level of the structural slabs shall be the floor level.

2.8.1.3 Plinth level: Floor 1 level or 1.2 m above the ground level whichever is lower shall be the plinth level.

### **2. Special Structures**

2.8.2.1 For structures like retaining walls, wing walls, chimneys, overhead reservoirs/tanks and other elevated structures, where elevations/heights above a defined datum level have not been specified and identification of floors cannot be done as in case of buildings, levels at 1.2 m above the ground level shall be the floor level as well as plinth level. Level at a height of 3.5 m above floor 1 level will be reckoned as floor 2 levels and level at a height of 3.5 m above the floor 2 level will be floor 3 levels and so on. Where the total height above floor 1 level is not a whole number multiple of 3.5 m, top most floor level shall be the next in sequence to the floor level below even if the difference in height between the two upper most floor levels is less than 3.5 m.

## **2.9 Foundation and Plinth**

1. The work in foundation and plinth shall include:

1. For buildings: All Works up to 1.2 m above ground level or up to floor 1 level whichever is lower;
2. For abutments, piers and well steining: All works up to 1.2 m above the bed level;
3. For retaining walls, wing walls, compound walls, chimneys, overhead reservoirs/tanks and other elevated structures: All Works up to 1.2 m above the ground level;
4. For reservoirs/tanks (other than overhead reservoirs/tanks): All Works up to 1.2 m above the ground level
5. For basements: All Works up to 1.2 m above ground level or up to floor 1 level whichever is lower.

*Note: Specific provisions shall be made in the estimate for such situations where the foundation level is more than 3 m depth from the plinth for all types of structures mentioned above.*

## **2.10 Maintaining Utility Service and Traffic –**

### **1. Public Utilities**

2.10.1.1 Drawings scheduling the affected services like water pipes, sewers, oil pipelines, cables, gas ducts etc. owned by various authorities including Public Undertakings and Local Authorities included in the Contract Documents shall be verified by the Contractor for the accuracy of the information prior to the commencement of any work.

2.10.1.2 Notwithstanding the fact that the information on affected services may not be exhaustive, the final position of these services within the Works shall be supposed to have been indicated based on the information furnished by different bodies and to the extent the bodies are familiar with the final proposals. The intermediate stages of the Works are, however, unknown at the design stage, these being dictated by the Contractor's methods of working. Accordingly, the Contractor's programme must

take into account the period of notice and duration of diversionary Works of each body as given on the Drawings and the Contractor must also allow for any effect of these services and alterations upon the Works and for arranging regular meetings with the various bodies at the commencement of the Contract and throughout the period of the Works in order to maintain the required co-ordination. During the period of Works, the Contractor shall have no objection if the public utility bodies vary their decisions in the execution of their proposals in terms of programme and construction, provided that, in the opinion of the Engineer, the Contractor has received reasonable notice thereof before the relevant alterations are put in hand.

- 2.10.1.3 No clearance or alterations to the utility shall be carried out unless specially ordered by the Engineer.
- 2.10.1.4 Any services affected by the Works must be temporarily supported by the Contractor who must also take all measures reasonably required by the various bodies to protect their services and property during the progress of the Works.
- 2.10.1.5 The Contractor may be required to carry out certain Works for and on behalf of the various bodies and he shall also provide, with the prior approval of the Engineer, such assistance to the various bodies as may be authorised by the Engineer.
- 2.10.1.6 The work of temporarily supporting and protecting the public utility services during execution of the Works shall be deemed to be part of the Contract and no extra payment shall be made for the same.
- 2.10.1.7 The Contractor may be required to carry out the removal or shifting of certain services/utilities on specific orders from the Engineer for which payment shall be made to him. Such workers shall be taken up by the Contractor only after obtaining clearance from the Engineer and ensuring adequate safety measures.

## 2. Arrangement for Traffic during Construction –

### 2.10.2.1 General

The Contractor shall at all times carry out work on the roads in a manner creating least interference to the flow of traffic while consistent with the satisfactory execution of the same. For all Works involving improvements to the existing roads, the Contractor shall, in accordance with the directives of the Engineer, provide and maintain, during execution of the work, a passage for traffic either along a part of the existing carriageway under improvement, or along a temporary diversion constructed close to the road. The Contractor shall take prior approval of the Engineer regarding traffic arrangements during construction.

### 2.10.2.2 Passage of Traffic along a part of the Existing Carriageway under Improvement

- 1. For widening/strengthening existing carriageway where part width of the existing carriageway is proposed to be used for passage of traffic, treated shoulders shall be provided on the side on which work is not in progress. The treatment to the shoulder shall consist of providing at least 150 mm thick granular base course covered with bituminous surface dressing in a width of at least 1.5 m and the surface shall be maintained throughout the period during which traffic uses the same to the satisfaction of the Engineer. The continuous length in which such a work shall be carried out, would be limited normally to 500 m at a place. However, where work is allowed by the Engineer in longer stretches passing places at least 20 m long with additional paved width of 2.5 m shall be provided at every 0.5 km interval.
- 2. In case of widening existing two-lane to four-lane, the additional two lanes would be constructed first and the traffic diverted to it and only thereafter the required treatment to the existing carriageway

would be carried out. However, in case where on the request of the Contractor, work on existing two-lane carriageway is allowed by the Engineer with traffic using part of the existing carriageway, stipulations as in para above shall apply.

3. After obtaining, permission of the Engineer, the treated shoulder shall be dismantled, the debris disposed off and the area cleared as per the direction of the Engineer.

#### 2.10.2.3 Passage of Traffic along a Temporary Diversion

1. In stretches where it is not possible to pass the traffic on part width of the carriageway, a temporary diversion shall be constructed with 7 m carriageway and 2.5 m earthen shoulders on each side (total width of roadway 12 m) with the following provision for road crust in the 7 m width:
  - 200 mm (compacted) granular sub base;
  - 225 mm (compacted) granular base course; and
  - Premix carpet with Seal Coat/Mix Seal Surfacing.
2. The alignment and longitudinal section of diversion including junctions and temporary cross drainage provision shall be as approved by the Engineer.

#### 2.10.2.4 Traffic Safety and Control

1. The Contractor shall take all necessary measures for the safety of traffic during construction and provide, erect and maintain such barricades, including signs, markings, flags, lights and flagmen as may be required by the Engineer for the information and protection of traffic approaching or passing through the section of the highway under improvement. Before taking up any construction, an agreed phased programme for the diversion of traffic on the highway shall be drawn up in consultation with the Engineer.
2. The barricades erected on either side of the carriageway/portion of the carriageway closed to traffic, shall be of strong design to resist violation, and painted with alternate black and white stripes. Red lanterns or warning lights of similar type shall be mounted on the barricades at night and kept lit throughout from sunset to sunrise.
3. At the points where traffic is to deviate from its normal path (whether on temporary diversion or part width of the carriage way) the channel for traffic shall be clearly marked with the aid of pavement markings, painted drums or a similar device as per the directions of the Engineer. At night, the passage shall be delineated with lanterns or other suitable light source.
4. One-way traffic operation shall be established whenever the traffic is to be passed over part of the carriageway inadequate for two-lane traffic. This shall be done with the help of temporary traffic signals or flagmen kept positioned on opposite sides during all hours. For regulation of traffic, the flagmen shall be equipped with red and green flags and lanterns/lights.
5. On both sides, suitable regulatory/warning signs as approved by the Engineer shall be installed for the guidance of road users. On each approach, at least two signs shall be put up, one close to the point where transition of carriageway begins and the other 120 m away. The signs shall be of approved design and of reflectory type, if so directed by the Engineer.

#### 2.10.2.5 Maintenance of Diversions and Traffic Control Devices

Signs, lights, barriers and other traffic control devices, as well as the riding surface of diversions shall be maintained in a satisfactory condition till such time they are required as directed by Engineer. The

temporary traveled way shall be kept free of dust by frequent applications of water, as directed by the Engineer.

#### 2.10.2.6 Measurements for Payment and Rate -Deleted

### 2.11 Setting Out

The Contractor shall establish working Bench Marks tied with the Reference Bench Mark in the area soon after taking possession of the site. The Reference Bench Mark for the area shall be as indicated in the Contract Documents and the values of the same shall be obtained by the Contractor from the Engineer. The working Bench Marks shall be at the rate of four per km and also at or near all drainage structures, over-bridges and underpasses. The working Bench Marks/levels shall be approved by the Engineer. Checks must be made on these Bench Marks once every months and adjustments, if any, agreed with the Engineer and recorded. An up-to-date record of all Bench marks including approved adjustments, if any, shall be maintained by the Contractor and also a copy supplied to the Engineer for his record.

1. The lines and levels of formation, side slopes, drainage Works, carriage ways and shoulders shall be carefully set out and frequently checked, care being taken to ensure that correct gradients and cross-sections are obtained everywhere.
2. In order to facilitate the setting out of the Works, the centre line of the carriageway or highway must be accurately established by the Contractor and approved by the Engineer. It must then be accurately referenced in a manner satisfactory to the Engineer, every 50 m intervals in plain and rolling terrain and 20 m intervals in hilly terrain and at all curve points as directed by the Engineer, with marker pegs and chainage boards set in or near the fence line, and a schedule of reference dimensions shall be prepared and supplied by the Contractor to the Engineer. These markers shall be maintained until the Works reach finished formation level and are accepted by the Engineer.
3. On construction reaching the formation level stage, the centre line shall again be set out by the Contractor and when approved by the Engineer, shall be accurately referenced in a manner satisfactory to the Engineer by marker pegs set at the outer limits of the formation.
4. No reference peg or marker shall be moved or withdrawn without the approval of the Engineer and no earthwork or structural work shall be commenced until the centre line has been referenced.
5. The Contractor will be the sole responsible party for safeguarding all survey monuments, bench marks, beacons, etc. The Engineer will provide the Contractor with the data necessary for setting out of the centre line. All dimensions and levels shown on the Drawings or mentioned in documents forming part of or issued under the Contract shall be verified by the Contractor on the site and he shall immediately inform the Engineer of any apparent errors or discrepancies in such dimensions or levels. The Contractor shall, in connection with the staking out of the centre line, survey the terrain along the road and shall submit to the Engineer for his approval, a profile along the road centre line and cross-sections at intervals as required by the Engineer.
6. After obtaining approval of the Engineer, work on earthwork can commence and the profile and cross sections shall form the basis for measurements and payment. The Contractor shall be responsible for ensuring that all the basic traverse points are in placed at the commencement of the contract and if any are missing, or appear to have been disturbed, the Contractor shall make arrangements to re-establish these points. A "Survey File" containing the necessary data will be made available for this purpose. If in the opinion of the Engineer, design modifications of the centre line or grade are advisable, the Engineer will issue detailed instructions to the Contractor and the Contractor shall

perform the modifications in the field, as required, and modify the ground levels on the cross-sections accordingly as many times as required. There will be no separate payment for any survey work performed by the Contractor. The cost of these services shall be considered as being included in the cost of the items of work in the Bill of Quantities.

7. The work of setting out shall be deemed to be a part of general Works preparatory to the execution of work and no separate payment shall be made for the same.
8. Precision automatic levels, having a standard deviation of  $\pm 2$  mm per km, and fitted with micrometer attachment shall be used for all double run leveling work. Setting out of the road alignment and measurement of angles shall be done by using theodolite with traversing target, having an accuracy of one second. Measurement of distances shall be done using precision instruments like Distomat or equivalent.

#### **2.12 Methodology and Sequence of Work**

1. Prior to start of the construction activities at site, the Contractor shall, within 30 days after the date of the Letter of Acceptance, submit to the Engineer for approval, the detailed construction methodology including mechanical equipment proposed to be used, sequence of various activities and schedule from start to end of the project. Programme relating to pavement and shoulder construction shall be an integrated activity to be done simultaneously in a coordinated manner. The methodology and the sequence shall be so planned as to provide proper safety, drainage and free flow of traffic.

#### **2.13 Approval of Materials**

1. Approval of all sources of material for Works shall be obtained in writing from the Engineer before their use on the project.
2. Where the terms crushed gravel/shingle, crushed stone, broken stone or stone aggregate appear in any part of the Tender Documents or Drawings issued for work, they refer to crushed gravel / crushed shingle / crushed stone aggregate obtained from an integrated crushing plant having appropriate primary crusher, secondary crusher and vibratory screen.
3. Raw and processed samples of the mineral aggregates from the approved quarry shall be submitted by the Contractor at no extra cost.

#### **2.14 Access to Abutting Properties**

1. For the duration of the Works the Contractor shall at all times provide convenient access to paths, steps, bridges or drives for all entrances to property abutting the site and maintain them clear, tidy, and free from mud and objectionable matter.
2. In addition to the above, in order to ensure uninterrupted traffic flow in the cross roads, the Contractor has to provide and maintain suitable crossing arrangement for the existing traffic to move across the construction work for all categories of roads crossing the roads under construction/improvement during the entire period of construction or till such time that alternative arrangement for the traffic is made.

#### **2.15 Use of Equipment on Works**

1. The following conditions regarding use of equipment's on works shall be followed:



1. The Contractor shall be required to give a trial run of the equipment(s) or establishing their capability to achieve the required Specifications and tolerance to the satisfaction of the Engineer before commencement of the work.
2. All equipment's provided shall be proven efficiency and shall be operated and maintained at all times in a manner acceptable to the Engineer.
3. No equipment or personnel will be removed from site without permission of Engineer.

#### **2.16 Quality Control on Works and Materials**

1. The Contractor shall be responsible for the quality of the work in the entire construction work within the contract. He shall, therefore, have his own independent and adequate set-up for ensuring the same.
  2. The Engineer shall inspect the work from time to time during and after construction and ascertain the quality of the work tested (by himself, by his Testing and Quality Control Units or by any other agency deemed fit by him) generally as per the requirements of the Handbook of Quality Control for construction of roads and runways (IRC Special Publication No. 11 and MoST Specifications for Roads and Bridge Works III Revision). Additional tests may also be conducted where, in the opinion of the Engineer, need for such test exists. In the absence of clear indications and frequency of tests for any item in the above mentioned publication, procedures and tests as directed by the Engineer shall be followed.
- 2.16.2.1 The Contractor shall provide necessary cooperation and assistance in obtaining the samples for tests and carrying out the field tests as required by the Engineer from time to time. This may include provision of labour, attendance, assistance in packing and dispatching and any other assistance considered necessary in connection with the tests.
1. For the work of embankment, subgrade and pavement, construction of subsequent layer of same or other material over the finished layer shall be done after obtaining permission from the Engineer.
  2. Similar permission from the Engineer shall be obtained in respect of other items of work prior to proceeding with the next stage of construction.
  3. The Contractor shall carry out modification in procedure of work, if any, as directed by the Engineer during inspection.
  4. Works falling short of quality as per tests indicated in **Clause 1.15.2** above shall be rectified by the Contractor as directed by the Engineer at his own cost.
  5. For testing of samples of soil, soil mix, granular material and mix, bituminous mix, aggregates, cores etc. Samples in the required quantity and form shall be supplied to the Engineer by the Contractor at his own cost
  6. For cement, bitumen and similar other materials where essential tests are to be carried out at the manufacturer's plants or at laboratories other than the site laboratory, the cost of samples, sampling, testing and furnishing of test certificates shall be borne by the Contractor. He shall also furnish the test certificates to the Engineer.
  7. For testing of cement concrete at site during construction arrangement for supply of samples, sampling, testing and supply of test results shall be made by the Contractor as per the frequency and

number of tests specified in the Handbook of Quality Control for Construction of roads and runways, IRC Special Publication No. 11, and relevant IS codes or relevant

**Clauses (1702, 1704, 1707, 1717 etc.,) as specified for in most Specifications for Roads and Bridge Works (IV Revision).**

8. The method of sampling and testing of materials shall be as required by the Handbook of Quality Control for construction of roads and runways (IRC Special Publication No. 11), and the Ministry of Shipping and Transport Specifications and where the same are silent, as per the relevant IRC Standards, Specifications, guidelines, Special publications and IS Standards. In the absence of relevant Indian Standards, the sampling and testing procedure to be used shall be as approved by the Engineer.
9. Where the Engineer considers that in the interest of the control of the quality on materials or workmanship, modifications, if any, are necessary, such modifications shall be carried out by the Contractor at no extra cost.
10. The Contract rate quoted for various items of work in the Bill of Quantities shall be deemed to be inclusive of all costs of the provisions indicated in the above mentioned clauses.

## **2.2 Surveying and Measuring Equipment's**

1. Equipment for surveying and measurement on the work shall be procured by the Contractor for his use. The same shall also be made available to the Engineer at site for any work connected with the Contract without any additional charge.

## **2.3 Completion Drawings**

1. The Contractor shall submit to the Engineer within two months of actual completion, "Completion" Drawings as specified below and operation and maintenance instructions for the whole of the works. These Drawings shall be accurate and correct in all respects and shall be shown to and approved by the Engineer.
2. Completion Drawings on two prints & one Polyester film shall be supplied by the Contractor.

## **3 SITE CLEARANCE (CLEARING AND GRUBBING)**

### **3.1 Scope**

1. This work shall consist of cutting, removing and disposing of all materials such as trees, bushes, shrubs, stumps, roots, grass, weeds, top organic soil not exceeding 150 mm in thickness, rubbish etc., from the area of Works which in the opinion of the Engineer are unsuitable for incorporation in the Works, and such other areas as may be specified on the Drawings or by the Engineer. It shall include necessary excavation, backfilling of pits resulting from uprooting of trees and stumps to required compaction, handling, salvaging, and disposal of cleared materials. Clearing and grubbing shall be performed in advance of earthwork operations and in accordance with the requirements of these Specifications.

### **3.2 Preservation of Property/Amenities**

1. Trees, shrubs, any other plants, pole lines, fences, signs, monuments, buildings, pipelines, sewers and all facilities within or adjacent to the site which are not to be disturbed shall be protected from injury or damage. The Contractor shall provide and install at his own expense, suitable safeguards approved by the Engineer for this purpose.

2. During clearing and grubbing, the Contractor shall take all adequate precautions against soil erosion, water pollution, etc., and where required, undertake additional Works to that effect vide relevant Clauses of **Chapter 5**. Before start of operations, the Contractor shall submit to the Engineer for approval, his work plan including the procedure to be followed for disposal of waste materials, etc., and the schedules for carrying out temporary and permanent erosion control Works as stipulated in **Chapter 5**.

### **3.3 Methods, Tools and Equipment**

1. Only such methods, tools and equipment as are approved by the Engineer and which will not affect the property to be preserved shall be adopted for the Work. If the area has thick vegetation / roots / trees, a crawler or pneumatic tyred dozer of adequate capacity may be used for clearance purposes. The dozer shall have ripper attachments for removal of tree stumps. All trees, stumps, etc., falling within excavation and fill lines shall be cut to such depth below ground level that in no case these fall within 500 mm of the subgrade / foundation / bed level. Also, all vegetation such as roots, under-growths, grass and other deleterious matter unsuitable for incorporation in the Work shall be removed between fill lines to the satisfaction of the Engineer. On the areas beyond these limits, trees and stumps required to be removed as directed by the Engineer shall be cut down to 1 m below ground level so that these do not present any unsightly appearance.
2. All branches of trees extending above the roadway shall be trimmed as directed by the Engineer.
3. All excavations below the general ground level arising out of the removal of trees, stumps, etc., shall be filled with suitable material and compacted thoroughly so as to make the surface as these points conform to the surrounding area.
4. Ant-hills both above and below the ground, as are liable to collapse and obstruct free subsoil water flow shall be removed and their workings, which may extend to several meters, shall be suitably treated.

### **3.4 Disposal of Materials**

1. All materials arising from clearing and grubbing operations shall be the property of Employer and shall be disposed of by the Contractor as hereinafter provided or directed by the Engineer.
2. Trunks and stumps of trees shall be cleaned of limbs and roots and stacked. Also boulders, stones and other materials usable in construction shall be neatly stacked as directed by the Engineer. Stacking stumps, boulders, stones etc., shall be done at specified spots with all lifts and up to a lead of 1000 m.
3. All products of clearing and grubbing which, in the opinion of the Engineer, cannot be used or auctioned shall be cleared away from the site in a manner as directed by the Engineer. Care shall be taken to see that unsuitable waste materials are disposed off in such a manner that there is no likelihood of these getting mixed up with the materials meant for construction.

### **3.5 Measurements for Payment – Deleted**

### **3.6 Rates – Deleted**

## **4 DISMANTLING AND DEMOLITION**

### **4.1 Scope**

1. This work shall consist of removing, as hereinafter set forth, existing buildings, roofs, ceiling, flooring and paving, concrete and brick roofs and suspended floors, walls and columns, reinforced concrete and brick work, partitions, wood work, steel and iron work, doors and windows, pipes and sewer lines, posts or struts, fencing wire mesh, glazing, culverts, bridges, pavements, kerbs and other structures like guard-rails, utility services, catch basins, inlets, etc., which are in place but interfere with the new construction or are not suitable to remain in place, and of salvaging and disposing of the resulting materials and back filling the resulting trenches and pits.
2. Existing culverts, bridges, pavements and other structures which are within the highway and which are designated for removal, shall be removed up to the limits and extent specified in the Drawings or as indicated by the Engineer.
3. Dismantling and removal operations shall be carried out with such equipment and in such a manner as to leave undisturbed, adjacent pavement, structures and any other work to be left in place.
4. All operations necessary for the removal of any existing structure which might endanger new construction shall be completed prior to the start of new work.

#### 4.2 Applicable Codes

IS: 1200-1974 (Part: XVIII)	Method of Measurements of Building and Civil Engineering Works. Demolition and Dismantling (Reaffirmed 1992) (3rd Revision).
IS: 41301991	Demolition of Buildings - Code of Safety (2nd Revision).

#### 4.3 Terminology

1. The term '**Dismantling**' implies carefully separating the parts without damage and removing. This may consist of dismantling one or more parts of the structure as specified or shown on the Drawings.
2. The term '**Demolition**' implies breaking up. This shall consist of demolishing whole or part of work including all relevant items as specified or shown on the Drawings.

#### 4.4 Buildings

1. Precautions
  1. All materials obtained from dismantling or demolition shall be the property of the Employer unless otherwise specified and shall be kept in safe custody until they are handed over to the Engineer.
  2. The demolition shall always be well planned before hand and shall generally be done in reverse order of the one in which the structure was constructed. The operations shall be got approved from the Engineer-In-Charge before starting the work.
  3. Due care shall be taken to maintain the safety measures prescribed in IS: 4130.
  4. Necessary propping, shoring and or under pinning shall be provided to ensure the safety of the adjoining work or property before dismantling and demolishing is taken up and the work shall be carried out in such a way that no damage is caused to the adjoining work or property. Wherever specified, temporary enclosures or partitions shall also be provided, as directed by the Engineer.
  5. Necessary precautions shall be taken to keep down the dust nuisance to the minimum.

6. Dismantling shall be done in a systemic manner. All materials which are likely to be damaged by dropping from a height or by demolishing roofs, masonry etc. shall be carefully removed first. The dismantled articles shall be removed manually or otherwise, lowered to the ground (and not thrown) and then properly stacked as directed by the Engineer.
7. Where existing fixing is done by nails, screws, bolts, rivets, etc., dismantling shall be done by taking out the fixing with proper tools and not by tearing or ripping off.
8. Any serviceable material, obtained during dismantling or demolition, shall be separated out and stacked properly as directed by the Engineer within a lead of 50 m. All unserviceable materials rubbish etc. shall be disposed off as directed by the Engineer.
9. The Contractor shall maintain / disconnect existing services, whether temporary or permanent, where required by the Engineer.

Measurements – Deleted

Rates – Deleted

## 2.1 Roofs –

1. Roof coverings generally including battens boarding, mats, bamboo jaffari or other subsidiary supports shall be measured in sq mt except lead sheet roof covering, which shall be measured in quintals (**Clause 3.5.4**) and stone slab roof covering which shall be measured in cum.
2. Ridges, hips and valleys shall be girthed and included with the roof area. Corrugated or semi corrugated surfaces shall be measured flat and not girthed.
3. Mud phuska on roofs shall be measured in cum.
4. Lead sheets in roofs shall be measured in quintals and hips, valleys, flashings, lining to gutter etc. Shall be included in this weight.
5. R.B. or R.C.C. roofs shall be measured as specified in **Clause 3.10**.
6. Supporting members, such as rafters, purlins, beams joists, trusses etc. where of wood shall be measured in cum and steel or iron sections in quintals.

## 2.2 Ceiling –

1. The stripping of ceilings shall be measured in sqm.
2. Dismantling of supporting joists, beams, etc. shall be measured in cum or in quintals as specified in **Clause 3.5.6**.
3. Height above floor levels if it exceeds 3.5 m shall paid for separately.

## 2.3 Flooring and Paving

1. Dismantling of floors (except concrete and brick floors) shall be measured in sqm. Supports such as joints, beams etc. if any shall be measured as per **Clause 3.5.6**. Concrete and bricks paving shall be measured as per **Clause 3.8**.

**2.4 Concrete and Brick Roofs and Suspended Floors - Deleted**

**2.5 Walls and Piers**

1. Taking down walls and independent piers or columns of brick, stone or concrete shall be measured, in cum. All copings, corbels, cornices and other projections shall be included with the wall measurements.
2. In measuring thickness of plastered walls, the thickness of plaster shall be ignored.
3. Ashlar face stones, dressed stone work, precast concrete articles, etc. if required to be taken down intact shall be so stated, and measured separately in cum.
4. Cleaning bricks stacking for measurements including all extra handling and removal and disposing off the rubbish as stated shall be enumerated in thousand of cleaned bricks.
5. Cleaning stone obtained from demolished / dismantling stone masonry of any description including ashlar facing dressed stone work, stone slabs or flagging and precast concrete blocks including all extra handling and disposing of the rubbish as stated shall be measured in cum of cleaned stone.
6. Honey comb works or cavity walls of bricks stone or concrete shall be measured as solid.

**2.6 Reinforced Concrete and Brick Work –**

1. Reinforced concrete structures and reinforced brick roof and walls shall be measured in cum and if reinforcement is required to be salvaged, it shall be so stated.
2. Where reinforcement is required to be separated, scraped and cleaned, the work shall be measured separately in quintal of salvaged steel.

**2.7 Partitions, Trellis Work, Etc. –**

1. Partitions or light walls of lath and plaster, trellis work, expanded metal, thin concrete or terracotta slabs and other similar materials including frame work if any shall be measured in sqm stating the over all thickness.

**2.8 Wood Work - Deleted**

**2.9 Steel and Iron Work – Deleted**

**2.10 Doors and Windows –**

1. Dismantling of doors, windows, clerestory windows, ventilators etc. (Wood or metal) whether done separately or along with removal of wall by making recess in the wall shall be enumerated. Those exceeding 3 sqm each in area shall be measured separately. The item shall include removal of chowkhats architraves, hold fasts and other attachments.
2. If only shutters are to be taken out it shall be measured separately.

**2.11 Pipes and Sewer Lines - Deleted**

**2.12 Posts or Struts - Deleted**

**2.13 Fencing Wire Mesh – Deleted**

**2.14 Glazing –**

1. Taking out any portion of serviceable glass except polished plate, from old sashes, skylights, etc. (any thickness, weight or size) raking out old putty, etc. shall be measured in square m.
2. Irregular or circular panes shall be measured as rectangle or square enveloping the same. The width and height being measured correct to the nearest 0.5 cm.

**2.15 Dismantling Culverts, Bridges and Other Structures/Pavements –**

1. Dismantling Pavements and Other Structures
  - i. In removing pavements, kerbs, gutters and other structures like guard-rails, fences, manholes, catch-basins, inlets, etc. where portions of the existing construction are to be left in the finished work, the same shall be removed to an existing joint or cut and chipped to a true line with a face perpendicular to the surface of the existing structure. Sufficient removal shall be made to provide for proper grades and connections with the new work as directed by the Engineer.
  - ii. All concrete pavements, base courses in carriageway and shoulders etc., designated for removal shall be broken to pieces whose volume shall not exceed 0.02 cum and stockpiled at designated locations if the material is to be used later or otherwise arranged for disposal as directed (see **Clause 3.19.4**).
2. Back-filling
  - iii. Holes and depressions caused by dismantling operations shall be backfilled with excavated or other approved materials and compacted to required density as directed by the Engineer.
3. Disposal of Materials
  - i. All materials obtained by dismantling shall be the property of Employer. Unless otherwise specified, materials having any salvage value shall be placed in neat stacks of like materials within the right-of-way, as directed by the Engineer with all lifts and up to a lead of 1000 m.
  - ii. Pipe culverts that are removed shall be cleaned and neatly piled on the right-of-way at points designated by the Engineer with all lifts and lead up to 1000 m.
  - iii. Structural steel removed from old structures shall, unless otherwise specified or directed, be stored in a neat and presentable manner on blocks in locations suitable for loading. Structures or portions thereof which are specified in the Contract for re-erection shall be stored in separate piles.

- iv. Timber or lumber from old structures which is designated by the Engineer as materials to be salvaged shall have all nails and bolts removed there from and shall be stored in neat piles in locations suitable for loading.
- v. All materials obtained from dismantling operations which, in the opinion of the Engineer, cannot be used or auctioned shall be disposed of as directed by the Engineer with all lifts and up to a lead of 1000 m.

### **CARRIAGE OF MATERIALS – Deleted**

## **3 EARTHWORK, EROSION CONTROL AND DRAINAGE**

### **3.1 Scope**

1. This Specification covers the general requirements of earthwork in excavation in different materials necessary for the construction of the Works including structures, roadway, side drains, sewers and water supply lines in accordance with requirements of these Specifications and the lines, grades and cross-section shown in the Drawings or as indicated by the Engineer. This Specification also includes site grading, filling in areas as shown in Drawing, filling back around foundations, plinths and approach ramps, conveyance and disposal of surplus spoils or stacking them properly as shown on the Drawings or as directed by the Engineer and all operations covered within the intent and purpose of this Specification. It shall also include the hauling and stacking of or hauling to sites of embankment and subgrade construction, suitable cut materials as required, as also the disposal of unsuitable cut materials in specified manner, trimming and finishing of the road to specified dimensions or as directed by the Engineer.
2. Excavation for structures shall consist of the removal of material for the construction of foundation for bridges, culverts, retaining walls, headwalls, cutoff walls, pipe culverts and other similar structures, in accordance with the requirements of these Specifications and the lines and dimensions shown on the Drawings or as indicated by the Engineer. The work shall include construction of the necessary cofferdams and cribs and their subsequent removal; all necessary sheeting, shoring, bracing, draining and pumping; the removal of all logs, stumps, grubs and other deleterious matter and obstructions, necessary for placing the foundations; trimming bottoms of excavations; backfilling and clearing up the site and the disposal of all surplus material.

### **3.2 Applicable Codes**

The following Indian Standard Codes, unless otherwise specified herein, shall be applicable.  
In all cases, the latest revision of the codes shall be referred to.

1. IS: 783 Code of practice for laying of concrete pipes.
2. IS: 1200 Method of Measurement of Building Works (Part I).
3. IS: 3764 Safety code for excavation work.
4. IS: 3385 Code of practice for measurement of Civil Engineering Works.
5. IS: 2720 Method of test of soils (All parts)
6. IS: 1498 Classification and identification of soils for General Engineering purposes
7. IS: 2809 Glossary of terms and symbols relating to Soil Engineering
8. IS: 4081 Safety code for blasting and related drilling operations
9. IS: 4988 Glossary of terms and classifications of earth moving machinery (All Parts)

### **3.3 Drawings – Deleted**



### **3.4 Classification of Excavated Material – Deleted**

### **3.5 General**

1. Contractor shall furnish all tools, plants, instruments, qualified supervisory personnel, labour, materials, any temporary work, consumable, any and everything necessary, whether or not such items are specifically stated herein for completion of the job in accordance with Specification requirements.
2. Contractor shall carry out the survey of the site before excavation and properly mark all lines and establish levels for various works such as earthwork in excavation for grading, basement, foundations, plinth filling, roads, drains, cable, trenches, pipelines etc. Such survey shall be carried out by taking accurate cross sections of the area perpendicular to established reference / grid lines at intervals as determined by Engineer based on ground profile. These shall be checked by Engineer and thereafter properly recorded.
3. The excavation shall be done to correct lines and levels. This shall also include, where required, proper shoring to maintain excavations and also the furnishing, erecting and maintaining of substantial barricades around excavated areas and warning lamps at night for ensuring safety.
4. The rates quoted shall also include the dumping of excavated materials in regular heaps, bunds, riprap with regular slopes as directed by Engineer, within the lead specified and leveling the same as to provide natural drainage. Rock / soil excavated shall be stacked properly as directed by Engineer. As a rule, all softer material shall be laid along the center of heaps, the harder and more weather resisting materials forming the casing on the sides and the top. Rock shall be stacked separately.

### **3.6 Clearing**

1. The area to be excavated / filled shall be cleared as described in Chapter 2.

### **3.7 Timber Shoring**

1. Close timbering shall be done by completely covering the sides of the trenches and pits generally with short, upright members called 'Polling Boards'. These shall be of minimum 25 cm X 4 cm sections or as directed by Engineer. The boards shall generally be placed in position, vertically, side by side without any gap, on each side of the excavation and shall be secured by horizontal walling of strong wood at maximum 1.2 metres spacing, strutted with "Ballies" or as directed by Engineer. The length of the "Ballie" struts shall depend on the width of the trench or pit. If the soil is very soft and loose, the boards shall be placed horizontally against each side of the excavation and supported by vertical walling, which in turn shall be taken into the ground and no portion of the vertical side of the trench or pit shall remain exposed, so as to render the earth liable to slip out.
2. Timber shoring shall be 'close' or 'open' type, depending on the nature of soil and the depth of pit or trench. The type of timbering shall be as approved by Engineer In- Charge. It shall be the responsibility of Contractor to take all necessary steps to prevent the sides of excavation, trenches, pits, etc., from collapsing.
3. Timber shoring may be required to keep the sides of excavations vertical to ensure safety of adjoining structures or to limit the slope of excavations, or due to space restrictions or for other reasons. Such shoring shall be carried out, except in an emergency, only on instructions from Engineer.

4. The withdrawal of the timber shall be done very carefully, to prevent collapse, systematically from one end to the other end. Concrete or masonry shall not be damaged during the removal of the timber. No claim shall be entertained for any timber which cannot be withdrawn and is lost or buried.
5. In case of open timbering, the entire surface of the side of trench or pit is not required to be covered. The vertical boards of minimum 25 cm X 4 cm sections shall be spaced sufficiently apart to leave unsupported strips of maximum 50 cm average width. The detailed arrangement, sizes of the timber and the spacing shall be subject to the approval of Engineer. In all other respects, Specification for close timbering shall apply to open timbering.
6. In case of large pits and open excavations, where shoring is required for securing safety of adjoining structures or for any other reasons and where the planking across sides of excavations / pits cannot be strutted against, suitable inclined struts supported on the excavated bed shall be provided. Load from such struts shall be suitably distributed on the bed to ensure no yielding of the strut. If, however, Engineer directs any timbering to be left-in, keeping in mind the type of construction or any other factor, Contractor shall be paid for, at the scheduled item rate, for such left-in timbering.
7. Measurement - Deleted

### **3.8 Slips and Slides**

1. If slips, slides, over-breaks or subsidence occur in cuttings during the process of construction, they shall be removed at the cost of the Contractor as ordered by the Engineer. Should slips occur, the slipped material shall be removed and the slope dressed to a modified stable slope. Removal of the slipped earth will not be paid for if the slips are due to the negligence of Contractor. Adequate precautions shall be taken to ensure that during construction, the slopes are not rendered unstable or give rise to recurrent slides after construction. If finished slopes slide into the roadway subsequently, such slides shall be removed and paid for at the Contract rate for the class of excavation involved, provided the slides are not due to any negligence on the part of the Contractor. The classification of the debris material from the slips, slides etc., shall conform to its condition at the time of removal and payment made accordingly regardless of its condition earlier.

### **3.9 Dewatering**

1. If water is met within the excavations due to springs, seepage, rain or other causes, it shall be removed by suitable diversions, pumping or bailing out and the excavation kept dry whenever so required or directed by the Engineer. Care shall be taken to discharge the drained water into suitable outlet as not to cause damage to the works, crops or any other property. Due to any negligence on the part of the Contractor, if any such damage is caused, it shall be the sole responsibility of the Contractor to repair / restore to the original condition at his own cost or compensate for the damage. Sumps made for dewatering must be kept clear of the excavations / trenches required for further work. Method of pumping shall be approved by Engineer; but in any case, the pumping arrangement shall be such that there shall be no movement of subsoil or blowing in due to differential head of water during pumping. Pumping arrangements shall be adequate to ensure no delays in construction.
2. All excavations shall be kept free of water. Grading in the vicinity of excavations shall be controlled to prevent surface water running into excavated areas.
3. When there is a continuous inflow of water and quantum of water to be handled is considered in the opinion of Engineer, as large, 'Well Point System' - single stage or multistage, shall be adopted. Contractor shall submit to Engineer his scheme of well point system including the stages, the spacing, number and diameter of well points, headers, etc. and the number, capacity and location of

pumps for approval. Unless separately provided for in the schedule of prices, the cost of dewatering shall be included in the item rate for excavation.

4. Unless separately provided for in the schedule of quantities, dewatering is deemed to have been included in the unit rates quoted for excavation. If separately provided for, the unit of measurement shall be as indicated in the schedule of quantities.

**3.10 Methods, Tools and Equipment – Deleted**

**3.11 Rock Excavation – Deleted**

**3.12 Marsh Excavation – Deleted**

**3.13 Construction Operations for Roadways – Deleted**

**3.14 Construction Operation for Structures**

1. Setting out

After the site has been cleared according to Chapter 2, the limits of excavation shall be set out true to lines, curves and slopes to **Clause 5.13.1**.

2. Excavation

- i. Excavation shall be taken to the width of the lowest step of the footing and the sides shall be left plumb where the nature of soil allows it. Where the nature of soil or the depth of the trench and season of the year do not permit vertical sides, the Contractor at his own expense shall put up necessary shoring, strutting and planking or cut slopes to a safer angle or both with due regard to the safety of personnel and works and to the satisfaction of the Engineer.
- ii. The depth to which the excavation is to be carried out shall be as shown on the Drawings, unless the type of material encountered is such as to require changes, in which case the depth shall be as ordered by the Engineer. Propping shall be undertaken when any foundation or stressed zone from the adjoining structure is within a line of 1 vertical to 2 horizontal from the bottom of the excavation.
- iii. Where blasting is to be resorted to, the same shall be carried out in accordance with **Clause 5.17** and all precautions indicated therein observed. Where blasting is likely to endanger adjoining foundations or other structures, necessary precautions such as controlled blasting, providing rubber mat cover to prevent flying of debris etc., shall be taken to prevent any damage.

3. Dewatering and protection

1. Normally, open foundations shall be laid dry. Where water is met with in excavation due to stream flow, seepage, springs, rain or other reasons, the Contractor shall take adequate measures such as bailing, pumping, constructing diversion channels, drainage channels, bunds, depression of water level by well point system, cofferdams and other necessary

works to keep the foundation trenches dry when so required and to protect the green concrete / masonry against damage by erosion or sudden rising of water level. The methods to be adopted in this regard and other details thereof shall be left to the choice of the Contractor but subject to approval of the Engineer. Approval of the Engineer shall, however, not relieve the Contractor of the responsibility for the adequacy of dewatering and protection arrangements and for the quality and safety of the works.

2. Where cofferdams are required, these shall be carried to adequate depths and heights, be safely designed and constructed and be made as watertight as is necessary for facilitating construction to be carried out inside them. The interior dimensions of the cofferdams shall be such as to give sufficient clearance for the construction and inspection and to permit installation of pumping equipment, etc., inside the enclosed area.
3. If it is determined beforehand that the foundation cannot be laid dry or the situation is found that the percolation is too heavy for keeping the foundation dry, the foundation concrete shall be laid under water by tremie pipe only. In case of flowing water or artesian springs, the flow shall be stopped or reduced as far as possible at the time of placing the concrete.
4. Pumping from the interior of any foundation enclosure shall be done in such a manner as to preclude the possibility of the movement of water through any fresh concrete. No pumping shall be permitted during the placing of concrete or for any period of at least 24 hours thereafter, unless it is done from a suitable sump separated from the concrete work by a watertight wall or other similar means.
5. At the discretion of the Contractor, cement grouting or other approved methods may be used to prevent or reduce seepage and to protect the excavation area.
6. The Contractor shall take all precautions in diverting channels and in discharging the drained water as not to cause damage to the works, crops or any other property.

#### 4. Preparation of Foundation

1. The bottom of the foundation shall be leveled both longitudinally and transversely or stepped as directed by the Engineer. Before footing is laid, the surface shall be slightly watered and rammed. In the event of excavation having been made deeper than that shown on the Drawings or as otherwise ordered by the Engineer, the extra depth shall be made up with concrete or masonry of the foundation at the cost of the Contractor as per **Clause 2104.1** of MoST Specifications for Roads and Bridge Works (IV Revision). Ordinary filling shall not be used for the purpose to bring the foundation to level.
2. When rock or other hard strata is encountered, it shall be freed of all soft and loose material, cleaned and cut to a firm surface either level and stepped as directed by the Engineer. All seams shall be cleaned out and filled with cement mortar or grout to the satisfaction of the Engineer. In the case of excavation in rock, annular space around footing shall be filled with lean concrete (1:3:6 nominal mix) upto the top level of rock.

3. If the depth of fill required is more than 1.5 m above the top of the footing, filling up to 1.5 m above top of footing shall be done with lean concrete (1:3:6 nominal mix) followed by boulders grouted with cement.
4. When foundation piles are used, the excavation of each pit shall be substantially completed before beginning pile-driving operations therein. After pile driving operations in a given pit are completed, all loose and displaced materials therein shall be removed to the elevation of the bottom of the footings.
5. Slips and slip-outs: If there are any slips or slip-outs in the excavation, these shall be removed by the Contractor at his own cost.

5. Public Safety

Near towns, villages and all frequented places, trenches and foundation pits shall be securely fenced, provided with proper caution signs and marked with red lights as night to avoid accidents. The Contractor shall take adequate protective measures to see that the excavation operations do not affect or damage adjoining structures. For safety precautions, guidance may be taken from IS: 3764.

6. Backfilling

Backfilling shall be done with approved material after concrete or masonry is fully set and carried out in such a way as not to cause undue thrust on any part of the structure. All space between foundation masonry or concrete and the sides of excavation shall be refilled to the original surface in layers not exceeding 150 mm compacted thickness. The compaction shall be done with the help of suitable equipment such as mechanical tamper, rammer, plate vibrator etc., after necessary watering, so as to achieve a density not less than the field density before excavation.

7. Disposal of Surplus excavated materials shall be as per **Clause 5.13.5**

8. Measurement for Payment – Deleted

9. Rates – Deleted

**3.15 Construction Operation for Sewers and Water Supply Lines – Deleted**

**3.16 Construction Operation for Surface/Sub-Surface Drains – Deleted**

**3.17 Blasting Operations – Deleted**

**3.18 Pre-splitting Rock Excavation Slopes – Deleted**

**3.19 Tolerances**

1. The presplit face shall not deviate more than 300 mm from the plane passing through adjacent drill holes, except where the character of the rock is such that as determined by the Engineer, irregularities are unavoidable. When completed, the average plane of the slopes shall conform to the slopes indicated on the plans and no point on the completed slopes shall vary from the designated slopes by more than 300 mm. These tolerances shall be measured perpendicular to the plane of the slope. In no case shall any portion of the slope encroach on the side drains.

2. As long as equally satisfactory presplit slopes are obtained, then either the slope face may be presplit before drilling for production blasting or presplitting the slope face and production blasting may be done at the same time, provided that the presplitting drill holes are fired with zero delay and the production holes are delayed starting at the row of holes farthest from the slope and progressing in steps to the row of holes nearest the presplit line, which row shall be delayed at least 50 milliseconds. In either case the presplitting holes shall extend either to the end of the excavation or for a distance of not less than 15 m beyond the limits of the production holes to be detonated.
3. Measurements for Payment – Deleted
4. Rates - Deleted

### 3.20 Embankment Construction

#### 1. Scope

These Specifications shall apply to the construction of embankments including sub grades, earthen shoulders and miscellaneous backfills with approved materials obtained from roadway and drain excavation, borrow pits or other sources. All embankments, subgrade, earthen shoulders and miscellaneous backfills shall be constructed in accordance with the requirements of these Specifications and in conformity with the lines, grades, and cross sections as directed by the Engineer.

#### 2. Physical Requirements of materials

1. The materials used in embankments, sub grades, earthen shoulders and miscellaneous backfills shall be soil, moorum, gravel, a mixture of those or any other material approved by the Engineer. Such materials shall be free of logs, stumps, roots, rubbish or any other ingredient likely to deteriorate or affect the stability of the embankment/subgrade.
2. The following types of material shall be considered unsuitable for embankment:
  - a. Materials from swamps, marshes and bogs;
  - b. Peat, log, stump and perishable material; any soil that classifies as OL, OI, OH or Pt in accordance with IS: 1498.
  - c. Materials susceptible to spontaneous combustion;
  - d. Materials in a frozen conditions;
  - e. Clay having liquid limit exceeding 70 and plasticity index exceeding 45; and 6. Materials with salts resulting in leaching in the embankment.
3. Expansive clay exhibiting marked swell and shrinkage properties (“free swelling index” exceeding 50 percent when tested as per IS: 2720 Part 40) shall not be used as a fill material. Where expansive clay with acceptable “free swelling index” value is used as a fill material, subgrade and top 500 mm portion of the embankment just below subgrade shall be non-expansive in nature.
4. Any fill material with a soluble sulphate content exceeding 1.9 grams of sulphate (expressed as SO<sub>3</sub>) per litre when tested in accordance with BS: 1377 Test 10, but using a 2:1 water-soil ratio shall not be deposited within 500 mm or other distance described in the Contract, of concrete, cement bound materials or other cementitious materials forming part of the Permanent Works.

5. Materials with a total sulphate content (expressed as SO<sub>3</sub>) exceeding 0.5 percent by mass, when tested in accordance with BS: 1377 Test 9 shall not be deposited within 500 mm, or other distances described in the Contract, of metallic items forming part of the Permanent Works.
6. The size of the coarse material in the mixture of earth shall ordinarily not exceed 75 mm when being placed in the embankment and 50 mm when placed in the subgrade. However, the Engineer may at his discretion permit the use of material coarser than this also if he is satisfied that the same will not present any difficulty as regards the placement of fill material and its compaction to the requirements of these Specifications. The maximum particle size shall not be more than two-thirds of the compacted layer thickness.
7. Ordinarily, only the materials satisfying the density requirements given in **Table 5-3** shall be employed for the construction of the embankment and the subgrade.

**Table 5-3. Density Requirements of Embankment and Subgrade Materials**

Sr.	Type of Work	Maximum laboratory dry unit weight when tested as per IS: 2270 (Part 8)
1.	Embankments up to 3 metres height, not subjected to extensive flooding.	Not less than 15.2 kN/cum.
2.	Embankments exceeding 3 metres height or embankments of any height subject to long periods of inundation	Not less than 16.0 kN/cum.
3.	Sub grades and earthen shoulders / verges / backfill	Not less than 17.5 kN/cum.

*Notes:*

1. *This Table is not applicable for lightweight fill material e.g. cinder, fly ash etc.*
2. *The Engineer may relax these requirements at his discretion taking into account the availability of materials for construction and other relevant factors.*
3. *The material to be used in subgrade should also satisfy design CBR at the dry unit weight applicable as per **Table 5-4**.*

3. General requirements of materials

1. The materials for embankment shall be obtained from approved sources with preference given to materials becoming available from nearby roadway excavation or any other excavation under the same Contract.
2. The work shall be so planned and executed that the best available materials are saved for the subgrade and the embankment portion just below the subgrade.
3. Borrow Materials
  1. Where the materials are to be obtained from designated borrow areas, the location, size and shape of these areas shall be as indicated by the Engineer and the same shall not be opened without his written permission. Where specific borrow areas are not designated by the Employer / the Engineer, arrangement for locating the source of supply of material for embankment and subgrade as well as compliance to environmental requirements in respect of excavation and borrow areas as stipulated, from time to time by the Ministry of Environment and Forests, Government of India and the local bodies, as applicable, shall be the sole responsibility of the Contractor.

2. Borrowpits along the road shall be discouraged. If permitted by the Engineer, these shall not be dug continuously. Ridges of not less than 8 m width should be left at intervals not exceeding 300 m. Small drains shall be cut through the ridges to facilitate drainage. The depth of the pits shall be so regulated that their bottom does not cut an imaginary line having a slope of 1 vertical to 4 horizontal projected from the edge of the final section of the bank, the maximum depth in any case being limited to 1.5 m. Also, no pit shall be dug within the offset width from the toe of the embankment required as per the consideration of stability with a minimum width of 10 m.
3. Haulage of material to embankments or other areas of fill shall proceed only when sufficient spreading and compaction plants is operating at the place of deposition.
4. No excavated acceptable material other than surplus to requirements of the Contract shall be removed from the site. Should the Contractor be permitted to remove acceptable material from the site to suit his operational procedure, then he shall make good any consequent deficit of material arising there from.
5. Where the excavation reveals a combination of acceptable and unacceptable materials, the Contractor shall, unless otherwise agreed by the Engineer, carry out the excavation in such a manner that the acceptable materials are excavated separately for use in the permanent works without contamination by the unacceptable materials. The acceptable materials shall be stockpiled separately.
6. The Contractor shall ensure that he does not adversely affect the stability of excavation or fills by the methods of stockpiling materials, use of plants or siting of temporary buildings or structures.
7. The Contractor shall obtain representative samples from each of the identified borrow areas and have these tested at the site laboratory following a testing programme approved by the Engineer. It shall be ensured that the subgrade material when compacted to the density requirements as in Table 5-4 shall yield the design CBR value of the subgrade.

**Table 5-4. Compaction Requirements for Embankment and Subgrade**

Sr	Type of work/ material	Relative compaction as percentage of max. laboratory dry density as per IS: 2720 (Part 8)
1.	Subgrade and earthen shoulders	Not less than 97
2.	Embankment	Not less than 95
3.	Expansive Clays	
	a) Subgrade and 500 mm portion just below the subgrade	Not allowed
	b)	Not less than 90

The Contractor shall at least 7 working days before commencement of compaction submit the following to the Engineer for approval:

1. The values of maximum dry density and optimum moisture content obtained in accordance with IS: 2720 (Part 7) or (Part 8), as the case may be, appropriate for each of the fill materials he intends to use.



2. A graph of density plotted against moisture content from which each of the values in (1) above of maximum dry density and optimum moisture content were determined.
3. The Dry density-moisture content-CBR relationships for light, intermediate and heavy compactive efforts (light corresponding to IS: 2720 (Part 7), heavy corresponding to IS: 2720 (Part 8) and intermediate in-between the two) for each of the fill materials he intends to use in the subgrade.

Once the above information has been approved by the Engineer, it shall form the basis for compaction.

#### 4. Construction Operations for Embankments

##### 1. Setting out

After the site has been cleared to **Chapter 2**, the work shall be set out to **Clause 1.10**. The limits of embankment/subgrade shall be marked by fixing batter pegs on both sides at regular intervals as guides before commencing the earthwork. The embankment / subgrade shall be built sufficiently wider than the design dimension so that surplus materials may be trimmed, ensuring that the remaining material is to the desired density and in position specified and conforms to the specified side slopes.

##### 2. Dewatering

If the foundation of the embankment is in an area with stagnant water, and in the opinion of the Engineer it is feasible to remove it, the same shall be removed by bailing out or pumping, as directed by the Engineer and the area of the embankment foundation shall be kept dry. Care shall be taken to discharge the drained water so as not to cause damage to the works, crops or any other property. Due to any negligence on the part of the Contractor, if any such damage is caused, it shall be the sole responsibility of the Contractor to repair / restore it to original condition or compensate the damage at his own cost. If the embankment is to be constructed under Water, **Clause 5.20.5.6** shall apply.

##### 3. Stripping and Storing topsoil

In localities where most of the available embankment materials are not conducive to plant growth, or when so directed by the Engineer, the topsoil from all areas of cutting and from all areas to be covered by embankment foundation shall be stripped to specified depths not exceeding 150 mm and stored in stockpiles of height not exceeding 2 m for covering embankment slopes, cut slopes and other disturbed areas where re-vegetation is desired. Topsoil shall not be unnecessarily trafficked either before stripping or when in a stockpile. Stockpiles shall not be surcharged or otherwise loaded and multiple handling shall be kept to a minimum.

##### 4. Compacting ground supporting Embankment / Subgrade

1. When necessary, the original ground shall be leveled to facilitate placement of first layer of embankment, scarified, mixed with water and then compacted by rolling so as to achieve minimum dry density as given in **Table 5-4**.
2. In case where the difference between the subgrade level (top of the subgrade on which pavement rests) and ground level is less than 0.5 m and the ground does not have 97 percent relative compaction with respect to the dry density as given in

**Table 5-4**, the ground shall be loosened up to a level 0.5 m below the subgrade level, watered and compacted in layers in accordance with **Clause 5.20.4.5 and 5.20.4.6** to not less than 97 percent of dry density as given in **Table 5-4**.

3. Where so directed by the Engineer, any unsuitable material occurring in the embankment foundation shall be removed and replaced by approved materials laid in layers to the required degree of compaction.
  4. Embankment or subgrade work shall not proceed until the foundations of embankments/subgrade have been inspected by the Engineer for satisfactory condition and approved.
  5. Any foundation treatment specified for embankments especially high embankments, resting on suspect foundations as revealed by borehole logs shall be carried out in a manner and to the depth as desired by the Engineer. Where the ground on which embankment is to be built has any of the material types (1) to (6) in **Clause 5.20.2.2**, at least 500 mm of such material must be removed and replaced by acceptable fill material before embankment construction commences.
5. Spreading material in layers and bringing to appropriate moisture content
1. The embankment and subgrade material shall be spread in layers of uniform thickness not exceeding 200 mm compacted thickness over the entire width of embankment by mechanical means, finished by a motor grader and compacted as per **Clause 5.20.4.6**. The motor grader blade shall have hydraulic control suitable for initial adjustment and maintain the same so as to achieve the specific slope and grade. Successive layers shall not be placed until the layer under construction has been thoroughly compacted to the specified requirements as in **Table 5-4** and got approved by the Engineer. Each compacted layer shall be finished parallel to the final cross-section of the embankment.
  2. Moisture content of the material shall be checked at the site of placement prior to commencement of compaction; if found to be out of agreed limits, the same shall be made good. Where water is required to be added in such construction, water shall be sprinkled from a water tanker fitted with sprinkler capable of applying water uniformly with a controllable rate of flow to variable widths of surfaces but without any flooding. The water shall be added uniformly and thoroughly mixed in soil by blading, discing or harrowing until a uniform moisture content is obtained throughout the depth of the layer.
  3. If the material delivered to the roadbed is too wet, it shall be dried, by aeration and exposure to the sun, till the moisture content is acceptable for compaction. Should circumstances arise, where owing to wet weather, the moisture content cannot be reduced to the required amount by the above procedure, compaction work shall be suspended.
  4. Moisture content of each layer of soil shall be checked in accordance with IS: 2720 (Part 2), and unless otherwise mentioned, shall be so adjusted, making due allowance for evaporation losses, that at the time of compaction it is in the range of 1% above to 2% below the optimum moisture content determined in accordance with IS: 2720 (Part 7) or IS: 2720 (Part 8) as the case may be. Expansive clays shall, however, be compacted at moisture content corresponding to the specified dry

- density, but on the wet side of the optimum moisture content obtained from the laboratory compaction curve.
5. After adding the required amount of water, the soil shall be processed by means of graders, harrows, rotary mixers or as otherwise approved by the Engineer unit the layer is uniformly wet.
  6. Clods or hard lumps of earth shall be broken to have a maximum size of 75 mm when being placed in the embankment and a maximum size of 50 mm when being placed in the subgrade.
  7. Embankment and other areas of fill shall, unless otherwise required in the Contract or permitted by the Engineer, be constructed evenly over their full width and their fullest possible extent and the Contractor shall control and direct construction plant and other vehicular traffic uniformly over them. Damage by construction plant and other vehicular traffic shall be made good by the Contractor with material having the same characteristics and strength as the material had before it was damaged.
  8. Embankments and other areas of unsupported fills shall not be constructed with steeper side slopes, or to greater widths than those shown in the Contract, except to permit adequate compaction at the edges before trimming back, or to obtain the final profile following any settlement of the fill and the underlying material.
  9. Whenever fill is to be deposited against the face of a natural slope, or sloping earthworks face including embankments, cuttings, other fills and excavations steeper than 1 vertical on 4 horizontal, such faces shall be benched as per **Clause 5.20.5.1** immediately before placing the subsequent fill.
  10. All permanent faces of side slopes of embankments and other areas of fill formed shall, subsequent to any trimming operations, be reworked and sealed to the satisfaction of the Engineer by tracking a tracked vehicle, considered suitable by the Engineer, on the slope or any other method approved by the Engineer.
6. Compaction
1. Only the compaction equipment approved by the Engineer shall be employed to compact the different material types encountered during construction. Smooth wheeled, vibratory, pneumatic tyred, sheepfoot or pad foot rollers, etc., of suitable size and capacity as approved by the Engineer shall be used for the different types and grades of materials required to be compacted either individually or in suitable combinations.
  2. The compaction shall be done with the help of vibratory roller of 80 to 100 kN static weight with plain or pad foot drum or heavy pneumatic tyred roller of adequate capacity capable of achieving required compaction.
  3. The Contractor shall demonstrate the efficacy of the equipment he intends to use by carrying out compaction trials. The procedure to be adopted for these site trials shall first be submitted to the Engineer for approval.
  4. Earthmoving plant shall not be accepted as compaction equipment nor shall the use of a lighter category of plant to provide any preliminary compaction to assist the use of heavier plant be taken into account.

5. Each layer of the material shall be thoroughly compacted to the densities specified in **Table 5-4**. Subsequent layers shall be placed only after the finished layer has been tested according to **Clause 903.2.2** of MoST Specifications for Roads and Bridge Works (IV Revision) and accepted by the Engineer. The Engineer may permit measurement of field dry density by a nuclear moisture / density gauge used in accordance with agreed procedure and the gauge is calibrated to provide results identified to that obtained from tests in accordance with IS: 2720 (Part 28). A record of the same shall be maintained by the Contractor.
6. When density measurement reveal any soft areas in the embankment / subgrade / earthen shoulders, further compaction shall be carried out as directed by the Engineer. If in spite of that the specified compaction is not achieved, the material in the soft areas shall be removed and replaced by approved material, compacted to the density requirements and satisfaction of the Engineer.

#### 7. Drainage

The surface of the embankment / subgrade at all times during construction shall be maintained at such a cross fall (not flatter than that required for effective drainage of an earthen surface) as will shed water and prevent ponding.

#### 8. Repairing of damages caused by rain / spillage of water

The soil in the affected portion shall be removed in such areas as directed by the Engineer before next layer is laid and refilled in layers and compacted using appropriate mechanical means such as small vibratory roller, plate compactor or power rammer to achieve the required density in accordance with **Clause 5.20.4.6**. If the cut is not sufficiently wide for use of required mechanical means for compaction, the same shall be widened suitably to permit their use for proper compaction. Tests shall be carried out as directed by the Engineer to ascertain the density requirements of the repaired area. The work of repairing the damages including widening of the cut, if any, shall be carried out by the Contractor at his own cost, including the arranging of machinery / equipment for the purpose.

#### 9. Finishing operations

1. Finishing operations shall include the work of shaping and dressing the shoulders / verge / roadbed and side slopes to conform to the alignment, levels, cross-sections and dimensions shown on the Drawings or as directed by the Engineer subject to the surface tolerance described in **Clause 902** of MoST Specifications for Roads and Bridge Works (IV Revision). Both the upper and lower ends of the side slopes shall be rounded off to improve appearance and to merge the embankment with the adjacent terrain.
2. The topsoil, removed and conserved earlier (**Clause 5.13.2 and 5.20.4.3**) shall be spread over the fill slopes as per directions of the Engineer to facilitate the growth of vegetation. Slopes shall be roughened and moistened slightly prior to the application of the topsoil in order to provide satisfactory bond. The depth of the topsoil shall be sufficient to sustain plant growth, the usual thickness being from 75 mm to 150 mm.

3. Where directed, the slopes shall be turfed with sods in accordance with **Clause 5.22**. If seeding and mulching of slopes is prescribed, this shall be done to the requirement of **Clause 5.23**.
  4. When earthwork operations have been substantially completed, the road area shall be cleared of all debris, and ugly scars in the construction area responsible for objectionable appearance eliminated.
5. Construction of Embankment and Subgrade under Special Conditions
1. Earthwork for widening existing road embankment
    1. When an existing embankment and / or subgrade is to be widened and its slope are steeper than 1 vertical on 4 horizontal, continuous horizontal benches, each at least 300 mm wide, shall be cut into the old slope for ensuring adequate bond with the fresh embankment / subgrade material to be added. The material obtained from cutting of benches could be utilized in the widening of the embankment / subgrade. However, when the existing slope against which the fresh material is to be placed is flatter than 1 vertical on 4 horizontal, the slope surface may only be ploughed or scarified instead of resorting to benching.
    2. Where the width of the widened portions is insufficient to permit the use of conventional rollers, compaction shall be carried out with the help of small vibratory rollers / plate compactors / power rammers of any other appropriate equipment approved by the Engineer. End dumping of material from trucks for widening operations shall be avoided except in difficult circumstances when the extra width is too narrow to permit the movement of any other types of hauling equipment.
  2. Earthwork for embankment and subgrade to be placed against sloping ground:
    1. Where an embankment / subgrade is to be placed against sloping ground, the latter shall be appropriately benched or ploughed / scarified as required in **Clause 5.20.5.1** before placing the embankment / subgrade material. Extra earthwork involved in benching or due to ploughing / scarifying etc. shall be considered incidental to the work.
    2. For wet conditions, benches with slightly inward fall subsoil drains at the lowest point shall be provided as per the Drawings, before the fill is placed against sloping ground.
    3. Where the Contract requires construction of transverse subsurface drain at the cut-fill interface, work on the same shall be carried out to **Clause 5.16** in proper sequence with the embankment and subgrade work as approved by the Engineer.
  3. Earthwork over existing road surface:

Where the embankment is to be placed over an existing road surface, the work shall be carried out as indicated below:

    1. If the existing road surface is of granular or bituminous type and lies within 1 m of the new subgrade level, the same shall be scarified to a depth of 50 mm or more if specified, so as to provide ample bond between the old and new material ensuring

that at least 500 mm portion below the top of new subgrade level is compacted to the desired density.

2. If the existing road surface is of cement concrete type and lies within 1 m of the new subgrade level the same shall be removed completely.
3. If the level difference between the existing road surface and the new formation level is more than 1 m, the existing surface shall be permitted to stay in place without any modification.
4. Embankment and subgrade around structures:
  1. To avoid interference with the construction of abutments, wing walls or return walls of culvert / bridge structures, the Contractor shall, at points to be determined by the Engineer suspend work on embankment forming approaches to such structures, until such time as the construction of the latter is sufficiently advanced to permit the completion of approaches without the risk of damage to the structure.
  2. Unless directed otherwise, the filling around culverts, bridges and other structures up to a distance of twice the height of the road from the back of the abutment shall be carried out independent of the work on the main embankment. The fill material shall not be placed against any abutment or wing wall, unless permission has been given by the Engineer but in any case not until the concrete or masonry has been in position for 14 days. The embankment and subgrade shall be brought up simultaneously in equal layers on each side of the structure to avoid displacement in equal layers on each side of the structure to avoid displacement and unequal pressure. The sequence of work in this regard shall be got approved from the Engineer.
  3. The material used for backfill shall not be an organic soil or highly plastic clay having plasticity index and liquid limit more than 20 and 40 respectively when tested according to IS: 2720 (Part 5). Filling behind abutments and wing walls for all structures shall conform to the general guidelines given in Appendix 6 of IRC:78 (Standard Specifications and Code of Practice for Road Bridges-Section VII) in respect of the type of material, the extent of backfill, its laying and compaction etc. The fill material shall be deposited in horizontal layers in loose thickness and compacted thoroughly to the requirements of **Table 5-4**.
  4. Where the provision of any filter medium is specified behind the abutment, the same shall be laid in layers simultaneously with the laying of fill material. The material used for filter shall conform to the requirements for filter medium spelt out in **Clause 2502** of MoST Specifications for Roads and Bridge Works (IV Revision) / **Clause 5.16.2.1 Para 2** unless otherwise specified in the Contract.
  5. Where it may be impracticable to use conventional rollers, the compaction shall be carried out by appropriate mechanical means such as small vibratory roller, plate compactor or power rammer. Care shall be taken to see that the compaction equipment does not hit or come too close to any structural member so as to cause any damage to them or excessive pressure against the structure.
5. Construction of Embankment over Ground Incapable of Supporting Construction Equipment:

Where embankment is to be constructed across ground which will not support the weight of repeated heavy loads of construction equipment, the first layer of the fill may be constructed by placing successive loads of material in a uniformly distributed layer of a minimum thickness required to support the construction equipment as permitted by the Engineer. The Contractor, if so desired by him, may also use suitable geosynthetic material to increase the bearing capacity of the foundation. This exception to normal procedure will not be permitted where, in the opinion of the Engineer, the embankments could be constructed in the approved manner over such ground by the use of lighter or modified equipment after proper ditching and drainage have been provided. Where this exception is permitted, the selection of the material and the construction procedure to obtain an acceptable layer shall be the responsibility of the Contractor. The cost of providing suitable traffic conditions for construction equipment over any area of the Contract will be the responsibility of the Contractor and no extra payment will be made to him. The remainder of the embankment shall be constructed as specified in **Clause 5.20.4.**

6. Embankment construction under water

Where filling or backfilling is to be placed under water, only acceptable granular material or rock shall be used unless otherwise approved by the Engineer. Acceptable granular material shall consist of graded, hard durable particles with maximum particle size not exceeding 75 mm. The material should be non-plastic having uniformity coefficient of not less than 10. The material placed in open water shall be deposited by end tipping without compaction.

7. Earthwork for high embankment

1. In the case of high embankments, the Contractor shall normally use the material from the specified borrow area. In case he desires to use different material for his own convenience, he shall have to carry out necessary soil investigations and redesign the high embankment at his own cost. The Contractor shall then furnish the soil test data and design of high embankment for approval of the Engineer, who reserve the right to accept or reject it.
2. If necessary, stage construction of fills and any controlled rates of filling shall be carried out in accordance with the Contract including installation of instruments and its monitoring.
3. Where required, the Contractor shall surcharge embankments or other areas of till with approved material for the periods specified in the Contract. If settlement of surcharged fill results in any surcharging material, which is unacceptable for use in the fill being surcharged, lying below formation level, the Contractor shall remove the unacceptable material and dispose it as per direction of the Engineer. He shall then bring the resultant level up to formation level with acceptable material.

1. Settlement period

1. Where settlement period is specified in the Contract, the embankment shall remain in place for the required settlement period before excavating for abutment, wingwall, retaining wall, footings, etc., or driving foundation piles. The duration of the required settlement period at each location shall be as provided for in the Contract or as directed by the Engineer.

2. Plying of Traffic

Construction and other vehicular traffic shall not use the prepared surface of the embankment and / or subgrade without the prior permission of the Engineer. Any damage arising out of such use shall, however, be made good by the Contractor at his own expense as directed by the Engineer.

3. Surface Finish and Quality Control of Work

The surface finish of construction of subgrade shall conform to the requirements of **Clause 902** of MoST Specifications for Roads and Bridge Works (IV Revision). Control on the quality of materials and works shall be exercised in accordance with **Clause 903** of MoST Specifications for Roads and Bridge Works (IV Revision).

2. Subgrade Strength

1. It shall be ensured prior to actual execution that the borrow area material to be used in the subgrade satisfies the requirements of design CBR.
2. Subgrade shall be compacted and finished to the design strength consistent with other physical requirements. The actual laboratory CBR values of constructed subgrade shall be determined on undisturbed samples cut out from the compacted subgrade in CBR mould fitted with cutting shoe or on remoulded samples, compacted to the field density at the field moisture content.
3. Measurements for Payment – Deleted

3. Rates – Deleted

**3.6 Soil Erosion and Sedimentation Control – Deleted**

**3.7 Turfing with Sods – Deleted**

**3.8 Seeding and Mulching – Deleted**

**3.9 Preparation and Surface Treatment of Formation – Deleted**

**3.10 Works to be Kept Free of Water**

1. The Contractor shall arrange for the rapid dispersal of water collected / accumulated on the earthwork or completed formation during construction or on the existing roadway or which enters the earthwork or any other item of work from any source, and where practicable, the water shall be discharged into the permanent outfall of the drainage system. The arrangement shall be made in respect of all earthwork including excavation for pipe trenches, foundations or cuttings.
2. The Contractor shall provide, where necessary, temporary water courses, ditches, drains, pumping or other means for maintaining the earthwork free from water. Such provisions shall include carrying out the work of forming the cut sections and embankments in such manner that their surfaces have at all times a sufficient minimum crossfall and, where practicable, a sufficient longitudinal gradient to enable them to shed water and prevent ponding.
3. The works involved in keeping the earthwork or any other item of works free of water shall be deemed as incidental to the respective item of work and as such no separate payment shall be made for the same.



### **3.11 Water Courses at Culverts**

1. Excavation carried out in the diversion, enlargement deepening or straightening water courses at culverts, where necessary, shall include the operations such as clearing, grubbing, removal of vegetation, trimming of slopes, grading of beds, disposal of excavated materials, pumping, timbering etc., necessary for dealing with the flow of water.
2. The beds and sloping sides of water courses shall, where shown on the Drawings, be protected against the action of water by rubble paving to form a flat or curved surface as indicated. The protection shall consist of large smooth faced stones or of blocks of precast concrete. Stones for rubble paving shall be roughly dressed square. No stone shall be less than 255 mm in depth nor less than 0.02 cum. in volume and no rounded boulders shall be used. After completion of construction of culverts, temporary diversion of water course, if any, shall be closed and water course restored for flow through the culvert as per the direction of the Engineer.
3. Measurements for Payment – Deleted
4. Rates – Deleted

### **3.12 Construction of Rock Fill Embankment**

#### 1. Scope

In normal circumstances, the embankment should not be constructed with rock fill material. However, where specifically permitted by the Engineer because of imperative economic or technical reasons, construction of rock fill embankments shall be in accordance with the lines, grades and cross-sections as shown in Drawings or as directed by the Engineer. Rock fill shall not be used at least for a depth of 500 mm below the formation level. There should be a minimum of 500 mm thick earthen cushion over the rock fill.

#### 2. Material

1. The size of rock pieces used in rock fill embankments shall be such that they can be deposited in layers so as to suit the conditions evaluated in the field compaction trials or as directed by the Engineer. The rock fill shall consist of hard, durable and inert material, preferably maximum size not exceeding 300 mm and percent finer than 125 mm not exceeding 10 per cent.
2. Argillaceous rocks (clay, shales etc.), unburnt colliery stock and chalk shall not be used in rock fill.
3. The rock fragments and blinding material required for filling the voids shall also satisfy the above requirements.

#### 3. Spreading and Compaction

1. The material shall be tipped, spread and leveled in layers extending to the full width of embankment by a suitable dozer. Fragments of rock shall then be spread on the top of layer to the required extent and layer compacted by minimum of 5 passes of vibratory roller having

2. The top layer of rock fill, on which normal earth fill will rest, shall be thoroughly blinded with suitable granular material to seal its surface.

4. Measurements for Payment – Deleted

5. Rate – Deleted

## **4 SURFACE AND SUB-SURFACE GEOTECHNICAL EXPLORATION**

### **4.5 General**

1. The objective of sub-surface exploration is to determine the suitability or otherwise of the soil or rock surrounding the foundation and soil parameters and rock characteristics for the design of foundation by in-situ testing or testing of samples/cores taken out of exploration. The subsurface exploration shall be planned in such a way that different types of soil up to the desired depth and their profile for the full proposed length of the bridge can be recorded and other information such as mechanical and physical properties like grain-size distribution, sensitivity, any existence of deleterious material in soil or ground water, etc., are determined along with soil parameters and rock characteristics. The sub-surface exploration shall also throw light on porosity of rock and subsidence due to mining, ground water level, artesian condition, if any, likely sinking and driving effort, likely constructional difficulties, etc.
2. Field Investigation
  1. Reconnaissance
  2. Preliminary Explorations
  3. Detailed Explorations
  1. Reconnaissance includes a review of available topographic and geological information, aerial photographs and data from previous investigations and site examination.
  2. Preliminary investigation shall include the study of existing geological information, previous site reports, geological maps; air photos, etc., and surface geological examination. For large and important structures the information may be supplemented by geophysical methods. In some cases where no previous sub-strata data are available, exploratory geophysical investigation may need to be supplemented by resorting to a few bore-holes. These will help to narrow down the number of sites under consideration and also to locate the most desirable location for detailed sub-surface investigation like bore or drill holes, sounding probes, etc.
  3. The scope of detailed investigation for bridges may be decided based on data obtained after preliminary investigations. Based on data obtained after preliminary investigations, the bridge site, type of structure with span arrangement and the location and type of foundations, shall be tentatively decided. Thereafter, the scope of detailed investigation including the extent of exploration, number of bore-holes, type of soundings, type of tests, number of tests, etc., shall be decided, so that adequate data considered to be necessary for the detailed design and execution, are obtained.
  4. The width of exploration: One purpose of detailed exploration for high embankments is to ascertain the compressibility of the clayey strata. It is, therefore, necessary that detailed and well illustrated description of the characteristics of stratification should be prepared. After the general shape and trend of the boundaries of the various soil

deposits have been determined and rough assessment of their strength has been made by sub-surface sounding, with or without sampling in exploratory boring, the location of bore-hole(s) for undisturbed sampling shall be decided. At least one representative undisturbed sample should be collected from each strata. When homogeneous strata is very thick, one representative sample shall be collected for each 3 m thickness of the strata.

5. Soil investigation for foundations shall contain a programme for boring and retrieval of samples. The field work shall consist of excavation, drilling of bore-holes for the purposes of collection of undisturbed and disturbed samples, standard penetration tests, in-situ vane tests, static and dynamic cone penetration tests, other field tests, as specified by the Engineer and preparation of bore-logs. Collection and preservation for testing of disturbed and undisturbed samples from boreholes, borrow pits, etc., as specified by the Engineer shall form a part of the above, All in-situ tests shall be supplemented by laboratory investigations. Relevant Indian Standards such as IS: 1498, IS: 1888, IS: 1892, IS: 2131, IS: 2132, IS: 2720, IS: 4434 and IS: 4968 and Appendix I of IRC:78, etc., shall be followed for guidance.
6. The soundings by dynamic method shall be carried out in bore-holes using a standard sampler as specified in IS: 2131.

#### **4.6 Preliminary Investigation**

##### **1. Foundations**

1. Preliminary exploration shall be carried out to determine the soil profile showing the boundaries between the different soil types and between loose and dense parts in the same type of deposits. For guidance reference may be made to IRC: 75. For this purpose, as a first step, a suitable type of sub-surface sounding (e.g., static or dynamic cone penetration test) shall be carried out. As many soundings as necessary should be made, until the penetration data is complete enough to leave no doubt concerning the general shape and the trend of boundaries of the various soil deposits., Exploratory drill holes should then be made at one or two locations where average condition prevails and near those few points where the penetration diagrams indicate maximum deviations from the average.
2. The exploration shall cover the entire length of the bridge and also extend at either side for a distance about twice the depth below bed of the last main foundations. If there is any necessity for designing investigation for approaches particularly on soft soil or with high embankment or there is a possibility of considering alternatives between viaduct or earthen embankment, the extended length and location of the borings beyond the proposed location of abutment should determined and executed.
3. The depth of exploration should be at least  $1 \frac{1}{2}$  times the minimum width of foundation below the proposed foundation level. Where such investigation end in any unsuitable or questionable foundation material the exploration shall be extended to a sufficient depth into firm and stable solid or rock but not less than four times the minimum depth of foundation below the earlier contemplated foundation level... In case of good sound rock the stipulation of minimum depth may be decreased based on difficulty to conduct core drilling and the minimum depth may be restricted to 3 metres.

## 2. Guide bund and Embankment

1. The depth of exploration should include all strata likely to affect stability of embankment, guide bund and/or cause undesirable settlement. In general, the requirement of settlement governs the depth of exploration for high embankments in particular. However, borings can be terminated at shallower depths when firm strata or bed rock is encountered. Ordinarily, the boring shall be taken to a depth of at least 1.5 times the height of embankment and guide bund. However, where highly compressible strata are encountered, the boring may have to be taken deeper. In order to ensure that firm strata is sufficiently thick, the boring should extend 3 metre into the firm strata.

### 4.7 Detailed Exploration

1. The exploration shall cover the entire length of the bridge and also extend at either end for a distance of about twice the depth below bed of the last main foundation to assess the effect of the approach embankment on the end foundations. Generally the sub-surface investigations (preliminary and detailed) for bridges shall extend to a depth below the anticipated foundation level equal to about one and a half times the width of the foundation. However, where such investigations end in any unsuitable or questionable foundation material, the exploration shall be extended to a sufficient depth into firm and stable soils or to rock.
2. The type and extent of exploration shall be divided into the following groups as per requirement of foundation design and likely method of data collection:
  1. Foundation requiring shallow depth of exploration
  2. Foundation requiring large depth of exploration
  3. Fills behind abutments and protection works

## 2. Location Boring

Where the data made available by detailed exploration indicates appreciable variation or where variations in a particular foundation are likely to appreciably affect the construction (specially in case of bridge foundations resting on rock), it will be necessary to resort to additional bores/soundings to establish complete profile of the underlying strata. The additional borings/soundings shall be decided depending upon the extent of variation at a particular foundation location and should cover the entire area of the particular foundation.

## 3. Construction Stage Exploration

Whenever a change in the sub-soil strata/rock profile is encountered during construction, explorations shall be resorted to establish the correct data for further decisions.

4. Logging of bore-holes by radio-active methods shall be done for detailed investigations as specified in the contract or in special provisions.
5. For bridge works, the investigations shall be comprehensive enough to enable the designer to estimate or determine the following:
  1. the engineering properties of the soil/rock,
  2. the location and extent of soft layers and gas pockets, if any, under the hard founding strata,

3. the geological condition like type of rock, faults, fissures or subsidence due to mining, porosity etc.,
4. the ground water level,
5. artesian conditions, if any,
6. quality of water in contact with the foundation,
7. the depth and extent of scour,
8. suitable depth of foundation,
9. the bearing capacity of the foundation,
10. probable settlement and probable differential settlement of the foundations
11. likely sinking or driving effort, and
12. likely construction difficulties.

#### 4.8 Exploration for Bridge Foundations Resting on Rock

1. Investigation and interpretation of data for rock is specialized work. To arrive at the characteristic strength of rock mass, reliance shall be placed more on in-situ tests in comparison to laboratory tests. An engineering geologist shall also be associated in the exploration programme.
2. Identification and classification of rock types for engineering purposes may in general be limited to broad, basic geological classes in accordance with accepted practice. Strength of parent rock alone is of limited value because overall characteristics depend considerably on character, spacing and distribution of discontinuities of the rock mass, such as the joints, bedding planes, faults and weathered seams. An important factor affecting the behaviour is the weathered zone at top.
3. Basic Information Required from Explorations
  1. Depth of rock strata and its variation over the site,
  2. Whether isolated boulder or massive rock formation,
  3. Extent and character of weathered zone,
  4. Structure of rock - including bedding planes, faults, fissures, solution cavities etc.,
  5. Properties of rock material - strength, geological formation, etc.,
  6. Erodibility of rock to the extent possible,
  7. Colour of water.
4. Exploration Programme
  - i. If preliminary investigations have revealed presence of rock within levels where the foundation is to rest, it is essential to take up detailed investigation to collect necessary information mentioned in **Clause above**. The exploratory bore-hole shall be drilled into the rock to a depth of about 3 metres to distinguish a boulder from a continuous rock formation.
  - ii. The extent of exploration shall be adequate enough to give a complete picture of the rock profile both in depth and across the channel width to assess the constructional difficulties in reaching the foundation levels.
  - iii. The depth of boring in rock depends primarily on local geology, erodibility of the rock, extent of structural loads to be transferred to foundation etc. Normally, it shall pass through the upper weathered or otherwise weak zone, well into the sound rock. Minimum depth of boring in sound rock shall be 3 metres.
5. Detailed Investigation for Rock

1. This covers sounding, boring and drilling. An adequate investigation programme shall be planned to cover the whole area for general characteristics and in particular the foundation location, to obtain definite information regarding rock-depth and its variation over the foundation area. The detailed programme of exploration will depend on the type and depth of over-burden, the size and importance of the structure, etc. To decide this, geophysical methods adopted at the preliminary investigation stage will be helpful, this data being supplemental by sounding, bore-holes and drill holes.
  2. Drilling through rock is a very specialised work and every care shall be taken to notice and record any small change during drilling. The time required to drill through a certain depth, amount of core recovery, physical condition, length of pieces of core, joints, colour of water residue, weathering and evidence of disturbance and other effects shall be carefully noticed and entered in the drilling log. for guidance, IS: 5313 may be referred to. The data shall be presented in accordance with IS: 4464.
  3. The cores shall be stored properly in accordance with IS: 4078.
  4. The rock cores obtained shall be subjected to following laboratory tests:
    1. Visual identification for texture, structure, composition, colour and grain size.
    2. Laboratory tests shall be done for specific gravity, porosity and moisture content.
  5. In-situ tests shall be made in accordance with IS: 7292; IS: 7317; and IS: 7746. In addition, laboratory tests can also be made on samples.
  6. Use of in-situ tests for measuring strength and deformation characteristics shall be made. Use of bore-hole photography will be desirable to evaluate the presence of faults, fissures or cavities, etc.
6. Special Cases
1. Investigation for conglomerate

A drill hole shall be made same as for rock. The samples collected shall be subjected suitable tests depending upon the material, special care shall be taken to ascertain erodibility of the matrix. Where possible, specially for shallow foundation, Plate Load Test shall be conducted.
  2. Investigation for laterites

The investigation shall be generally similar to that required for cohesive soils, use of penetration tests shall be preferred, if suitable correlation charts are available. This may be static or dynamic penetration tests or vane shear tests. In the case of hard laterite, recourse may have to be made to core drilling as for soft rocks. For laterites at shallow depths, use of Plate Load Test may be advantageous.
7. Caution
- i. The interpretation of laboratory results on rock samples depends upon the relationship of the specimens tested to the overall rock characteristics, enumerated in Appendix I of IRC: 78. For this purpose, care shall be exercised in the choice of specimen size and its orientation in relation to the joint pattern.

- ii. In some cases, the foundation behaviour will be dominated by a possible mode of failure involving movement along some joint surface, fissures or weak layer within a generally strong rock system and also by possible weathering. In-situ shear tests may be conducted wherever feasible, as such tests are likely to give more representative data than the shear tests conducted on core samples.

#### 8. Presentation of Data

The data shall be given in diagrammatic form in 3 sheets giving the following details:

1. Sheet 1: Plan showing the position of bore-holes clearly marked so as to fix the position at a future date.
2. Sheet 2: This shall contain the bore-log chart and test results of the samples separately for each bore-hole/pit etc.
3. Sheet 3: This shall contain pictorial representation of the borelog data to get an overall picture of the soil profile at the cross-section of the river.

*Note: For guidance, refer to IRC: 78*

#### 4.9 Boring

1. Boring shall be done by any of the following methods depending on the soil type and types of samples required for the investigation:
  1. Auger Boring
  2. Shell and Auger Boring
  3. Percussion Boring
  4. Wash Boring
  5. Rotary Boring
2. For preliminary and detailed sub-surface investigation only rotary drills shall be used. The casing shall also be invariably provided with diameters not less than 150 mm up to the level of rock, if any. However, use of percussion or wash boring equipment shall be permitted only to penetrate through bouldery or gravelly strata for progressing the boring but not for the collection of samples. While conducting detailed borings, the resistance to the speed of drilling i.e., rate of penetration, core loss, etc., as already specified in Appendix 3 of IRC: 78 shall be carefully recorded to evaluate the different types of strata and to distinguish specially sand from sandstone, clay from shale, etc.

#### 4.10 Records of Borings and Trial Pits

1. The field records for the preliminary and detailed exploration shall contain the date when the boring was made, the location of the boring with reference to a permanent system of coordinates and the elevation of the ground surface with respect to a permanent bench mark. They shall include elevation at which the water table and the upper boundary of each of the successive soil strata were encountered, the investigator's clarification of the layer on the basis of general information obtained from field examination (refer to Appendix 2.1 of IRC:75) and the value of the resistance obtained by means of Standard Penetration Test. The type of tools used for borings shall be recorded. If the tools were changed, the depth at which the change was made and the reason thereof shall also be noted. Incomplete and abandoned borings shall be described with no less care than successfully completed drill holes. The notes shall contain everything of significance observed on the job such as the elevation at which wash water was lost from the hole.

2. For all borings and trial pits, necessary information as detailed below shall be given. A site plan showing the disposition of the bore holes shall also be attached:
  1. Agency
  2. Location with reference map
  3. Pit/Bore-hole number
  4. reduced level (R.L.) of ground surface or other reference point
  5. Dates of starting and completion
  6. Name of supervisor
  7. Scales of plans and sections
  8. Dimensions, methods of advancing exploration such as by hand tools, blasting, boring, etc.
  9. General description of strata met with and RLs at which they are met
  10. Position and altitude of contacts, faults, strong joint, slacken sides, etc.
  11. Inflow of water, methods of controlling the water, required capacity of pumps for dewatering
  12. The level at which the sub-soil water is met with
  13. Dip and strike of bedding and of cleavage.
  14. Visual description of strata
  15. Results of field tests e.g. SPT, in-situ vane shear test etc.
  16. Any other information and remarks.
  
3. Upon removal of sampling tube, the length of the sample in the tube and the length between the top of the tube and the top of the sample in the tube shall be measured and recorded.

#### 4.11 Methods of Sampling

There are two types of samples viz., (a) Disturbed sample (b) Undisturbed sample. The usual methods for sampling conforming to IS: 1892 and IS: 2132 are given ahead:

Name of Ground	Type of Sample	Method of Sampling
Soil	Disturbed	Hand Samples / Auger Samples / Shell Samples
	Undisturbed	Hand Samples / Tube Samples
Rock	Disturbed	Wash Samples from percussion or rotary
	Undisturbed	drilling Cores

#### 4.12 Procedure for Taking Samples

1. For proper identification of sub-surface material, sample should be recovered containing all the constituents of the materials in their proper proportion. In clayey deposits such samples could be collected by split spoon samplers. In the case of sandy deposits, sampling spoons shall be fitted with suitable devices for retaining samples. All data required for soil identification (Appendix 2.1 of IRC: 75) should be collected from the samples so extracted when undisturbed samples, which are more desirable for collection of some of the data, are not available. Penetration test should be carried out with the standard split-spoon sampler or penetrometers if the soil is coarse grained. When it is known in advance that the soil profile is fairly regular, preliminary and detailed investigation may be combined. Tube samplers can be used in place of split spoon samplers for collecting samples in clayey strata.
  
2. Disturbed Soil Samples



1. Disturbed samples of soil shall be obtained in the course of excavation and boring. For procuring samples from below the ground water level, where possible, special type of sampler shall be used. Where Standard Penetration Test is conducted, representative samples shall be obtained from the split spoon. While collecting disturbed samples from borrow areas it shall be ensured that the samples collected represented all types of borrow materials to be used in the construction of embankment and sub-grade.
2. The size of sample generally required shall be as given in Table 6-1.

**Table 6-1 Size of Soil Sample Required**

Sr.	PURPOSE OF SAMPLE	SOIL TYPE	WEIGHT OF SAMPLE REQUIRED (kg)
1.	Soil identification, natural moisture content tests, mechanical analysis and index properties, chemical tests	Cohesive soils Sands and Gravel	1 3
2.	Compression tests	Cohesive soils and sand	12.5
3.	Comprehensive examination of construction material and borrow area soil including soil stabilisation	Cohesive soils and sands Gravelly soil	25 - 50 50 - 100

7.8.2.3 While taking out disturbed soil samples, Standard Penetration Test may also be conducted to find out the bearing capacity of the sub-soils at specified levels.

#### 7.8.3 Undisturbed Soil Samples

1. The location of the bore-hole shall be as indicated on the Drawing or given by the Engineer. The depth of the bore-hole shall be as indicated on the Drawing or shall be governed by the criteria given therein or as directed by the Engineer.
2. Samples shall be obtained in such a manner that their moisture content and structure do not get altered. This may be ensured by careful protection and packing and by use of correctly designed sampler.
3. 7.8.3.3 Standard Penetration Test may have to be conducted in each case to obtain additional data as directed by Engineer. In soft clay, in-situ vane shear test as per IS: 4434 may have to be conducted. Where all the three operations have to be carried out in one layer, the sequence shall be undistributed soil sampling followed by in-situ vane shear test, followed by Standard Penetration Test.
4. 7.8.3.4 For compression test samples, core of 40 mm diameter and about 150 to 200 mm length may sufficient, but for other laboratory tests, a core of 100 mm diameter and 300 mm length shall be taken as far as possible, unless otherwise specified by the Engineer.
5. 7.8.3.5 The upper few millimetres of both types of sample shall be rejected as the soil at the bottom of the bore hole usually gets disturbed by the boring tools.

#### 7.8.4 Rock Samples

##### 7.8.4.1 Disturbed samples

The sludge from percussion borings or from rotary borings which have failed to yield a core, shall be collected for a disturbed sample. It may be recovered from circulating water by settlement in a trough.

##### 7.8.4.2 Undisturbed samples

Block samples taken from the rock formation shall be dressed to a size of about 90 x 75 x 50 mm. For core samples - cores of rock shall be taken by means of rotary drills fitted with a coring bit with core retainer, if warranted.

7.8.4.3 In case of rock at shallow depths which can be conveniently reached, test pits or trenches are the most dependable and valuable methods since they permit a direct examination of the surface, the weathered zone and presence of any discontinuities. It is also possible to take representative samples for tests. For guidance, IS: 4453 may be referred to.

#### 7.9 Protection, Handling and Labeling of Samples

7.9.1 Care shall be taken in handling and labeling of samples so that they are received in a fit state for examination and testing and can be correctly identified as coming from a specified trial pit or boring.

7.9.2 The disturbed material in the upper end of the tube shall be completely removed before applying wax for sealing. The length and type of sample so removed should be recorded.

7.9.3 The soil at the lower end of the tube shall be reamed to a distance of about 20 mm. After cleaning, both ends shall be sealed with wax applied in a way that will prevent wax from entering the sample. Wax used for sealing should not be heated to more than a few degrees above its melting temperature. The empty space in the samplers, if any, should be filled with moist soil, saw dust, etc., and the ends covered with tight fittings caps.

7.9.4 Labels giving the following information should be affixed to the tubes:

1. Tube number
2. Job designation
3. Sample location
4. Boring number
5. Sample number
6. Depth
7. Penetration
8. Gross recovery ratio

7.9.5 The tube and boring numbers should be marked in duplicate. Duplicate markings of the boring number and sample number on a sheet which will not be affected by moisture should be enclosed inside the tube.

#### 7.10 Tests for Exploration of Shallow Foundations of Bridges

- 7.10.1 Test pits or trenches are the most dependable and valuable methods of exploration since they permit direct visual examination and more reliably the type of soil and their stratification. This will also allow in-situ tests like plate bearing tests, shear tests and uni-axial jacking tests, etc.
- 7.10.2 Tests shall be conducted on undisturbed samples, which may be obtained from open pits. The use of Plate Load Test (as per IS: 1888) is considered desirable to ascertain the safe bearing pressure and settlement characteristics. A few exploratory bore holes or soundings shall be made to safeguard against presence of weak strata underlying the foundation. This shall extend to a depth of about 1½ times the proposed width of foundation.
- 7.10.3 The laboratory results shall correlate with in-situ tests like Plate Load Tests and Penetration Test results.

### **7.11 Tests for Exploration for Deep Foundations of Bridges**

7.11.1 The tests to be conducted at various locations for properties of soil., etc., are different for cohesive and cohesionless soils. These are enumerated below and shall be carried out, wherever practicable, according to soil type.

#### 7.11.1.1 Cohesionless soil

1. Classification tests, density, etc.
2. Field tests:
  - Plate Load test as per IS: 1888
  - Dynamic Penetration test as per IS: 2131 and Use of Dynamic Cone penetration test as per IS: 4968 (Part 1 or Part 2) may be conducted where considered appropriate.
3. Laboratory tests: Shearing strength test - triaxial or box shear tests - in case of the possibility of rise of water table, the test shall be done on saturated samples.

#### 7.11.1.2 Cohesive soil

1. Classification tests, density, etc.
2. Field tests:
  - Plate Load test
  - Unconfined Compression Test as per IS: 2720 (Part 10)
  - Vane shear test as per IS: 4434
  - Static cone Penetration test as per IS: 4968 (Part 3).
3. Laboratory tests: Shearing strength test - triaxial tests (IS: 2720 Part 9). Consolidation Test (IS: 2720 Part 17).

7.11.2 The sub-surface exploration for bridge works can be divided into 3 zones:

1. between bed level and upto anticipated maximum scour depth (below H.F.L.)
2. from the maximum scour depth to the foundation level.
3. from foundation to about 1½ times the width of the foundation below it.

7.11.3 The sub-soil water shall be tested for chemical properties to ascertain the hazard of deterioration to foundations. Where dewatering is expected to be required, permeability characteristics shall be determined.

7.11.4 For the different zones categorised in **Clause 6.11.2** the data required, such as soil classification, particle size distribution, shearing strength characteristics, method of sampling disturbed and undisturbed samples, testing, including particle size distribution, shear strength, unconfined compression test, shall be complied with.

**7.12 Testing of Material for Guide Bund and High Embankment and Its Foundations**

7.12.1 The soil properties for the embankment foundation shall be as specified in particular Specifications and shall be got verified prior to construction operation. In case the actual soil properties do not match the particular Specification, then embankment design shall be revised.

7.12.2 Field investigation for the embankment material should be carried out to collect general information as indicated in IRC: 75. For details refer to **Clause 5.20**. Field investigations for sub-soil strata shall consist of taking minimum two bore holes for each approach to a bridge along centre line of the alignment at a distance of 50 m and 120 m behind the abutment positions on both sides. The depth of bore holes below the ground level may ordinarily be 2.5 times the maximum height of the embankment subject to minimum depth of 20 m. Thin walled sampling tubes of 100 mm internal diameter and 450 mm minimum length conforming to IS: 2132 shall be used for collecting undisturbed samples from bore-holes at an interval of 2.5 to 3.5 m. Standard penetration test should be conducted immediately after undisturbed sample is collected.

7.12.3 In addition to the relevant identification tests, mentioned in IRC: 75, it shall be necessary to conduct some of the following tests on the undisturbed samples collected from the sub-strata. The choice of test is primarily determined by the type of soil, type of stability analysis (vide Table 6-2), availability of apparatus and cost of investigation.

**Table 6-2 Shear Strength Tests for Stability Analysis**

Sr.	Stage in Life of Embankment	Strength Parameters	Shear Test	Type of Analysis
1.	(a) During construction or immediate postconstruction	$c_{uu}, \phi_{uu}$	Unconsolidated undrained triaxial shear test on undisturbed samples and on compacted embankment material	Total stress analysis
2.	(b) During construction or immediate postconstruction	$S_u$	Unconfined compression test in laboratory or vane shear test	Total stress analysis
3.	(c) During construction or immediate postconstruction	$C'\phi'$	Consolidated undrained test with pore-pressure measurement on as compacted soil samples of embankment materials and on disturbed samples	Effective stress analysis
4.	Long term stability	$C'\phi'$	Consolidated undrained test with pore-pressure measurement on as compacted soil samples of embankment materials and on disturbed samples	Effective stress analysis

#### 7.12.4 Laboratory Investigations of Embankment Material

7.12.4.1 The following tests should be conducted on representative samples of embankment material:

Sr.	TEST	TEST METHOD
1.	Gradation Test (Sieve Analysis)	IS: 2720 (Part 4)
2.	Atterberg Limit Test	IS: 2720 (Part 5)
3.	Standard Proctor Test	IS: 2720 (Part 7)
4.	Natural Moisture Content	IS: 2720 (Part 2)

7.12.4.2 In addition to the above, there is need for shear strength tests on compacted samples of the till material. For this purpose, the relative compaction should be 95 per cent of the Standard Proctor maximum dry density and moisture content, same as that likely to prevail in the embankment during the period covered by the stability analysis or to be used in the field during construction. Undrained test shall be run on cohesive soils and shear strength parameters should be ascertained for the ranges of normal pressures which are likely to be experienced in the field. In cases where effective stress analysis is required to be done, pore pressure measurements should also be made during the undrained tests and effective strength and pore-pressure parameters should be found out. For fill material of cohesionless soils, a direct shear box test (IS: 2720 - Part 13) may be conducted to ascertain shear strength of soil.

7.12.4.3 The results of reconnaissance, field and laboratory investigations for embankments shall be consolidated into a well-knit report. The record of findings and recommendations, if any, may be presented in the form of written test, graphs, figures and tables, as appropriate for different types of data and findings.

7.12.4.4 Information and data to be contained in the report should include general location map, pertinent geological information on reconnaissance observations, sub-soil properties (Fig. 2.1 of IRC: 75), boring logs and summary of sub-soil properties (Fig. 2.2 of IRC: 75), graphs and tables related to laboratory investigations, results of borrow area investigations (Fig 2.3 of IRC: 75) and recommendations, if any.

7.12.4.5 The undisturbed samples shall be collected from each layer of sub-soil unless the stratum is such that undisturbed samples cannot be collected using ordinary sampler. Where indicates by the Engineer, undisturbed samples shall be collected using piston sampler or core-cutter or such special devices. In thick layers undisturbed samples shall be collected at 3 m interval.

**7.13 Measurements for Payment – Deleted**

**7.14 Rate – Deleted**

## **8 MATERIALS FOR STRUCTURES**

### **8.1 Scope**

8.1.1 Materials to be used in the work shall conform to the Specifications mentioned on the Drawings, the requirements laid down in this section and Specifications for relevant items of work covered under these Specifications.

8.1.2 If any material, not covered in these Specifications, is required to be used in the work, it shall conform to relevant Indian Standards, if there are any, or to the requirements specified by the Engineer.

## **8.2 Sources of Material**

8.2.1 The Contractor shall notify the Engineer of his proposed sources of materials prior to delivery. If it is found after trial that sources of supply previously approved do not produce uniform and satisfactory products, or if the product from any other source proves unacceptable at any time, the Contractor shall furnish acceptable material from other sources at his own expense.

## **8.3 Bricks**

8.3.1 Burnt clay bricks shall conform to the requirement of IS: 1077, except that the minimum compressive strength when tested flat shall not be less than 8.4 MPa for individual bricks and 10.5 MPa for average of 5 specimens. They shall be free from cracks and flaws and nodules of free lime. The brick shall have smooth rectangular faces with sharp corners and emit a clear ringing sound when struck. The size may be according to local practice with a tolerance of  $\pm 5$  per cent.

## **8.4 Stones**

8.4.1 Stones shall be of the type specified. It shall be hard, sound, free from cracks, decay and weathering and shall be freshly quarried from an approved quarry. Stone with round surface shall not be used.

8.4.2 The stones, when immersed in water for 24 hours, shall not absorb water by more than 5 per cent of their dry weight when tested in accordance with IS: 1124.

8.4.3 The length of stones shall not exceed 3 times its height nor shall they be less than twice its height plus one joint. No stone shall be less in width than the height and width on the base shall not be greater than three-fourth of the thickness of the wall nor less than 150 mm.

## **8.5 Cast Iron – Deleted**

## **8.6 Cement**

8.6.1 Cement to be used in the works shall be any of the following types with the prior approval of the Engineer:

1. Ordinary Portland Cement, 33 Grade, conforming to IS: 269.
2. Rapid Hardening Portland Cement, conforming to IS: 8041.
3. Ordinary Portland Cement, 43 Grade, conforming to IS: 8112.
4. Ordinary Portland Cement, 53 Grade, conforming to IS: 12269.
5. Sulphate Resistant Portland Cement, conforming to IS: 12230.

8.6.2 Cement conforming to IS: 269 shall be used only after ensuring that the minimum required design strength can be achieved without exceeding the maximum permissible cement content of 540 kg/cum. of concrete.

8.6.3 Cement conforming to IS: 8112 and IS: 12269 may be used provided the minimum cement content mentioned elsewhere from durability considerations is not reduced. From strength considerations, these cements shall be used with a certain caution as high early strengths of cement in the 1 to 28-day range can be achieved by finer grinding and higher constituent ratio of  $C_3S/C_2S$ , where  $C_3S$  is

Tricalcium Silicate and  $C_2S$  is Dicalcium Silicate. In such cements, the further growth of strength beyond say 4 weeks may be much lower than that traditionally expected. Therefore, further strength tests shall be carried out for 56 and 90 days to fine tune the mix design from strength considerations.

- 8.6.4 Cement conforming to IS: 12330 shall be used when sodium sulphate and magnesium sulphate are present in large enough concentration to be aggressive to concrete. The recommended threshold values as per IS: 456 are sulphate concentration in excess of 0.2 percent in soil substrata or 300 ppm (0.03 percent) in ground water. Tests to confirm actual values of sulphate concentration are essential when the structure is located near the sea coast, chemical factories, and agricultural land using chemical fertilizers and sites where there are effluent discharges or where soluble sulphate bearing ground water level is high. Cement conforming to IS: 12330 shall be carefully selected from strength considerations to ensure that the minimum required design strength can be achieved without exceeding the maximum permissible cement content of 540 kg/cum. of concrete.
- 8.6.5 Cement conforming to IS: 8041 shall be used only for precast concrete products after specific approval of the Engineer.
- 8.6.6 Total chloride content in cement shall in no case exceed 0.05 percent by mass of cement also, total sulphur content calculated as sulphuric anhydride ( $SO_3$ ) shall in no case exceed 2.5 percent and 3.0 percent when tri-calcium aluminate percent by mass is upto 5 or greater than 5 respectively.

## 8.7 Lime

- 8.7.1 Lime used shall conform to IS: 712-1984.
- 8.7.2 Building limes are classified as follows:

Class A	Eminently hydraulic lime used for structural purposes.
Class B	Semi hydraulic lime used for masonry mortars.
Class C	Fat Lime used for finishing coat in plastering, white washing etc., and addition of Pozzolanic material for Masonry Mortar.
Class D	Magnesium lime used for finishing coat in plastering, white washing etc.
Class E	Kankar lime used for masonry mortars.

### 8.7.3 Quick Lime

- 8.7.3.1 Quick Lime shall be supplied in the form of lumps and not in powder. Soon after delivery, lump lime shall be separated from powder and all underburnt/overburnt lumps and the powder removed. Quick lime shall not be used directly in the work and shall invariably be slaked and converted to lime putty before used.

### 8.7.4 Hydrated Lime

- 8.7.4.1 Hydrated Lime shall be in the form of a fine dry powder. It shall be supplied in suitable containers such as jute bags lined with water proofing membrane. The bags shall bear marking indication the class of lime, net weight, date of manufacture and the brand name. It shall be used within 4 months of its date of manufacture.

## 8.8 Coarse Aggregates

- 8.8.1 For plain and reinforced cement concrete (PCC and RCC) or prestressed concrete (PSC) works, coarse aggregate shall consist of clean, hard, strong, dense, non-porous and durable pieces of crushed stone, crushed gravel, natural gravel or a suitable combination thereof or other approved inert material. They shall not consist pieces of disintegrated stones, soft, flaky, elongated particles, salt, alkali, vegetable matter or other deleterious materials in such quantities as to reduce the strength and durability of the concrete, or to attack the steel reinforcement. Coarse aggregate having positive alkali silica reaction shall not be used. All coarse aggregates shall conform to IS: 383 and tests for conformity shall be carried out as per IS: 2386 Parts I to VIII.
- 8.8.2 The Contractor shall submit for the approval of the Engineer, the entire information indicated in Appendix A of IS: 383.
- 8.8.3 Maximum nominal size of coarse aggregate for various structural components in PCC, RCC or PSC, shall conform to **Chapter 9**.
- 8.8.4 The maximum value for flakiness index for coarse aggregate shall not exceed 35 percent. The coarse aggregate shall satisfy the following requirements of grading:

IS Sieve Size	Percent by Weight Passing the Sieve		
	40 mm	20 mm	12.5 mm
63 mm	100	-	-
40 mm	95-100	100	-
20 mm	30-70	95-100	100
12.5 mm	-	-	90-100
10 mm	10-35	25-55	40-85
4.75 mm	0-5	0-10	0-10

## 8.9 Sand/Fine Aggregates

- 8.9.1 For masonry work, sand shall conform to the requirements of IS: 2116.
- 8.9.2 For plain and reinforced cement concrete (PCC and RCC) or prestressed concrete (PSC) works, fine aggregate shall consist of clean, hard, strong and durable pieces of crushed stone, crushed gravel, or a suitable combination of natural sand, crushed stone or gravel. They shall not contain dust, lumps, soft or flaky, materials, mica or other deleterious materials in such quantities as to reduce the strength and durability of the concrete, or to attack the embedded steel. Motorised sand washing machines should be used to remove impurities from sand. Fine aggregate having positive alkali-silica reaction shall not be used. All fine aggregate shall conform to IS: 383 and test for conformity shall be carried out as per IS: 2386 (Part I to VIII). The Contractor shall submit to the Engineer the entire information indicated in Appendix A of IS: 383. The fineness modulus of fine aggregate shall neither be less than 2.0 nor greater than 3.5.
- 8.9.3 Sand/fine aggregate for structural concrete shall conform to the following grading requirements:

IS Sieve Size	Percent by Weight Passing the Sieve		
	Zone I	Zone II	Zone III
10 mm	100	100	100
4.75 mm	90-100	90-100	90-100



2.36 mm	60-95	75-100	85-100
1.18 mm	30-70	55-90	75-100
600 micron	15-34	35-59	60-79
300 micron	5-20	8-10	12-40
150 micron	0-10	0-10	0-10

8.9.4 Broken Brick (Burnt Clay) Fine aggregate

8.9.4.1 Broken Brick (Burnt Clay) Fine Aggregate, also known as Surkhi, shall be made by grinding well burnt (but not under or over burnt) broken bricks as specified in IS: 3068-1986. It shall not contain any harmful impurities, such as iron, pyrites, salts, coal, mica, shale or similar laminated or other materials in such form of quantity as to adversely affect hardening, strength, durability or appearance of the mortar. The maximum quantities of clay, fine silt, fine dust and organic impurities in surkhi (all taken together) shall not exceed five percent by weight. The particle size grading of surkhi for used in lime mortars shall be within the limits specified in Table below:

IS Sieve Designation	Percentage passing (by wt)
4.75 mm	100
2.36 mm	90-100
1.18 mm	70-100
600 microns	40-100
300 microns	5-70
150 microns	0-15

**8.10 Steel**

8.10.1 Cast Steel

8.10.1.1 The use of cast steel shall be limited to bearings and other similar parts. Steel for castings shall conform to Grade 280-520N of IS: 1030. In case where subsequent welding is unavoidable in the relevant cast steel components, the letter N at the end of the grade designation of the steel casting shall be replaced by letter W. 0.3 percent to 0.5 per cent copper may be added to increase the corrosion resistance properties.

8.10.2 Steel for Prestressing

8.10.2.1 The prestressing steel shall conform to either of the following:

1. Plain hand drawn steel wire conforming to IS: 1785 (Part I) and IS: 1785 (Part II).
2. Cold drawn indented wire conforming to IS: 6003.
3. High tensile steel bar conforming to IS: 2090.
4. Uncoated stress relieved strands conforming to IS: 6006.

8.10.3 Reinforcement / Untensioned Steel

8.10.3.1 For plain and reinforced cement concrete (PCC and RCC) or prestressed concrete (PSC) works, the reinforcement / untensioned steel as the case may be shall consist of the following grades of reinforcing bars:

Grade Designation	Bar Type conforming to governing IS Specification	Characteristic Strength $f_y$ MPa	Elastic Modulus GPa
S 240	IS: 432 Part I Mild Steel Bar	240	200
S 415	IS: 1786 High Yield Strength Deformed Bars	415	200

- 8.10.3.2 Other grades of bars conforming to IS: 432 and IS: 1786 shall not be permitted.
- 8.10.3.3 All steel shall be procured from original producers, no re-rolled steel shall be incorporated in the work.
- 8.10.3.4 Only new steel shall be delivered to the site. Every bar shall be inspected before assembling on the work and defective, brittle or burnt bar shall be discarded. Cracked ends of bars shall be discarded.
- 8.10.3.5 Fusion-bonded epoxy coated reinforcing bars shall meet the requirements of IS: 13620. Additional requirements for the use of such reinforcement bars have been given below:
1. Patch up materials shall be procured in scared containers with certificates from the agency who has supplied the fusion bonded epoxy bars.
  2. PVC coated G.I. binding wires of 18G shall only be used in conjunction with fusion bonded epoxy bars.
  3. Chairs for supporting the reinforcement shall also be of fusion bonded epoxy coated bars.
  4. The cut ends and damaged portions shall be touched up with repair patch up material
  5. The bars shall be cut by saw-cutting rather than flame cutting.
  6. While bending the bars, the pins of work benches shall be provided with PVC or plastic sleeves.
  7. The coated steel shall not be directly exposed to sun rays or rains and shall be protected with opaque polyethylene sheets or such other approved materials.
  8. While concreting, the workmen or trolleys shall not directly move on coated bars but can move on wooden planks placed on the bars.
- 8.10.3.6 When specified in the contract, protective coating prescribed by the CECRI shall be provided in conformance to Specifications given in Appendix 1000/I. The CECRI coating process shall be allowed to be implemented at the site of works provided a representative of the Institute is present throughout the duration of the coating process who shall certify that the materials and workmanship are in accordance with prescribed Specifications developed by the Institute.

#### 8.10.4 Grey Iron Castings

- 8.10.4.1 Grey Iron Castings to be used for the bearings shall have the following minimum properties:

1.	Minimum Ultimate Tensile Strength	370 MPa
2.	Modulus of Elasticity	147000 MPa
3.	Brinell Hardness	230 MPa
4.	Shear Strength	370 MPa

5.	Compressive Strength	1370 MPa
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8.10.4.2 The testing shall be as specified in IS: 210.

#### 8.10.5 Steel Forgings

8.10.5.1 Forged steel pins shall comply with **Clause 3, 3A or 4 of IS: 1875** and steel forgings shall comply with **Clause 3, 3A or 4 of IS: 2004**. Raw materials of the forging will be taken as per IS: 1875 with minimum reduction ratio of 1.8:1. Alternatively, if forging is made from ingot, a minimum reduction ratio between the ingot and forging will be 4:1. Forging shall be normalised.

#### 8.10.6 Structural Steel

8.10.6.1 Unless otherwise permitted herein, all structural steel shall before fabrication comply with the requirement of the following Indian Standards:

IS: 226	Structural Steel (Standard Quality)
IS: 961	Structural Steel (High Tensile)
IS: 2062	Weldable Structural Steel
IS: 8500	Weldable Structural Steel (medium & high strength qualities)
IS: 1148	Hot rolled rivet bars (upto 40mm dia) for structural purposes
IS: 1149	High tensile rivet bars for structural purposes
IS: 1161	Steel tubes for structural purposes
IS: 4923	Hollow Steel sections for structural use
IS: 11587	Structural weather resistant steel
IS: 808	Specifications for Rolled Steel Beam, Channel and Angle Sections
IS: 1239	Mild Steel Tubes
IS: 1730	Dimension for Steel Plate, sheet and strip for structural and general engineering purposes
IS: 1731	Dimension for Steel flats for structural and general engineering purposes
IS: 1732	Dimension for round and square steel bars for structural and general engineering purposes
IS: 1852	Rolling and cutting tolerances for hot rolled steel products

8.10.6.2 The use of structural steel not covered by the above standards may be permitted with the specific approval of the authority. Refer to Section 1900 for further details.

#### 8.10.7 Stainless Steel

8.10.7.1 Stainless steel shall be austenitic chromium-nickel steel, possessing rust, acid and heat resistant properties conforming to IS: 6603 and IS: 6911. Mechanical properties/grade for such stainless steel shall be as specified by the accepting authority, but in no case be inferior to mild steel. Generally, stainless steel is available as per AISI grades. AISI 304 which is equivalent to grade 04Cr18Ni110 of IS: 6911 satisfies the requirements of mechanical properties of structural steel. Other grades of stainless steel for specific purposes may be provided as per specific requirements. For application in

adverse/corrosive environment, stainless steel shall conform to AISI 316L or 02G17 Ni Mo2 of IS: 6911.

#### 8.10.8 Bitumen

8.10.8.1 The bitumen shall be paving bitumen of Penetration Grade S65 or A 65 (60/70) as per Indian Standard Specifications for "Paving Bitumen" IS: 73. In case of non-availability of bitumen of this grade, S90 (80/1-00) grade bitumen may be used with the approval of the Engineer. Guidance to selection of the grade of bitumen may be taken from **Appendix 4** of MoST Specifications for Roads and Bridge Works (IV Revision).

### 8.11 Water

8.11.1 Water used for mixing and curing shall be clean and free from injurious amounts of oils, acids, alkalis, salts, sugar, organic materials or other substances that may be deleterious to concrete or steel. Potable water is generally considered satisfactory for mixing concrete. Mixing and curing with sea water shall not be permitted. As a guide, the following concentrations represent the maximum permissible values:

1. To neutralise 200 ml sample of water, using phenolphthalein as an indicator, it should not require more than 2 ml of 0.1 normal NaOH.
2. To neutralise 200 ml sample of water, using methyl orange as an indicator, it should not require more than 10 ml of 0.1 normal HCl.
3. The permissible limits for solids shall be as follows when tested in accordance with IS: 3025:

1.	Organic	200 mg/lit
2.	Inorganic	3000 mg/lit
3.	Sulphates (SO <sub>4</sub> )	500 mg/lit
4.	Chlorides (Cl)	500 mg/lit *
5.	Suspended matter	2000 mg/lit

*\* In case of structures of lengths 30m and below, the permissible limit of chlorides may be increased upto 1000 mg/lit.*

*All samples of water (including potable water) shall be tested and suitable measures may be where necessary to ensure conformity of the water to the requirements states herein.*

4. The pH value shall not be less than 6.

### 8.12 Timber

8.12.1 The timber used for structural purposes shall conform to IS: 883.

### 8.13 Concrete Admixtures

8.13.1 General

8.13.1.1 Admixtures are materials added to the concrete before or during mixing with a view to modify one or more of the properties of concrete in the plastic or hardened state.

- 8.13.1.2 Concrete admixtures are proprietary items of manufacture and shall be obtained only from established manufacturers with proven track record, quality assurance and full fledged laboratory facilities for the manufacture and testing of concrete.
- 8.13.1.3 The Contractor shall provide the following information concerning each admixture after obtaining the same from the manufacturer:
1. Normal dosage and detrimental effects, if any, of under dosage and over dosage.
  2. The chemical names of the main ingredients in the admixtures.
  3. The chloride content, if any, expressed as a percentage by weight of the admixture.
  4. Values of dry material content, ash content and relative density of the admixture which can be used for Uniformity Tests.
  5. Whether or not the admixture leads to the entrainment of air when used as per the manufacturer's recommended dosage and it so to what extent.
  6. Where two or more admixtures are proposed to be used in any one mix, confirmation as to their compatibility.
  7. There would be no increase in risk of corrosion of the reinforcement or other embedments as a result of using the admixture.

#### 8.13.2 Physical and Chemical Requirements

- 8.13.2.1 Admixtures shall conform to the requirements of IS: 9103. In addition, the following conditions shall be satisfied:
1. "Plasticisers" and "Super - Plasticisers" shall meet the requirements indicated for "Water reducing Admixture".
  2. Except where resistance to freezing and thawing and to disruptive action of deicing salts is necessary, the air content of freshly mixed concrete in accordance with the pressure method given in IS: 1199 shall not be more than 2 per cent higher than that of the corresponding control mix and in any case not more than 3 per cent of the test mix.
  3. The chloride content of the admixture shall not exceed 0.2 per cent when tested in accordance with IS: 6925. In addition, the maximum permissible limit of chloride content of all the constituents as indicated in **Chapter 9** shall also be observed.
  4. Uniformity tests on the admixtures are essential to compare qualitatively the composition of different samples taken from batch to batch or from the same batch at different times.

The tests that shall be performed along with permissible variations in the same are indicated below:

- Dry Material Content: to be within 3 per cent and 5 per cent of liquid and solid admixtures respectively of the value stated by the manufacturer.
- Ash content: to be within 1 per cent of the value stated by the manufacturer.

Relative density (for liquid admixtures): to be within 2 percent of the value stated by the manufacturer.

5. All tests relating to the concretes admixtures shall be conducted periodically at an independent laboratory and compared with the data given by the manufacturer.

**8.14 Reinforced Concrete Pipes – Deleted**

**8.15 Storage of Materials**

8.15.1 General

8.15.1.1 All materials may be stored at proper places so as to prevent their deterioration or intrusion by foreign matter and to ensure their satisfactory quality and fitness for the work. The storage space must also permit easy inspection, removal and restorage of the materials. All such materials even though stored in approved godowns/places, must be subjected to acceptance test prior to their immediate use.

8.15.2 Brick

8.15.2.1 Bricks shall not be dumped at site. They shall be stacked in regular tiers as they are unloaded, to minimise breakage and defacement. The supply of bricks shall be available at site at any time. Bricks selected for use in different situations shall be stacked separately.

8.15.3 Aggregates

8.15.3.1 Aggregate stockpiles may be made on ground that is denuded of vegetation, is hard and well drained. If necessary, the ground shall be covered with 50 mm plank.

8.15.3.2 Coarse aggregates, unless otherwise agreed by the Engineer in writing, shall be delivered to the site in separate sizes (2 sizes when nominal size is 25 mm or less and 3 sizes when the nominal size is 32 mm or more). Aggregates placed directly on the ground shall not be removed from the stockpile within 30 cm of the ground until the final cleaning up of the work, and then only the clean aggregate will be permitted to be used.

8.15.3.3 In the case of fine aggregates, these shall be deposited at the mixing site not less than 8 hours before use and shall have been tested and approved by the Engineer.

8.15.3.4 Broken Brick (Burnt Clay) Fine Aggregate (Surkhi) shall be stacked on a hard surface or platform so as to prevent the admixture of clay, dust, vegetation and other foreign matter. It shall be also protected from rain and dampness and kept under adequate covering.

8.15.4 Cement

8.15.4.1 Cement shall be transported, handled and stored on the site in such a manner as to avoid deterioration or contamination. Cement shall be stored above ground level in perfectly dry and water-tight sheds and shall be stacked not more than eight bags high. Wherever bulk storage containers are used their capacity should be sufficient to cater to the requirement at site and should be cleaned at least once every 3 to 4 months.

8.15.4.2 Each consignment shall be stored separately so that, it may be readily identified and inspected and cement shall be used in the sequence in which it is delivered at site. Any consignment or part of a consignment of cement which had deteriorated in any way, during storage, shall not be used in the works and shall be removed from the site by the Contractor without charge to the Employer.

- 8.15.4.3 The Contractor shall prepare and maintain proper records on site in respect of delivery, handling, storage and use of cement and these records shall be available for inspection by the Engineer at all times.
- 8.15.4.4 The Contractor shall make a monthly return to the Engineer on the date corresponding to the interim certificate date, showing the quantities of cement received and issued during the month and in stock at the end of the month.
- 8.15.5 Lime
- Lime shall be stored in water proof sheds. Hydrated lime shall be stored in the same manner as cement. Lime which has been damaged by moisture or air-slaking shall not be used. All damaged and rejected lime shall be removed from the site of work forthwith.
- 8.15.6 Reinforcement / Untensioned Steel
- 8.15.6.1 The reinforcement bars, when delivered on the job, shall be stored above the surface of the ground upon platforms, skids, or other supports, and shall be protected from mechanical injury and from deterioration by exposure.
- 8.15.7 Prestressing Materials
- 8.15.7.1 All prestressing steel, sheathing, anchorages and sleeves or coupling must be protected during transportation, handling and storage. The prestressing steel, sheathing and other accessories must be stored under cover from rain or damp ground and protected from the ambient atmosphere if its is likely to be aggressive. Storage at site must be kept to the absolute minimum.
1. Tendon: Wire, strand and bar from which tendons are to be fabricated shall be stored about 300 mm above the ground in a suitably covered and closed space so as to avoid direct climatic influences and to protect them from splashes from any other materials and from the cutting operation of any oxy-acetylene torch or arc welding process in the vicinity. Under no circumstances, tendon material shall be subjected to any welding operation or on site heat treatment or metallic coating such as galvanising. Storage facilities and the procedures for transporting material into or out of store shall be such that the material does not become kinked or notched. Wire or strand shall be stored in large diameter coils which enable the tendons to be laid out straight. As a guide, for wires above 5 mm dia, coils of about 2 m diameter without breaks or joints shall be obtained from manufacturer and stored. Protective wrapping for tendons shall be chemically neutral. All prestressing steel must be provided with temporary protection during storage.
  2. Anchorage Components: The handling and storing procedures shall maintain the anchorage components in a condition in which they can subsequently perform their function to an adequate degree. Components shall be handled and stored so that mechanical damage and detrimental corrosion are prevented. The use of correctly formulated oils and greases or of other corrosion preventing materials is recommended where prolonged storage is required. Such protective material shall be guaranteed by the producer to be non-aggressive and non-degrading.
- 8.15.7.2 Prestressing steel shall be stored in a closed store having single door with double locking arrangements and no windows. Also the air inside the store shall be kept dry as far as possible by using various means to the satisfaction of the Engineer. Also instrument measuring the air humidity shall be installed inside the store. This is with a

view to eliminating the possibility of initial rusting of prestressing steel during storage. The prestressing steel shall be coated with water solvable grease. The prestressing steel should be absolutely clean and without any signs of rust.

- 8.15.7.3 All prestressing steel shall be stored at least 30 cm above ground level and it shall be invariably wrapped by protective cover of tar paper or polythene or any other approved material.
- 8.15.7.4 The Contractor should see that prestressing steel shall be used within 3 months of its manufacture. He should chalk out his programme in this respect precisely, so as to avoid initial corrosion before placing in position.

#### 8.15.8 Water

- 8.15.8.1 Water shall be stored in containers / tanks covered at top and cleaned at regular intervals in order to prevent intrusion by foreign matter or growth of organic matter. Water from shallow, muddy or marshy surface shall not be permitted. The intake pipe shall be enclosed to exclude silt, mud, grass and other solid materials and there shall be a minimum depth of 0.60 m of water below the intake at all times.

### 8.16 Tests and Standard of Acceptance

- 8.16.1 All materials, even though stored in an approved manner shall be subjected to an acceptance test prior to their immediate use. Independent testing of cement for every consignment shall be done by the Contractor at site in the laboratory approved by the Engineer before use. Any cement with lower quality than those shown in manufacturer's certificate shall be debarred from use. In case of imported cement, the same series of tests shall be carried out before acceptance.
- 8.16.2 Testing and Approval of Material
  - 8.16.2.1 The Contractor shall furnish test certificates from the manufacturer/supplier of materials along with each batch of material(s) delivered to site.
  - 8.16.2.2 The Contractor shall set up a field laboratory with necessary equipment for testing of all materials, finished products used in the construction as per requirements of conditions of contract and the relevant Specifications. The testing of all the materials shall be carried out by the Engineer or his representative for which the Contractor shall make all the necessary arrangements and bear the entire cost.
  - 8.16.2.3 Tests which cannot be carried out in the field laboratory have to be got done at the Contractor's cost at any recognised laboratory/testing establishments approved by the Engineer.
- 8.16.3 Sampling of Materials
  - 8.16.3.1 Samples provided to the Engineer or his representative for their retention are to be in labeled boxes suitable for storage.
  - 8.16.3.2 Samples required for approval and testing must be supplied well in advance by at least 48 hours or minimum period required for carrying out relevant tests to allow for testing and approval. Delay to works arising from the late submission of samples will not be acceptable as a reason for delay in the completion of the works.



- 8.16.3.3 If materials are brought from abroad, the cost of sampling/testing whether in India or abroad shall be borne by the Contractor.
- 8.16.4 Rejection of Materials not Conforming to the Specifications
  - 8.16.4.1 Any stack or batch of material(s) of which sample(s) does not conform to the prescribed tests and quality shall be rejected by the Engineer or his representative and such materials shall be removed from site by the Contractor at his own cost. Such rejected materials shall not be made acceptable by any modifications.
- 8.16.5 Testing and Approval of Plant and Equipment
  - 8.16.5.1 All Plants and equipment used for preparing, testing and production of materials for incorporation into the permanent works shall be in accordance with manufacturer's Specifications and shall be got approved by the Engineer before use.

**9 STRUCTURAL STEEL – Deleted**

**10 STRUCTURAL CONCRETE AND MORTAR**

**10.1 Scope**

This Specification covers the general requirements for concrete to be used on jobs using on-site production facilities including requirements in regard to the quality, handling, storage of ingredients, proportioning, batching, mixing and testing of concrete and also requirements in regard to the quality, storage, bending and fixing of reinforcement. This also covers the transportation of concrete from the mixer to the place of final deposit and the placing, curing, protecting, repairing and finishing of concrete.

**10.2 Applicable Codes and Specifications**

10.2.1 The following Specifications, standards and codes are made a part of this Specification. All Standards, Specifications, Codes of Practice referred to herein shall be the latest editions including all applicable official amendments and revisions. In case of discrepancy between this Specification and those referred to herein, this Specification shall govern.

10.2.2 Materials

IS: 269	Specification for Ordinary, Rapid-Hardening and Low Heat Portland Cement.
IS: 455	Specification for Portland Blast Furnace Slag Cement.
IS: 1489	Specification for Portland-Pozzolana Cement.
IS: 4031	Methods of Physical Tests for Hydraulic Cement.
IS: 650	Specification for Standard Sand for Testing of Cement.
IS: 383	Specification for Coarse and Fine Aggregates From Natural Sources for Concrete.
IS: 2386	Methods of Test for Aggregates for Concrete. (Part I To VIII)
IS: 516	Method of Test for Strength of Concrete.
IS: 1199	Method of Sampling and Analysis of Concrete.
IS: 3025	Method of Sampling and Test (Physical and Chemical) Water

	Used In Industry.
IS: 432	Specification for Mild Steel and Medium Tensile Steel Bars and Hard Drawn Steel Wire for Concrete Reinforcement. (Part I & II)
IS: 1139	Specification for Hot Rolled Mild Steel and Medium Tensile Steel Deformed Bar for Concrete Reinforcement.
IS: 1566	Specification for Plain Hard Drawn Steel Wire Fabric for Concrete (Part I) Reinforcement.
IS: 1785	Specification for Plain Hard Drawn Steel Wire for Prestressed Concrete.
IS: 1786	Specification for Cold Twisted Steel Bars for Concrete Reinforcement.
IS: 2090	Specification for High Tensile Steel Bars Used In Prestressed Concrete.
IS: 4990	Specification for Plywood for Concrete Shuttering Work.
IS: 2645	Specification for Integral Cement Water-Proofing Compounds.
BS4461	Cold Worked Steel Bars for The Reinforcement of Concrete.
IS: 4098	Lime Pozzolana Mixture (1st Revision) (Amendment 2)

#### 10.2.3 Equipment

IS: 1791	Specification for Batch Type Concrete Mixers.
IS: 2438	Specification for Roller Pan Mixer.
IS: 2505	Specification for Concrete Vibrators, Immersion Type.
IS: 2506	Specification for Screen Board Concrete Vibrators.
IS: 2514	Specification for Concrete Vibrating Tables.
IS: 3366	Specification for Pan Vibrators.
IS: 4656	Specification for Form Vibrators for Concrete.
IS: 2722	Specification for Portable Swing Weigh Batchers for Concrete (Single and Double Bucket Type).
IS: 2750	Specification for Steel Scaffoldings.
IS: 2438	Roller Fan Mixer (Reaffirmed 1990)

#### 10.2.4 Codes of Practice

IS: 456	Code of Practice for Plain and Reinforced Concrete.
IS: 1343	Code of Practice for Prestressed Concrete.
IS: 457	Code of Practice for General Construction of Plain and Reinforced Concrete for Dams and Other Massive Structures.
IS: 3370	Code of Practice for Concrete Structures for Storage of Liquids (Part I to IV)
IS: 3955	Code of Practice for Composite Construction.
IS: 3201	Criteria for Design and Construction of Precast Concrete Trusses.
IS: 2204	Code of Practice for Construction of Reinforced Concrete Shell Roof.
IS: 2210	Criteria for The Design of R.C. Shell Structures and Folded Plates.
IS: 2751	Code of Practice for Welding of Mild Steel Bars Used for Reinforced Concrete Construction.
IS: 2502	Code of Practice for Bending and Fixing Vibrators for Consolidating Concrete.

IS: 3558	Code of Practice for Use of Immersion Vibrators for Consolidating Concrete.
IS: 3414	Code of Practice for Design and Installation of Joints In Buildings.
IS: 4014	Code of Practice for Steel Tubular Scaffolding. (Part I & II)
IS: 2571	Code of Practice for Laying Insitu Cement Concrete Flooring.
IS: 2250	Code of Practice for Preparation and Use of Masonry Mortar (1st Revision)

10.2.5 Construction Safety

IS: 3696	Safety Code for Scaffolds and Ladders. (Part I & II)
IS: 3385	Code of Practice for Measurement of Civil Engineering Works.

10.2.6 Measurement

IS: 1200	Method of Measurement of Building Works.
IS: 3385	Code of Practice for Measurement of Civil Engineering Works.

10.2.7 In the event that state, city or other governmental bodies have requirements more stringent than those set forth in this Specification, such requirement shall be considered part of this Specification and shall supersede this Specification where applicable.

**10.3 General**

10.3.1 The quality of materials and method and control of manufacture and transportation of all concrete work irrespective of mix, whether reinforced or otherwise, shall conform to the applicable portions of this Specification.

10.3.2 Engineer shall have the right to inspect the source(s) of material(s), the layout and operation of procurement and storage of materials, the concrete batching and mixing equipment, and the quality control system. Such an inspection shall be arranged and Engineer's approval obtained, prior to starting of concrete work.

**10.4 Materials**

10.4.1 All materials shall conform to the requirements laid in **Chapter 7**.

10.4.2 Steel Reinforcement

1. Laps

Laps and splices for reinforcement shall be as shown on the Drawings. Splices in adjacent bars shall be staggered and the locations of all splices, except those specified on the Drawings, shall be approved by Engineer. The bars shall not be lapped unless the length required exceeds the maximum available length of bars at site.

2. Bending

1. Reinforcing bars supplied bent or in coils, shall be straightened before they are cut to size. Straightening of bars shall be done in cold and without damaging the bars. This is considered as a part of reinforcement bending fabrication work.

2. All bars shall be accurately bent according to the sizes and shapes shown on the detailed working Drawings / bar bending schedules. They shall be bent gradually by machine or other approved means. Reinforcing bars shall not be straightened and rebent in a manner that will injure the material and bars containing cracks or splits shall be rejected. They shall be bent cold, except bars of over 25 mm in diameter which may be bent hot if specifically approved by Engineer. Bars which depend for their strength on cold working, shall not be bent hot. Bars bent hot shall not be heated beyond cherry red colour (nor exceeding 845°C) and after bending, shall be allowed to cool slowly without quenching. Bars incorrectly bent shall be used only if the means used for straightening and rebending be such as shall not, in the opinion of Engineer, injure the material. No reinforcement shall be bent when in position in the work without approval, whether or not it is partially embedded in hardened concrete. Bars having kinks or bends other than those required by design shall not be used.

3. Fixing

Reinforcement shall be accurately fixed by any approved means and maintained in the correct position shown in the Drawings by the use of blocks, spacers and chairs as per IS: 2502 to prevent displacement during placing and compaction of concrete. Bars intended to be in contact at crossing points shall be securely bound together at all such points with number 16 gauge annealed soft iron wire. The vertical distances required between successive layers of bar in beams or similar members shall be maintained by the provision of mild steel spacer bars at such intervals that the main bars do not perceptibly sag between spacer bars.

4. Welding of Bars

When permitted or specified on the Drawings, joints of reinforcement bars shall be butt welded so as to transmit their full strength. Welded joints shall preferably be located at points where the reinforcement steel will not be subject to more than 75 % of the maximum permissible stresses and the welded joints should be staggered such that, at any one section, not more than 33% of bars are welded. Only electric arc welding using a process which excludes air from the molten metal and conforms to any or all other special provisions for the work will be accepted. Suitable means shall be provided for holding the bars securely in position during welding. It must be ensured that no voids are left in welding and when welding is done two or three stages, the previous surfaces shall be cleaned properly. Ends of bars shall be cleaned of all loose scale, rust, grease, paint and other foreign matter before welding. Only competent welders shall be employed on the work. The MS electrodes used for welding shall conform to IS: 814. Welded pieces of reinforcement shall be tested. Specimens shall be taken from the actual site and their number and frequency of test shall be as directed by the Engineer.

5. Cover

Unless indicated otherwise on the Drawings, clear concrete cover for reinforcement (exclusive of plaster or other decorative finish) shall be as follows:

1. At each end of reinforcing bar, not less than 25 mm nor less than twice the diameter of the bar.
2. For a longitudinal reinforcing bar in a column, not less than 40 mm, nor less than the diameter of the bar. In case of columns of minimum dimension of 20 cm. or under, with reinforcing bars of 12 mm and less in diameter, a cover of 25 mm may be used.
3. For longitudinal reinforcing bars in a beam, not less than 25 mm nor less than the diameter of the bar.
4. For tensile, compressive, shear, or other reinforcement in a slab or wall, not less than 13 mm, nor less than the diameter of such reinforcement.

5. For any other reinforcement, not less than 13 mm, nor less than the diameter of such reinforcement.
6. For footings and other principal structural members in which the concrete is deposited directly against the ground, cover to the bottom reinforcement shall be 75 mm. If concrete is poured on a layer of lean concrete the bottom cover may be reduced to 50 mm.
7. For concrete surfaces exposed to the weather or the ground after removal of forms, such as retaining walls, grade beams, footing sides and top, etc., not less than 50 mm for bars larger than 16 mm diameter and not less than 40 mm for bars 16 mm diameter or smaller.
8. Increased cover thickness shall be provided, as indicated on the Drawings, for surfaces exposed to the action of harmful chemicals (or exposed to earth contaminated by such chemical), acid, alkali, saline atmosphere, sulphurous smoke, etc.
9. For reinforced concrete members, totally or periodically immersed in sea water or subject to sea water spray, the cover of concrete shall be 50 mm more than those specified in (1) to (5) above.
10. For liquid retaining structures, the minimum cover to all steel shall be 40 mm or the diameter of the main bar, whichever is greater. In the presence of sea water and soils and waters of a corrosive character the cover shall be increased by 10 mm.
11. Protection to reinforcement in case of concrete exposed to harmful surroundings may also be given by providing a dense impermeable concrete with approved protective coatings, as specified on the Drawings. In such a case the extra cover mentioned in (8) and (9) above, may be reduced by Engineer to those shown on the Drawings.
12. The correct cover shall be maintained by cement mortar cubes or other approved means. Reinforcement for footings, grade beams and slabs on subgrade shall be supported on precast concrete blocks as approved by Engineer. The use of pebbles or stones shall not be permitted.
13. The 28 day crushing strength of cement mortar cubes / precast concrete cover blocks shall be atleast equal to the specified strength of concrete in which these cubes / blocks are embedded.
14. The minimum clear distance between reinforcing / bars shall be in accordance with IS: 456 or as shown in Drawings.

6. Inspection

Erected and secured reinforcement shall be inspected and approved by Engineer prior to placement of concrete.

7. Payment

For payment of work done under this item, the actual quantity of steel embedded in concrete as calculated and approved by Engineer, irrespective of the level or the height at which the work is done, shall be taken. The unit rate for reinforcement shall include all wastage, binding wire, etc. for which no separate payment shall be made. Laps as shown in Drawings or as approved by Engineer and minimum number of chairs and spacer bars shall be measured and paid for.

10.4.3 Steel shapes encased in concrete

Structural steel columns, beams, girders and bracings to be encased in concrete shall be unpainted, if so indicated on the Drawings. The encasing shall be done in concrete with 10 mm maximum size aggregate and a cube strength not less than 150 Kg/cm<sup>2</sup> at 28 days unless otherwise specified in Drawings. The steel member shall be wrapped with galvanized wire mesh of the size indicated on the Drawings. The galvanized wire mesh shall be kept 20 mm from the edge or surface of the steel member and shall be held in position securely. The steel member will have a minimum cover of 50 mm unless otherwise indicated on the Drawings. Where the clear cover to steel is more than 75 mm, mild steel bar and concrete with 20 mm coarse aggregate can be used.

## 10.5 Controlled Concrete

- 10.5.1 All concrete in the works shall be "Controlled Concrete" as defined in IS: 456, unless it is a nominal mix concrete such as 1:3:6, 1:4:8 or 1:5:10. Whether reinforced or otherwise, all controlled concrete works to be carried out under this Specification shall be divided into the following classification:
- 10.5.2 Minimum compressive strength of 15 cm. Cubes at 7 and 28 days after mixing, conducted in accordance with IS: 516

Class	Preliminary test Kg/cm <sup>2</sup>		Work test Kg/cm <sup>2</sup>		Max. size of aggregate	Location for use
	At 7 days	At 28 days	At 7 days	At 28 days		
M400	335	500	270	400	20	As shown in schedule of quantity
M350	300	440	235	350	20	
M300	250	380	200	300	40 or 20	
M250	220	320	170	250	40 or 20	
M200	175	260	135	200	40 or 20	
M150	135	200	100	150	40 or 20	

*Note: It shall be very clearly understood that whenever the class of concrete such as M200 is specified it shall be Contractor's responsibility to ensure that minimum crushing strength stipulated for the respective class of concrete is obtained at works. The maximum total quantity of aggregate by weight per 50 Kg. of cement shall not exceed 450 Kg., except when otherwise specifically permitted by Engineer.*

## 10.6 Mix Design

- 10.6.1 This is to investigate the grading of aggregates, water cement ratio, workability and the quantity of cement required to give preliminary and works cubes of the minimum strength specified. The proportions of the mix shall be determined by weight. Adjustment of aggregate proportions due to moisture present in the aggregate shall be made. Mix proportioning shall be based on the principles given in IS: 456-2000 and SP: 23-1982 "Handbook for Design Mix Concrete."
- 10.6.2 Whenever there is a change either in required strength of concrete, or water-cement ratio or workability or the source of aggregates and / or cement, preliminary tests shall be repeated to determine the revised proportions of the mix to suit the altered conditions. While designing mix proportions, over-wet mixes shall always be avoided.
- 10.6.3 While fixing the value for water / cement ratio for preliminary mixes, assistance may be derived from the graph (Appendix A IS: 456) showing the relationship between the 28-day compressive strengths of concrete mixes with different water / cement ratios and the 7 day compressive strength of cement tested in accordance with IS: 269.
- 10.6.4 Preliminary tests
1. Tests specimens shall be prepared with at least two different water / cement ratios for each class of concrete, consistent with workability required for the nature of the work. The materials and proportions used in making preliminary tests shall be similar in all respects to those, to be actually employed in the works as the object of these tests is to determine the proportions of cement, aggregates and water necessary to produce concrete of required consistency and to give the specified strength. It will be Contractor's sole responsibility to carry out statement of proportions

proposed to be used for the various concrete mixes. For preliminary tests, the following procedure shall be followed:

2. Materials shall be brought to the room temperature and all materials shall be in a dry condition. The quantities of water, cement and aggregates for each batch shall be determined by weight to an accuracy of 1 part in 1000 parts.

#### 10.6.5 Mixing Concrete

1. For all works, concrete shall be mixed in a mechanical mixer which along with other accessories shall be kept in first class working condition and so maintained through out the construction. Mixing shall be continued till materials are uniformly distributed and a uniform colour of entire mass is obtained and each individual particle of the coarse aggregate shows a complete coating of mortar containing its proportionate amount of cement. In no case, the mixing be done for a period of not less than two minutes after all ingredients have been put into the mixer. In case of hand mixing, quantity of cement shall be increased by 10% above that specified in **Clause 9.6.1**, the cost of increased cement quantity being borne by the Contractor. Hand mixing shall be permitted only under exceptional conditions and the Contractor must take the permission of the Engineer in advance. Mixers which have been out of use for more than 30 minutes shall be thoroughly cleaned before putting a new batch. Unless otherwise agreed by the Engineer, the first batch of concrete from the mixer shall contain only two thirds of the normal quantity of coarse aggregate. The mixing plant shall be thoroughly cleaned before changing from one type of cement to another.

#### 10.6.6 Consistency

1. The consistency of each batch of concrete shall be measured immediately after mixing, by the slump test, care should be taken to ensure that no water or other material is lost, the material used for the slump test may be remixed with the remainder of the concrete for making the specimen test cubes. the period of re-mixing shall be as short as possible yet sufficient to produce a homogeneous mass.

#### 10.6.7 Size of Test Cubes

1. Compression tests of concrete cubes shall be made as per IS: 516 on 15 cm cubes. Each mould shall be provided with a metal base plate having no leakage. The base plate shall be preferably attached to the mould when assembled and shall be positively and rigidly held together. Before placing concrete, the mould and base plate shall be cleaned and oiled. The dimensions and internal faces of the mould shall be accurate within the following limits:
  1. Height and distance between the opposite faces of the mould shall be of specified size + 0.2 mm. The angle between the adjacent internal faces and between internal faces and top and bottom planes of mould shall be  $90^{\circ} + 0.5^{\circ}$ . The interior faces of the mould shall be plane surfaces with a permissible variation of 0.03 mm.

#### 10.6.8 Compacting

1. Concrete tests cubes shall be moulded by placing fresh concrete in the mould and compacted as specified in IS: 516.

#### 10.6.9 Curing

1. Curing shall be as specified in IS: 516. The cubes shall be kept in moist air of at least 90% relative humidity at a temperature of  $27^{\circ}\text{C} \pm 2^{\circ}\text{C}$  for 2 hours  $\pm$  1/2 hr. from the time of adding

water to the dry ingredients. Thereafter in clean, fresh water and kept at  $27^{\circ} \pm 2^{\circ}\text{C}$  temperature until seven days. A record of maximum and minimum temperatures at the places of storage of the cubes shall be maintained during the period they remain in storage.

#### 10.6.10 Testing of Specimens

1. The strength shall be determined based on not less than five cube test specimens for each age and each water cement ratio. All these laboratory test results shall be tabulated and furnished to Engineer. The test results shall be accepted by Engineer if the average compressive strengths of the specimens tested is not less than the compressive strength specified for the age at which specimens are tested, subject to the condition that only one out of the five consecutive tests may give a value less than the specified strength for that age. Engineer may direct Contractor to repeat the tests if the results are not satisfactory and also to make such changes as he considers necessary to meet the requirements specified. All these preliminary tests shall be conducted by Contractor at his own cost in an approved laboratory.

### 10.7 Proportioning, Consistency, Batching and Mixing of Concrete

1. Proportioning
2. Aggregate

The proportions which shall be decided by conducting preliminary tests shall be by weight. These proportions of cement, fine and coarse aggregates shall be maintained during subsequent concrete batching by means of weigh batchers conforming to IS: 2722 capable of controlling the weights within one percent of the desired value. Except where it can be shown to the satisfaction of Engineer that supply of properly graded aggregate of uniform quality can be maintained over the period of work, the grading of aggregate shall be controlled by obtaining the coarse aggregate in different sizes and blending them in the right proportions. The different sizes shall be stocked in separate stock piles. The grading of coarse and fine aggregate shall be checked as frequently as possible, as determined by Engineer, to ensure maintaining of grading in accordance with the sample used in preliminary mix design. The material shall be stock piled well in advance of use.

3. Cement

The cement shall be measured by weight.

4. Water

Only such quantity of water shall be added to the cement and aggregates in the concrete mix as to ensure dense concrete, specified surface finish, satisfactory workability, consistent with the strength stipulated for each class of concrete. The water added to the mix shall be such as not to cause segregation of material or the collection of excessive free water on the surface of the concrete.

5. Definition of Water / Cement Ratio.

The water cement (W/C) ratio is defined as the weight of water in the mix (including the surface moisture of the aggregates) divided by the weight of cement in the mix.

6. Water / Cement Ratio



The actual water cement ratio to be adopted shall be determined in each instance by Contractor and approved by Engineer.

7. Proportioning by Water / Cement Ratio

The W/C ratio specified for use by Engineer shall be maintained. Contractor shall determine the water content of the aggregates as frequently as directed by Engineer In-Charge as the work progresses and as specified in IS: 2386 (part III) and the amount of mixing water added at the mixer shall be adjusted as directed by Engineer so as to maintain the specified by W/C ratio. To allow for the variation in weight of aggregates due to variation in their moisture content, suitable adjustments in the weights of aggregates shall also be made.

10.7.2 Consistency and slump

1. Concrete shall be of a consistency and workability suitable for the condition of the job. After the amount of water required is determined, the consistency of the mix shall be maintained throughout the progress of the corresponding parts. Compacting factor tests, in accordance with IS: 1199, shall be conducted from time to time to ensure the maintenance of such consistency.
2. The following table gives a range of slumps which shall generally be used for various types of construction unless otherwise instructed by the Engineer.

Types of Construction	Slump in mm	
	Maximum	Minimum
Reinforced foundation walls and footings	75	25
Plain footings, caissons and substructure walls	75	25
T.G. and massive compressor foundations	50	25
Slabs, Beams and reinforced walls	100	25
Pumps & miscellaneous Equipment	75	25
Building columns	100	25
Pavements	50	25
Heavy mass construction	50	25

10.7.3 Batching and mixing of concrete

1. The materials and proportions of concrete materials as established by the preliminary tests for the mix design shall be rigidly followed for all concrete on the project and shall not be changed except when specifically permitted by Engineer.
2. Concrete shall be produced only by weigh batching the ingredients. The mixer and weigh batchers shall be maintained in clean, serviceable condition. The accuracy of weigh batchers shall be periodically checked. They shall be set up level on a firm base and the hopper shall be loaded evenly. The needle shall be adjusted to zero when the hopper is empty. Fine and coarse aggregates shall be weighed separately. Volume batching will not be permitted. However, Engineer In-Charge may permit volume batching by subsequent conversion of the weights of important pours involving concrete of not more than 0.25 cubic metres, on days when other pours involving weigh batching are not likely to be taken up. Concrete shall be of strength stipulated in the respective items. All concrete shall be mixed in mechanically operated batch mixers complying

with IS: 1791 and of approved make with suitable provision for correctly controlling the water delivered to the drum.

3. The quantity of water actually entering the drum shall be checked with the reading of the gauge or valve setting, when starting a job. The test should be made while the mixer is running. The volume of the mixed material shall not exceed the manufacturer's rated mixer capacity. The batch shall be charged into the mixer so that some water will enter the drum in advance of cement and aggregates. All water shall be in the drum by the end of the first 15 seconds of the specified mixing time. Each batch shall be mixed until the concrete is uniform in colour, for a minimum period of two minutes after all the materials and water are in the drum. The entire contents of the drum shall be discharged in one operation before the raw materials for the succeeding batches are fed into the drum.
4. Each time the work stops, the mixer shall be cleaned out and when next commencing the mixing, the first batch shall have 10% additional cement to allow for sticking in the drum.

#### 10.7.4 Sampling and testing concrete in the field

1. Facilities required for sampling materials & concrete in the field, if Engineer so desires, shall be provided by Contractor at no extra cost. The following equipment with operator shall be made available at Engineer's request (all must be in serviceable condition)

Sr.	EQUIPMENT	QUANTITY
1	Concrete cube testing machine suitable for 15 c cm cubes of 100 Tones capacity with proving calibration ring	1 No.
2	Cast Iron cube moulds 15 cm size.	6 Nos.(min.)
3	Slump cone complete with tamping rod	1 set
4	Laboratory balance to weigh upto 5 Kg, with sensitivity of 10 gm.	1 No.
5	IS Sieves for coarse and fine aggregates.	1 set
6	Electric oven with thermostat upto 120°C.	1 No.
7	Flakiness gauge.	1 No.
8	Elongation index gauge.	1 No.
9	Sedimentation pipette.	1 No.
10	Pycnometer.	1 No.
11	Calibrated glass jar 1 litre capacity.	2 Nos.
12	Glass flasks & metal containers.	As required
13	Chemical reagents like sodium hydroxide, tannic acid, litmus papers etc.	As required
14	Laboratory balance of 2 Kg capacity and of sensitivity of 1 gm.	1 No.

*Note: Arrangement can be made by Contractor to have the cubes tested in an approved laboratory in lieu of a testing machine at site at his expense, with the prior consent of the Engineer.*

2. Sampling for strength of concrete:

At least 6 test cubes of each class of concrete shall be taken for every 150 cum. concrete or part thereof. Such samples shall be drawn on each day for each type of concrete. of each set of 6 cubes, three shall be tested at 7 days age and three at 28 days age. The laboratory test results shall be tabulated and furnished to Engineer. Engineer will pass the concrete if average strength of the specimens tested is not less

than the strength specified, subject to the condition that only one out of three consecutive tests may give a value less than the specified strength but this shall not be less than 90% of the specified strength.

3. Consistency:

Slump tests shall be carried out as often as demanded by Engineer and invariably from the same of concrete from which the test cubes are made. Slump tests shall be done immediately after sampling.

10.7.5 Admixtures:

1. Admixtures may be used in concrete only with the approval of Engineer based upon evidence that, with the passage of time, neither the compressive strength nor its durability will reduce. Calcium chloride shall not be used for accelerating set of the cement for any concrete containing reinforcement, or embedded steel parts. When calcium chloride is permitted to be used, such as in mass concrete works, it shall be dissolved in water and added to the mixing water in an amount not to exceed 1½ percent of the weight of the cement in each batch of concrete. When admixtures are used, the designed concrete mix shall be corrected accordingly. Admixtures shall be used as per manufacturer's instructions and in the manner and with the control specified by Engineer. However, the specific requirements as given in **Chapter 7** shall be adhered to.

2. Air entraining agents:

Where specified and approved by Engineer, neutralized vinsol resin or any other approved air entraining agent may be used to produce the specified amount of air in the concrete mix and these agents shall conform to the requirements of ASTM standard 6-260; Air Entraining Admixtures for Concrete. The recommended total air content of the concrete is 4% ± 1%. The method of measuring air content shall be as per IS: 1199.

3. Water reducing admixtures:

Where specified and approved by Engineer water reducing lignosulfonate mixture shall be added in quantities specified by Engineer. The admixtures shall be added in the form of a solution.

4. Retarding admixtures:

Where specified and approval by Engineer, retarding agents shall be added to the concrete mix in quantities specified by Engineer.

5. Water proofing agent:

Where specified and approved by Engineer, water proofing agent conforming to IS: 2645, shall be added in quantities specified by Engineer.

6. Other admixtures:

Engineer may at his discretion instruct Contractor to use any other admixture in the concrete.

10.7.6 Optional Tests

1. Engineer, if he so desires, may order tests to be carried out on cement, sand, coarse aggregate, water in accordance with the relevant Indian Standards.

2. Tests on cement shall include:
  1. Fineness test
  2. Test for normal consistency
  3. Test for setting time
  4. Test for soundness
  5. Test for tensile strength
  6. Test for compressive strength
  7. Test for heat of hydration (by experiment and by calculations) in accordance with IS: 269.
  
3. Tests on sand shall include:
  1. Sieve test
  2. Test for organic impurities
  3. Decantation test for determining clay and silt content
  4. Specific gravity test
  5. Test for unit weight and bulkage factor
  6. Test for sieve analysis and fineness modulus.
  
4. Tests on coarse aggregate shall include
  1. Sieve analysis
  2. Specific gravity and unit weight of dry, loose and rodded aggregate
  3. Soundness and alkali aggregate reactivity
  4. Petrographic examination
  5. Deleterious materials and organic impurities
  6. Test for aggregate crushing value.
  
5. Any or all these tests would normally be ordered to be carried out only if Engineer In- Charge feels the materials are not in accordance with the Specifications or if the specified concrete strengths are not obtained and shall be performed by Contractor at an approved test laboratory. If the tests are successful, owner shall pay for all such optional tests otherwise Contractor shall have to pay for them.
  
6. If the works cubes do not give the stipulated strengths, Engineer reserves the right to ask Contractor to dismantle such portions of the work, which in his opinion are unacceptable and re-do the work to the standard stipulated, at Contractor's cost. The unit rate for concrete shall be all inclusive, including making preliminary mix design and test cubes, works, cubes, testing them as per Specification, slump tests, optional tests, etc. complete.
  
7. Load test on members or any other tests:

In the event of any work being suspected of faulty material or workmanship or both, Engineer requiring its removal and reconstruction may order, or Contractor may request that it should be load tested in accordance with the following provisions:

1. The test load shall be 125 percent of the maximum super- imposed load for which the structure was designed. Such test load shall not be applied before 56 days after the effective hardening of concrete. During the test, struts strong enough to take the whole load shall be placed in position leaving a gap under the members. The test load shall be maintained for 2 hours before removal.

2. If within 24 hours of the removal of the load, the structure does not show a recovery of at least 75 percent of the maximum deflection shown during the 24 hours under load, the test loading shall be repeated after a lapse of at least 72 hours. The structure shall be considered to have failed to pass the test if the recovery after the second test is not at least 75 percent of the maximum deflection shown during the second test. If the structure is certified as failed by the Engineer, the cost of the load test shall be borne by the Contractor.
3. Any other tests, e.g. taking out in an approved manner concrete cores, examination and tests on such cores removed from such parts of the structure as directed by Engineer In- Charge, sonic testing etc. shall be carried out by Contractor if so directed.

Unsatisfactory tests:

1. Should the results of any test prove unsatisfactory, or the structure shows signs of weakness, undue deflection or faulty construction Contractor shall remove and rebuild the member or members involved or carry out such other remedial measures as may be required by Engineer / Owner. Contractor shall bear the cost of so doing, unless the failure of the member or members to fulfill the test conditions is proved to be solely due to faulty design. The cost of load and other tests shall be borne by Contractor if the tests show unsatisfactory results; otherwise such costs will be borne by Owner.

10.7.7 Concrete in alkali soils and alkaline water:

1. Where concrete is liable to attack from alkali salts or alkaline water, special cements containing low amount of tricalcium aluminate shall be used, if so specified on the Drawings. Such concrete shall have a minimum 28 days compressive strength of 250 kg/cm<sup>2</sup> and shall contain not less than 370 Kg of cement per cubic metre of concrete. If specified, additional protection shall be obtained by the use of a chemically resistant stone facing or a layer of Plaster of Paris covered with suitable fabric, such as jute, thoroughly impregnated with tar.

10.7.8 Preparation prior to concrete placement, final inspection and approval

1. Before the concrete is actually placed in position, the insides of the formwork shall be inspected to see that they have been cleaned and oiled. Temporary openings shall be provided to facilitate inspection, especially at bottom of columns and wall forms, to permit removal of saw dust, wood shavings, binding wire, rubbish, dirt etc. Openings shall be placed or holes drilled so that these materials and water can be removed easily. Such openings / holes shall be later suitably plugged.
2. The various traders shall be permitted ample time to install drainage and plumbing lines, floor and trench drains, conduits, hangers, anchors, inserts, sleeves, bolts, frames and other miscellaneous embedments to be cast in the concrete as indicated on the Drawings or as is necessary for the proper execution of the work. Contractor shall cooperate fully with all such agencies, and shall permit the use of scaffolding, formwork etc. by other trades at no extra cost.
3. All embedded parts, inserts etc. supplied by Owner or Contractor shall be correctly positioned and securely held in the forms to prevent displacement during depositing and vibrating of concrete.
4. All anchor bolts shall be positioned and kept in place with the help of properly manufactured templates unless specifically waived in writing by Engineer. The use of all such templates, fixtures

etc. shall be deemed to be included in the rates. Slots, openings, holes, pockets etc. shall be provided in the concrete work in the positions indicated in the Drawings or as directed by Engineer.

5. Reinforcement and other items to be cast in concrete shall have clean surfaces that will not impair bond.
6. Prior to concrete placement all work shall be inspected and approved by Engineer and if found unsatisfactory, concrete shall not be poured until after all defects have been corrected at Contractor's cost.
7. Approval by Engineer of any and all materials and work as required herein shall not relieve Contractor from his obligation to produce finished concrete in accordance with the Drawings and Specifications.

10.7.9 Rain or wash water:

1. No concrete shall be placed in wet weather or on a water covered surface. Any concrete that has been washed by heavy rains shall be entirely removed, if there is any sign of cement and sand having been washed away from the concrete mixture. To guard against damage which may be caused by rains, the works shall be covered with tarpaulins immediately after the concrete has been placed and compacted before leaving the work unattended. Any water accumulating on the surface of the newly placed concrete shall be removed by approved means and no further concrete shall be placed thereon until such water is removed. To avoid flow of water over / around freshly placed concrete, suitable drains & sumps shall be provided.

10.7.10 Bonding mortar:

1. Immediately before concrete placement begins, prepared surfaces except formwork, which will come in contact with the concrete to be placed, shall be covered with a bonding mortar as specified in paragraph 24.7 of this section.

10.7.11 Transportation:

1. All buckets, containers or conveyers used for transporting concrete shall be mortar-tight. Irrespective of the method of transportation adopted, concrete shall be delivered with the required consistency and plasticity without segregation or loss of slump. However, chutes shall not be used for transport of concrete without the written permission of Engineer and concrete shall not be rehandled before placing.

10.7.12 Retempered or contaminated concrete:

1. Concrete must be placed in its final position before it becomes too stiff to work. On no account, water shall be added after the initial mixing. Concrete which has become stiff or has been contaminated with foreign materials shall be rejected and disposed off as directed by Engineer.
2. Cleaning of equipment:
3. All equipment used for mixing, transporting and placing of concrete shall be maintained in clean condition. All pans, buckets, hoppers, chutes, pipelines and other equipment shall be thoroughly cleaned after each period of placement.

**10.8 Procedure for Placing of Concrete:**

10.8.1 Engineer's approval of equipment & methods:

1. Before any concrete is placed, the entire placing programme, consisting of equipment, layout, proposed procedures and methods shall be submitted to Engineer for approval if so demanded by Engineer and no concrete shall be placed until Engineer's approval has been received. Equipment for conveying concrete shall be of such size and design as to ensure a practically continuous flow of concrete during depositing, without segregation of materials, considering the size of the job and placement location.

10.8.2 Time interval between mixing and placing

1. Concrete shall be placed in its final position before the cement reaches its initial set and concrete shall normally be compacted in its final position within thirty minutes of leaving the mixer, and once compacted it shall not be disturbed.

10.8.3 Avoiding segregation

1. Concrete shall, in all cases, be deposited as nearly as practicable directly in its final position, and shall not be rehandled or caused to flow in a manner which will cause segregation, loss of materials, displacement of reinforcement, shuttering or embedded inserts or impair its strength. For locations where direct placement is not possible, and in narrow forms, Contractor shall provide suitable drop and "Elephant Trunks" to confine the movement of concrete.
2. Special care shall be taken when concrete is dropped from a height, especially if reinforcement is in the way, particularly in columns and thin walls.

10.8.4 Placing by manual labour

1. Except when otherwise approved by Engineer, concrete shall be placed in the shuttering by shovels or other approved implements and shall not be dropped from a height more than 1.0 M or handled in a manner which will cause segregation.

10.8.5 Placing by mechanical equipment

1. The following Specification shall apply when placing of concrete by use of mechanical equipment is specifically called for while inviting bids or is warranted considering the nature of work involved.
2. The control of placing shall begin at the mixer discharge by a vertical drop into the middle of the bucket or hopper and this principle of a vertical discharge of concrete shall be adhered to throughout all stages of delivery until the concrete comes to rest in its final position.

10.8.6 Type of Buckets.

1. Central-bottom-dump buckets of a type that provides for positive regulation of the amount and rate of deposition of concrete in all dumping position shall be employed.

10.8.7 Operation of Bucket

1. Placing concrete in large open areas, the bucket shall be spotted directly over the position designated and then lowering for dumping. The open bucket shall clear the concrete already in place and the height of drop shall not exceed 1.00 M. The bucket shall be opened slowly to avoid high vertical bounce. Dumping of buckets on the swing or in any manner which results in separation of ingredients or disturbance of previously placed concrete will not be permitted.

10.8.8 Placement in restricted forms

1. Concrete placed in restricted forms by barrows, buggies, short chutes hand shoveling shall be subject to the requirement for vertical delivery of limited height to avoid segregation and shall be deposited as nearly as practicable in its final position.

10.8.9 Chuting

1. Where it is necessary to use transfer chutes, specific, approval of Engineer must be obtained to type, length, slopes, baffles, vertical terminals and timing of operations. These shall be so arranged that an almost continuous flow of concrete is obtained at the discharge and without segregation. To allow for the loss of mortar against the sides of the chutes, the first mixes shall have less coarse aggregate. During cleaning of chutes, the waste water shall be kept clear of the forms. Concrete shall not be permitted to fall from the end of the chutes by more than 1.0 M. Chutes, when approved for use, shall have slopes not flatter than 1 vertical: 3 horizontal and not steeper than 1 vertical: 2 horizontal. Chutes shall be of metal or metal lined and of rounded cross section. The slopes of all chute sections shall be approximately the same. The discharge end of the chutes shall be maintained above the surface of the concrete in the forms.

10.8.10 Placing by pumping / pneumatic placers

1. Concrete may be conveyed and placed by mechanically operated equipment e.g. pumps or pneumatic placers, only with the written permission necessary for conveying concrete by this method.
2. When pumping is adopted, before pumping of concrete is started, the pipeline shall be lubricated with one or two batches of mortar composed of one part cement and two parts sand. The concrete mix shall be specially designed to suit pumping. Care shall be taken to avoid stoppages in work once pumping has started.
3. When pneumatic placer is used, the manufacturer's advice on layout of pipeline shall be followed to avoid blockages and excessive wear. Restraint shall be provided at the discharge box to take care for the reaction at this end.
4. Manufacturer's advice shall be followed regarding concrete quality and all other related matters when pumping / pneumatic placing equipment are used.

10.8.11 Concrete in layers

1. Concrete, once started, shall be continuous until the pour is completed. Concrete shall be placed in successive horizontal layers of uniform thickness ranging from 15 to 90 cm or as directed by Engineer. These shall be placed as rapidly as practicable to prevent the formation of cold joints or planes of weakness between each succeeding layer within the pour. The thickness of each layer shall be such that it can be deposited before the previous layer has stiffened. The bucket loads or other units of deposit, shall be spotted progressively along the face of the layer with such overlap as will facilitate spreading the layer to uniform depth and texture with a minimum of shoveling. Any tendency to segregation shall be corrected by shoveling stones. Such a condition shall be corrected by redesign of mix or other means, as directed by Engineer.

10.8.12 Bedding of layers

1. The top surface of each pour and Bedding planes shall be approximately horizontal unless otherwise instructed.



#### 10.8.13 Compaction

1. Concrete shall be compacted during placing, with approved vibrating equipment until the concrete has been consolidated to the maximum practicable density, is free of pockets of coarse aggregate fits tightly against all form surfaces, reinforcement and embedded fixtures. Particular care shall be taken to ensure that all concrete placed against the form faces and into corners of forms or against hardened concrete at joints is free from voids or cavities. The use of vibrators shall be consistent with the concrete mix and caution exercised not to over vibrate the concrete to the point that segregation results.

#### 10.8.14 Type of Vibrators

1. Vibrators shall conform to IS Specifications. Type of vibrator to be used shall depend on the structure where concrete is to be placed. Shutter vibrators to be effective, shall be firmly secured to the formwork which must be sufficiently rigid to the transmit the vibration and strong enough not to be damaged by it. Immersion vibrators shall have "no load" frequency, on the size of the vibrator.
2. Immersion vibrators in sufficient numbers and each of adequate size shall be used to properly consolidate all concrete. Tapping or external vibrating of forms by hand tools or immersion vibrators will not be permitted.

#### 10.8.15 Use of Vibrators

1. The exact manner of application and the most suitable machines for the purpose must be carefully considered and operated by experienced men. Immersion vibrators shall be inserted vertically at points not more than 450 mm apart and withdrawn when air bubbles cease to come to the surface. Immersion vibrators shall be withdrawn very slowly. In no case shall immersion vibrators be used to transport concrete inside the forms. Particular attention shall be paid to vibration at the top of lift e.g. in a column or wall.

#### 10.8.16 Melding Successive Batches

1. When placing concrete in layers, which are advancing horizontally as the work progresses, great care shall be exercised to ensure adequate vibration, blending and melding of the concrete between the succeeding layers.

#### 10.8.17 Penetration of Vibrator

1. The immersion vibrator shall penetrate the layer being placed and also penetrate the layer below while the underlayer is still plastic to ensure good bond and homogeneity between the two layers and prevent the formation of cold joints.

#### 10.8.18 Vibrating Against Reinforcement

1. Care shall be taken to prevent contact of immersion vibrators against reinforcement steel. Immersion vibrators shall not be allowed to come in contact with reinforcement steel after start of initial set. They shall also not be allowed to come in contact with forms or finished surfaces.

#### 10.8.19 Use of Form Attached Vibrators

1. Form attached vibrators shall be used only with specific authorization of Engineer.

10.8.20 Use of Surface Vibrators

1. The use of surface vibrators will not be permitted under normal conditions. However, for thin slabs, such as highways, runways and similar constructions, surface vibration by specially designed vibrators may be permitted, upon approval of Engineer.

10.8.21 Stone pockets and Mortar Pondages

1. The formation of stone pockets or mortar pondages in corners and against faces of forms shall not be permitted. Should these occur, they shall be dug out, reformed and refilled to sufficient depth and shape for through bonding, as directed by Engineer.

10.8.22 Placement interval

1. Except when placing with slip forms, each placement of concrete in multiple lift work, shall be allowed to set for atleast 24 hours after the final set of concrete and before the start of a subsequent placement.

10.8.23 Special provision in placing

1. When placing concrete in walls with openings, in floors of integral slabs and beam construction and other similar conditions, the placing shall stop when the concrete reaches the top of the opening in walls or bottom horizontal surface of the slab, as the case may be. Placing shall be resumed before the concrete in place takes initial set, but not until it has had time to settle as determined by Engineer In- Charge.

10.8.24 Placing concrete through reinforcing steel

1. When placing concrete through reinforcing steel, care shall be taken to prevent segregation of the coarse aggregate. Where the congestion of steel makes placing difficult, it may be necessary to temporarily move the top aside to get proper placement and restore reinforcing steel to design position.

10.8.25 Bleeding

1. Bleeding or free water on top of concrete being deposited into the forms, shall be a cause to stop the concrete pour and the conditions causing this defect corrected before any further concreting is resumed.

**10.9 Construction Joints and Keys**

10.9.1 Concrete shall be placed without interruption until completion of the part of the work between predetermined construction joints, as specified hereinafter. Time lapse between the pouring of adjoining units shall be as specified on the Drawings or as directed by Engineer.

10.9.2 If stopping of concreting becomes unavoidable anywhere, a properly formed construction joint shall be made where the work is stopped. Joints shall be either vertical or horizontal, unless shown otherwise on Drawings. In case of an inclined or curved member, the joint shall be at right angles to the axis of the member. Vertical joints shall be formed against a stop board; horizontal joints shall be level and wherever possible, arranged so that the joint lines coincide with the architectural features of the finished work. Battens shall be nailed to the formwork to ensure a horizontal line and if directed, shall also be used to form a grooved joint. For tank walls and similar works joints shall be formed as per IS: 3370. Concrete that is in the process of setting shall not be disturbed or shaken

by traffic either on the concrete itself or upon the shuttering. Horizontal and vertical construction joints and shear keys shall be located and shall conform to the requirements of the plans unless otherwise directed by Engineer. Where not described, the joint shall be in accordance with the following:

1. Column Joint

In a column, the joint shall be formed 75 mm below the lowest soffit of the beams including haunches if any. In flat slab construction, the joint shall be 75 mm below the soffit of column capital. At least 2 hours shall elapse after depositing concrete in columns, piers or walls, before depositing in beams, girders or slabs supported thereon.

2. Beam and Slab Joints

Concrete in a beam shall be placed throughout without a joint but if the provision of a joint is unavoidable the joint shall be vertical and at the centre or within the middle third of the span unless otherwise shown on Drawings. Where a beam intersects a girder, the joints in the girder shall be offset by a distance equal to twice the width of the beam and additional reinforcement provided for shear. The joints shall be vertical throughout the full thickness of the concrete member. A joint in a slab shall be vertical and parallel to the principal reinforcement. Where it is unavoidably at the right angles to the principal reinforcement, the joint shall be vertical and at the middle of the span.

3. Joints in Liquid Retaining Structures

Vertical construction joints in watertight construction will not be permitted unless indicated on the Drawings. Where a horizontal construction joint is required to resist water pressure, special care shall be taken in all phases of its construction to ensure maximum water-tightness.

10.9.3 Dowels

1. Dowels for concrete work, not likely to be taken up in the near future, shall be wrapped in tar paper & burlap.

10.9.4 Mass Foundations

1. Mass Foundations shall be poured in lifts not exceeding 1.5m. in height unless otherwise indicated on the Drawings or approved by Engineer.

10.9.5 Treatment of construction joints on resuming concreting

1. A drier mix shall be used for the top lift of horizontal pours to avoid laintance. All laintance and loose stones shall be thoroughly and carefully removed by wire brushing / hacking and surface washed.
2. Just before concreting is resumed, the roughened joint surface shall be thoroughly cleaned and loose matter removed and then treated with a thin layer of cement group of proportion specified by Engineer and worked well into the surface. The new concrete shall be well worked against the prepared face before the grout mortar sets. Special care shall be taken to obtain thorough compaction and to avoid segregation of the concrete along the joint plane.

## **10.10 Curing, Protecting, Repairing and Finishing**

### 10.10.1 Curing

1. All concrete shall be cured by keeping it continuously damp for the period of time required for complete hydration and hardening to take place. Preference shall be given to the use of continuous sprays, or ponded water, continuously saturated covering of sacking, canvas, hessian or other absorbent materials, or approved effective curing compounds applied with spraying equipment capable of producing a smooth, even- textured coat. Extra precautions shall be exercised in curing concrete during cold and hot weather as outlined hereinafter. The quality of curing water shall be the same as the one used for mixing concrete.
2. Certain types of finish or preparation for overlaying concrete must be done at certain stages of the curing process and special treatment may be required for specific concrete surface finish.
3. Curing of concrete made of high alumina cement and supersulphated cement shall be carried out as directed by Engineer.
4. Curing with water

Fresh concrete shall be kept continuously wet for a minimum period of 10 days from the date of placing of concrete, following a lapse of 12 to 14 hours after laying concrete. The curing of horizontal surfaces exposed to the drying winds shall however begin immediately after the concrete has hardened. Water shall be applied to unformed concrete surfaces within 1 hour after concrete has set. Water shall be applied to formed surfaces immediately upon removal of forms. Quantity of water applied shall be controlled so as to prevent erosion of freshly placed concrete.

5. Continuous Spraying:

Curing shall be assured by use of an ample water supply under pressure in pipes, with all necessary appliance of hose, sprinklers and spraying devices. Continuous fine mist spraying or sprinkling shall be used, unless otherwise specified or approved by Engineer.

6. Alternate Curing Methods:

Whenever, in the judgment of Engineer, it may be necessary to omit the continuous spray method, a covering of clean sand or other approved means such as wet gunny bags which will prevent loss of moisture from the concrete, may be used. No type of covering will be approved which would stain or damage the concrete during or after the curing period. Covering shall be kept continuously wet during the curing period.

7. For curing of concrete in pavements, side-walks, floors, flat roofs or other level surfaces, the ponding method of curing is preferred. The method of containing the ponded water shall be approved by Engineer. Special attention shall be given to edges and corners of the slabs to ensure proper protection to these areas. The ponded areas shall be kept continuously filled with water during the curing period.
8. Curing Compounds:

Surface coating type curing compounds shall be used only by special permission of Engineer. Curing compounds shall be liquid type white pigmented, conforming to U.S. Bureau of Reclamation Specification. No curing compound shall be used on surfaces where future blending with concrete, water or acid proof membrane, or painting is specified.

9. Curing Equipment:

All equipment and materials required for curing shall be on hand and ready for use before concrete is placed.

10.10.2 Protecting fresh concrete:

1. Fresh concrete shall be protected from the elements, from defacements and damage due to construction operations by leaving forms in place for an ample period as specified later in this Specification. Newly placed concrete shall be protected by approved means such as tarpaulins from rain, sun and winds. Steps as approved by Engineer shall also be taken to protect immature concrete from damage by debris, excessive loading, vibration, abrasion or contact with other materials etc. that may impair the strength and / or durability of the concrete. Workmen shall be warned against and prevented from disturbing green concrete during its setting period. If it is necessary that workmen enter the area of freshly placed concrete, Engineer may require that bridges be placed over the area.

10.10.3 Repair and replacement of unsatisfactory concrete

1. Immediately after the shuttering is removed, the surface of concrete shall be very carefully gone over and all defective areas called to the attention of Engineer who may permit patching of the defective areas or also reject the concrete unit either partially or in its entirety. Rejected concrete shall be removed and replaced by Contractor at no additional expense to Owner.
2. Holes left by form bolts etc. shall be filled up and made good with mortar composed of one part of cement to one and half parts of sand passing 2.36 mm IS sieve after removing any loose stones adhering to the concrete. Mortar filling shall be struck off flush at the face of the concrete. Concrete surfaces shall be finished as described under the particular items of work.
3. Superficially honeycombed surfaces and rough patches shall be similarly made good immediately after removal of shuttering, in the presence of Engineer and superficial water and air holes shall be filled in. The mortar shall be well worked into the surface with a wooden float. Excess water shall be avoided. Unless instructed otherwise by Engineer, the surface of the exposed concrete placed against shuttering to remove fine or other irregularities, care being taken to avoid damaging the surface. Surface irregularities shall be removed by grinding.
4. If reinforcement is exposed or the honey combing occurs at vulnerable positions e.g. ends of beams or columns it may be necessary to cut out the member completely or in part and reconstruct. The decision of Engineer shall be final in this regard.
5. If only patching is necessary, the defective concrete shall be cut out till solid concrete is reached (or to a minimum depth of 25 mm) the edges being cut perpendicular to the affected surface or with a small under cut if possible. Anchors, tees or dovetail slots shall be provided whenever necessary to attach the new concrete securely in place.
6. An area extending several centimeters beyond the edges and the surfaces of the prepared voids shall be saturated with water for 24 hours immediately before the patching material is placed.
7. Use of Polymers:
8. The use of polymers for bonding fresh concrete used for repairs will be permitted upon written approval of Engineer In- Charge. polymers shall be applied in strict accordance with the instruction of the manufacturer.

9. Method of Repair:

Small size holes having surface dimensions about equal to the depth of the hole, holes left after removal of form bolts, grout insert holes and slots cut for repair of cracks shall be repaired as follows:

1. The hole to be patched shall be roughened and thoroughly soaked with clean water until absorption stops. A 5 mm thick layer of grout of equal parts of cement and sand shall be well brushed into the surface to be patched followed immediately by the patching concrete which shall be well consolidated with a wooden float and left slightly proud of the surrounding surface. The concrete patch shall be built up in 10 mm thick layers. After an hour or more, depending upon weather conditions, it shall be worked off flush with a wooden float and a smooth finish obtained by wiping with hessian, a steel trowel shall be used for this purpose. The mix for patching shall be of the same materials and in the same proportions as that used in the concrete being repaired, although some reduction in the maximum size of the coarse aggregates may be necessary and the mix shall be kept as dry as possible.
2. Mortar filling by air pressure (guniting) shall be used for repair of areas too large and / or too shallow for patching with mortar. Patched surfaces shall be given a final treatment to match the colour and texture of the surrounding concrete. White cement shall be substituted for ordinary cement, if so directed by Engineer, to match the shade of the patch with the original concrete.

10. Curing of Patched Work

The patched area shall be covered immediately with an approved non-staining, water-saturated material such as gunny bags which shall be kept continuously wet and protected against sun and wind for a period of 24 hours. Thereafter, the patched area shall be kept wet continuously by a fine spray, or sprinkling for not less than 10 days.

11. Approval by Engineer:

All materials, procedures and operations used in the repair of concrete and also the finished repair work shall be subject to the approval of Engineer. All fillings shall be tightly bonded to the concrete and shall be sound, free from shrinkage cracks after the fillings have been cured and dried.

10.10.4 Finishing:

1. This Specification is intended to cover the treatment of concrete surfaces of all structures. Areas requiring special finish not covered by this Specification shall be clearly indicated on the Drawings and special Specifications shall be furnished.
2. Finish for Formed Surfaces
  1. The type of finish for formed concrete surfaces shall be as follows, unless otherwise specified by the Engineer In- Charge:
  2. For surfaces against which backfill or concrete is to be placed, no treatment is required except repair of defective areas.

3. For surfaces below grade which will receive waterproofing treatment, the concrete shall be free of surface irregularities which would interfere with proper application of the waterproofing material which is specified for use.
  4. Unless specified, surfaces which will be exposed when the structure is in service shall receive no special finish, except repair of damaged or defective concrete, removal of fins and abrupt irregularities, filling of holes left by form ties and rods and clean up of loose or adhering debris.
3. Surfaces which will be exposed to the weather and which would normally be level, shall be sloped for drainage. Unless the Drawing specifies a horizontal surface or shows the slope required, the tops of narrow surfaces such as stair treads, walls, curbs and parapets shall be sloped across the width approximately 1 in 30. Broader surfaces such as walkways, roads, parking areas and platforms shall be sloped about 1 in 50. Surfaces that will be covered by backfill or concrete, subfloors to be covered with concrete topping, terrazzo or quarry tile, and similar surfaces shall be smooth screeded and leveled to produce even surfaces. Surface irregularities shall not exceed 6 mm. Surfaces which will not be covered by backfill, concrete or tile toppings such as outside decks, floors of galleries and sumps, parapets, gutters, sidewalks, floors & slabs, shall be consolidated, screeded and floated. Excess water & laitance shall be removed before final finishing. Floating may be done with hand or power tools and started as soon as the screeded surface has attained a stiffness to permit finishing operations and these shall be the minimum required to produce a surface uniform in texture and free from screen marks or other imperfections. Joints and edges shall be tooled as called for on the Drawings or as directed by Engineer In- Charge.
4. Standard Finish for Exposed Concrete
1. Exposed concrete shall mean any concrete, other than floors or slabs, exposed to view upon completion of the job.
  2. Unless otherwise specified on the Drawings, the standard finish for exposed concrete shall be a smooth finish.
  3. A smooth finish shall be obtained with the use of lined or plywood forms having smooth and even surfaces and edges. Panels and form linings shall be of uniform size and be as large as practicable and installed with closed joints. Upon removal of forms the joint marks shall be smoothed off and all blemishes, projections, etc. removed leaving the surfaces reasonably smooth and unmarred.
5. Integral Cement concrete Finish
- When specified on the Drawings an integral cement concrete finish of specified thickness for floors and slabs shall be applied either monolithic or bonded, as specified on the Drawings, as per IS: 2571. The surface shall be compacted and then floated with a wood float or power floating machine. The surface shall be tested with a straight edge and any high and low spots eliminated. Floating or trowelling of the finish shall be permitted only after all surface water has evaporated. Dry cement or a mixture of dry cement and sand shall not be sprinkled directly on the surface of the cement finish to absorb moisture or to stiffen the mix.
6. Rubbed Finish
- A rubbed finish shall be provided only on exposed concrete surfaces as specified on the Drawings. Upon removal of forms, all fins and other projections on the surfaces shall be carefully removed, offsets leveled and voids and / or damaged sections immediately saturated with water

and repaired by filling with a concrete or mortar of the same composition as was used in the surface. The surfaces shall then be thoroughly wetted and rubbed with carborundum or other abrasive. Cement mortar may be used in the rubbing, but the finished surfaces shall not be brush coated with either cement or grout after rubbing. The finished surfaces shall present a uniform and smooth appearance.

10.10.5 Protection

1. All concrete shall be protected against damage until final acceptance by Engineer / Owner.

**10.11 Formwork**

10.11.1 The formwork shall consist of shores, bracings, sides of beams and columns, bottom of slabs including ties, anchors, hangers, inserts and shall be properly designed and planned for the work. False work shall be so constructed that vertical adjustments can be made to compensate for take up and settlements. Wedges may be used at the top or bottom of timber shores, but not at both ends, to facilitate vertical adjustment or dismantling of the formwork.

10.11.2 Design of formwork

1. The design and engineering of the formwork as well as its construction shall be the responsibility of Contractor. If so instructed, the Drawings and / or calculations for the design of the formwork shall be submitted to Engineer In- Charge for approval before proceeding with work, at no extra cost to Owner. Engineer's approval shall not however relieve Contractor of the full responsibility for the design and construction of the formwork. The design shall take into account all the loads vertical as well as lateral, that the forms will be carrying including live and vibration loadings.

10.11.3 Camber

Suitable camber shall be provided in horizontal members of structure, especially in cantilever spans to counteract the effect of deflection. The formwork shall be so assembled as to provide for camber. The camber for beams and slabs shall be 4 mm per metre (1 to 25) or as directed by the Engineer, 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.

10.11.4 Tolerances

1. Tolerance is specified as permissible variation from lines, grade or dimensions given in Drawings. No tolerances specified for horizontal or vertical building lines or footings shall be construed to permit encroachment beyond the legal boundaries. Unless otherwise specified, the following tolerances will be permitted.

2. Tolerance for R.C. Buildings

1. Variation from the plumb

- In the lines and surfaces of columns, piers, walls and in arises 5 mm per 2.5 m. or 25 mm, whichever is less.
- For exposed corner columns and other conspicuous lines.

In any bay or 5 m maximum	-	5 mm
In 10 m or more	-	10 mm

2. Variation from the level or from the grades indicated on the Drawings.

- In slab soffits, ceilings, beam soffit, and in arises



- 
- In 2.5 m - 5 mm
  - In any bay or 5 m maximum - 8 mm
  - In 10 m or more - 15 mm
  - For exposed lintels, sills, parapets, horizontal grooves and other conspicuous lines.
    - In any bay or 5 m maximum - 5 mm
    - In 10m or more - 10 mm
  - 3. Variation of the linear building lines from established position in plan and related position of columns, wall and partitions.
    - In any bay or 5 m maximum - 10 mm
    - In 10 m or more - 20 mm
  - 4. Variation in the sizes and locations of sleeves, openings in walls and floors 5 mm except in the case of anchor bolts.
  - 5. Variation in cross-sectional dimensions of columns and beams and in the thickness of slabs and walls
    - Minus - 5 mm
    - Plus - 10 mm
  - 6. Footings
    - Variation in dimension in plans
      - Minus - 5 mm
      - Plus - 10 mm
    - Misplacement or eccentricity
      - 2% of footing width in the direction of misplacement but not more than 50 mm
      - Reduction in thickness
        - Minus - 5% of specified thickness subject to a maximum of 50 mm.
    - Variation in steps
      - In a flight of stairs : Rise - 3 mm; Tread - 5 mm
      - In consecutive steps: Rise - 1.5 mm; Tread - 3 mm
  - 3. Tolerances in other Concrete Structures
    - 1. All Structures
      - Variation of the constructed linear outline from established position in plan.
        - In 5 m - 10 mm
        - In 10 m or more - 15 mm
      - Variations of dimensions to individual structure features from established positions.
        - In 20 m or more - 25 mm
        - In buried construction - 50 mm
      - Variation from plumb, from specified batter or from curved surfaces of all structures.
        - In 2.5 m - 25 mm
        - In 10 m or more - 25 mm
        - In buried-construction - Twice the above amounts
      - Variation from level or grade indicated on Drawings in slab, beams, soffits, horizontal grooves and visible arises.
        - In 2.5 - 5 mm
        - In 7.5 m or more - 10 mm
        - In buried-construction - Twice the above amounts
      - Variation in cross-sectional dimensions of columns beams, buttresses, piers and similar members.
        - Minus - 5 mm

- Plus - 10 mm
- Variation in the thickness of slabs, walls, arch sections and similar members
  - Minus - 5 mm
  - Plus- - 10 mm
- 2. Footing for columns, piers, walls, buttresses and similar members
  - Variation of dimensions in plan
    - Minus - 10 mm
    - Plus - 50 mm
  - Misplacement or eccentricity  
2% of footing width in the direction of misplacement but not more than 50 mm.
  - Reduction in thickness  
5% of specified thickness subject to a max. of 50 mm.
- 4. Tolerances in other types of structures shall generally conform to those given in **Clause 2.4** of Recommended Practice for Concrete Formwork (ACI 347)
- 5. Tolerances in fixing anchor bolts shall be as follows:
  - 1. Anchor bolts without sleeves :  $\pm 1.5$  mm in plan
  - 2. Anchor bolts with sleeves :  $\pm 5.0$  mm in elevation
  - For bolts upto & including 28 mm diameter :  $\pm 5$  mm in all directions.
  - For bolts 32 mm diameter and above :  $\pm 3$  mm in all direction.
  - 4. Embedded parts :  $\pm 5$  mm in all direction.

#### 10.11.5 Type of formwork

- 1. Formwork may be of timber, plywood, metal, plastic or concrete. For special finishes the formwork may be lined with plywood, steel sheets, oil tempered hard board, etc. Sliding forms and slip forms may be used with the approval of Engineer.

#### 10.11.6 Formwork requirements

- 1. Forms shall conform to the shapes, lines, grades and dimensions including camber of the concrete as called for on the Drawings. Ample studs, walers, braces, ties, straps, shores, etc. shall be used to hold the forms in proper position without any distortion whatsoever until the concrete has set sufficiently to permit removal of the form. In special cases where form vibrators are to be used, the shuttering shall be close boarded. Timber shall be well seasoned, free from sap, shakes, loose knots, worm holes, warps or other surface defects in contact with concrete. Faces coming in contact with the concrete shall be free from adhering grout, plaster, paint, projecting nails, splits or other defects. Joints shall be sufficiently tight to prevent loss of water and fine material from concrete.
- 2. Plywood shall be used for Exposed Concrete surfaces; where called for. Sawn and wrought timber may be used for unexposed surfaces. Inside faces of forms for concrete surfaces which are to be rubbed finished shall be planned to remove irregularities or unevenness in the face. Formwork with linings will be permitted.
- 3. All new and used form lumber shall be maintained in a good condition with respect to shape, strength, rigidity, water tightness, smoothness and cleanliness of surfaces. Form lumber unsatisfactory in any respect shall not be used and; if rejected by Engineer, shall be removed from the site.

4. Shores supporting successive stories shall be placed directly over those below or be so designed and placed that the load will be transmitted directly on to them Truss supports shall be provided for shores that cannot be secured on adequate foundations.
5. Formwork, during any stage of construction showing signs of distortion or distorted to such a degree that the intended concrete work will not conform to the exact contours indicated on the Drawings, shall be repositioned and strengthened. Poured concrete affected by the faulty formwork, shall be removed in its entirety and the formwork corrected prior to placing new concrete.
6. Excessive construction camber to compensate for shrinkage settlement, etc. that may impair the structural strength of members will not be permitted.
7. Forms for substructure concrete may be omitted when, in the opinion of Engineer the open excavation is firm enough to act as the form. Such excavations shall be slightly larger than required by the Drawings to compensate for irregularities in excavation and to ensure the design requirements.
8. Forms shall be so designed and constructed that their removal will not damage the concrete. Face formwork shall provide true vertical and horizontal joints, conform to the architectural features of the structure as to location of joints and be as directed by Engineer.
9. Where Exposed smooth or rubbed concrete finishes are required, the forms shall be constructed with special care so that the resulting concrete surfaces require a minimum finish.

#### 10.11.7 Bracing, struts and props

1. Shuttering shall be braced, strutted, propped and so supported that it shall not deform under weight and pressure of the concrete and also due to the movement of men and other materials. Bamboo shall not be used as props or cross bearers.
2. The shuttering for beams and slabs shall be so erected that the shuttering on the sides of the beams and under the soffit of slabs can be removed without disturbing the beam bottoms. Repropping of beams shall not be done except when props have to be reinstated to take care of construction loads anticipated to be in excess of the design load. Vertical props shall be supported on wedges or other measures shall be take whereby the props can be gently lowered vertically while striking the shuttering.
3. If the shuttering for a column is erected for the full height of the column, one side shall be left open and built up in sections as placing of concrete proceeds, or windows may be left for pouring concrete from the sides to limit the drop of concrete to 1.0 M or as directed by Engineer.

#### 10.11.8 Mould oil

1. Care shall be taken to see that the faces of form-work coming in contact with concrete are perfectly cleaned and two coats of mould oil or any other approved materials applied before fixing reinforcement and placing concrete. Such coating shall be insoluble in water, non-staining and not injurious to the concrete. It shall not become flaky or be removed by rain or wash water. Reinforcement and / or other items to be cast in the concrete shall not be placed until coating of the forms is complete. Adjoining concrete surfaces shall also be protected against contamination from the coating materials.

10.11.9 Chamfers and fillets

1. All corners and angles exposed in the finished structure shall be formed with mouldings to form chamfers or fillets on the finished concrete. The standard dimensions of chamfers and fillets, unless otherwise specified, shall be 20 mm X 20 mm. Care shall be exercised to ensure accurate mouldings. The diagonal face of the moulding shall be planed or surfaced to the same texture as the forms to which it is attached.

10.11.10 Vertical construction joint chamfers

1. Vertical construction joints on faces which will be exposed at the completion of the work shall be chamfered as above except where not permitted by Engineer for structural or hydraulic reasons.

10.11.11 Wall ties

1. Wire ties passing through the walls shall not be allowed. In their place bolts passing through sleeves shall be used.

10.11.12 Reuse of forms

1. Before reuse, all forms shall be thoroughly scraped, cleaned, nails removed, holes that may leak suitably plugged and joints examined and when necessary, repaired and the inside retreated to prevent adhesion, to the satisfaction of Engineer. Warped lumber shall be resized. Contractor shall equip himself / herself with enough shuttering to complete the job in the stipulated time.

10.11.13 Removal of forms

1. Contractor shall record on the Drawing or on a special register the date upon which the concrete is placed in each part of the work and the date on which the shuttering is removed therefrom.
2. In no circumstances shall forms be struck until the concrete reaches a strength of at least twice the stress due to self weight and any construction / erection loading to which the concrete may be subjected at time of striking formwork.
3. Informal circumstances (generally where temperatures are above 20°C) forms may be struck after expiry of the following periods:

Item	Ordinary Portland cement concrete	Rapid hardening Portland cement concrete
1. Walls, columns and vertical sides of beams	24 to 48 hours or as directed by the Engineer	24 hours
2. Slabs (props left under).	3 days	2 days
3. Beam soffits (Props left under)	7 days	4 days
4. Removal of props to slabs: • Spanning upto 4.5 m • Spanning over 4.5 m	7 days 14 days	4 days 8 days
5. Removal of props to beams & arches: • Spanning upto 6 m. • Spanning over 6 m.	14 days 21 days	8 days. 12 days.

4. Striking shall be done slowly with utmost care to avoid damage to arises and projections and without shock or vibration, by gently easing the wedges. If after removing the formwork, it is found that timber has been embedded in the concrete, it shall be removed and made good as specified earlier.
5. Reinforced temporary openings shall be provided, as directed by Engineer, to facilitate removal of formwork which otherwise may be inaccessible.
6. Tie rods, clamps, form bolts, etc. which must be entirely removed from walls or similar structures shall be loosened neither sooner than 24 hours nor later than 40 hours after the concrete has been deposited. Ties, except those required to hold forms in place, may be removed at the same time. Ties, withdrawn from walls and grade beams shall be pulled toward the inside face. Cutting ties back from the faces of walls and grade beams will not be permitted.
7. For liquid retaining structures no sleeves for through bolts shall be used nor shall through bolts be removed as indicated in **Clause 9.11.13.6**. The bolts, in this case, shall be cut at 25 mm depth from the surface and then the hole shall be made good by sand cement mortar of the same proportions as the concrete just after striking the formwork.

#### **10.12 Foundation Bedding, Bonding and Jointing**

- 10.12.1 All surfaces upon or against which concrete will be placed shall be suitably prepared by thoroughly cleaning, washing and dewatering, as may be indicated in the plans or as Engineer, may direct, to meet the various situations encountered in the work.
- 10.12.2 Soft or spongy areas shall be cleaned out and back filled with either a soil-cement mixture, lean concrete or clean sand fill compacted to a minimum density of 90% Modified Proctor, unless otherwise mentioned in Schedule of Quantities.
- 10.12.3 Prior to construction of formwork for any item where soil will act as bottom form, approval shall be obtained from Engineer as to the suitability of the soil.
- 10.12.4 Preparation of rock strata of foundations
  1. To provide tight bond with rock foundations, the rock surface shall be prepared and the following general requirements shall be observed.
  2. Concrete shall not be deposited on large sloping rock surfaces. Where required by Engineer or as indicated on the plans, the rock shall be cut to form rough steps or benches to provide roughness or a more suitable bearing surface.
  3. Rock foundation stratum shall be prepared by picking, barring, wedging and similar methods which will leave the rock in an entirely sound and unshattered condition.
  4. Shortly before concrete is placed, the rock surface shall be cleaned with high pressure water and air jet even though it may have been previously cleaned in that manner.
  5. Prior to placing concrete, the rock surface shall be kept wet for a period of 2 to 4 hours unless otherwise directed by Engineer.
  6. Before placing concrete on work surfaces all water shall be removed from depressions to permit thorough inspection and proper bonding of the concrete to the rock.

10.12.5 Preparation of earth strata of foundations

1. All earth surfaces upon which or against which concrete is to be placed, shall be well compacted and free from standing water, mud or debris. Soft, yielding soil shall be removed and replaced with suitable earth well compacted as directed by Engineer. Where specified, lean concrete shall be provided on the earth stratum for receiving concrete. The surface of absorptive soils against which concrete is to be placed shall be moistened thoroughly so that no moisture will be drawn from the freshly placed concrete and later shall help to cure the concrete.

10.12.6 Preparation of concrete surfaces

1. The preparation of concrete surfaces upon which additional concrete is to be placed later, shall preferably be done by scarifying and cleaning while the concrete is between its initial and final set. This method shall be used wherever practicable and shall consist of cutting the surface with picks and stiff brooms and by use of an approved combination of air and water jet as directed by Engineer. Great care shall be taken in performing this work to avoid removal of too much mortar and the weakening of the surface by loosening of aggregate.
2. When it is not practicable to follow the above method, it will be necessary to employ air tools to remove laitance and roughen the surface.
3. The final required result shall be a pitted surface from which all dirt, unsound concrete, laitance and glazed mortar have been removed.

10.12.7 Bonding Treatment (Mortar)

1. After rock or concrete surfaces upon which new concrete is to be placed have been scarified, cleaned and wetted as specified herein, they shall receive a bonding treatment, immediately before placement of the concrete.
2. The bonding medium shall be a coat of cement-sand mortar. The mortar shall have the same cement-sand proportions as the concrete which shall be placed on it. The water-cement ratio shall be determined by placing conditions and as approved by Engineer.
3. Bonding mortar shall be placed in sufficient quantity to completely cover the surface about 10 mm thick for rock surface and about 5 mm thick for concrete surfaces. It shall be brushed or broomed over the surface and worked thoroughly into all cracks, crevices and depressions. Accumulations or puddles of mortar shall not be allowed to settle in depressions and shall be brushed out to a satisfactory degree, as determined by Engineer.
4. Mortar shall be placed at such a rate that it can be brushed over the surface just in advance of placement of concrete. Only as much area shall be covered with mortar as can be covered with concrete before initial set in the mortar takes place. The amount of mortar that will be permitted to be placed at any one time, on the area which it is to cover, shall be in accordance with Engineer's directions.

10.12.8 Cleaning and bonding formed construction joints

1. Vertical construction joints shall be cleaned as specified above or by other methods approved by Engineer. In placing concrete against formed construction joints, the surface of the joints, where accessible, shall be coated thoroughly with the specified bed-joint bonding mortar immediately before they are covered with concrete or by scrubbing with wire brooms dipped into the fresh

concrete. Where it is impracticable to apply such a mortar coating, special precautions shall be taken to ensure that the new concrete is brought into intimate contact with the surface of the joint by careful puddling and spading with aid of vibrators and suitable tools.

10.12.9 Expansion and contraction joints

1. Provision shall be made for expansion and contraction in concrete by use of special type joints at locations shown on the Drawing. Contraction joint surfaces shall be treated as per the Specifications on the Drawings or as directed by Engineer.

10.12.10 Hot weather requirement

1. All concrete work performed in hot weather shall be in accordance with IS: 456 except as herein modified.
2. Admixtures may be used only when approved by Engineer.
3. Adequate provisions shall be made to lower concrete temperatures by cool ingredients, eliminating excessive mixing, preventing exposure of mixers and conveyors to direct sunlight and the use of reflective paints on mixers, etc. The temperature of the freshly placed concrete shall not be permitted to exceed 38°C.
4. Consideration shall be given to shading aggregate stockpiles from direct rays of the sun and spraying stockpiles with water, use of cold water when available, and burying, insulating, shading and / or painting white the pipe lines and water storage tanks and conveyances.
5. In order to reduce loss of mixing water, the aggregates, wooded forms, subgrade, adjacent concrete and other moisture absorbing surfaces shall be well wetted prior to concreting. Placement and finishing shall be done as quickly as possible.
6. Extra precautions shall be taken for the protection and curing of concrete. Consideration shall be given to continuous water curing and protection against high temperatures and drying hot winds for a period of at least 7 days immediately after concrete has set and after which normal curing procedures may be resumed.

**10.13 Placing Concrete Underwater**

10.13.1 Under all ordinary conditions all foundations shall be completely dewatered and concrete placed in the dry. However, when concrete placement under water is necessary, all work shall conform to IS: 456 and the procedure shall be as described in the following paragraphs:

10.13.2 Method of placement

Concrete shall be deposited underwater by means of tremies, or drop bottom buckets of approved type.

10.13.3 Direction, Inspection and Approved

All work requiring placement of concrete underwater shall be designed, directed and inspected with due regard to local circumstances and purposes. All underwater concrete shall be placed according to the plans or Specifications and as directed and approved by Engineer.

## **10.14 Precast Concrete**

10.14.1 Precast concrete shall comply with IS: 456 and with the following requirements:

1. All precast units shall be cast on a suitable bed or platform with firm foundation and free from wind.
2. Contractor shall be responsible for the accuracy of the level or shape of the bed or platform. A suitable serial number and the date of casting shall be impressed or painted on each unit.

10.14.2 Striking forms

1. Side shutters shall not be struck in less than 24 hours after depositing concrete and no precast unit shall be lifted until the concrete reaches a strength of at least twice the stress to which the concrete may be subjected to at the time of lifting.

10.14.3 Precast units

1. The lifting and removal of precast units shall be undertaken without causing shock, vibration or undue bending. Contractor shall satisfy Engineer or his representative that the methods proposed to adopt for these operations will not over-stress or otherwise effect seriously the strength of the precast units. The reinforced side of the units shall be distinctly marked.

10.14.4 Curing

1. All precast work shall be protected from the direct rays of the sun for at least 7 days after casting and during that period each unit shall be kept constantly watered or preferably be completely immersed in water if the size of the unit so permits. Otherwise curing practice as given in **Clause 9.6.9** shall be followed.

## **10.15 Slots, Openings, etc.**

10.15.1 Slots, openings or holes, pockets etc. shall be provided in the concrete work in the positions indicated in the Drawings or as directed by Engineer. Any deviation from the approved Drawings shall be made good by Contractor at his own expense, without damaging any other work. Sleeves, bolts, inserts, etc. shall also be provided in concrete work where so specified.

## **10.16 Grouting**

10.16.1 Standard grout

1. Grout shall be provided as specified on the Drawings.
2. The proportions of grout shall be such as to produce a flowable mixture consistent with minimum water content and shrinkage. The grout proportions shall be limited as follows:



Use	Grout Thickness	Mix Proportions	Max W/C Ratio
Fluid Mix.	Under 25 mm	One part Portland Cement to one part sand.	0.44
General	25 mm and over but less than 50 mm.	One part Portland Cement to two parts of sand	0.53
Stiff Mix	50 mm and above.	One part Portland Cement to 3 parts of sand.	0.53

3. Sand

1. Sand shall be such, as to produce a flowable grout without any tendency to segregate.
  2. Sand, for general grouting purposes, shall be graded within the following limits:
 

Passing IS 2.36 mm sieve.	95 to 100%
Passing IS 2.18 mm sieve.	65 to 95%
Passing IS 300 micron sieve.	10 to 30%
Passing IS 150 micron sieve.	3 to 10%
  3. Sand for fluid grouts, shall have the fine material passing the 300 and 150 micron sieves at the upper limits Specified above.
  4. Sand, for stiff grouts, shall meet the usual grading Specifications for concrete.
4. Surfaces to be grouted shall be thoroughly roughened and cleaned of all foreign matter and latency.
  5. Anchor bolts, anchor bolt holes and the bottom of equipment and column base plates shall be cleaned of all oil, grease, dirt and loose material. The use of hot, strong caustic solution for this purpose will be permitted.
  6. Prior to grouting, the hardened concrete surfaces to be grouted shall be saturated with water.
  7. Water in anchor bolt holes shall be removed before grouting is started.
  8. Forms around base plates shall be reasonably tight to prevent leakage of the grout.
  9. Adequate clearance shall be provided between forms and base plate to permit grout to be worked properly into place.
  10. Grouting, once started, shall be done quickly and continuously to prevent segregation, bleeding and breakdown of initial set. Grout shall be worked from one side of one end to the other to prevent entrapment of air. To distribute the grout and to ensure more complete contact between base plate and foundation and to help release entrapped air, link chains can be used to work the grout into place.
  11. Grouting through holes in base plates shall be by pressure grouting.
  12. Variations in grout mixes and procedures shall be permitted if approved by Engineer.

10.16.2 Special grout

1. Special grout, where specified on the Drawings, shall be provided in strict accordance with the manufacturer's instructions / Specifications on the Drawings.

#### **10.17 Inspection**

- 10.17.1 All materials, workmanship and finished construction shall be subject to the continuous inspection and approval of Engineer.
- 10.17.2 All materials supplied by Contractor and all work or construction performed by Contractor rejected as not in conformance with the Specifications and Drawings, shall be immediately replaced at no additional expense to the Owner.
- 10.17.3 Approvals of any preliminary materials or phase or work shall in no way relieve the Contractor from the responsibility of supplying concrete and or producing finished concrete in accordance with the Specifications and Drawings.
- 10.17.4 All concrete shall be protected against damage until final acceptance by Engineer or his representative.

#### **10.18 Clean-up**

- 10.18.1 Upon the completion of concrete work, all forms, equipment, construction tools, protective coverings and any debris resulting from the work shall be removed from the premises.
- 10.18.2 All debris i.e. empty containers, scrap wood, etc. shall be removed to "dump" daily or as directed by Engineer.
- 10.18.3 The finished concrete surfaces shall be left in a clean condition satisfactory to Engineer.

#### **10.19 Measurement and Rate**

- 10.19.1 The cement concrete shall be measured in cubic meters. In reinforced concrete the volume occupied by the reinforcement shall not be deducted.
- 10.19.2 Any concrete used in excess of the theoretical dimensions as shown on the Drawings will not be paid for.
- 10.19.3 The unit rate for concrete work under various categories shall be all inclusive and no claims for extra payment on account of such items as leaving holes, embedding inserts, etc. shall be entertained unless separately provided for in the schedule of quantities. No extra claim shall also be entertained due to change in the number, position and / or dimensions of holes, slots or openings, sleeves, inserts or on account of any increased lift or scaffolding etc. All these factors should be taken into consideration while quoting the unit rates. Unless provided for in the Schedule of Quantities the rates shall also include fixing inserts in all concrete work, whenever required.
- 10.19.4 Payments of concrete will be made on the basis of unit rates quoted for the respective items in the schedule of quantities. No deduction in the concrete quantity will be made for reinforcements, inserts etc. and opening less than 1/20 of a sqm. in area where concrete is measured in sqm. and 1/150 cum. where concrete is measured in cum. Where no such deduction for concrete is made, payment for shuttering work provided for such holes, pockets, etc. will not be made. Similarly the unit rates for concrete work shall be inclusive or exclusive of shuttering as provided for in the schedule of quantities. Where formwork is paid for separately, it shall be very clearly understood that payment for form propping, scaffolding, etc. complete.

10.19.5 Payment for beams will be made for the quantity based on the depth being reckoned from the underside of the slabs and length measured as the clear distance between supports. Payment for columns shall be made for the quantity based on height reckoned upto the underside of slabs.

10.19.6 The unit rate for precast concrete members shall include formwork, mouldings, finishing, hoisting and setting in position including setting mortar, provision of lifting arrangement etc. complete. Only if reinforcement is used, it shall be measured and paid for separately under item rate.

## **10.20 Preparation of Mortars and its Grade**

### 10.20.1 Grade of Masonry Mortar

1. The grade of masonry mortar will be defined by its compressive strength in N/mm<sup>2</sup> at the age of 28 days as determined by the standard procedure detailed in IS: 2250-1981.

10.20.2 For proportioning the ingredients by volume, the conversion of weight into volume shall be made on the following basis:

1. Dry hydrated lime	700 kg/cum
2. Burnt Clay Pozzolana	860 kg/cum
3. Lime Pozzolana mixture	770 kg/cum
4. Coarse Sand (dry)	1280 kg/cum
5. Fine sand (dry)	1600 kg/cum
6. fly Ash	590 kg/cum

### 10.20.3 Lime Mortar

1. Lime mortar shall be prepared using lime putty obtained by slaking quick-lime or dry hydrated lime powder and sand with or without the addition of Pozzolana in the specified proportions.

#### 2. Proportioning

The ingredient in specified proportions shall be measured using boxes of suitable sizes. Sand and pozzolanic material shall be measured on basis of their dry volume.

#### 3. Lime Putty

Lime putty shall be prepared from quick lime which is quite fresh and in the form of lumps. For the preparation of lime putty, three large tanks shall be made, one tank shall be at a level higher than the other, so that the contents from the upper tank can flow into the lower tank by gravity. The tank at the higher level may be 50 cm deep and the other tanks may be 80 cm deep.

1. The lumps of quick lime for slaking shall be broken to size between 50 mm and 100 mm. Medium and slow slaking limes may be broken to size smaller than 50 mm for expeditious slaking. The tank at the higher level shall be cleaned of all unslaked stones of lime and other materials left over from previous slaking and filled to half the depth with water and sufficient quick lime added gradually to fill up the tank to about half the depth of water. Lime shall be added to water and not water to lime. Stirring and hoing shall be started at once, taking care that lime does not get exposed above water. The mix shall be stirred all through the slaking process and continued at least 5 minutes after the boiling has stopped, and as the mix thickens more water shall be added. The lime in a state of suspension shall then be allowed to flow through IS sieve designation 4.75 mm into the tank at the lower level., where it shall be kept standing for at least 72 hours. Water at top is removed leaving lime putty in the form of paste.

Lime putty so formed shall be kept wet till it is completely used. It can be stored without getting spoiled for a fortnight provided it is protected from drying out.

4. Mixing and Grinding

1. Using lime putty: Lime putty and sand in the specified proportion shall be mixed on a water tight platform or in trough. Specified Pozzolanic material may also be added in the required proportion if its use has been indicated. The mix can be put to use after grinding by the following methods:

- (i) Using power driven mobile roller pan mixer conforming to IS: 2438-1963 or as directed by the Engineer.
- (ii) Using manually driven or animal driven mortar mill where mortar shall be grounded by not less than 180 revolutions or, for a minimum of three house. The mortar shall be continuously raked and turned over during grinding particular from corners and sides. Water shall be added as required during grinding, so as to get a stiff plaster of necessary working consistency.

However, preference will be given to the method under Para (i) above.

2. Using lime powder: Where the mortar is to be made using dry hydrated lime powder, the mixing of ingredients shall be done in a mechanical mixer unless otherwise permitted by the Engineer in writing. After dry mixing is complete, just sufficient quantity of water shall be added to get mortar of required working consistency. The mortar shall be mixed at least for three minutes after the addition of water.
3. Where mechanical mixer is not available, the mixing may be allowed by manually operated mixer with the written order to the Engineer. The mixing time shall be suitably increased to get the mortar of working consistency.
4. The Engineer may, however, permit hand mixing at his discretion, taking into account the nature, magnitude and location of the work and practicability of the use of these machines etc., of where items involving small quantities are to be done or if, in his opinion the use of the mechanical mixers is not feasible. In cases, where mechanical mixers are not to be used, the Contractor shall take permission of the Engineer in writing before the commencement of work. The ingredients of the mortar which can be used within 30 minutes shall then be mixed dry on a watertight masonry platform or in troughs by hand mixing and then the mortar shall be kneaded back and forth for 10 to 15 minutes with the addition of required quantity of water to get mortar of necessary working consistency.

5. Precaution

Lime mortar shall be used as soon as possible after mixing or grinding. As a rule mortar shall be used on the day it is made. If eminently hydraulic lime (Class A) as present as an ingredient, the mortar shall be used within four hours after mixing or grinding in mortar mill or mixture. Lime mortar made with semi-hydraulic lime (Class B) or fat lime (Class C) and Pozzolana as ingredients shall be used within 36 hours of mixing or grinding and lime sand mortar within 72 hours. After the close of each day's work, mixing trough pans shall be thoroughly washed and cleaned. Lime mortar shall be kept damp with wet sack or by any other suitable means and shall on no account be allowed to dry.

#### 10.20.4 Cement Mortar

1. This shall be prepared by mixing cement and sand with or without the addition of Pozzolana as specified.

#### 2. Proportioning

Cement bag weighting 50 kg shall be taken as 0.035 cubic metre. Other ingredients in specified proportion shall be measured using boxes of size 40 X 35 X 25 cm. Sand shall be measured on the basis of its dry volume.

#### 3. Mixing

The mixing of mortar shall be done in mechanical mixers operated manually or by power as decide by Engineer. The Engineer may, however, permit hand mixing at his discretion taking into account the nature, magnitude and location of the work and practicability of the use of mechanical mixers or where item involving small quantities are to be done or if in his opinion the used of mechanical mixer is not to be used, the Contractor shall take permission of the Engineer in writing before the commencement of the work.

1. Mechanical Mixing: Cement and sand in the specified proportions shall be mixed dry thoroughly in a mixer. Water shall then be added gradually and wet mixing continued for at least three minutes. Only the required quantity of water shall be added which will produce mortar of workable consistency but not stiff paste. Only the quantity of mortar, which can be used within 30 minutes of its mixing shall be prepared at a time. Mixer shall be cleaned with water each time before suspending the work.

2. Hand Mixing: The measured quantity of sand shall be leveled on a clean masonry platform and cement bags emptied on top. The cement and sand shall be thoroughly mixed dry by being turned over and over, backwards and forwards, several times till the mixture is of a uniform colour. The quantity of dry mix which can be used within 30 minutes shall then be mixed in a masonry trough with just sufficient quantity of water to bring the mortar to a stiff plaster of necessary working consistency.

#### 4. Precautions

Mortar shall be used as soon as possible after mixing and before it begins to set, and in any case within half hour, after the water is added to the dry mixture.

#### 10.20.5 Cement Lime Mortar

1. This shall be prepared by mixing cement, lime putty/dry hydrated lime powder and sand in specified proportions. Mixing shall be done in a mechanical mixer (Operated manually or by power as decided by Engineer).

2. The Engineer may, however, permit hand mixing at his discretion, taking into account the nature, magnitude and location of the work and practicability of the use of mechanical mixers or where item involving small quantities are to be done or if in his opinion the use of mechanical mixer is not feasible. In case, where mechanical mixers are not to be used, the Contractor shall take permission of the Engineer in writing before the commencement of the work.

#### 3. Proportioning

Cement, lime putty/dry hydrated lime and sand shall be taken in specified proportions. Cement bag weighing 50 kg shall be taken as 0.035 cubic metre. Other ingredients in specified proportion shall be measured using boxes of size 40 x 35 x 25 cm. Sand shall be measured on the basis of its dry volume.

4. Mixing and Grinding

1. Mechanical Mixing: Lime putty and sand shall be mixed and ground in the manner described in **Clause 9.20.3.4.1(i)** before mixing the same with cement. In case where factory made dry hydrated lime powder is used, prior grinding of lime and sand is not necessary. In that case mixing may be done in one operation in mechanical mixer. Only quantity of this mixture which could be used within two hours of its mixing with cement, shall be taken out and mixed thoroughly with specified quantity of cement in mechanical mixer.
2. Hand Mixing: Cement and sand shall be mixed dry thoroughly on clean and water tight masonry platforms or in troughs. Lime putty shall be mixed with water to make mild of lime, which shall be added to the mixture of cement and sand. The mixture shall be kneaded back and forth for about 10 minutes with addition of milk of lime to obtain mortar to workable consistency.

5. Precautions

Mortar shall be used as soon as possible after mixing and maximum within two hours. Mortar unused for more than 2 hours shall be rejected and removed from the site of work. Mixture of lime putty and sand can be kept for 72 hours for preparation of lime cement mortar in respect of Class 'B' and 'C' lime and for six hours in case of Class 'A' lime provided it is kept damp and not allowed to dry.

**11 BRICK MASONRY**

**11.1 Description**

- 11.1.1 This work shall consist of construction of structures with bricks jointed together by cement mortar in accordance with the details shown on the Drawings or as approved by the Engineer.

**11.2 Applicable Codes**

- 11.2.1 The following Indian Standard Codes, unless otherwise specified herein, shall be applicable. In all cases, the latest revision of the codes shall be referred to:

IS - 1077	Specifications for common burnt clay building bricks
IS - 1200	Measurements for Building works
IS - 1725	Specifications for solid cement blocks used in general building construction
IS - 1905	Code of practice for structural safety of buildings: Masonry walls.
IS - 2116	Sand for masonry mortars
IS - 2180	Specification for heavy duty burnt clay building bricks
IS - 2185	Specification for concrete masonry units: Hollow and solid concrete blocks
IS - 2212	Code of practice for brick work
IS - 2222	Specification for burnt clay perforated building bricks
IS - 2691	Specification for burnt clay facing bricks
IS - 3115	Specification for lime based blocks
IS - 3414	Code of practice for design and installation of joints in buildings

IS - 3466	Specification for masonry cement
IS - 3861	Method of measurement of plinth, carpet and rentable areas of buildings.
IS - 3952	Specification for burnt clay hollow blocks for walls and partitions
IS - 4098	Specification for lime-pozzolana mixture
IS - 4139	Specification for sand lime bricks
IS - 4441	Code of practice for use of silicate type chemical resistant mortars.
IS - 4442	Code of practice for use of sulphur type chemical resistant mortars

11.2.2 Others I.S. Codes not specifically mentioned here but pertaining to the use of bricks for structural purposes form part of these Specifications.

### **11.3 Materials**

11.3.1 All materials to be used in the work shall confirm to the requirements laid down in Chapter 7.

### **11.4 Personnel**

11.4.1 Only trained personnel shall be employed for construction and supervision.

### **11.5 Cement Mortar**

11.5.1 Cement and sand shall be mixed in specified proportions given in the Drawings. Cement shall be proportioned by weight, taking the unit weight of cement as 1.44 tonne per cubic metre. Sand shall be proportioned by volume taking into account due allowance for bulking. All mortar shall be mixed with a minimum quantity of water to produce desired workability consistent with maximum density of mortar. The mix shall be clean and free from injurious type of soil/acid/alkali/organic matter or deleterious substances.

11.5.2 The mixing shall preferably be done in a mechanical mixer operated manually or by power. Hand mixing can be resorted to as long as uniform density of the mix and its strength are assured subject to prior approval of the Engineer. Where permitted, specific permission is to be given by the Engineer. Hand mixing operation shall be carried out on a clean water-tight platform, where cement and sand shall be first mixed dry in the required proportion by being turned over and over, backwards and forwards several times till the mixture is of uniform colour. Thereafter, minimum quantity of water shall be added to bring the mortar to the consistency of a stiff paste. The mortar shall be mixed for at least two minutes after addition of water.

11.5.3 Mortar shall be mixed only in such quantity as required for immediate use. The mix which has developed initial set shall not be used. Initial set of mortar with ordinary Portland Cement shall normally be considered to have taken place in 30 minutes after mixing. In case the mortar has stiffened during initial setting time because of evaporation of water, the same can be retempered by adding water as frequently as needed to restore the requisite consistency, but this re-tampering shall not be permitted after 30 minutes. Mortar unused for more than 30 minutes shall be rejected and removed from site of work.

### **11.6 Soaking of Bricks**

11.6.1 All bricks shall be thoroughly soaked in a tank filled with water for a minimum period of one hour prior to being laid. Soaked bricks shall be removed from the tank sufficiently in advance so that they are skin dry at the time of actual laying. Such soaked bricks shall be stacked on a clean place where they are not contaminated with dirt, earth, etc.

## **11.7 Joints**

- 11.7.1 The thickness of joints shall not exceed 10 mm. All joints on exposed faces shall be tooled to give concave finish.

## **11.8 Laying**

- 11.8.1 All brickwork shall be laid in an English bond, even and true to line, in accordance with the Drawing or as directed by the Engineer, plumb and level and all joints accurately kept. Half and cut bricks shall not be used except when necessary to complete the bond. Closer in such cases shall be cut to the required size and used near the ends of the walls. The bricks used at the face and also at the angles forming the junction of any two walls shall be selected whole bricks of uniform size, with true and rectangular faces.
- 11.8.2 All bricks shall be laid with frogs up on a full bed of mortar except in the case of tile bricks. Each brick shall be properly bedded as set in position by slightly pressing while laying, so that the mortar gets into all their surface pores to ensure proper adhesion. All head and side joints shall be completely filled by applying sufficient mortar to brick already placed and on brick to be placed. All joints shall be properly flushed and packed with mortar so that no hollow spaces are left. No bats or cut bricks shall be used except to obtain dimensions of the different courses for specified bonds or wherever a desired shape so requires.
- 11.8.3 The brick work shall be built in uniform layers, and for this purpose wooden straight edge with graduations indicating thickness of each course including joint shall be used. Corners and other advanced work shall be raked back. Brickwork shall be done true to plumb or in specified batter. All courses shall be laid truly horizontal and vertical joints shall be truly vertical. Vertical joints in alternate courses shall come directly one over the other. During construction, no part of work shall rise more than one metre above the general construction level, to avoid unequal settlement and improper jointing. Where this is not possible in the opinion of the Engineer, the works shall be raked back according to the bond (and not toothed) at an angle not steeper than 45 degrees with prior approval of the Engineer. Toothing may also be permitted where future extension is contemplated.
- 11.8.4 Before laying bricks in foundation, the foundation slab shall be thoroughly hacked, swept clean and wetted. A layer of mortar not less than 12 mm thick shall be spread on the surface of the foundation slab and the first course of bricks shall be laid.

## **11.9 Jointing Old and New Work**

- 11.9.1 Where fresh masonry is to join the masonry that is partially/entirely set, the exposed jointing surface of the set masonry shall be cleaned, roughened and wetted, so as to effect the best possible bond with the new work. All loose bricks and mortar or other material shall be removed.
- 11.9.2 In the case of vertical or inclined joints, it shall be further ensured that proper bond between the old and new masonry is obtained by interlocking the bricks. Any portion of the brickwork that has been completed shall remain undisturbed until thoroughly set.
- 11.9.3 In case of sharp corners specially in skew bridges, a flat cutback of 100 mm shall be provided so as to have proper and bonded laying of bricks.

## **11.10 Curing**

- 11.10.1 Green work shall be protected from rain by suitable covering and shall be kept constantly moist on all faces for a minimum period of seven days. Brick work carried out during the day shall be suitably



- marked indicating the date on which the work is done so as to keep a watch on the curing period. Top of the masonry work shall be left flooded with water at the close of the day. Watering may be done carefully so as not to disturb or wash out the green mortar.
- 11.10.2 During hot weather, all finished or partly completed work shall be covered or wetted in such a manner as will prevent rapid drying of the brickwork.
- 11.10.3 During the period of curing of brick work, it will be suitably protected from all damages. At the close of day's work or for other period of cessation, watering and curing shall have to be maintained. Should the mortar perish i.e., become dry, white or powdery, through neglect of curing, work shall be pulled down and rebuilt as directed by the Engineer. If any stains appear during watering, the same shall be removed from the face.
- 11.11 Scaffolding – Deleted**
- 11.12 Weep Holes - Deleted**
- 11.13 Equipment- Deleted**
- 11.14 Finishing of Surfaces - Deleted**
- 11.15 Acceptance of Work**
- 11.16 Measurements for Payment – Deleted**
- 11.17 Rate – Deleted**
- 12 STONE MASONRY**
- 12.1 Description**
- 12.1.1 This work shall consist of the construction of structures with stones jointed together by cement mortar in accordance with the details shown on the Drawings and these Specifications or as approved by the Engineer.
- 12.2 Materials**
- 12.2.1 All materials used in stone masonry shall conform to **Chapter 7** except cement mortar for stone masonry which shall conform to **Clause 10.5**.
- 12.3 Personnel**
- 12.3.1 Only trained personnel shall be employed for construction and supervision.
- 12.4 Type of Masonry**
- 12.4.1 The type of masonry used for structures shall be random masonry (coursed or uncoursed) or coursed rubble masonry (First sort.). However, for bridge work generally, course rubble stone masonry shall be used. The actual type of masonry used for different parts of structures shall be specified on the Drawings.
- 12.4.2 For facing work, ashlar masonry shall be used where indicated on the Drawings.

## **12.5 Construction Operations**

### **12.5.1 General Requirements**

1. The dressing of stone shall be as specified for individual type masonry work and it shall also conform to the general requirements of IS: 1597 and requirement for dressing of stone covered in IS: 1129. Other specific requirements are covered separately with respect to particular types of rubble stone work.

### **12.5.2 Laying**

1. The masonry work shall be laid to lines, levels, curves and shapes as shown in the plan. The height in each course shall be kept same and every stone shall be fine tooled on all beds joints and face full and true. The exposed faces shall be gauged out, grooved, regulated and sunk or plain moulded as the case may be. The faces of each stone between the draft be left rough as the stone comes from quarry except where sacrificial layer is to be provided or plastering is resorted to due to aggressive environment.
2. Stones shall be sufficiently wetted before laying to prevent absorption of water from mortar.
3. Stratified stones must be laid on their natural beds. All bed joints shall be normal to the pressure upon them.
4. Stones in the hearting shall be laid on their broadest face that gives a better opportunity to fill the spaces between stones.
5. The courses of the masonry shall ordinarily be pre-determined. They shall generally be of the same height. When there is to be variation in the height of courses, the larger courses are to be placed at lower levels, heights of courses decreasing gradually towards the top of the wall. The practice of placing loose mortar on the course and pouring water on it to fill the gaps in stones is not acceptable. Mortar may be fluid mixed thoroughly and then poured in the joints. No dry or hollow space shall be left anywhere in the masonry and each stone shall have all the embedded faces completely covered with mortar.
6. In tapered walls, the beds of the stones and the planes of course should be at right angles to the batter. In case of bridge piers with batter on both sides, the course shall be horizontal.
7. The bed which is to receive the stone shall be cleaned, wetted and covered with a layer of fresh mortar. All stones shall be laid full in mortar both in bed and vertical joints and settled carefully in place with a wooden mallet immediately on placement and solidly embedded in mortar before it has set. Clean chips and spalls shall be wedged into the mortar joints and bed wherever necessary to avoid thick beds or joints of mortar. When the foundation masonry is laid directly on rock, the face stones of the first course shall be dressed to fit into rock snugly when pressed down in the mortar bedding over the rock. No dry or hollow space shall be left anywhere in the masonry and each stone shall have all the embedded faces completely covered with mortar. For masonry works over rock, a leveling course of 100 mm thickness and in concrete M 15 shall be laid over rock and then stone masonry work shall be laid without foundation concrete block.
8. Face works and hearting shall be brought up evenly but the top of each course shall not be leveled up by the use of flat chips.

9. For sharp corners specially in skew bridges, through stones shall be used in order to avoid spalling of corners.
  10. In case any stone already set in mortar is disturbed or the joints broken, it shall be taken out without disturbing the adjoining stones and joints. Dry mortar and stones thoroughly cleaned from the joints and stones and the stones reset in fresh mortar. Attempt must never be made to slide one stone on top of another, freshly laid.
  11. Shaping and dressing shall be done before the stone is laid in the work. No dressing and hammering, which will loosen the masonry, will be allowed after it is once placed. All necessary chases for joggles, dowels and clamps should be formed before hand.
  12. Sufficient transverse bonds shall be provided by the use of bond stone extending from the front to the back of the wall and in case of thick wall from outside to the interior and vice versa. In the latter case, bond stones shall overlap each other in their arrangement.
  13. In case headers are not available, precast headers of M 15 concrete shall be used. Cast-insitu headers are not permitted.
  14. Stones shall break joint on the face for at least half the height of the course and the bond shall be carefully maintained throughout.
  15. In band work at all angle junctions of walls the stones at each alternate course shall be carried into each of the respective walls so as to unite the work thoroughly.
  16. The practice of building up thin faces tied with occasional through stones and filling up the middle with small stuff or even dry packing is not acceptable.
  17. All quoins and angles of the opening shall be made from selected stones, carefully squared and bedded and arranged to bond alternately long and short in both directions.
  18. All vertical joints shall be truly vertical. Vertical joints shall be staggered as far as possible. Distance between the nearer vertical joints of upper layer and lower shall not be less than half the height of the course.
  19. Only rectangular shaped bond stones or headers shall be used. Bond stones shall overlap each other by 150 mm or more.
  20. All connected masonry in a structure shall be carried up nearly at one uniform level throughout but when breaks are unavoidable the masonry shall be raked in sufficiently long steps to facilitate jointing of old and new work. The stepping of raking shall not be more than 45 degrees with the horizontal.
- 12.5.3 Random Masonry (Uncoursed and Coursed)
1. **Dressing:** Stone shall be hammer dressed on the face, the sides and beds to enable it to come in proximity with the neighboring stone. The bushing on the exposed face shall not be more than 40 mm.
  2. **Insertion of chips:** Chips and spalls of stone may be used wherever necessary to avoid thick mortar beds or joints and it shall be ensured that no hollow spaces are left anywhere in the masonry. The chips shall not be used below hearting stones to bring these upto the level of face

stones. Use of chips shall be restricted to filling of interstices between the adjacent stones in hearting and they shall not exceed 20 percent of the quantity of stone masonry.

3. **Hearting stones:** The hearting or interior filling of the wall face shall consist of rubble stones not less than 150 mm in any direction, carefully laid, hammered down with a wooden mallet into position and solidly bedded in mortar. The hearting should be laid nearly level with facing and backing.
4. **Bond stones:** Through bond stones shall be provided in masonry upto 600 mm thickness and in case of masonry above 600 mm thickness, a set of two or more bond stones overlapping each other at least by 150 mm shall be provided in a line from face to back. In case of highly absorbent types of stones (porous limestone and sandstones, etc.,) the bond stone shall extend only about two-third into the wall, as through stones in such cases may give rise to penetration of dampness and therefore, for all thicknesses of such masonry, a set of two or more bond stones overlapping each other by at least 150 mm shall be provided. One bond stones or a set of bond stones shall be provided for every 0.50 sq. m. of the masonry surface.
5. **Quoin stone:** Quoin stone i.e., stone specially selected and nearly dressed for forming an external angle in masonry work, shall not be less then 0.03 cubic metre in volume.
6. **Plum stone:** The plum stones are selected long stones embedded vertically in the interior of the masonry to form a bond between successive courses and shall be provided at about 900 mm intervals.
7. **Laying:** The masonry shall be laid with or without courses as specified. The quoin shall be laid header and stretcher alternately. Every stone shall be fitted to the adjacent stone so as to form neat and close joint. Face stone shall extend and bond well in the back. These shall be arranged to break joints, as much as possible, and to avoid long vertical lines of joints.
8. **Joints:** The face joints shall not be more than 20 mm thick, but shall be sufficiently thick to prevent stone-to-stone contact and shall be completely filled with mortar.

#### 12.5.4 Square Rubble - Coursed Ruble (First Sort)

1. **Dressing:** Face stones shall be hammer dressed on all beds and joints so as to give them rectangular shape. These shall be square on all joints and beds. The bed joints shall be chisel drafted for at least 80 mm back from the face and for at least 40 mm for the side joints. No portion of dressed surface shall show a depth of gap more than 6 mm from the straight edge placed on it. The remaining unexposed portion of the stone shall not project beyond the surface of bed and side joints. The requirements regarding bushing shall be the same as for random rubble masonry.
2. **Hearting stones:** The hearting or interior filling of the wall face shall consist of flat bedded stone carefully laid, on prepared beds in mortar. The use of chips shall be restricted to the filling of interstices between the adjacent stones in hearting and these shall not exceed 10 percent of the quantity of masonry. while using chips it shall be ensured that no hollow spaces are left anywhere in the masonry.
3. **Bond stones:** The requirements regarding through or bond stone shall be the same as for random rubble masonry, but these, shall be provided at 1.5 metre to 1.8 metre apart clear in every course.
4. **Quoin stone:** The quoins shall be of the same height of the course in which these occur and shall be formed of header stones not less than 450 mm in length. They shall be laid lengthwise

alternately along each face, square in their beds which shall be fairly dressed to a depth of at least 100 mm.

5. **Face stone:** face stones shall tail into the work for not less than their heights and at least one-third of the stones shall tail into the work for a length not less than twice their height. These shall be laid as headers and stretchers alternately.
6. **Laying:** The stones shall be laid on horizontal courses and all vertical joints should be truly vertical. The quoin stones should be laid header and stretcher alternately and shall be laid square on their beds, which shall be rough chisel dressed to a depth of at least 100 mm.
7. **Joints:** The face joints shall not be more than 10 mm thick, but shall be sufficiently thick to prevent stone-to-stone contact and shall be completely filled with mortar.

#### 12.5.5 Ashlar Masonry (Plain Ashlar)

1. **Dressing:** Every stone shall be cut to the required size and shape, chisel dressed on all beds and joints so as to be free from all bushing. Dressed surface shall not show a depth of gap of more than 3 mm from straight edge placed on it. The exposed faces and joints, 6 mm from the face shall be fine tooled so that a straight edge can be laid along the face of the stone in contact with every point. All visible angles and edges shall be true and square and free from chipping. The corner stones(quoins) shall be dressed square and corner shall be straight and vertical.
2. **Bond Stones:** Through bond stones shall be provided in masonry upto 600 mm thickness and in case of masonry above 600 mm thickness, a set of two or more bond stones overlapping each other at least by 150 mm shall be provided in a line from face to back. In case of highly absorbent types of stones (porous limestone and sandstones, etc.,) the bond stone shall extend only about two-third into the wall, as through stones in such cases may give rise to penetration of dampness and, therefore, for all thickness of such masonry a set of two or more bond stones overlapping each other by at least 150 mm shall be provided. One bond stone or a set of bonds tones shall be 1.5 metres to 1.8 metres apart clear in every course.
3. **Laying:** The face stone shall be laid header and stretcher alternately, the header being arranged to come as nearly as possible in the middle of stretchers above and below. Stones shall be laid in regular courses not less than 300 mm in height and all courses of the same height unless otherwise specified. No stone shall be less in width than its height or less in length than twice its height, unless otherwise specified.
4. **Joints:** All joints shall be full of mortar. These shall not less than 3 mm thick. Face joints shall be uniform throughout, and a uniform recess of 20 mm depth from face shall be left with the help of a stone plate during the progress of work.
5. **Pointing:** Pointing shall be carried out using mortar not leaner than 1:3 by volume of cement and sand or as shown on the Drawing. The mortar shall be filled and pressed into the raked out joints before giving the required finish. The pointing shall conform to **Clause 10.13.3** of the Specification. The work shall conform to IS: 2212. The thickness of joints shall not be less than 3 mm for Ashlar masonry. However, the maximum thickness of joints in different works shall be as follows:

Random Rubble	20 mm
Coursed Rubble	15 mm
Ashlar Masonry	5 mm

12.5.6 Curing

Curing shall conform to **Clauses 10.10** and **10.13.5**

12.5.7 Scaffolding

For scaffolding **Clause 10.11** shall apply.

12.5.8 Weep Holes

Weep holes shall conform to **Clause 2706** of MoST Specifications for Road and Bridge Works (IV Revision).

12.5.9 Joining with Existing Structures

For Jointing with existing structures, the Specifications given under **Clause 10.9** shall apply.

12.5.10 Architectural Coping For Wing/Return/Parapet Walls

Architectural coping for wing/return/parapet wall shall conform to **Clause 10.15**.

12.5.11 Tests and standard of acceptance

1. All work shall be done to the lines and levels as indicated on the Drawing or as directed by the Engineer subject to tolerances as specified in these Specifications.
2. Mortar cubes shall be taken in accordance with IS: 2250 for compressive strength, consistency of mortar and its water retentivity. The frequency of testing shall be one sample for every two cubic metres of mortar subject to a minimum 3 samples for a day's work.

**12.6 Measurement for Payment – Deleted**

**12.7 Rate - Deleted**

**13 FINISHING**

**13.1 Scope**

These Specifications cover the general requirements of different kinds of finishes.

**13.2 Applicable Codes**

IS: 16-1991 (Part:I)	Shellac:Part:I-Hand Made Shellac (3rd Revision).
IS: 16-1991 (Part:II)	Shellac:Part: II-Machine Made Shellac (3rd Revision)
IS: 75-1973	Linseed Oil, Raw and Refined (Reaffirmed 1990) (2nd Revision)
IS: 77-1976	Ready Mixed Paint, Brushing, Red Lead, Non setting, Priming (Reaffirmed 1991)(Revised)

IS: 102-1962	Specification for Ready Mixed Paint, Brushing, Zinc Chrome, Priming (Reaffirmed 1993) (2nd Revision)
IS: 104-1979	Ready Mixed Paint, brushing, priming Plaster to Indian Standard Colour No. 361, 631 White and off White (Reaffirmed 1993) (1st Revision)
IS: 109-1968	Ready Mixed Paint, Brushing, priming Plaster to Indian Standard Colour No. 361, 631 White and off White (Reaffirmed 1993) (1st Revision)
IS: 117-1964	Ready Mixed Paint, Brushing, Finishing Exterior, Semigloss for General Purposes to Indian Standards Colours (Reaffirmed 1988) (Revised)
IS: 133-1993	Enamel, Interior (a) Under Coating (b) Finishing (3rd Revision)
IS: 137-1965	Ready Mixed Paint, Brushing, Matt or Egg Shell Flat, Finishing Interior to Indian Standard Colour as required (Revised 1993)
IS: 158-1981	Ready Mixed Paint, Brushing, Bituminous Black, Lead Free, Acid, Alkali and Heat Resisting (Reaffirmed 1988) (3rd Revision)
IS: 217-1988	Specification for Cut Back Bitumen (2nd Revision)
IS: 218-1983	Specification for Creosote and Anthracene Oil for Use As Wood Preservatives (Reaffirmed 1990) (2nd Revision)
IS: 290-1961	Coal Tar Black Paint (Reaffirmed 1991) (1st Revision)
IS: 337-1975	Varnish, Finishing Interior (Reaffirmed 1991) (1st Revision)
IS: 341-1973	Black Japan, Types 'A', 'B' & 'C' (Reaffirmed 1991) (1st Revision)
IS: 345-1952	Wood Filter, Transparent - Liquid (withdrawn)
IS: 347-1975	Varnish, Shellac for General Purposes (Reaffirmed 1991) (1st Revision)
IS: 348-1968	French Polish (Reaffirmed 1991) (1st Revision)
IS: 419-1967	Putty for Use On Window Frames (Reaffirmed 1992) (1st Revision)
IS: 427-1965	Distemper, Dry Colour as Required (Reaffirmed 1993) (Revised)
IS: 428-1969	Distemper, Oil Emulsion, Colour as Required (Reaffirmed 1993) (1st Revision)
IS: 524-1983	Varnish, Finishing, Exterior, Synthetic Air Drying (Reaffirmed 1990) (2nd Edition)
IS: 533-1973	Gum Spirit of Turpentine (Oil of Turpentine) (Reaffirmed 1990) (1st Revision)
IS: 712-1984	Specification for Building Limes (Reaffirmed 1991) (3rd Revision)
IS: 1200-1976 (Part:XII)	Method of Measurements of Building and Civil Engineering Works: Part:XII-Plastering and Pointing (Reaffirmed 1992) (3rd Revision)
IS: 1200-1987	Method of Measurements of Building and Civil Engineering Works:
IS: 1200-1994 (Part:XIII)	Method of Measurements of Building and Civil Engineering Works: Part 13 White Washing, Colour Washing Distempering and

	Painting of Building surfaces. (5th Revision)
IS: 1200-1987 (Part:XV)	Method of Measurements of Building and Civil Engineering Works: Part:XV-Painting Polishing, Varnishing etc. (Reaffirmed 1992) (4th Revision)
IS: 2339-1963	Aluminum Paint for General Purposes, In Dual Container (Reaffirmed 1993)
IS: 2932-1994	Enamel, Synthetic, Exterior (a) Undercoating, (b) Finishing (2nd Revision)
IS: 2933-1975	Enamel, Exterior (a) Undercoating (b) Finishing (Reaffirmed 1991) (1st Revision)
IS: 5410-1992	Cement Paint (1st Revision)
IS: 5411-1974 (Part:I)	Plastic Emulsion: Paint Part I for Interior Use (Reaffirmed 1991) (1st Revision)
IS: 6278-1971	Code of Practice for White Washing and Colour Washing (Reaffirmed 1991).

- 13.3 **12 mm Lime Plaster** – Deleted
- 13.4 **15 mm Thick Lime Plaster** – Deleted
- 13.5 **Cement Plastering** - Deleted
- 13.6 **Cement Plaster with a Floating Coat of Neat Cement** - Deleted
- 13.7 **6 mm Cement Plaster on Cement Concrete and Reinforced Cement Concrete Work** - Deleted
- 13.8 **6 mm Cement Plaster on top of wall for Slab Bearing** - Deleted
- 13.9 **Neat Cement Punning** - Deleted
- 13.10 **Rough Cast Plaster** - Deleted
- 13.11 **18 mm Plastering with Terrazzo Finish** - Deleted
- 13.12 **Plain Bands of Cement Mortar** - Deleted
- 13.13 **Cement Water Proofing Compound** - Deleted
- 13.14 **White Washing with Lime** - Deleted
- 13.15 **Satna Lime Washing** - Deleted
- 13.16 **Colour Washing** - Deleted
- 13.17 **Dry Distempering** - Deleted
- 13.18 **Oil Emulsion (Oil Bound) Washable Distempering** - Deleted
- 13.19 **Cement Primer Coat** - Deleted



**13.20 Cement Paint - Deleted**

**13.21 Painting**

13.21.1 Materials

1. Paints, oils varnishes etc. of approved brand and manufacture shall be used. Only ready mixed paint (exterior grade) as received from the manufacturer without any admixture shall be used.
2. If for any reason, thinning is necessary in case of ready mixed paint, the brand of thinner recommended by the manufacturer or as instructed by the Engineer shall be used.
3. Approved paints, oil or varnishes shall be brought to the site of work by the Contractor in their original containers in sealed condition. The material shall be brought in at a time in adequate quantities to suffice for the whole work or at least of fortnight's work. The empties shall not be removed from the site of work till the relevant item of work has been completed and permission obtained from the Engineer.

13.21.2 Commencing Work

1. Painting shall not be started until the Engineer has inspected the items of work to be painted satisfied himself about their proper quality and given his approval to commence the painting work. Painting of external surface should not be done in adverse weather condition like hail storm and dust storm.
2. Painting, except the priming coat, shall generally be taken in hand after practically finishing all other building work.
3. The room should be thoroughly swept out and the entire building cleaned up, at least one day in advance of the paint work being started.

13.21.3 Preparation of Surface

1. The surface shall be thoroughly cleaned and dusted off. All rust, dirt, scales, smoke splashes, mortar droppings and grease shall be thoroughly removed before painting is started. The prepared surface shall have received the approval of the Engineer after inspection, before painting is commenced.

13.21.4 Application

1. Before pouring into smaller containers for use, the paint shall be stirred thoroughly in its containers, when applying also, the paint shall be continuously stirred in the smaller containers so that its consistency is kept uniform.
2. The painting shall be laid on evenly and smoothly by means of crossing and laying off, the latter in the direction of the grains of wood. The crossing and laying off consists of covering the area over with paint, brushing the surface hard for the first time over and then brushing alternately in opposite direction, two or three times and then finally brushing lightly in a direction at right angles to the same. In this process, no brush marks shall be left after the laying off is finished. The full process of crossing and laying off will constitute one coat.

3. Where so stipulated, the painting shall be done by spraying. Spray machine used may be (a) high pressure (small air aperture) type, or (b) a low pressure (large air gap) type, depending on the nature and location of work to be carried out. Skilled and experienced workmen shall be brought to the requisite consistency by adding a suitable thinner.
4. Spraying should be done only when dry condition prevails. Each coat shall be allowed to dry out thoroughly and rubbed smooth before the next coat is applied. This should be facilitated by thorough ventilation. Each coat except the last coat, shall be lightly rubbed down with sand paper or fine pumice stone and dust cleaned off before the next coat is laid.
5. No left over paint shall be put back into the stock tins. When not in use, the containers shall be kept properly closed.
6. No hair marks from the brush or clogging of paint puddles in the corners of panels, angles of mouldings etc. Shall be left on the work.
7. In painting doors and windows, the putty round the glass panes must also be painted but care must be taken to see that no paint stains etc. are left on the glass. Tops of shutters and surfaces in similar hidden locations shall not be left out in painting. However, bottom edge of the shutters where the painting is not practically possible, need not be done nor any deduction on this account will be done but two coats of primer of approved make shall be done on the bottom edge before fixing the shutters.
8. On painting steel work, special care shall be taken while painting over bolts, nuts, rivets overlaps etc.
9. The additional Specifications for primer and other costs of paints shall be as according to the detailed Specifications under the respective headings.

13.21.5 Brushes and Containers

1. After work, the brushes shall be completely cleaned of paint and linseed oil by rinsing with turpentine. A brush in which paint has dried up is ruined and shall on no account be used for painting work. The containers when not in use, shall be kept closed and free from air so that paint does not thicken and also shall be kept safe from dust. When the paint has been used, the containers shall be washed with turpentine and wiped dry with soft clean cloth, so that they are clean, and can be used again.

13.21.6 Measurements – Deleted

13.21.7 Rate – Deleted

**13.22 Painting Priming Coat on Wood, Iron or Plastered Surfaces – Deleted**

**13.23 Painting with Ready Mixed Paint – Deleted**

**13.24 Painting Ready Mixed Paint over G.S. Sheets – Deleted**

**13.25 Painting Cast Iron Rain Water, Soil, Waste and Vent Pipes and Fittings – Deleted**

**13.26 Painting with Wood Preservative – Deleted**

**13.27 Coal Tarring – Deleted**

**13.28 Wall Painting with Plastic Emulsion Paint – Deleted**

**13.29 Painting with Enamel Paint – Deleted**

**13.30 Painting with Synthetic Enamel Paint**

13.30.1 Synthetic enamel paint (confirming to IS: 2932) of approved brand and manufacture and of the required colour shall be used for the top coat and an undercoat of ordinary paint of shade to match top coat as recommended by the same manufacture as for the top coat shall be used.

13.30.2 Painting of New Surface

1. Preparation of surface shall be as specified in **Clause 12.23.3**.

2. Application

The number of coats including the undercoat shall be as stipulated in the item.

3. Under Coat

One coat of the specified ordinary paint of shade suited to the shade of the top coat, shall be applied and allowed to dry overnight. It shall be rubbed next day with the finest grade of wet abrasive paper to ensure a smooth and even surface, free from brush marks and all loose particles dusted off.

4. Top Coat

Top coats of synthetic enamel paint of desired shade shall be applied after the undercoat is thoroughly dry. Additional finishing coats shall be applied if found necessary to ensure properly uniform glossy surface.

5. Other details shall be as specified in **Clause 12.21** as far as they are applicable.

**13.31 Painting with Aluminium Paint – Deleted**

**13.32 Painting with Acid Proof Paint – Deleted**

**13.33 Painting with Anti-Corrosive Bitumastic Paint**

13.33.1 Ready mixed paint (conforming to IS: 158-1981) shall be of approved brand and manufacture. It shall be black, lead free, acid-alkali-heat-water resistant.

13.33.2 Preparation of surface and application shall be as specified in **Clause 12.23** for painting on new or old surfaces as the case may be.

13.33.3 The drying time between consecutive coats, however, shall be not less than 3 hours.

13.33.4 Other details shall be as specified in **Clause 12.21** as far as applicable.

**13.34 Varnishing – Deleted**

**13.35 French Spirit Polishing – Deleted**

### **13.36 Lettering with Paint**

13.36.1 Black Japan paint (conforming to IS: 341) or ready mixed paint as ordered by the Engineer shall be used. The paint shall be of approved brand and manufacture. Ordinary ready mixed paint shall be of the shade required by the Engineer.

13.36.2 Lettering on New Surface

1. Application

1. The letters and figures shall be to the heights and width as ordered by the Engineer. These shall be stenciled or drawn in pencil and got approved before painting. They shall be of uniform size and finished neatly. The edges shall be straight or in pleasant smooth curves. The thickness of the lettering shall be as approved by the Engineer. Lettering shall be vertical or slanting as required.
2. Two or more coats of paint shall be applied till uniform colour and glossy finish are obtained.

2. Measurements – Deleted

3. Rate – Deleted

## **14 ROADS AND PAVEMENTS**

### **14.1 Granular Sub-Base**

14.1.1 Scope

1. This work shall consist of laying and compacting well-graded material on prepared subgrade in accordance with the requirements of these Specifications. The material shall be laid in one or more layers as sub-base or lower sub-base and upper sub-base (termed as sub-base hereinafter) as necessary according to lines, grades and cross-sections shown on the Drawings or as directed by the Engineer.

14.1.2 Materials

1. The material to be used for the work shall be natural sand, moorum, gravel, crushed stone, or combination thereof depending upon the grading required. Materials like crushed slag, crushed concrete, brick metal and kankar may be allowed only with the specific approval of the Engineer. The material shall be free from organic or other deleterious constituents and conform to one of the three gradings given in Table 13-1.
2. While the grading in Table 13-1 are in respect of close-graded granular sub-base materials, one each for maximum particle size of 75 mm, 53 mm and 26.5 mm, the corresponding gradings for the coarse-graded materials for each of the three maximum particle sizes are given at Table 13-2. The grading to be adopted for a project shall be as specified in the Contract.
3. Physical requirements

14.1.2.3.1 The material shall have a 10 percent fineness value of 50 kN or more (for sample in soaked condition) when tested in compliance with BS: 812 (Part III). The water absorption value of the coarse aggregate shall be determined as per IS: 2386 (Part 3);; if

this value is greater than 2 percent, the soundness test shall be carried out on the material delivered to site as per IS: 383. For Grading II and III materials, the CBR shall be determined at the density and moisture content likely to be developed in equilibrium conditions which shall be taken as being the density relating to a uniform air voids content of 5 per cent.

**Table 13-1. Grading for Close-Graded Granular Sub-Base Materials**

IS sieve Designation	Per cent by weight passing the IS sieve		
	Grade I	Grading II	Grading III
75.0 mm	100	-	-
53.0 mm	80-100	100	-
26.5 mm	55-90	70-100	100
9.50 mm	35-65	50-80	65-95
4.75 mm	25-55	40-65	50-80
2.36 mm	20-40	30-50	40-65
0.425 mm	10-25	15-25	20-35
0.075 mm	3-10	3-10	3-10
CBR Value (Minimum)	30	25	20

**Table 13-2. Grading for Coarse Graded Granular Sub-Base Materials**

IS Sieve Designation	Percent by weight passing the IS Sieve		
	Grading I	Grading II	Grading III
75.00 mm	100	-	-
53.0 mm		100	
26.5 mm	55-75	50-80	100
9.50 mm			
4.75 mm	10-30	15-35	25-45
2.36 mm			
0.425 mm			
0.075 mm	< 10	< 10	< 10
CBR Value (Minimum)	30	25	20

*Note: The material passing 425 micron (0.425 mm) sieve for all the three gradings when tested according to IS: 2720 (Part 5) shall have liquid limit and plasticity index not more than 25 and 6 per cent respectively.*

#### 14.1.3 Strength of Sub-base

1. It shall be ensured prior to actual execution that the material to be used in the sub-base satisfies the requirements of CBR and other physical requirements when compacted and finished.
2. When directed by the Engineer, this shall be verified by performing CBR tests in the laboratory as required on specimens remoulded at field dry density and moisture content and any other tests for the "quality" of materials, as may be necessary.

#### 14.1.4 Construction Operations

##### 1. Preparation of subgrade

14.1.4.1.1 Immediately prior to the laying of sub-base, the subgrade already finished to applicable **Clauses of Chapter 5** shall be prepared by removing all vegetation and other extraneous matter, lightly sprinkled with water if necessary and rolled with two passes of 80-100 kN smooth wheeled roller.

##### 2. Spreading and compacting

14.1.4.2.1 The sub-base material of grading specified in the Contract shall be spread on the prepared subgrade with the help of mortar grade of adequate capacity, its blade having hydraulic controls suitable for initial adjustment and for maintaining the required slope and grade during the operation or other means as approved by the Engineer.

3. When the sub-base materials consists of combination of materials mentioned in **Clause 13.1.2**, mixing shall be done mechanically by the mix-in-place method.
4. Manual mixing shall be permitted only where the width of laying is not adequate for mechanical operations, as in small-sized jobs. The equipment used for mix-in-place construction shall be a rotavator or similar approved equipment capable of mixing the material to the desired degree. If so desired by the Engineer, trial runs with the equipment shall be carried out to establish its suitability for the work.
5. Moisture content of loose material shall be checked in accordance with IS: 2720 (Part 2) and suitably adjusted by sprinkling additional water from a truck mounted or trailer mounted water tank and suitable for applying water uniformly and at controlled quantities to variable widths of surface or other means approved by the Engineer so that, at the time of compaction, it is from 1 per cent above to 2 per cent below the optimum moisture content corresponding to IS: 2720 (Part 8). While adding water, due allowance shall be made for evaporation losses. After water has been added, the material shall be processed by mechanical or other approved means like disc harrows, rotavators until the layer is uniformly wet.
6. Immediately thereafter, rolling shall start. If the thickness of the compacted layer does not exceed 100 mm, a smooth wheeled roller of 80 to 100 kN weight may be used. For a compacted single layer upto 225 mm, the compaction shall be done with the help of vibratory roller of minimum 80 to 100 kN static weight with plain drum or pad foot drum or heavy pneumatic tyred roller of minimum 200 to 300 kN weight having a minimum tyre pressure of 0.7 MN/m<sup>2</sup> or equivalent capacity roller capable of achieving the required compaction. Rolling shall commence at the lower edge and

proceed towards the upper edge longitudinally for portions having unidirectional crossfall and super elevation and shall commence at the edges and progress towards the centre for portions having crossfall on both sides.

7. Each pass of the roller shall uniformly overlap not less than one-third of the track made in the preceding pass. During rolling, the grade and crossfall (camber) shall be checked and any high spots or depressions which become apparent, corrected by removing or adding fresh material. The speed of the roller shall not exceed 5 km per hour.
8. Rolling shall be continued till the density achieved is at least 98 per cent of the maximum dry density for the material determined as per IS: 2720 (Part 8). The surface of any layer of material on completion of compaction shall be well closed, free from movement under compaction equipment and from compaction planes, ridges, cracks or loose material. All loose, segregated or otherwise defective areas shall be made good to the full thickness of layer and re-compacted.

#### 14.1.5 Surface Finish and Quality Control of Work

1. The surface finish of construction shall conform to the requirements of **Section 902** of MoST Specifications for Road and Bridge Works (IV Revision).
2. Control on the quality of materials and works shall be exercised by the Engineer in accordance with **Section 900** of MoST Specifications for Road and Bridge Works (IV Revision).

#### 14.1.6 Arrangement for Traffic

1. During the period of construction, the arrangement of traffic shall be done as per **Clause 1.9.2**.

#### 14.1.7 Measurements for Payment

1. Granular sub-base shall be measured as finished work in position in cubic metres.
2. The protection of edges granular sub-base extended over the full formation as shown in the Drawing shall be considered incidental to the work of providing granular sub-base and as such not extra payment shall be made for the same.

#### 14.1.8 Rate

1. The contract unit rate for granular sub-base shall be payment in full for carrying out the required operations including full compensation for:
  1. Making arrangements for traffic to **Clause 1.9.2** except for initial treatment to verges, shoulders and construction of diversions;
  2. Furnishing all materials to be incorporated in the work including all royalties, fees, rents where necessary and all leads and life;
  3. All labour; tools, equipment and incidentals to complete the work to the Specifications;
  4. Carrying out the work in part widths of road where directed; and
  5. Carrying out the required tests for quality control.

### 14.2 Water Bound Macadam Sub-Bas/Base

#### 14.2.1 Scope

1. This work shall consist of clean, crushed aggregates mechanically interlocked by rolling and bonding together with screening, binding material where necessary and water laid on a properly

prepared subgrade/sub-base/base or existing pavement, as the case may be and finished in accordance with the requirements of these Specifications and in close conformity with the lines, grades, cross-sections and thickness as per approved plans or as directed by the Engineer.

2. It is, however, not desirable to lay water bound macadam on an existing thin black topped surface without providing adequate drainage facility for water that would get accumulated at the interface of existing bituminous surface and water bound macadam.

#### 14.2.2 Materials

1. Coarse aggregates

14.2.2.1.1 Coarse aggregates shall be either crushed or broken stone, crushed slag, overburnt (Jhama) brick aggregate or any other naturally occurring aggregates such as kankar and laterite of suitable quality. Material other than crushed or broken stone and crushed slag shall be used in sub-base courses only. If crushed gravel/shingle is used, not less than 90 per cent by weight of the gravel, shingle pieces retained on 4.75 mm sieve shall have at least two fractured faces. The aggregates shall conform to the physical requirements set forth in Table 13-3. The type and size range of the aggregate shall be specified in the Contract or shall be as specified by the Engineer. If the water adsorption value of the coarse aggregate is greater than 2 percent, the soundness test shall be carried out on the material delivered to site as per IS: 2386 (Part 5).

2. Crushed or broken stone

14.2.2.2.1 The crushed or broken stone shall be hard, durable and free from excess flat, elongated, soft and disintegrated particles, dirt and other deleterious material.

**Table 13-3: Physical Requirements of Coarse Aggregates for Water Bound Macadam for Sub-Base/Base Courses**

Sr.	Test	Test Method	Requirements
1.	* Los Angeles Abrasion Value or ** Aggregate Impact value	IS: 2386 (Part -4) IS: 2386 (Part-4) or IS: 5640**	40 per cent (Max.) 30 per cent (Max.)
2.	Combined Flakiness and Elongation Indices (total)***	IS: 2386 (Part-1)	30 per cent (Max.)

\* Aggregate may satisfy requirements of either of the two tests.

\*\* Aggregates like brick metal, kankar, laterite etc. Which get softened in presence of water shall be tested for impact value under wet conditions in accordance with IS: 5640

\*\*\* The requirement of flakiness index and elongation index shall be enforced only in the case of crushed broken stone and crushed slag

#### 14.2.2.3 Crushed slag

14.2.2.3.1 Crushed slag shall be made from air-cooled blast furnace slag. It shall be of angular shape, reasonably uniform in quality and density and generally free from thin, elongated and soft pieces, dirt or other deleterious materials. The weight of crushed slag shall not be less than 11.2 kN per m<sup>3</sup> and the percentage of glossy material shall not be more than 20. It should also comply with the following requirements:



1. Chemical stability : To comply with requirements of appendix of BS:1047
2. Sulphur content : Maximum 2 per cent
3. Water absorption : Maximum 10 per cent

#### 14.2.2.4 Overburnt (Jhama) brick aggregates

14.2.2.4.1 Jhama brick aggregates shall be made from overburnt bricks or brick bats and be free from dust and other objectionable and deleterious materials.

#### 14.2.2.5 Grading requirement of coarse aggregates

14.2.2.5.1 The coarse aggregates shall conform to one of the Gradings given in Table 13-4 as specified, provided, however, the use of Grading No. 1 shall be restricted to sub-base courses only.

**Table 13-4, Grading Requirements of Coarse Aggregates**

Grading No.	Size Range	IS Sieve Designation	Per cent by weight passing
1.	90 mm to 45 mm	125 mm	100
		90 mm	90-100
		63 mm	25-60
		45 mm	0-15
		22.4 mm	0-5
2.	63 mm to 45 mm	90 mm	100
		63 mm	90-100
		53 mm	25-75
		45 mm	0-15
		22.4 mm	0-5
3.	53 mm to 22.4 mm	63 mm	100
		53 mm	95-100
		45 mm	65-90
		22.4 mm	0-10
		11.2 mm	0-5

*Note: The compacted thickness for a layer with Grading 1 shall be 100 mm while for layer with other Gradings i.e., 2 & 3, it shall be 75 mm.*

#### 14.2.2.6 Screenings

14.2.2.6.1 Screenings to fill voids in the coarse aggregate shall generally consist of the same material as the coarse aggregate. However, where permitted, predominantly non-plastic material such as moorum or gravel (Other than rounded river borne material) may be used for this purpose provided liquid limit and plasticity index of such material are below 20 and 6 respectively and fraction passing 75 micron sieve does not exceed 10 per cent.

14.2.2.6.2 Screenings shall conform to the grading set forth in Table 13-5. The consolidated details of quantity of screenings required for various grades of stone aggregates are given in Table 136. The table also gives the quantities of materials (loose) required for 10 m<sup>2</sup> for subbase/base compacted thickness of 100/75 mm.

14.2.2.6.3 The use of screenings shall be omitted in the case of soft aggregates such as brick metal, kankar, laterites, etc. As they are likely to get crushed to a certain extent under rollers.

**Table 13-5: Grading for Screenings**

Grading Classification	Size of Screenings	IS Sieve Designation	Percent by weight passing the IS Sieve
A	13.2 mm	13.2 mm	100
		11.2 mm	95-100
		5.6 mm	15-35
		180 micron	0-10
B	11.2 mm	11.2 mm	100
		5.6 mm	90-100
		180 mm	15-35

**Table 13-6: Approximate Quantities of Coarse Aggregates and Screenings Required for 100/75 mm Compacted Thickness of Water Bound Macadam (WBM) Sub-Base /Base Course for 10m<sup>2</sup> Area**

Classification	Size Range	Compacted thickness	Loose Qty.	Screenings			
				Stone Screening		Crushable Type such as Moorum or Gravel	
				Grading Classification & size	For. WBM Sub-base/base course (Loose quantity)	Grading Classification & size	Loose Qty.
Grading 1	90 mm to 45 mm	100 mm	1.21 to 1.43 m <sup>3</sup>	Type A 13.2 mm	0.27 to 0.30 m <sup>3</sup>	Not uniform	0.30 to 0.32 m <sup>3</sup>
Grading 2	63 mm to 45 mm	75 mm	0.91 to 1.07 m <sup>3</sup>	Type A 13.2 mm	0.12 to 0.15 m <sup>3</sup>	-do-	0.22 to 0.24 m <sup>3</sup>
-do-	-do-	-do-	-do-	Type B 11.2 mm	0.20 to 0.22 m <sup>3</sup>	-do-	-do-
Grading 3	53 mm to 22.4 mm	75 mm	-do-	-do-	0.18 to 0.21 m <sup>3</sup>	-do-	-do-

#### 14.2.2.7 Binding material

- 14.2.2.7.1 Binding material to be used for water bound macadam as a filler material meant for preventing ravelling, shall comprise of a suitable material approved by the Engineer having a Plasticity Index (PI) value of less than 6 as determined in accordance with IS: 2720 (Part-5).
- 14.2.2.7.2 The quantity of binding material where it is to be used, will depend on the type of screenings. Generally, the quantity required for 75 mm compacted thickness of water bound macadam will be 0.06-0.09 m<sup>3</sup>/10m<sup>2</sup> and 0.08-0.10m<sup>3</sup>/10m<sup>2</sup> for 100 mm compacted thickness.
- 14.2.2.7.3 The above mentioned quantities should be taken as a guide only, for estimation of quantities of construction etc.
- 14.2.2.7.4 Application of binding materials may not be necessary when the screenings used are of crushable type such as moorum or gravel.

#### 14.2.3 Construction Operations

##### 14.2.3.1 Preparation of base

- 14.2.3.1.1 The surface of the subgrade/sub-base/base to receive the water bound macadam course shall be prepared to the specified lines and crossfall (camber) and made free of dust and other extraneous material. Any ruts or soft yielding places shall be corrected in an approved manner and rolled until firm surface is obtained if necessary by sprinkling water. Any subbase/base/surface irregularities, where predominant, shall be made good by providing appropriate type of profile corrective course (leveling course) to **Clause 13.4** of these Specifications.
- 14.2.3.2 As far as possible, laying water bound macadam course over an existing thick bituminous layer may be avoided since it will cause problems of internal drainage of the pavement at the interface of two courses. It is desirable to completely pick out the existing thin bituminous wearing course where water bound macadam is proposed to be laid over it. However, where the intensity of rain is low and the interface drainage facility is efficient, water bound macadam can be laid over the existing thin bituminous surface by cutting 50 mm x 50 mm furrows at an angle of 45 degrees to the centre line of the pavement at one m intervals in the existing road. The directions and depth of furrows shall be such that they provide adequate bondage and also serve to drain water to the existing granular base course beneath the existing thin bituminous surface.
- 14.2.3.3 Inverted choke
  - 14.2.3.3.1 If water bound macadam is to be laid directly over the subgrade, without any other intervening pavement course, a 25 mm course of screenings (Grading B) or coarse sand shall be spread on the prepared subgrade before application of the aggregates is taken up. In case of a fine sand or silty or clayey subgrade, it is advisable to lay 100 mm insulating layer of screening or coarse sand on top of fine grained soil, the gradation of which will depend upon whether it is intended to act as a drainage layer as well. As a preferred alternative to inverted choke, appropriate geosynthetics performing functions of separation and drainage may be used over the prepared subgrade as directed by the Engineer. **Section 700** of MoST specifications for Road and Bridge Works (IV Revision) shall be applicable for use of Geosynthetics.

#### 14.2.3.4 Spreading coarse aggregates

14.2.3.4.1 The coarse aggregates shall be spread uniformly and evenly upon the prepared subgrade/sub-base/base to proper profile by using templates placed across the road about 6m apart, in such quantities that the thickness of each compacted layer is not more than 100 mm for Grading 1 and 75 mm for Grading 2 and 3, as specified in **Clause 13.2.2.5**. Wherever possible, approved mechanical devices such as aggregate spreader shall be used to spread the aggregates uniformly so as to minimise the need for manual rectification afterwards. Aggregates placed at locations which are inaccessible to the spreading equipment, may be spread in one or more layers by any approved means so as to achieve the specified results.

14.2.3.4.2 The spreading shall be done from stockpiles along the side of the roadway or directly from vehicles. No segregation of large or fine aggregates shall be allowed and the coarse aggregate as spread shall be uniform gradation with no pockets of fine material.

14.2.3.4.3 The surface of the aggregates spread shall be carefully checked with templates and all high or low spots remedied by removing or adding aggregates as may be required. The surface shall be checked frequently with a straight edge while spreading and rolling so as to ensure a finished surface as per approved Drawings.

14.2.3.4.4 The coarse aggregates shall not normally be spread more than 3 days in advance of the subsequent construction operations.

#### 14.2.3.5 Rolling

14.2.3.5.1 Immediately following the spreading of the coarse aggregate, rolling shall be started with three wheeled power rollers of 80 to 100 kN capacity or tandem or vibratory rollers of 80 to 100 kN static weight. The type of roller to be used shall be approved by the Engineer based on trial run.

14.2.3.5.2 Except on superelevated portions where the rolling shall proceed from inner edge to the outer, rolling shall begin from the edges gradually progressing towards the centre. First the edge/edges shall be compacted with roller running forward and backward. The roller shall then move inward parallel to the centre line of the road, in successive passes uniformly lapping preceding tracks by at least one half width.

14.2.3.5.3 Rolling shall be discontinued when the aggregates are partially compacted with sufficient void space in them to permit application of screenings. However, where screenings are not to be applied, as in the case of crushed aggregates like brick metal, laterite and kankar, compaction shall be continued until the aggregates are thoroughly keyed. During rolling, slight sprinkling of water may be done, if necessary. Rolling shall not be done when the subgrade is soft or yielding or when it causes a wave-like motion in the subgrade or subbase course.

14.2.3.5.4 The rolled surface shall be checked transversely and longitudinally, with templates and any irregularities corrected by loosening the surface, adding or removing necessary amount of aggregates and re-rolling until the entire surface conforms to desired crossfall (camber) and grade. In no case shall the use of screenings be permitted to make up depressions.

14.2.3.5.5 Material which gets crushed excessively during compaction or becomes segregated shall be removed and replaced with suitable aggregates.

14.2.3.5.6 It shall be ensured that shoulders are built up simultaneously along with water bound macadam courses as per **Clause 13.9.4.1**.

14.2.3.6 Application of screenings

14.2.3.6.1 After the coarse aggregate has been rolled to **Clause 13.2.3.5**, screenings to completely fill the interstices shall be applied gradually over the surface. These shall not be damp or wet at the time of application. Dry rolling shall be done while the screening are being spread so that vibrations of the roller cause them to settle into the voids of the coarse aggregate. The screenings shall not be dumped in piles but be spread uniformly in successive thin layers either by the spreading motions of hand shovels or by mechanical spreaders, or directly from tipper with suitable grit spreading arrangement. Tipper operating for spreading the screenings shall be so driven as not to disturb the coarse aggregate.

14.2.3.6.2 The screenings shall be applied at a slow and uniform rate (in three or more applications) so as to ensure filling of all voids. This shall be accompanied by dry rolling and brooming with mechanical brooms, hand brooms or both. In no case shall the screenings be applied so fast and thick as to form cakes or ridges on the surface in such a manner as would prevent filling of voids or prevent the direct bearing of the roller on the coarse aggregate. These operations shall continue until no more screenings can be forced into the voids of the coarse aggregate.

14.2.3.6.3 The spreading, rolling, and brooming of screenings shall be carried out in only such lengths of the road which could be completed within one day's operation.

14.2.3.7 Sprinkling of water and grouting

14.2.3.7.1 After the screenings have been applied, the surface shall be copiously sprinkled with water, swept and rolled. Hand brooms shall be used to sweep the wet screenings into voids and to distribute them evenly. The sprinkling, sweeping and rolling operation shall be continued, with additional screenings applied as necessary until the coarse aggregate has been thoroughly keyed, well-bonded and firmly set in its full depth and a grout has been formed of screenings. Care shall be taken to see that the base or subgrade does not get damaged due to the addition of excessive quantities of water during construction.

14.2.3.7.2 In case of lime treated soil sub-base, construction of water bound macadam on top of it can cause excessive water to flow down to the lime treated sub-base before it has picked up enough strength (is still "green") and thus cause damage to the sub-base layer. The laying of water bound macadam layer in such cases shall be done after the sub-base attains adequate strength, as directed by the Engineer.

14.2.3.8 Application of binding material

14.2.3.8.1 After the application of screenings in accordance with **Clauses 13.2.3.6 and 13.2.3.7** the binding material where it is required to be used (**Clause 13.2.2.7**) shall be applied successively in two or more thin layers at a slow and uniform rate. After each application, the surface shall be copiously sprinkled with water, the resulting slurry swept in with hand brooms, or mechanical brooms to fill the voids properly, and rolled during which water shall be applied to the wheels of the rollers if necessary to wash down the binding material sticking to them. These operations shall continue until the resulting slurry after filling of voids, forms a wave ahead of the wheels of the moving roller.

#### 14.2.3.9 Setting and drying

14.2.3.9.1 After the final compaction of water bound macadam course, the pavement shall be allowed to dry overnight. Next morning hungry spots shall be filled with screenings or binding material as directed, lightly sprinkled with water if necessary and rolled. No traffic shall be allowed on the road until the macadam has set. The Engineer shall have the discretion to stop hauling traffic from using the completed water bound macadam course, if in his opinion it would cause excessive damage to the surface.

14.2.3.9.2 The compacted water bound macadam course should be allowed to completely dry and set before the next pavement course is laid over it.

#### 14.2.4 Surface Finish and Quality Control of work

14.2.4.1 The surface finish of construction shall conform to the requirements of **Section 902** of MoST Specifications for Road and Bridge Works (IV Revision).

14.2.4.2 Control on the quality of materials and works shall be exercised by the Engineer in accordance with **Section 900** of MoST Specifications for Road and Bridge Works (IV Revision).

14.2.4.3 The water bound macadam work shall not be carried out when the atmospheric temperature is less than 0 degree centigrade in the shade.

#### 14.2.4.4 Reconstruction of defective macadam

14.2.4.4.1 The finished surface of water bound macadam shall conform to the tolerance of surface regularity as prescribed in **Section 902** of MoST Specifications for Road and Bridge Works (IV Revision). However, where the surface irregularity of the course exceeds the tolerances or where the course is otherwise defective due to subgrade soil mixing with the aggregates, the course to its full thickness shall be scarified over the affected area, reshaped with added material or removed and replaced with fresh material as applicable and recompacted. In no case shall depressions be filled up with screenings or binding material.

#### 14.2.5 Arrangement for Traffic

14.2.5.1 During the period of construction, the arrangement of traffic shall be done as per **Clause 1.9.2**.

#### 14.2.6 Measurements for payment

14.2.6.1 Water bound macadam shall be measured as finished work in position in cubic metres.

#### 14.2.7 Rate

14.2.7.1 The Contract unit rate for water bound macadam sub-base/base course shall be payable in full for carrying out the required operations including full compensation for all components listed in **Clause 13.1.8.1** (1) to (5) including arrangement of water used in the work as approved by the Engineer.

### 14.3 Wet Mix Macadam Sub-Base/Base

14.3.1 Scope

14.3.1.1 This work shall consist of laying and compacting clean, crushed, graded aggregate and granular material, premixed with water, to a dense mass on prepared subgrade/subbase/base or existing pavement as the case may be in accordance with the requirements of these Specifications. The material shall be laid in one or more layers as necessary to lines, grades and cross-sections shown on the approved Drawings or as directed by the Engineer.

14.3.1.2 The thickness of a single compacted Wet Mix Macadam Layer shall not be less than 75 mm. When vibrating or other approved types of compacting equipment are used, the compacted depth of a single layer of the sub-base course may be increased to 200 mm upon approval of the Engineer.

14.3.2 Materials

14.3.2.1 Aggregates

14.3.2.1.1 Physical requirements

Coarse aggregates shall be crushed stone. If crushed gravel/shingle is used, not less than 90 per cent by weight of the gravel/shingle pieces retained on 4.75 mm sieve shall have at least two fractured faces. The aggregates shall conform to the physical requirements set forth in Table 13-7 below.

**Table 13-7 Physical Requirements of Coarse Aggregates for Wet Mix Macadam for Sub-Base/Base Courses**

Sr	Test	Test Method	Requirements
1.	*Los Angeles Abrasion value	IS: 2386 (Part-4)	40 per cent (Max.)
	* Aggregate Impact value	IS: 2386 (Part-4) or IS: 5640	30 per cent (Max.)
2.	Combined Flakiness and Elongation Indices (Total)	IS: 2386 (Part-1)	30 per cent (Max.)

- Aggregate may satisfy requirements of either of the two tests.
- To determine this combined proportion, the flaky stone from a representative sample should first separated out. Flakiness index is weight of flaky stone metal divided by weight of stone sample. Only the elongated particles be separated out from remaining (Non-Flaky) stone metal. Elongation index is weight of elongation particles divided by total number of flaky particles. The value of flakiness index and elongation index so found are added up.

If the water absorption value of the coarse aggregate is greater than 2 per cent, the soundness test shall be carried out on the material delivered to site as per IS: 2386 (Part-5).

14.3.2.1.2 Grading requirements

The aggregates shall conform to the grading given in Table 13-8.

**Table 13-8. Grading Requirements of Aggregates for Wet Mix Macadam**

IS Sieve Designation	Per cent by weight passing the IS sieve
53.00 mm	100
45.00 mm	95-100
26.50 mm	-
22.40 mm	60-80
11.20 mm	40-60
4.75 mm	25-40
2.36 mm	15-30
600.00 micron	8-22
75.00 micron	0-8

Materials finer than 425 micron shall have plasticity Index (PI) not exceeding 6.

The final gradation approved within these limits shall be well graded from coarse to fine and shall not vary from the low limit on one sieve to the high limit on the adjacent sieve or vice versa.

#### 14.3.3 Construction Operations

##### 14.3.3.1 Preparation of base

14.3.3.1.1 Clause 13.2.3.1 shall apply.

##### 14.3.3.2 Provision of lateral confinement of aggregates

14.3.3.2.1 While constructing wet mix macadam, arrangement shall be made for the lateral confinement of wet mix. This shall be done by laying materials in adjoining shoulders along with that of wet mix macadam layer and following the sequence of operations described in **Clause 13.9.4.1**.

##### 14.3.3.3 Preparation of mix

14.3.3.3.1 Wet mix macadam shall be prepared in an approved mixing plant of suitable capacity having provision for controlled addition of water and forced/positive mixing arrangement like pugmill or pan type mixer of concrete batching plant. For small quantity of wet mix work, the Engineer may permit the mixing to be done in concrete mixers.

14.3.3.3.2 Optimum moisture for mixing shall be determined in accordance with IS: 2720 (Part-8) after replacing the aggregate fraction retained on 22.4 mm sieve with material of 4.75 mm to 22.4 mm size while adding water, due allowance should be made for evaporation losses. However, at the time of compaction, water in the wet mix should not vary from the optimum value by more than agreed limits. The mixed material should be uniformly wet and no segregation should be permitted.

##### 14.3.3.4 Spreading of mix



- 14.3.3.4.1 Immediately after mixing, the aggregates shall be spread uniformly and evenly upon the prepared subgrade/sub-base/base in required quantities. In no case should these be dumped in heaps directly on the area where these are to be laid nor shall their hauling over a partly completed stretch be permitted.
- 14.3.3.4.2 The mix may be spread either by a paver finisher or motor grader. For portions where mechanical means cannot be used, manual means as approved by the Engineer shall be used. The motor grader shall be capable of spreading the material uniformly all over the surface. Its blade shall have hydraulic control suitable for initial adjustments and maintaining the same so as to achieve the specified slope and grade.
- 14.3.3.4.3 The paver finisher shall be self-propelled, having the following features:
1. Loading hoppers and suitable distribution mechanism
  2. The screed shall have tamping and vibrating arrangement for initial compaction to the layer as it is spread without rutting or otherwise marring the surface profile.
  3. The paver shall be equipped with necessary control mechanism so as to ensure that the finished surface is free from surface blemishes.
- 14.3.3.4.4 The surface of the aggregate shall be carefully checked with templates and all high or low spots remedied by removing or adding aggregate as may be required. The layer may be tested by depth blocks during construction. No segregation of larger and fine particles should be allowed. The aggregates as spread should be of uniform gradation with no pockets of fine materials.
- 14.3.3.5 Compaction
- 14.3.3.5.1 After the mix has been laid for the required thickness, grade and crossfall/camber the same shall be uniformly compacted, to the full depth with suitable roller. If the thickness of single compacted layer does not exceed 100 mm, a smooth wheel roller of 80 to 100 kN weight may be used. For a compacted single layer upto 200 mm, the compaction shall be done with the help of vibratory roller of minimum static weight of 80 to 100 kN or equivalent capacity roller. The speed of the roller shall not exceed 5 km/h.
- 14.3.3.5.2 In portions having unidirectional cross fall/superelevation, rolling shall commence from the lower edge and progress gradually towards the upper edge. Thereafter, roller should progress parallel to the centre line of the road, uniformly over-lapping each preceding track by at least one third width until the entire surface has been rolled. Alternate trips of the roller shall be terminated in stops at least 1 m away from any preceding stop.
- 14.3.3.5.3 In portions in camber, rolling should begin at the edge with the roller running forward and backward until the edges have been firmly compacted. The roller shall then progress gradually towards the centre parallel to the centre line of the road uniformly overlapping each of the preceding track by at least one-third width until the entire surface has been rolled.
- 14.3.3.5.4 Any displacement occurring as a result of reversing of the direction of a roller or from any other cause shall be corrected at once as specified and/or removed and made good.
- 14.3.3.5.5 Along forms, kerbs, walls or other places not accessible to the roller, the mixture shall be thoroughly compacted with mechanical tampers or a plate compactor. Skin patching of

an area without scarifying the surface to permit proper bonding of the added material shall not be permitted.

14.3.3.5.6 Rolling should not be done when the subgrade is soft or yielding or when it causes a wavelike motion in the sub-base/base course or subgrade. If irregularities develop during rolling which exceed 12 mm when tested with a 3 m straight edge, the surface should be loosened and premixed material added or removed as required before rolling again so as to achieve a uniform surface conforming to the desired grade and crossfall. In no case should the use of unmixed material be permitted to make up the depressions.

14.3.3.5.7 Rolling shall be continued till the density achieved is at least 98 per cent of the maximum dry density for the material as determined by the method outlined in IS: 2720 (Part-8).

14.3.3.5.8 After completion, the surface of any finished layer shall be well-closed, free from movement under compaction equipment or any compaction planes, ridges, cracks and loose material. All loose segregated or otherwise defective areas shall be made good to the full thickness of the layer and recompacted.

14.3.3.6 Setting and drying

14.3.3.6.1 After final compaction of wet mix macadam course, the road shall be allowed to dry for 24 hours.

14.3.4 Opening to Traffic

14.3.4.1.1 Preferably no vehicular traffic of any kind should be allowed on the finished wet mix macadam surface till it has dried and the wearing course laid.

14.3.5 Surface Finish and Quality Control of Work

14.3.5.1 Surface evenness

14.3.5.1.1 The surface finish of construction shall conform to the requirements of **Section 902** of MoST Specifications for Road and Bridge Works (IV Revision).

14.3.5.2 Quality control

14.3.5.2.1 Control on the quality of materials and works shall be exercised by the Engineer in accordance with **Section 900** of MoST Specifications for Road and Bridge Works (IV Revision).

14.3.6 Rectification of Surface Irregularity

14.3.6.1 Where the surface irregularity of the wet mix macadam course exceeds the permissible tolerances or where the course is otherwise defective due to subgrade soil getting mixed with the aggregates, the full thickness of the layer shall be scarified over the affected area, reshaped with added premixed material or removed and replaced with fresh premixed

material as applicable and recompacted in accordance with **Clause 13.3.3**. The area treated in the aforesaid manner shall not be less than 5 m long and 2 m wide. In no case shall depressions be filled up with unmixed and ungraded material or fines.

14.3.7 Arrangement for Traffic

14.3.7.1 During the period of construction, arrangement of traffic shall be done as per **Clause 1.9.2**.

14.3.8 Measurements for Payment

14.3.8.1 Wet mix macadam shall be measured as finished work in position in cubic metres.

14.3.9 Rates

14.3.9.1 The contract unit rate for wet mix macadam shall be payment in full for carrying out the required operations including full compensation for all components listed in **Clause 13.1.8.1**.

#### **14.4 Preparation of Surface [Base and Surface Courses (Bituminous)]**

14.4.1 Scope

14.4.1.1 This work shall consist of preparing an existing granular or black-topped surface bituminous course. The work shall be performed on such widths and lengths as shown on Drawings or as instructed by the Engineer. The existing surface shall be firm and clean and treated with Prime or Tack coat as shown on the drawings as otherwise stated in the contract.

14.4.2 Materials

14.4.2.1 For scarifying and re-laying the granular surface

14.4.2.1.1 The materials used shall be coarse aggregates salvaged from scarification of the existing granular base course supplemented by fresh coarse aggregates and screenings so that aggregates and screenings thus supplemented correspond to **Clause 13.2**: Water bound macadam or **Clause 13.3**: Wet mix macadam, as the case may be.

14.4.2.2 For patching potholes and sealing cracks

14.4.2.2.1 Where the existing surface to be overlaid is bituminous, any existing potholes and cracks shall be repaired and sealed in accordance with **Clause 3004.2** and **3004.3** of MoST Specifications for Road and Bridge Works (IV Revision).

14.4.2.3 For profile corrective course

14.4.2.3.1 A profile corrective course for correcting the existing pavement profile shall be laid to varying thickness as shown on the drawings or as indicated in the contract documents. The profile corrective course shall be laid to tolerances and densities as specified for wearing course if a single layer, or base course, if it is to be covered with wearing course layer.

14.4.2.4 Profile corrective course and its application

14.4.2.4.1 The type of material for profile corrective course shall be as shown on the Drawing or as directed by the Engineer. Where it is to be laid as part of the overlay/strengthening course, the profile corrective course material shall be of the same Specification as that of the overlay/strengthening course. However, if provided as a separate layer, it shall be of the same Specifications and details given in the contract drawings.

- (1) Any high spot in the existing surface shall be removed by a milling machine or other approved method, and all loose material shall be removed to the satisfaction of the Engineer.
- (2) Where the maximum thickness of profile corrective course will be not more than 40 mm, the profile corrective course shall be constructed as an integral part of the overlay layer, adopting such construction procedures and using such equipment as approved by the Engineer, to lay the specified type of material, to thickness and tolerance as specified, for the course, to be provided.

#### 14.4.3 Construction Operations

##### 14.4.3.1 Preparing existing granular surface

14.4.3.1.1 Where the existing surface is granular, all loose and disintegrated materials shall be removed and the surface lightly watered if the profile corrective course to be provided as a separate layer is also granular. Where the profile corrective course of bituminous material is to be laid over the latter shall, after removal of all loose material, be primed in accordance with **Clause 13.19**.

14.4.3.1.2 The surface finish of all granular layers on which bituminous work are to be placed, shall, unless otherwise specifically instructed by the Engineer, be free from dust. All such layers must be capable of being swept, after the removal of any non-integral loose material, by means of mechanical broom, with out shedding significant quantities of material and dust removed by air jet, washing, or other means approved by the Engineer.

14.4.3.1.3 After cleaning the surface shall be correct to line and level, with tolerances specified for base courses.

##### 14.4.3.2 Scarifying existing bituminous surface

14.4.3.2.1 Where specified or shown on drawings, the existing bituminous layer in the specified width shall be removed with care without causing undue disturbance to the underlying layer by suitable method approved by the Engineer. After removal, all loose and disintegrated material, the underlying layer which might have been disturbed should be suitably reworked and compacted to line and level. After supplementing the base material as necessary with suitable fresh stone, the compacted finished surface shall be primed in accordance with **Clause 13.19** on the process of removal shall, before laying of the overlay course, be reset properly by spreading/hand packing of aggregates and compacting with suitable roller/heavy hand rammers/approved mechanical temper so that the level of the top surface of such scarified area shall be even and properly graded with respect to adjoining surface. Where applicable, the granular surface, after removal of the existing bituminous layer, shall be primed as per **Clause 13.19**. Reusable materials shall be stacked as directed by the Engineer with all lift and lead of 1000m of their origin.

##### 14.4.3.3 Patching of potholes and sealing of cracks

14.4.3.3.1 Where the existing surface to be overlaid is bituminous, any existing pot-holes and cracks shall be repaired and sealed in accordance with **Clauses 3004.2 and 3004.3** of MoST Specifications for Road and Bridge Works (IV Revision) or as directed by Engineer.

#### 14.4.3.4 Laying the profile corrective course

14.4.3.4.1 Laying on granular base: After preparing the surface in accordance with **Clause 13.4.3.1** and **13.4.3.2** the profile corrective course shall be laid using material as described in **Clause 13.4.2.3** and **13.4.2.4** or as otherwise described in the contract and compacted to the requirement of particular specification.

14.4.3.4.2 Laying on existing bituminous surface: The existing bituminous surface shall be prepared in accordance with **Clause 13.4.3.3** and after applying tack coat conforming to **Clause 13.5**, the bituminous profile corrective course shall be laid and compacted to the requirements of the particular Specifications.

14.4.3.4.3 Correction of local depressions: Where local sags or depressions occur in the existing pavement, a specific filling operation shall be instructed by the Engineer, which should be laid in accordance with **Figure 500-1** Of MoST Specifications for Road and Bridge Works (IV Revision) Normally the maximum layer thickness at any point should not exceed 100mm. In placing multiple lifts, they should be arranged according to method as illustrated.

For correcting the camber or super elevation of the existing carriageway, the method shown in **Figure 500-2** Of MoST Specifications for Road and Bridge Works (IV Revision) shall be adopted depending on the profile of the existing carriageway.

#### 14.4.3.4.4 Covering the profile corrective course

Profile Corrective Course particularly shall be so planned that layer shall be covered by the designed base / wearing course at the earliest opportunity.

#### 14.4.4 Surface Finish and Quality Control of work

14.4.4.1 The relevant provisions of **Section 900** of MoST Specifications for Road and Bridge Works (IV Revision) shall apply.

#### 14.4.5 Arrangement for Traffic

14.4.5.1 During the construction operations, arrangement of traffic shall be done to **Clause 1.9.2**.

14.4.6 Environmental Protection The provision of **Clause 111 and the provision of Annexure A to Clause 501** of MoST Specifications for Road and Bridge works (IV Revision) shall apply.

#### 14.4.7 Measurements for Payment

##### 14.4.7.1 Pot holes and cracks

14.4.7.1.1 The work of filling potholes shall be measured separately and be paid in square meters.

14.4.7.1.2 The work of filling cracks by applying fog spray or emulsion slurry seal shall be measured in square meter, for the area covered by spray.

14.4.7.1.3 The work of filling cracks larger than 3 mm in width shall be measured and paid on a linear meter basis.

#### 14.4.7.2 Scarifying

14.4.7.2.1 Scarifying the existing bituminous surface shall be measured on a square meter basis.

#### 14.4.7.3 Profile Corrective Course

14.4.7.3.1 Profile corrective course shall be measured as the volume instructed and compacted in position and measured in cubic meter or in tonnage as stipulated in the contract. The volume shall be calculated by plotting the exact profile of the profile corrective course as required, and laid, superimposed on the existing pavement profile. Cross-sectional areas of the profile corrective course shall be measured at intervals as used in the design, or as determined by the Engineer, and the volume shall be calculated using the method of end areas.

14.4.7.4 Prime Coat Prime Coat is to be measured and paid for on a square meter basis.

14.4.7.5 Tack Coat this is to be a provisional: item which may be used in-part or not at all, at the Engineer's directions, and is to be measured and paid for, if used, on a square meter basis.

#### 14.4.8 Rates

14.4.8.1 Rate for scarifying: The contract unit rate for scarifying existing bituminous surfaces, including repairing/ reworking disturbed underlying layers and stacking reusable / unusable material shall include for but not necessarily be limited to, the cost of all labour, supply of materials needed for repair / reworking, hire charges of tools and plants, and transportation of scarified materials within 1000 m of their origin.

14.4.8.2 Rate for premixed bituminous material: The contractor's unit rate for premixed bituminous material shall be payment in full for carrying out the required operations including full compensation for, but not necessarily limited to

- (i) Making arrangements for traffic to **Clause 1.9.2** except for initial treatment to verge shoulders and construction of diversions
- (ii) Preparation of the surface to receive the material.
- (iii) Providing all materials to be incorporated in the work including arrangements in stock yards, all royalties, fees, rents where necessary and all leads and lifts.
- (iv) Mixing, transport, laying and compacting the mix, as specified.
- (v) All labour, tools, equipment, plant including installation hot mix plant, power supply units, and all machinery, incidental to complete the work to these specifications
- (vi) Carrying out the work in part widths of the road where directed
- (vii) Carrying out all tests for control of quality, and
- (viii) The rate shall cover the provision of bitumen at the rate specified in the contract, with the provision that the variation in actual percentage of bitumen used will be assessed and the payment adjusted accordingly.
- (ix) The rates for premixed material are to include for all wastage in cutting joints etc.
- (x) The rates are to include for all necessary testing, mix design, transporting and testing of samples, and cores. If there is not a project specific laboratory, the contractor must arrange to carry out all necessary testing at an out side laboratory, approved by the Engineer, and all costs incurred are deemed to be included in the rate quoted for the material.
- (xi) The cost of all plant and laying trials as specified to prove the mixing and laying methods is deemed to be included in the contractor's rate for the material.

#### 14.4.8.3 Rate for pot holes and crack sealing

14.4.8.3.1 The rate for patching potholes shall include for breaking out, trimming edges, cleaning out, painting edges and bottom with bitumen, and filling and compacting the excavation with specified material. The rate should be inclusive of all plants, tool, labour and material, transport and disposal of surplus material.

14.4.8.3.2 The contract unit rate for sealing cracks by applying fog spray shall be inclusive of providing all materials, tools, labour plant and carrying out the work.. The contract unit rate for sealing cracks by providing emulsion slurry seal shall be set forth in **Clause 516.9** of MoST Specifications for Road and Bridge Works (IV Revision)

14.4.8.3.3 The contract unit rate for crack sealing 3 mm to 6 mm cracks with straight run or other specified bitumen, shall be based on either a square meter basis or linear meter of cracks as measured, as stipulated by the contract

14.4.8.3.4 The contract unit rate for cracks between 6mm to 15 mm is to be measured on a linear meter basis, and the rate is to include for materials, tools, plant, labour and transport

### 14.5 Tack Coat

#### 14.5.1 Scope

14.5.1.1 This work shall consist of application of a single coat of low viscosity liquid bituminous material to an existing bituminous road surface preparatory to superimposition of a bituminous mix, when specified in the contract or instructed by the Engineer.

#### 14.5.2 Materials

##### 14.5.2.1 Binder

14.5.2.1.1 The binder used for tack coat shall be a bituminous emulsion complying with **IS 8887** of a type and grade as specified in the contract or as directed by the Engineer. The use of cut back bitumen as per **IS 217** shall be restricted only for sites at sub-zero temperature or for emergency applications as directed by the Engineer.

#### 14.5.3 Weather and Seasonal Limitations

14.5.3.1 Bituminous material shall not be applied to a wet surface or during a dust storm or when the weather is foggy, rainy, or windy or when the temperature in the shade is less than 10 degree C. Where the tack coat consists of emulsion, the surface shall be slightly damp, but not wet. Where the tack coat is of cut back bitumen, the surface shall be dry.

#### 14.5.4 Construction

14.5.4.1 Equipment: The tack coat distributor shall be self propelled or towed bitumen pressure sprayer, equipped for spraying the material uniformly at a specified rate. Hand spraying of small areas in accessible to the distributor, or in narrow strips, shall be sprayed with a pressure hand sprayer, or as directed by the Engineer

##### 14.5.4.2 Preparation of base

14.5.4.2.1 The surface on which the tack coat is to be applied shall be clean and free from dust, dirt, and any extraneous material, and be otherwise prepared in accordance with the requirement of **Clause 13.4 and Clause 902** of MoST Specifications for Road and Bridge Works (IV Revision) as appropriate. Immediately before the application of the tack coat, the surface shall be swept clean with a mechanical broom, and high pressure air jet, or by other means as directed by the Engineer.

#### 14.5.4.3 Application of tack coat

The application of tack coat shall be at the rate specified in the contract, and shall be applied uniformly; if rate of application of tack coat is not specified in the contract then it shall be at the rate specified in **Table 13-9**

**Table 13-9 Rate of Application of Tack Coat**

Sr.	Type Surface	Quantity of Liquid Bituminous Material in kg Per sqm area
1.	Normal bituminous surfaces	0.20 to 0.25
2.	Dry and hungry bituminous surfaces	0.25 to 0.30
3.	Granular surfaces treated with primer	0.25 to 0.30
4.	Non bituminous surfaces	
(i)	Granular base (not primed)	0.35 to 0.40
(ii)	Cement concrete pavement	0.30 to 0.35

*The normal range of spraying temperature for a bituminous emulsion shall be 20 degree C to 70 degree C. and for a cutback, 50 to 80 degree C if RC-70/MC-70 is used. Where a geosynthetic is proposed for use, provisions of **clauses 703.3.2 and 703.3.4** of MoST Specifications for Road and Bridge Works (IV Revision) shall apply. The method of application of the will depend on the type of equipment used, size of nozzles, pressure at the spray bar,, and speed of forward movement. The contractor shall demonstrate at aspraying trial, that the equipment and method to be used is capable of producing a uniform spray, with in the tolerances specified.*

*Where the material to receive an over lay is a freshly laid bituminous layer, that has not been subjected to traffic, or contaminated by dust, a tack coat is not mandatory where the overlay is completed with in two days.*

14.5.4.4 Curing of tack coat: The tack coat shall be left to cure until all the volatiles have been evaporated before any subsequent construction is started. No plant or vehicles shall be allowed on the tack coat other than those essential for the construction.

#### 14.5.5 Quality control of Work

14.5.5.1 For control of the quantity of material supplied and the works carried out, the relevant provision of **Section 900** of MoST Specifications for Road and Bridge Works (IV Revision). Shall apply.

#### 14.5.6 Arrangements for Traffic

14.5.6.1 During the period of construction, the arrangement of traffic shall be done to **Clause 1.9.2**.

#### 14.5.7 Measurement for Payment



14.5.7.1 Tack coat shall be measured in terms of surface area of application in square metres.

14.5.8 Rate

14.5.8.1 The contract unit rate for tack coat shall be payment in full for carrying out the required operations including for all components listed in **Clause 13.1.8.1** (1) to (5) as applicable to the work specified in these Specifications. The rate shall cover the provision of tack coat at 0.2 kg.

## **14.6 Dense Graded Bituminous Macadam**

14.6.1 Scope

14.6.1.1 This clause specifies the construction of Dense Graded Bitumen Macadam, (DBM), for use mainly, but not exclusively, base, binder and profile corrective course. DBM is also intended for use as road base material. This work shall consist of construction in a single or multiple layers of DBM on a previously prepared base or sub base. The thickness of a single layer shall be 50mm to 100 mm.

14.6.2 Materials

14.6.2.1 Bitumen

14.6.2.1.1 The bitumen shall be paving bitumen of Penetration Grade complying with Indian Standard Specification for "Paving Bitumen" IS 73, and of the penetration indicated in Table 13-11 for dense Bitumen or this Bitumen as modified by one of the methods specified in **Clause 521** of MoST Specifications for Road and Bridge Works (IV Revision) or as otherwise specified in the Contract. Guidance on the selection of an appropriate grade of bitumen is given in the Manual for Construction and Supervision of Bituminous Works.

14.6.2.2 Coarse aggregates

14.6.2.2.1 The coarse aggregates shall consist of crushed rock, crushed gravel or other hard material retained on 2.36 mm sieve. They shall be clean, hard, and durable, of cubical shape, free from dust and soft or friable matter, organic or other deleterious substances. Where the contractor's selected source of aggregates have poor affinity for bitumen, as a condition for the approval of that source, the bitumen shall be treated with an approved anti stripping agent, as per the manufacturer's recommendations, without additional payment. Before approval of source, the aggregates shall be tested for stripping. The aggregates shall satisfy the physical requirements specified in table 13.10 for dense bituminous macadam.

14.6.2.2.2 Where the crushed gravel is proposed for use as aggregates, not less than 90 % by weight of the crushed material retained on 4.75 mm sieve shall have at least two fractured faces.

14.6.2.2.3 The plasticity index of the fraction passing the 425 micron sieve shall not exceed 4.

14.6.2.3 Fine Aggregates

14.6.2.3.1 Fine aggregates shall consist of crushed or naturally occurring mineral material, or a combination of the two passing the 2.36 mm sieve and retained on the 75 micron sieve. They shall be clean, hard, durable, dry and free from dust, and soft or friable matter, organic or other deleterious matter.

14.6.2.3.2 The fine aggregates shall have a sand equivalent value of not less than 50 when tested in accordance with the requirement of IS 2720 (Part 37).

14.6.2.3.3 The plasticity index of the fraction passing the 0.425mm sieve shall not exceed 4. when tested in accordance with IS 2720 (Part 5)

**Table 13-10 Physical Requirements for Coarse Aggregates for Dense Graded Bituminous Macadam**

Property	Test	Specifications
Cleanliness (dust)	Grain size Analysis <sup>1</sup>	Max. 5% passing 0.075mm sieve
Particle Shape	Flakiness and elongation Index Combined <sup>2</sup>	Max. 30 %
Strength	Los Angeles Abrasion Value <sup>3</sup> Aggregate Impact Value <sup>4</sup>	Max. 35 % Max. 27 %
Durability	Soundness <sup>5</sup> Sodium Sulphate Magnesium Sulphate	Max. 12 % Max. 18 %
Water Absorption	Water Absorption <sup>6</sup>	Max. 2%
Stripping	Coating and stripping of Bitumen Aggregate Mixture <sup>7</sup>	Minimum retained coating 95 %
Water Sensitivity**	Retained Tensile Strength <sup>8</sup>	Minimum 80 %

**Notes**

1. IS 2386 Part 1
2. IS 2386 Part 1
3. IS 2386 Part 3 (the elongation test to be done only on non-flaky aggregate in the sample)
4. IS 2386 Part 4\*
5. IS 2386 Part 5
6. 7. IS 6241
7. IS 2386 Part 4\*
8. 8. AASHTO T 283\*\*

\* Aggregates may satisfy requirement of either of two tests.

\*\* The water sensitivity test is only required if the minimum retained coating in the stripping test is less than 95 %

**14.6.2.4 Filler**

14.6.2.4.1 Filler shall consist of finely divided mineral matter such as rock dust, hydrated lime or cement as approved by the Engineer.

14.6.2.4.2 The filler shall be graded within the limits indicated in Table 13.10A:

**Table 13-10A Grading Requirements for Mineral Filler**

IS Sieve (mm)	Cumulative Per cent passing by weight of total aggregate
0.6	100
0.3	95-100
0.075	85-100

14.6.2.4.3 The filler shall be free from organic impurities and have a Plasticity Index not greater than 4. The Plasticity Index requirement shall not apply if filler is cement or lime. When the coarse aggregate is gravel, 2 per cent of weight of total aggregate shall be Portland cement or hydrated lime and the percentage of fine aggregate reduced accordingly. Cement or hydrated lime is not required when the limestone aggregate is used. Where the aggregates fail to meet the requirements of water sensitivity test in Table 13.10, then 2 percent by total weight of aggregate, of hydrated lime shall be added without additional cost.

14.6.2.5 Aggregate grading and binder content

14.6.2.5.1 When tested in accordance with IS: 2386 Part 1 (wet sieving method), the combined grading of the coarse and fine aggregates and added filler for the particular mixture shall fall within limits shown in Table 13.11, for dense bituminous macadam grading 1 or 2 as specified in the contract. The type and quantity of bitumen, and appropriate thickness, are also indicated for each mixture type.

**Table 13-11. Composition of Dense Graded Bituminous Macadam Pavement Layers**

Grading	1	2
Nominal aggregate size	40 mm	25 mm
Layer Thickness	80-100 mm	50-75 mm
IS Sieve <sup>1</sup> (mm)	Cumulative % by weight of total aggregate passing	
45	100	
37.5	95-100	100
26.5	63.93	90-100
19	-	71-95
13.2	55-75	56-80
9.5	-	-
4.75	38-54	38-54
2.36	28-42	28-42
1.18	-	-
0.6	-	-
0.3	7-21	7-21
0.15	-	-
0.075	2-8	2-8
Bitumen content % by mass of total mix <sup>2</sup>	Min 4.0	Min 4.5
Bitumen grade (pen)	65 or 90	65 or 90

Note: 1. The combined aggregate grading shall not vary from the low limit on one sieve to the high limit on the adjacent sieve.

2. Determined by the Marshall method.

14.6.3 Mixture Design

14.6.3.1 Requirement for the mixture

14.6.3.1.1 Apart from conformity with grading and quality requirements of individual ingredients, the mixture shall meet the requirements set out in Table 13-12.

**Table 13-12 Requirements for Dense Graded Bituminous Macadam**

Minimum stability (kN at 60°C)	9.0
Minimum flow (mm)	2
Maximum flow (mm)	4
Compaction level (Number of blows)	75 blows on each of the two faces of the specimen
Per cent air voids	3-6
Per cent voids in mineral aggregate (VMA)	See table 13-12A below
Per cent filled with bitumen (VFB)	65-75

14.6.3.1.2 The requirements for minimum per cent voids in mineral aggregate (VMA) are set out in Table 13-12A.

**Table 13-12A: Minimum Per Cent Voids in Mineral Aggregate (VMA)**

Nominal Maximum Particle Size <sup>1</sup> (mm)	Minimum VMA, Per cent Related to Design Air Voids, Per cent <sup>2</sup>		
	3.0	4.0	5.0
9.5	14.0	15.0	16.0
12.5	13.0	14.0	15.0
19.0	12.0	13.0	14.0
25.0	11.0	12.0	13.0
37.5	10.0	11.0	12.0

Note: 1. The nominal maximum particle size is one size larger than the first sieve to retain more than 10 per cent  
 2. Interpolate minimum voids in the mineral aggregate (VMA) for design air voids values between those listed.

14.6.3.2 Binder content

14.6.3.2.1 The binder content shall be optimized to achieve the requirements of the mixture set out in Table 13-12 and the traffic volume specified in the Contract. The Marshall method for determining the optimum binder content shall be adopted as described in The Asphalt Institute Manual MS-2, replacing the aggregates retained on the 26.5 mm sieve by the aggregates passing the 26.5 mm sieve and retained on the 22.4 mm sieve, where approved by the Engineer.

14.6.3.2.2 Where 40 mm dense bituminous macadam mixture is specified, the modified Marshall method described in MS-2 shall be used. This method requires modified equipment and

procedures; particularly the minimum stability values in Table 13-12 shall be multiplied by 2.25, and the minimum flow shall be 3 mm.

14.6.3.3 Job mix formula

14.6.3.3.1 The Contractor shall inform the Engineer in writing, at least 20 days before the start of the work, of the job mix formula proposed for use in the works, and shall give the following details:

1. Source and location of all materials
2. Proportions of all materials expressed as follows where each is applicable:
  - Binder type, and percentage by weight of total mixture;
  - Coarse aggregate/Fine aggregate/Mineral filler as percentage by weight of total aggregate including mineral filler;
3. A single definite percentage passing each sieve for the mixed aggregate;
4. The individual gradings of the individual aggregate fractions, and the proportions of the each in the combined grading;
5. The results of tests enumerated in Table 13-12 as obtained by the Contractor;
6. Where the mixture is a batch mixture, the individual weight of each type of aggregate and binder per batch;
7. Test results of physical characteristics of aggregates to be used;
8. Mixing temperature and compacting temperature.

14.6.3.3.2 While establishing the job mix formula, the Contractor shall ensure that it is based on a correct and truly representative sample of the materials that will actually be used in the work and that the mixture and its different ingredients satisfy the physical and strength requirements of these Specifications.

14.6.3.3.3 Approval of the job mix formula shall be based on independent testing by the Engineer for which samples of all ingredients of the mix shall be furnished by the Contractor as required by the Engineer.

14.6.3.3.4 The approved job mix formula shall remain effective unless and until a revised job mix formula is approved. Should a change in the source of materials be proposed, a new job mix formula shall be forwarded to the Engineer for approval before the placing of the material.

14.6.3.4 Plant Trial - Permissible variation in job mix formula

14.6.3.4.1 Once the laboratory job mix formula is approved, the contractor shall carry out plant trials at the mixture to establish that the plant can be setup to produce the uniform mix conforming to the approved job mix formula. The permissible variation of the individual percentages of the various ingredients in the actual mix from the job mix formula to be used shall be within the limits as specified in Table 13-13. These variations are intended to apply to individual specimens taken for quality control tests in accordance with **Section 900** of MoST Specifications for Road and Bridge Works (IV Revision).

**Table 13-13 Permissible Variations from the Job Mix Formula**

Description	Permissible variation Base/ bin	Wearing course
	course	course

Aggregate passing 19 mm sieve or larger	± 8 %	± 7 %
Aggregate passing 13.2 mm, 9.5 mm	± 7 %	± 6 %
Aggregate passing 4.75 mm	± 6 %	± 5 %
Aggregate passing 2.36 mm, 1.18 mm, 0.6 mm	± 5 %	± 4 %
Aggregate passing 0.3 m, 0.15 mm	± 4 %	± 3 %
Aggregate passing 0.075 mm	± 2 %	± 1.5 %
Binder Content	± 0.3 %	± 0.3 %
Mixing temperature	± 10° C	± 10° C

14.6.3.4.2 Once the plant trials have demonstrated the capability of the plant, and the trials are approved, the laying operation may commence. Over the period of the first month of production for laying on the works, the Engineer shall require additional testing of the product to establish the reliability and consistency of the plant.

#### 14.6.3.5 Laying Trials

14.6.3.5.1 Once the plant trials have been successfully completed and approved, the Contractor shall carry out laying trials, to demonstrate that the proposed mix can be successfully laid, and compacted all in accordance with **Clause 501** of MoST specification for Road & Bridge Works (IV Revision). The laying trial shall be carried out on a suitable area which is not to form part of the works, unless specifically approved in writing by the Engineer. The area of the laying trials shall be a minimum of 100 square meter of construction similar to that of the project road, and it shall be in all respects, particularly compaction, the same as the project construction, on which the bituminous material is to be laid.

14.6.3.5.2 The Contractor shall previously inform the Engineer of the proposed method of laying and compacting the material. The plant trials shall then establish if the proposed laying plant, compaction plant, and methodology is capable of producing satisfactory results. The density of the finished paving layers shall be determined by taking cores, no sooner than 24 hours after laying, or by other approved method.

14.6.3.5.3 Once the laying have been approved, the same plant and methodology shall be applied to the laying of the material on the project, and no variation of either shall be acceptable, unless approved in writing by the Engineer, who may at his discretion require further laying trials.

#### 14.6.4 Construction Operations

##### 14.6.4.1 Weather and Seasonal Limitations

14.6.4.1.1 The provisions of **Clause 501.5.1** of MoST specification for Road & Bridge Works (IV Revision) shall apply.

##### 14.6.4.2 Preparation of base

14.6.4.2.1 The base on which Dense Graded Bituminous Material is to be laid shall be prepared in accordance with **Clauses 501 and 902** of MoST specification for Road & Bridge Works (IV Revision) as appropriate, or as directed by the Engineer. The surface shall be thoroughly swept clean by a mechanical broom, and the dust removed by compressed

air. In locations where mechanical broom cannot access, other approved method shall be used as directed by the Engineer.

14.6.4.3 Geosynthetics

14.6.4.3.1 Where Geosynthetics are specified in the Contract this shall be in accordance with requirements stated in **Clause 703** of MoST specification for Road & Bridge Works (IV Revision).

14.6.4.4 Stress absorbing layer

14.6.4.4.1 Where a stress absorbing layer is specified in the Contract, this shall be applied in accordance with the requirements of **Clause 522** of MoST specification for Road & Bridge Works (IV Revision).

14.6.4.5 Prime coat

14.6.4.5.1 Where the material on which the dense bituminous macadam is to be laid is other than a bitumen bound layer, a prime coat shall be applied, as specified, in accordance with the provisions of **Clause 13.19**, or as directed by the Engineer.

14.6.4.6 Tack coat

14.6.4.6.1 Where the material on which the dense bituminous macadam is to be placed is bitumen bound surface, a tack coat shall be applied, as specified, in accordance with the provisions of **Clause 13.5**, or as directed by the Engineer.

14.6.4.7 Mixing and Transportation of the mixture

14.6.4.7.1 The provisions as specified in **Clause 501.3 and 501.1** of MoST specification for Road & Bridge Works (IV Revision) shall apply.

14.6.4.8 Spreading

14.6.4.8.1 The provisions of **Clauses 501.5.3 and 501.5.4** of MoST specification for Road & Bridge Works (IV Revision) shall apply.

14.6.4.9 Rolling

14.6.4.9.1 The general provisions of **Clauses 501.6 and 501.7** of MoST specification for Road & Bridge Works (IV Revision) shall apply, as modified by the approved laying trials. The compaction process shall be carried out by the same plant, and using the same method, as approved in the laying trials, which may be varied only with the express approval of the Engineer in writing.

14.6.5 Opening to Traffic

14.6.5.1 The newly laid surface shall not be open to traffic for at least 24 hrs after laying and completion of compaction, without the express approval of the Engineer in writing.

14.6.6 Surface Finish and Quality Control of Work

14.6.6.1 The surface finish of the completed construction shall conform to the requirements of **Clause 902** of MoST Specifications for Road and Bridge Works (IV Revision). All materials and workmanship shall comply with the provisions set out in **Section 900** of MoST specification for Road & Bridge Works (IV Revision).

14.6.7 Arrangements for Traffic

14.6.7.1 During the period of construction, arrangements for the traffic shall be made in accordance with the provisions of **Clause 1.9.2**.

14.6.8 Measurements for payment

14.6.8.1 Dense Graded Bituminous Materials shall be measured as finished work either in cubic metres, tons or by the square meter at a specified thickness as detailed on the Contract drawings, or documents, or as directed by the Engineer.

14.6.9 Rate

14.6.9.1 The contract unit rate for Dense Graded Bituminous Macadam shall be payment in full for carrying out the required operations as specified, and shall include, but not necessarily limited to all components listed in **Clause 13.4.8.2 (i) to (xi)**. The rate shall include the provision of bitumen, at 4.25 per cent by weight of the total mixture.

The variance in actual percentage of bitumen used will be assessed and the payment adjusted, up or down, accordingly.

## **14.7 Bituminous Concrete**

14.7.1 Scope

14.7.1.1 This clause specifies the construction Bituminous Concrete, for use in wearing and profile corrective courses. This work shall consist of construction in a single or multiple layers of bituminous concrete on a previously prepared bituminous bound surface. A single layers shall be 25mm to 100mm in thickness.

14.7.2 Materials

14.7.2.1 Bitumen

14.7.2.1.1 The bitumen shall be paving bitumen of Penetration grade complying with Indian Standard Specification for Paving Bitumen, IS: 73 and of the penetration indicated in Table 13-14, for bituminous concrete, or this bitumen as modified by one of the methods specified in **Clause 521** of MoST specification for Road & Bridge Works (IV Revision), or as otherwise specified in the Contract. Guidance on the selection of an appropriate grade of bitumen is given in The Manual for Construction and Supervision of Bitumenous Works.

14.7.2.2 Coarse aggregates

14.7.2.2.1 The coarse aggregates shall be generally as specified in **Clause 13.6.2.2** shall apply, except that the aggregates shall satisfy the physical requirements of Tanle 13.14A.

14.7.2.3 Fine aggregates



14.7.2.3.1 The fine aggregates shall be all as specified in **Clause 13.6.2.3**.

14.7.2.4 Filler

14.7.2.4.1 Filler shall be generally as specified in **Clause 13.6.2.4**. Where the aggregates fail to meet the requirements of the water sensitivity test in Table 13.14A then 2 percent by total weight of aggregate, of hydrate lime shall be added without additional cost.

14.7.2.5 Aggregates grading and binder content

14.7.2.5.1 When tested in accordance with IS: 2386 Part 1 (Wet grading method), the combined grading of the coarse and fine aggregates and added filler shall fall within the limits shown in Table 13-14 for grading 1 or 2 as specified in the Contract.

14.7.3 Mixture Design

14.7.3.1 Requirement for the mixture

14.7.3.1.1 Apart from conformity with the grading and quality requirements of individual ingredients, the mixture shall meet the requirements set out in Table 13-15.

14.7.3.1.2 The requirements for minimum per cent voids in mineral aggregate (VMA) are set out in Table 13-12A

14.7.3.2 Binder content

14.7.3.2.1 The binder content shall be optimized to achieve the requirements of the mix set out in Table 13-15 and the traffic volume as specified in the Contract. The Marshall method for determining the optimum binder content shall be adopted as described in the Asphalt Institute Manual MS-2, replacing the aggregates retained on the 26.5mm sieve and retained on the 22.4mm sieve, where approved by the Engineer.

14.7.3.3 Job mix formula

14.7.3.3.1 The procedure for formulating the job mix formula shall be generally as specified in **Clause 13.6.3.3** and the results of the tests enumerated in Table 13-15.

**Table 13-14A: Physical Requirements for Coarse Aggregates for Bituminous Concrete Pavement Layer**

Property	Test	Specifications
Cleanliness (dust)	Grain size Analysis <sup>1</sup>	Max. 5% passing 0.075 mm sieve
Particle Shape	Flakiness and elongation Index	Max. 30 % (Combined) <sup>2</sup>
Strength*	Los Angeles Abrasion Value <sup>3</sup> Aggregate Impact Value <sup>4</sup>	Max. 30 % Max. 24 %
Polishing	Polished Stone Value <sup>5</sup>	Min 55
Durability	Soundness <sup>6</sup> Sodium Sulphate Magnesium Sulphate	Max. 12 % Max. 18 %

Water Absorption	Water Absorption <sup>7</sup>	Max. 2%
Stripping	Coating and stripping of Bitumen Aggregate Mixtures <sup>9</sup>	Minimum retained coating 95 %
Water Sensitivity**	Retained Tensile Strength <sup>8</sup>	Minimum 80 %

Notes

1. IS 2386 Part 1
2. 6. IS 2386 Part 5
3. IS 2386 Part 1
4. 7. IS 2386 Part 3  
(the elongation test to be done only on non-flaky aggregate in the sample)
5. IS 2386 Part 4\*
6. 8. AASHTO T 283\*\*
7. IS 2386 Part 4\*
8. 9. IS 6241
9. BS:812 Part 114

\* Aggregates may satisfy requirement of either of two tests.

\*\* The water sensitivity test is only required if the minimum retained coating in the stripping test is less than 95 %

14.7.3.4 Plant trials - Permissible variations from the job mix formula

14.7.3.4.1 The requirements for plant trials shall be all as specified in **Clause 13.6.3.4**, and permissible limits for variation as shown in Table 13.13.

14.7.3.5 Laying trials

14.7.3.5.1 The requirements for laying trials shall be all as specified in **Clause 13.6.3.5**.

14.7.4 Construction Operations

14.7.4.1 Weather and seasonal limitations

14.7.4.1.1 The provisions of **Clause 501.5.1** of MoST Specifications for Road and Bridge Works (IV Revision) shall apply.

**Table 13-14: Composition of Bituminous Concrete Pavement Layers**

Grading	1	2
Nominal aggregate size	19 mm	13 mm
Layer Thickness	50-65 mm	30-45 mm
IS Sieve <sup>1</sup> (mm)	Cumulative % by weight of total aggregate passing	
45		
37.5		
26.5	100	
19	79-100	100
13.2	59-79	79-100

9.5	52-72	70-88
4.75	35-55	53-71
2.36	28-44	42-58
1.18	20-34	34-48
0.6	15-27	26-38
0.3	10-20	18-28
0.15	5-13	12-20
0.075	2-8	4-10
Bitumen content % by mass of total mix <sup>2</sup>	5.0-6.0	5.0-7.0
Bitumen grade (pen)	65	65

Note: 1. The combined aggregate grading shall not vary from the low limit on one sieve to the high limit on the adjacent sieve. 2. Determined by the Marshall method.

**Table 13-15 Requirements for Bituminous Pavement Layer**

Minimum stability (kN at 60°C)	9.0
Minimum flow (mm)	2
Maximum flow (mm)	4
Compaction level (Number of blows)	75 blows on each of the two faces of the specimen
Per cent air voids	3-6
Per cent voids in mineral aggregate (VMA)	See table 13-12A
Per cent filled with bitumen (VFB)	65-75
Loss of stability on immersion in water at 60°C (ASTM D 1075)	Min. 75 per cent retained strength

#### 14.7.4.2 Preparation of base

14.7.4.2.1 The surface on which the bituminous concrete is to be laid shall be prepared in accordance with **Clause 501 and 902** of MoST Specifications for Road and Bridge Works (IV Revision) as appropriate, or as directed by the Engineer. The surface shall be thoroughly swept clean by mechanical broom and dust removed by compressed air. In location where mechanical broom cannot access, other approved method shall be used as directed by Engineer.

#### 14.7.4.3 Geosynthetics

14.7.4.3.1 Where Geosynthetics are specified in the contract this shall be in accordance with the requirements stated in **Clause 703** of MoST Specifications for Road and Bridge Works (IV Revision).

#### 14.7.4.4 Stress absorbing layer

14.7.4.4.1 Where a stress absorbing layer is specified in the Contract, this shall be applied in accordance with the requirements stated in **Clause 522** of MoST Specifications for Road and Bridge Works (IV Revision).

14.7.4.5 Tack coat

14.7.4.5.1 Where specified in the Contract, or otherwise required by the Engineer, a Tack coat shall be applied in accordance with the requirements of **Clause 13.5**

14.7.4.6 Mixing and transportation of the mixture

14.7.4.6.1 The provisions as specified in **Clause 501.3 and 501.4** of MoST Specifications for Road and Bridge Works (IV Revision) shall apply.

14.7.4.7 Spreading

14.7.4.7.1 The general provisions of **Clause 501.5.3 and 501.5.4** of MoST Specifications for Road and Bridge Works (IV Revision) shall apply.

14.7.4.8 Rolling

14.7.4.8.1 The general provisions of **Clause 501.6 and 501.7** of MoST Specifications for Road and Bridge Works (IV Revision) shall apply, as modified by the approved laying trials.

14.7.4.9 Opening to Traffic

14.7.4.9.1 The newly laid surface shall not be open to traffic for at least 24 hours after laying and the completion of compaction, without the express approval of the Engineer in writing.

14.7.4.10 Surface Finish and Quality Control of Work

14.7.4.10.1 The surface finish of the completed construction shall conform to the requirements of **Clause 902** of MoST Specifications for Road and Bridge Works (IV Revision). All materials and workmanship shall comply with the provisions set out in Section 9000 of this Specification.

14.7.4.11 Arrangements for Traffic

14.7.4.11.1 During the period of construction, arrangement of traffic shall be made in accordance with the provisions of **Clause 1.9.2**.

14.7.5 Measurements for Payment – Deleted

14.7.6 Rate – Deleted

**14.8 Cement Concrete Pavement – Deleted**

**14.9 Shoulders, Islands and Median – Deleted**

**14.10  
Concrete Kerb and Kerb with Channel**

**Cement**

## 14.11

### Footpaths and Separators – Deleted

## 14.12 Traffic Signs

### 14.12.1 General

14.12.1.1 The colour, configuration, size and location of all traffic signs for highways other than Expressways shall be in accordance with the Code of Practice for Road signs, IRC: 67 or as shown on the Drawings. For Expressways, the size of the signs, letters and their placement shall be as specified in the Contract Drawings and relevant Specifications. In the absence of any details or for any missing details, the signs shall be provided as directed by the Engineer.

14.12.1.2 The signs shall be either reflectorised or non-reflectorised as shown on the Drawings or as directed by the Engineer. When they are of reflectorised type, they shall be of retroreflectorised type and made of encapsulated lens type reflective sheeting vide **Clause 13.12.3**, fixed over aluminium sheeting as per these Specifications.

14.12.1.3 In general, cautionary and mandatory signs shall be fabricated through process of screen printing. In regard to informatory signs with inscriptions, either the message could be printed over the reflective sheeting, or cut letters of non-reflective black sheeting used for the purpose which must be bonded well on the base sheeting as directed by the Engineer.

### 14.12.2 Materials

14.12.2.1 The various materials and fabrication of the traffic signs shall conform to the following requirements:

14.12.2.1.1 Concrete shall be of the grade shown on the contract Drawings or otherwise as directed by the Engineer. The Specification for materials shall be as per **Chapter 7**.

14.12.2.1.2 Reinforcing steel shall conform to the requirement of IS: 1786 unless otherwise shown on the Drawing.

14.12.2.1.3 High strength bolts shall conform to IS: 1367 whereas precision bolts, nuts, etc., shall conform to IS: 1364.

14.12.2.1.4 Plates and support sections for the sign posts shall conform to IS: 226 and IS: 2062 or any other relevant IS Specifications.

14.12.2.1.5 Aluminium sheets used for sign boards shall be of smooth, hard and corrosion resistant aluminium alloy conforming to IS: 736-Material designation 24345 or 1900.

14.12.2.1.6 Signs with a maximum side dimension not exceeding 600 mm shall not be less than 1.5 mm thick. All other shall be at least 2 mm thick. The thickness of the sheet shall be related to the size of the sign and its support and shall be such that it does not bend or deform under the prevailing wind and other loads.

14.12.2.1.7 In respect of sign sizes not covered by IRC: 67, the structural details (thickness, etc) shall be as per the approved Drawings.

14.12.3 Traffic Signs Having Retro-reflective Sheeting

14.12.3.1 General requirements

14.12.3.1.1 The retro-reflective sheeting used on the sign shall consist of the white or coloured sheeting having a smooth outer surface which has the property of retro-reflection over its entire surface. It shall be weather-resistant and show colour fastness. It shall be new and unused and shall show no evidence of cracking, scaling, pitting, blistering, edge lifting or curling and shall have negligible shrinkage or expansion. A certificate of having tested the sheeting for these properties in an unprotected outdoor exposure facing the sun for two years and its having passed these tests shall be obtained from a reputed laboratory, by the manufacturer of the sheeting. The reflective sheeting shall be either of Engineering Grade material with enclosed lens or of High Intensity Grade with encapsulated lens. The type of the sheeting to be used would depend upon the type, functional hierarchy and importance of the road.

14.12.3.2 High intensity grade sheeting

14.12.3.2.1 This sheeting shall be of encapsulated lens type consisting of spherical glass lens, elements adhered to a synthetic resin and encapsulated by a flexible, transparent waterproof plastic having a smooth surface. The retro-reflective surface after cleaning with soap and water and in dry condition shall have the minimum co-efficient of retro-reflection (determined in accordance with ASTM Standard E: 810) as indicated in Table 13-18.

**Table 13-18: Acceptable Minimum Coefficient of Retro-Reflection for High Intensity Grade Sheeting (Candelas Per Lux Per Square Metre)**

Observation Angle (in °)	Entrance Angle (in °)	White	Yellow	Orange	Green/Red	Blue
0.2	-4	250	170	100	45	20
0.2	+30	150	100	60	25	11
0.5	-4	95	62	30	15	7.5
0.5	+30	65	45	25	10	5.0

14.12.3.2.2 When totally wet, the sheeting shall not show less than 90 per cent of the values of retroreflectance indicated in Table 13.18. At the end of 7 years, the sheeting shall retain at least 75 per cent of its original retro-reflectance.

14.12.3.3 Engineering grade sheeting

14.12.3.3.1 This sheeting shall be enclosed lens type consisting of microscope lens elements embedded beneath the surface of a smooth, flexible, transparent, water-proof plastic, resulting in a nonexposed lens optical reflecting system. The retro-reflective surface after cleaning with soap and water and in dry condition shall have the minimum coefficient of retro-reflection (determined in accordance with ASTM Standard: E-810) as indicated in Table 13-19.

**Table 13.19: Acceptable Minimum Coefficient of Retro-Reflection for Engineering Grade Sheeting (Candelas Per Lux Per Square Metre)**

Observation Angle (in °)	Entrance Angle (in °)	White	Yellow	Orange	Green	Red	Blue
0.2	-4	70	50	25	9.0	14.5	4.0
0.2	+30	30	22	7.0	3.5	6.0	1.7
0.5	-4	30	25	13.5	4.5	7.5	2.0
0.5	+30	15	13	4.0	2.2	3.0	0.8

14.12.3.3.2 When totally wet, the sheeting shall not show less than 90 per cent of the values, of retroreflection included in Table 13.19. At the end of 5 years, the sheeting shall retain at least 50 per cent of its original retro-reflectance.

14.12.3.4 Messages / borders

14.12.3.4.1 The messages (legends, letters, numerals etc.,) and borders shall either be screen-printed or of cut-outs. Screen printing shall be processed and finished with materials and in a manner specified by the sheeting manufacturer. Cut-outs shall be of materials as specified by the sheeting manufacturer and shall be bonded with the sheeting in the manner specified by the manufacturer.

14.12.3.5 For screen-printed transparent coloured areas on white sheeting, the co-efficient of retroreflection shall not be less than 50 percent of the values of corresponding colour in Tables 1318 and 13-19, as applicable.

14.12.3.6 Cut-out messages and borders, wherever used, shall be made out of retro-reflective sheeting (as per **Clause 13.12.2 or 13.12.3.** as applicable), except those in black which shall be of non-reflective sheeting.

14.12.3.7 Colour

14.12.3.7.1 Unless otherwise specified, the general colour scheme shall be as stipulated in IS: 5 “ Colour for Ready Mixed Paints”, viz.,

Blue	-	IS	Colour	No.166: French Blue
Red	-	IS	Colour	No.537: Signal Red
Green	-	IS	Colour	No.284: India Green
Orange	-	IS	Colour	No.591: Deep Orange.

14.12.3.7.2 The Colours shall be durable and uniform in acceptable hue when viewed in day light or under normal headlights at night.

14.12.3.8 Adhesives

14.12.3.8.1 The sheeting shall either have a pressure-sensitive adhesive of the aggressive-tack type requiring no heat, solvent or other preparation for adhesion to a smooth clean surface, or a tack free adhesive activated by heat, applied in a heat-vacuum applicator, in a manner recommended by the sheeting manufacturer. The adhesive shall be protected by an easily removable liner (removable by peeling without soaking in water or

other solvent) and shall be suitable for the type of material of the base plate used for the sign. The adhesive shall form a durable bond to smooth, corrosion and weather resistant surface of the base plate such that it shall not be possible to remove the sheeting from the sign base in one piece by use of sharp instrument. In case of pressure-sensitive adhesive sheeting, the sheeting shall be applied in accordance with the manufacturer's Specifications. Sheeting with adhesives requiring use of solvents or other preparation for adhesive shall be applied strictly in accordance with the manufacturer's instructions.

#### 14.12.3.9 Refurbishment

14.12.3.9.1 Where existing signs are specified for refurbishment, the sheeting shall have a semi-rigid aluminium backing pre-coated with aggressive-tack type pressure sensitive adhesive. The adhesive shall be suitable for the type of material used for the sign and should thoroughly bond with that material.

#### 14.12.3.10 Fabrication

14.12.3.10.1 Surface to be reflectorised shall be effectively prepared to receive the retro-reflective sheeting. The aluminium sheeting shall be de-greased either by acid or hot alkaline etching and all scale/dust removed to obtain a smooth plain surface before the application of retroreflective sheeting. If the surface is rough, approved surface primer may be used. After cleaning, metal shall not be handled, except by suitable device or clean canvas gloves, between all cleaning and preparation operation and application of reflective sheeting/primer. There shall be no opportunity for metal to come in contact with grease, oil or other contaminants prior to the application of retro-reflective sheeting.

14.12.3.10.2 Complete sheets of the material shall be used on the signs except where it is unavoidable; at splices, sheeting with pressure sensitive adhesives shall be overlapped not less than 5 mm. Sheeting with heat-activated adhesives may be spliced with an overlap not less than 5 mm or butted with a gap not exceeding 0.75 mm. Where screen printing with transparent colours is proposed, only butt jointing shall be used. The material shall cover the sign surface evenly and shall be free from twists, cracks and folds. Cut-outs to produce legends and borders shall be bonded with the sheeting in the manner specified by the manufacturer.

#### 14.12.3.11 Warranty and durability

14.12.3.11.1 The Contractor shall obtain from the manufacturer a seven-year warranty for satisfactory field performance including stipulated retro-reflectance of the retro-reflective sheeting of high intensity grade and a five year warranty for the adhesive sheeting of engineering grade and submit the same to the Engineer. In addition, a seven year and a five year warranty for satisfactory in-field performance of the finished sign with retro-reflective sheeting of high intensity grade and engineering grade respectively, inclusive of the screen printed or cut out letters/legends and their bonding to the retro-reflective sheeting shall be obtained from the Contractor/supplier and passed on to the Engineer. The Contractor/supplier shall also furnish a certification that the signs and materials supplied against the assigned work meets all the stipulated requirements and carry the stipulated warranty.

14.12.3.11.2 Processed and applied in accordance with recommended procedures, the reflective material shall be weather resistant and, following cleaning, shall show no appreciable discolouration, cracking, blistering or dimensional change and shall not have less than 50 percent of the specified minimum reflective intensity values (Tables 13-18 and 13-19)



when subjected to accelerated weathering for 1000 hours, using type E or EH Weatherometer (AASHTO Designation M 268).

#### 14.12.4 Installation

14.12.4.1 Sign posts, their foundations and sign mountings shall be so constructed as to hold these in a proper and permanent position against the normal storm wind loads or displacement by vandalism. Normally, signs with an area upto 0.9 sqm. shall be mounted on a single post, and for greater area two or more supports shall be provided. Sign supports may be of mild steel, reinforced concrete or galvanised iron (G.I.) Post-end(s) shall be firmly fixed to the ground by means of properly designed foundation. The work of foundation shall conform to relevant Specifications as specified.

14.12.4.2 All components of signs and supports, other than the reflective portion and G.I. posts below ground shall be thoroughly descaled, cleaned, primed and painted with two coats of epoxy paint. Any part of mild steel (M.S.) post below ground shall be painted with three coats of red lead paint.

14.12.4.3 The signs shall be fixed to the posts by welding in the case of steel posts and by bolts and washers of suitable size in the case of reinforced concrete or G.I. posts. After the nuts have been tightened, the tails of the bolts shall be furred over with a hammer to prevent removal.

#### 14.12.5 Measurements for Payment

14.12.5.1 The measurements of standard cautionary, mandatory and information signs shall be in numbers of different types of signs supplied and fixed, while for direction and place identification signs, these shall be measured by area in square metres.

#### 14.12.6 Rate

14.12.6.1 The Contract unit rate shall be payment in full for the cost of making the road sign, including all materials, installing it at the site and incidentals to complete the work in accordance with the Specifications.

<b>14.13</b> <b>Signs - Deleted</b>	<b>Overhead</b>
<b>14.14</b> <b>Markings - Deleted</b>	<b>Road</b>
<b>14.15</b> <b>Kilometre Stones - Deleted</b>	<b>Hectometre /</b>
<b>14.16</b> <b>Delineators - Deleted</b>	<b>Road</b>
<b>14.17</b> <b>Boundary Stones - Deleted</b>	
<b>14.18</b> <b>Road Traffic Signals - Deleted</b>	
<b>14.19</b> <b>over Granular Base</b>	<b>Prime Coat</b>

#### 14.19.1 Scope

14.19.1.1 This work shall consist of application of single coat of low viscosity liquid bituminous material to a porous granular surface preparatory to the superimposition of bituminous treatment or mix.

#### 14.19.2 Materials

##### 14.19.2.1 Primer

14.19.2.1.1 The choice of a bituminous primer shall depend upon the porosity characteristics of the surface to be primed as classified in IRC: 16. These are:

1. Surfaces of low porosity; such as wet mix macadam and water bound macadam,
2. Surfaces of medium porosity; such as cement stabilized soil base,
3. Surfaces of high porosity; such as a gravel base.

##### 14.19.2.2 Primer viscosity

14.19.2.2.1 The type and viscosity of the primer shall comply with the requirements of IS 8887, as sampled and tested for bituminous primer in accordance with these standards. Guidance on viscosity and rate of spray is given in Table 13-22.

**Table 13-22 Viscosity Requirement and Quantity of Bituminous Primer**

Type of surface	Kinematic Viscosity of Primer at 60° C (Centistokes)	Quantity of Liquid Bituminous Material per 10 sq. m. (Kg)
Low porosity	30-60	6 to 9
Medium porosity	70-140	9 to -12
High porosity	250-500	12 to 15

##### 14.19.2.3 Choice of primer

14.19.2.3.1 The primer shall be bitumen emulsion, complying with IS 8887 of a type and grade as specified in the contract or as directed by the Engineer. The use of medium curing cutback as per IS 217 shall be restricted only for sites at sub zero temperatures or for emergency as directed by the Engineer.

#### 14.19.3 Weather and Seasonal Limitations

14.19.3.1 The bituminous primer shall not be applied on a wet surface (see 13.19.4.2) or during dust storm or when the weather is foggy, rainy or windy or when the temperature in the shade is less than 10° C. Surfaces which are to receive emulsion primer should be damp, but no free or standing water shall be present.

#### 14.19.4 Construction

##### 14.19.4.1 Equipment

14.19.4.1.1 The primer distributor shall be a self-propelled or towed bitumen pressure sprayer equipped for spraying the material uniformly at specified rates and temperatures. Hand spraying of small areas inaccessible to the distributor, or in narrow strips shall be sprayed with a pressure hand sprayer, or as directed by the Engineer. By manual methods may be allowed for small areas at the discretion of the Engineer.

14.19.4.2 Preparation of road surface

14.19.4.2.1 The surface to be primed shall be prepared in accordance with **Clause 13.4 and Clause 902** of MoST Specifications for Road and Bridge Works (IV Revision) appropriate. Immediately prior to applying the primer the surface shall be carefully swept clean of dust and loose particles, care being taken not to disturb the interlocked aggregate. This is best achieved when the surface layer is slightly moist (lightly sprayed with water and the surface allowed to dry) and the surface should be kept moist until the primer is applied.

14.19.4.3 Application of bituminous primer

14.19.4.3.1 The viscosity and rate of application shall be as specified in the contract. or as determined by site trials carried out as directed by the Engineer. Where geosynthetic is proposed for use, the requirement of **Clauses 703.3.2 and 703.4** of MoST Specifications for Road and Bridge Works (IV Revision) shall apply. The bituminous primer shall be sprayed uniformly in accordance with **Clause 501** of MoST Specifications for Road and Bridge Works (IV Revision). The method of application of the primer will depend on the type of equipment to be used, size of nozzle, pressure at the spray bar and speed of forward movement. The

contractor shall demonstrate at a spraying trial that the equipment and method to be used is capable of producing a uniform spray, with in the tolerance specified

14.19.4.4 Curing of primer and opening to traffic

14.19.4.4.1 A primed surface shall be allowed to cure for at least 24 hours or such other period as is found to be necessary to allow all the volatile to evaporate before any subsequent surface treatment or mix is laid. Any un absorbed primer shall first be blotted with an application of sand, using the minimum quantity possible. A primed surface shall not be opened to traffic other than that necessary to lay the next course. A very thin layer of clean sand may be applied to the surface of the primer, to prevent the primer picking up under the wheels of the paver and the trucks delivering bituminous material to the paver.

14.19.4.5 Tack Coat

14.19.4.5.1 Over the primed surface a tack coat should be applied in accordance with **Clause 13.5**.

14.19.5 Quality control of work

14.19.5.1 For control of the quality of materials supplied and the works carried out, the relevant provision of Section **900** of MoST Specifications for Road and Bridge Works (IV Revision) Shall apply.

14.19.6 Arrangement for Traffic

14.19.6.1 During the construction operations, arrangement of traffic shall be done as per **Clause 1.9.2**.

14.19.7 Measurements for Payment - Deleted

14.19.8 Rate - Deleted

**14.20 Bituminous Macadam**

14.20.1 Scope

14.20.1.1 The work shall consist of construction, in a single course having 50mm to 100mm thickness or in multiple courses of compacted crushed aggregates premixed with a bituminous binder on a previously prepared base to the requirements of these Specifications. Bituminous macadam is more open graded than the dense graded bituminous materials described in **Clauses 13.6 and 13.7 and 508** of MoST Specifications for Road and Bridge Works (IV Revision).

14.20.2 Materials

14.20.2.1 Bitumen

14.20.2.1.1 The bitumen shall be paving bitumen of Penetration Grade complying with Indian Standard Specifications for "Paving Bitumen" IS: 73, and of the penetration indicated in Table 13-24.

14.20.2.2 Coarse aggregates

14.20.2.2.1 The coarse aggregates shall consist of crushed stone, crushed rock, crushed gravel or other hard material retained on the 2.36 mm sieve. They shall be clean, hard, durable, of cubical shape, free from dust and soft friable matter organic or other deleterious matter. Where the Contractor's selected source of aggregates have poor affinity for bitumen, as a condition for the approval of that source, the bitumen shall be treated with anti-stripping agents, as per manufacturer's recommendations, without additional payment. Before approval of the source, the aggregates shall be tested for stripping.

14.20.2.2.2 The aggregates shall satisfy the physical requirements set forth in Table 13-23.

14.20.2.2.3 Where crushed gravel is proposed for use as aggregate, not less than 90% by weight of the crushed material retained on the 4.75 mm sieve shall have at least two fractured faces.

**Table 13-23: Physical Requirements for Coarse Aggregates for Bituminous Macadam**

Property	Test	Specifications
Cleanliness	Grain size Analysis <sup>1</sup>	Max. 5% passing 0.075mm sieve
Particle Shape	Flakiness and elongation Index (Combined) <sup>2</sup>	Max. 30 %
Strength*	Los Angeles Abrasion Value <sup>3</sup> Aggregate Impact Value <sup>3</sup>	Max. 40 % Max. 30 %
Durability	Soundness <sup>4</sup> Sodium Sulphate Magnesium Sulphate	Max. 12 % Max. 18 %
Water Absorption	Water Absorption <sup>5</sup>	Max. 2%

Stripping	Coating and stripping of Bitumen Aggregate Mixtures <sup>6</sup>	Minimum retained coating 95 %
Water Sensitivity <sup>7</sup>	Retained Tensile Strength	Minimum 80 %

Notes 1. IS 2386 Part 1

4. IS 2386 Part 5 2.

(the elongation test to be done only on non-flaky aggregate in the sample)

3. IS 2386 Part 4\* 6. IS 6241

7. The water sensitivity test is only required if the minimum retained coating in the stripping test is less than 95 %

\* Aggregates may satisfy requirement of either of these two tests.

#### 14.20.2.3 Fine aggregates

14.20.2.3.1 Fine aggregates shall consist of crushed or naturally occurring material, or a combination of the two, passing 2.36 mm sieve and retained on 75 micron sieve. They shall be clean, hard, durable, dry and free from dust, and soft or friable matter, organic or other deleterious matter.

#### 14.20.2.4 Aggregate grading and binder content

14.20.2.4.1 When tested in accordance with IS: 2386 Part 1 (wet sieving method), the combined aggregate grading for the particular mixture shall fall within the limits shown in Table 13-24 for the grading specified in the Contract. The type and quantity of bitumen, and appropriate thickness, are also indicated for each mixture type.

#### 14.20.2.5 Proportioning of materials

14.20.2.5.1 The aggregates shall be proportioned and blended to produce a uniform mixture complying with the requirements of Table 13-24. The binder content shall be within a tolerance of  $\pm 0.3$  per cent by weight of total mixture when individual specimens are taken for quality tests in

accordance with the provisions of **Section 900** of MoST Specifications for Road and Bridge Works (IV Revision).

**Table 13-24: Composition of Bituminous Macadam**

Mix designation	Grading 1	Grading 2
Nominal aggregate size	40 mm	25 mm
Layer Thickness	80-100 mm	50-75 mm
IS Sieve <sup>1</sup> (mm)	Cumulative % by weight of total aggregate passing	
45	100	
37.5	90-100	
26.5	75-100	100
19	-	90-11
13.2	35-61	56-88

4.75	13-22	16-36
2.36	4-19	4-19
0.3	2-10	2-10
0.075	0-8	0-8
Bitumen content % by weight of total mixture <sup>1</sup>	3.1-3.4	3.3-3.5
Bitumen grade	35 or 90	35 or 90

Note: 1. Appropriate bitumen contents for conditions in the cooler areas of India may be up to 0.5% higher subject to the approval of Engineer.

#### 14.20.3 Construction Operations

##### 14.20.3.1 Weather and seasonal limitations

14.20.3.1.1 The provisions of **Clause 501.5.1** of MoST Specifications for Road and Bridge Works (IV Revision) shall apply.

##### 14.20.3.2 Preparation of the base

14.20.3.2.1 The base on which bituminous macadam is to be laid shall be prepared, shaped and compacted to the required profile in accordance with **Clause 13.4 and Clause 902.3** of MoST Specifications for Road and Bridge Works (IV Revision) as appropriate, and a prime coat, shall be applied in accordance with **Clause 13.19** where specified, or as directed by the Engineer.

##### 14.20.3.3 Tack coat

14.20.3.3.1 A tack coat in accordance with **Clause 13.5** shall be applied as required by the Contract documents, or as directed by the Engineer.

##### 14.20.3.4 Preparation and transportation of mixture

14.20.3.4.1 The provisions of **Clause 501.3 and 501.4** of MoST Specifications for Road and Bridge Works (IV Revision) shall apply.

##### 14.20.3.5 Spreading

14.20.3.5.1 The provisions of **Clause 501.5.3** of MoST Specifications for Road and Bridge Works (IV Revision) shall apply.

**Table 13-24A: Manufacturing and Rolling Temperatures**

Bitumen Penetration	Bitumen Mixing (°C)	Aggregate Mixing (°C)	Mixed Material (°C)	Rolling (°C)	Laying (°C)
35	160-170	160-175	170 Maximum	100 Minimum	130 Minimum
65	150-165	150-170	165 Maximum	90 Minimum	125 Minimum

90	140-160	140-165	155 Maximum	80 Minimum	115 Minimum
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14.20.4 Rolling

14.20.4.1.1 Compaction shall be carried out in accordance with the provisions of **Clause 501.6 nd 501.7** of MoST Specifications for Road and Bridge Works (IV Revision).

14.20.4.1.2 Rolling shall be continued until the specified density is achieved, or where no density is specified, until there is no further movement under the roller. The frequency of testing is defined in **Clause 903** of MoST Specifications for Road and Bridge Works (IV Revision).

14.20.5 Surface Finish and Quality Control of Work

14.20.5.1 The surface finish of completed construction shall conform to the requirements of **Clause 902** of MoST Specifications for Road and Bridge Works (IV Revision). For control of the quality of materials supplied and the works carried out, the relevant provisions of **Section 900** of MoST Specifications for Road and Bridge Works (IV Revision).

14.20.6 Protection of the Layer

14.20.6.1 The bituminous macadam shall be covered with either the next pavement course or wearing course, as the case may be, within a maximum of forty-eight hours. If there is to be any delay, the course shall be covered by a seal coat to the requirement of **Section 513** of MoST Specifications for Road and Bridge Works (IV Revision) before opening to any traffic. The seal coat in such cases shall be considered incidental to the work and shall not be paid for separately.

14.20.7 Arrangements of Traffic

14.20.7.1 During the period of construction, arrangement of traffic shall be made in accordance with the provisions of **Clause 1.9.2**.

14.20.8 Measurements for Payment

14.20.8.1 Bituminous macadam shall be measured as finished work in cubic metres, or by weight in metric tones, where used as regulating course, or square meters at the specified thickness as indicated in the Contract or shown on the drawings, or as otherwise directed by the Engineer.

14.20.9 Rate

14.20.9.1 The contract unit rate for bituminous macadam shall be payment in full for carrying out the required operations as specified. The rate shall include for, all components listed in **Clause 13.4.8.2 (i) to (xi)**.

**14.21 Close-Graded Premix Surfacing / Mixed Seal Surfacing**

14.21.1 Scope

14.21.1.1 This work shall consist of the preparation, laying and compaction of a close-graded premix surfacing material of 20 mm thickness composed of graded aggregate premixed

with a bituminous binder on a previously prepared surface, in accordance with the requirements of these Specifications, to serve as a wearing course.

14.21.1.2 Close graded premix surfacing shall be of Type A or Type B as specified in the Contract document.

14.21.2 Materials

14.21.2.1 Binder

14.21.2.1.1 The provisions of **Clause 511.1.2.1** of MoST Specifications for Road and Bridge Works (IV Revision) shall apply.

14.21.2.2 Course aggregates

14.21.2.2.1 The provisions of **Clause 511.1.2.2** of MoST Specifications for Road and Bridge Works (IV Revision) shall apply.

14.21.2.3 Fine aggregates

14.21.2.3.1 The fine aggregates shall consist of crushed rock quarry sands, natural gravel/ sand or a mixture of both. These shall be clean, hard, durable, un-coated, mineral particle, dry and free from injurious, soft or flaky particles and organic or deleterious substances.

14.21.2.4 Aggregate gradation

14.21.2.4.1 The coarse and fine aggregates shall be so graded or combined as to conform to one or the other grading shown in Table 13-25, as specified in the contract document.

**Table 13-25: Aggregates Gradation**

IS Sieve Designation	Cumulative per cent by weight of total aggregate passing	
	Type A	Type B
13.2 mm	-	100
11.2 mm	100	88-100
5.6 mm	52-88	31-52
2.8 mm	14-38	5-25
0.09 mm	0-5	0-5

14.21.2.5 Proportioning of materials

14.21.2.5.1 The total quantity of aggregates used for Type A or B close-graded premix surfacing shall be 0.27 cubic meter per 10 sqm area. The quantity of binder used for premixing in terms of straight-run bitumen shall be 22.0 kg and 19.0 kg per 10 square metres area for Type A and Type B surfacing respectively.

14.21.3 Construction Operations

14.21.3.1 The provisions of **Clause 511.1.3.1 through 511.1.3.5** of MoST Specifications for Road and Bridge Works (IV Revision) shall apply.



14.21.4 Opening to Traffic

14.21.4.1 Traffic may be allowed after completion of the final rolling when the mix has cooled down to the surrounding temperature. Excessive traffic speeds should not be permitted.

14.21.5 Surface Finish and Quality Control of Work

14.21.5.1 The surface finish of construction shall conform to the requirements of **Clause 902** of MoST Specifications for Road and Bridge Works (IV Revision). For control on the quality of materials supplied and the works carried out, the relevant provisions of **Section 900** of MoST Specifications for Road and Bridge Works (IV Revision) shall apply.

14.21.6 Arrangements for Traffic

14.21.6.1 During the period of construction, arrangement for traffic shall be in accordance with the provisions of **Clause 1.9.2**.

14.21.7 Measurements for Payment - Deleted

14.21.8 Rate - Deleted

**15 PIPE CULVERTS - Deleted**

**16 MANUFACTURING / SUPPLYING LAYING AND JOINTING OF PIPES**

**16.1 Reinforced Cement Concrete (RCC) Pipes**

16.1.1 Scope

16.1.1.1 This Specification covers the requirements for manufacturing, testing, supplying, jointing and, testing at work sites, of Reinforced Cement Concrete (RCC) pipes, of both pressure and non pressure varieties used for pumping mains, sewers and storm water drains.

16.1.2 Applicable Codes

16.1.2.1 The manufacturing, testing, supplying, jointing and testing at work sites of RCC pipes shall comply with all currently applicable statutes, regulations, standards and Codes. In particular, the following standards, unless otherwise specified herein, shall be referred. In all cases, the latest revision of the Codes shall be referred to. If requirements of this Specification conflict with the requirements of the Codes and standards, this Specification shall govern.

16.1.3 Materials

IS: 458	Specification for Concrete Pipes (with and Without Reinforcement).
IS: 3597	Method of Tests for Concrete Pipes.
IS: 5382	Specification for Rubber Sealing Rings for Gas Mains, Water Mains and Sewers.

16.1.3.1 Codes of practice

IS: 456	Code of Practice for Plain and Reinforced Concrete.
IS: 783	Code of Practice for Laying of Concrete Pipes.

16.1.4 Design

Design of RCC pipes shall be in accordance with the relevant clauses of IS: 454.  
The details of reinforcement shall be as per Clause 5.2 of IS: 458.  
The ends of pipes shall be in accordance with relevant clauses of IS: 458.

16.1.5 Manufacturing

16.1.5.1 General

1. The method of manufacture shall be such that the form and the dimensions of the finished pipes are accurate within the limits specified in relevant IS: 458. The surfaces and edges of the pipes shall be well defined and true, and their ends shall be square with the longitudinal axis. The ends of the pipes shall be further reinforced by an extra ring of reinforcement to avoid breakage during transportation.
2. The RCC pipes and collars / rubber rings shall be systematically checked for any manufacturing defects by experienced supervisors so as to maintain a high standard of quality.
3. Engineer shall at all reasonable times have free access to the places where the pipes and collars / rubber rings are manufactured for the purpose of examining and testing the pipes and collars / rubber rings and of witnessing the test and manufacturing.
4. All tests specified either in this Specification or in the relevant Indian Standards shall be performed by Supplier / Contractor at his own cost and in presence of Engineer if desired.  
for this, sufficient notice before testing of the pipes shall be given to Engineer.
5. If the test is found unsatisfactory, Engineer may reject any or all pipes of that lot. The decision of Engineer in this matter shall be final and binding on Contractor and not subject to any arbitration or appeal.

16.1.5.2 Materials

Materials should conform to the requirements given in **Chapter 7**.

16.1.5.3 Curing

Pipes manufactured in compliance with IS: 458 shall be either water cured or steam cured in accordance with the relevant requirements of IS: 458.

16.1.5.4 Dimensions

1. The internal diameter, wall thickness and length of barrel and collar of pipes, reinforcement (longitudinal and spiral), type of ends and minimum clear cover to

reinforcement and strength test requirements shall be as per the relevant clauses / tables of IS: 458 for different class of pipes.

2. The tolerances regarding overall length, internal diameter of pipes or socket and barrel wall thickness shall be as per relevant clauses of IS: 458.

#### 16.1.5.5 Workmanship and finish

1. Pipes shall be straight and free from cracks except that craze cracks may be permitted. The ends of the pipes shall be square with their longitudinal axis so that when placed in a straight line in the trench no opening between ends in contact shall exceed 3 mm in pipes upto 600 mm diameter (inclusive), and 6 mm in pipes larger than 600 mm diameter.
2. The outside and inside surfaces of the pipes shall be smooth, dense and hard, and shall not be coated with cement wash or other preparation unless otherwise agreed to between Engineer and the manufacturer or supplier.
3. The pipes shall be free from defects resulting from imperfect grading of the aggregate, mixing or moulding.
4. The pipes shall be free from local dents or bulges greater than 3.00 mm in depth and extending over a length in any direction greater than twice the thickness of barrel.
5. The deviation from straight in any pipes throughout its effective length, tested by means of a rigid straight edge parallel to the longitudinal axis of the pipe shall not exceed, for all diameters, 3 mm for every metre run.

#### 16.1.6 Testing

- 16.1.6.1 All pipes for testing purposes shall be selected at random from the stock of the manufacturer and shall be such as would not otherwise be rejected under the criteria of tolerances as mentioned in IS: 458.
- 16.1.6.2 During manufacture, tests on concrete shall be carried out as per IS: 456. The manufacturer shall supply, when required to do so by Engineer the results of compressive tests of concrete cylinders or cubes made from the concrete used for the pipes. Every pressure pipe shall be tested by the manufacturer for the hydrostatic test pressure.
- 16.1.6.3 The specimen of pipes for the following tests shall be selected in accordance with **Clause 9.1** of IS: 458 and tested in accordance with the methods described in IS: 3597:
  1. Hydrostatic test.
  2. Three edge bearing test or sand bearing test.
  3. Absorption test.
  4. Bursting test.

*Note: Three edge bearing strength to produce 0.25 mm crack in case of special design of pipes shall be as follows:*

300 mm Ø	1200 kg/m
350 mm Ø	3040 kg/m
400 mm Ø	3460 kg/m
450 mm Ø	4160 kg/m
500 mm Ø	4160 kg/m
600 mm Ø	4720 kg/m
700 mm Ø	5320 kg/m
800 mm Ø	6060 kg/m
900 mm Ø	6760 kg/m
1000 mm Ø	7400 kg/m
1100 mm Ø	8200 kg/m

#### 16.1.7 Sampling and inspection

- 16.1.7.1 In any consignment, all the pipes of same class and size and manufactured under similar conditions of production shall be grouped together to constitute a lot. The conformity of a lot to the requirements of this Specification shall be ascertained on the basis of tests on pipes selected from it.
- 16.1.7.2 The number of pipes to be selected from the lot shall be in accordance with column 1 and 2 of Table 9 of IS: 458.
- 16.1.7.3 Pipes shall be selected at random. In order to ensure randomness, all the pipes in the lot may be arranged in a serial order and starting from any pipe, every “r th” pipe be selected till the requisite number is obtained, “r” being the integral part of  $N/n$  where “N” is the lot size and “n” is the sample size.
- 16.1.7.4 All the pipes selected as per **Clause 15.1.7.3** shall be inspected for dimensional requirements, finish and deviation from straight.
- 16.1.7.5 The number of pipes to be tested for tests under **Clause 15.1.6.3** shall be in accordance with column of Table 9 of IS: 458. These pipes shall be selected from pipes that have satisfied the requirements mentioned in **Clause 15.1.7.4**
- 16.1.7.6 A lot shall be considered as conforming to the requirements of IS: 458 if the following conditions are satisfied.
1. The number of defective pipes (those not satisfying one or more of the requirements for dimensions, finish and deviation from straight) shall not be more than the permissible number given in Column 3 of Table 9 of IS: 458.
  2. All the pipes tested for various tests as per **Clause 15.1.6.3** shall satisfy corresponding requirements of the tests.
  3. In case the number of pipes not satisfying requirements of any one or more tests, one or two further sample of same size shall be selected and tested for the test or tests in which failure has occurred. All these pipes shall satisfy the corresponding requirements of the test.

#### 16.1.8 Marking

- 16.1.8.1 The following information shall be clearly marked on each pipe:
1. Internal diameter of pipe.

2. Class of pipe.
3. Date of manufacture, and
4. Name of manufacturer or his registered trademark or both.

16.1.9 Laying

- 16.1.9.1 Laying of pipe shall conform to **Clause 15.7**.

16.1.10 Jointing

- 16.1.10.1 Jointing of RCC pipes shall be done as per the requirements of following Specifications and as per the relevant IS. The type of joints shall be as specified in the Contract / Drawing. After jointing extraneous material if any, shall be removed from the inside of the pipe and newly made joints shall be thoroughly cured. In case, rubber sealing rings are used for jointing, these shall conform to IS: 5382.

16.1.10.2 Spigot and Socket Joint (Rigid)

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 1:1, which shall be rammed with caulking tool.

16.1.10.3 Collar Joint (Rigid)

After laying the RCC pipes at proper alignment and gradient their abutting faces shall be coated with hot bitumen in liquid condition by means of a brush. The wedge-shaped groove in the end of the pipe shall then be filled with a tarred gasket in one length for each joint. The collar shall then be slipped over the end of the pipe and the next pipe butted well against the tarred gasket by suitable appliances approved by Engineer so as to thoroughly compress the tarred gasket into the grooves, care being taken that the concentricity of the pipes and levels are not disturbed during this operation. The collar shall then be placed symmetrically over the end of the two pipes and the space between the inside of the collar and the outside of the pipe filled with a mixture of cement and sand in the proportion of 1:1, tempered with just sufficient water to have a consistency of the semi dry conditions, well packed and thoroughly rammed with caulking tools. The joints shall be finished off with a filled sloping at 45° to the side of the pipe. The finished joints shall be protected and cured thoroughly as directed by Engineer. Any plastic solution or cement mortar that may have been squeezed into the inside of the pipe shall be removed so as to leave the inside of the pipe perfectly clean.

16.1.10.4 Spigot and Socket Joint (Semi-flexible)

This joint is composed of specially shaped spigot and socket ends on the RCC pipes. A rubber ring, shall be lubricated and then placed on the spigot which is 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 socket, stiff mixture of cement and mortar in the proportion of 1:1, shall then be filled into the remaining annular space and rammed with a caulking tool.

16.1.10.5 Collar Joint (Semi-flexible)

This joint is made up of a loose collar which covers two specially shaped pipe ends. Each end shall be fitted with a rubber ring, which when compressed between the spigot and collar, seal the joint. Stiff mixture of cement mortar in the proportion of 1:1, shall then be filled into the remaining annular space and rammed with a caulking tool.

16.1.10.6 Spigot and Socket Joint (Flexible)

The RCC pipe with the rubber ring accurately positioned on the spigot shall be pushed well home into the socket of the previously laid pipes. The manufacturers instructions shall be used, and the manufacturers instructions shall be deemed to form a part of this Specifications. The rubber rings shall be lubricated before making the joint and the lubricant shall be soft soap water or an approved lubricant supplied by the manufacturer.

16.1.10.7 Flush Joint (Internal)

This joint shall be generally used for culvert pipe of 60 cm. diameter and over. The ends of the pipes are specially shaped to form a self-centering joint with an internal jointing spaces 1.3 cm wide. The finished joint is flush with both inside and outside with the pipe wall. The jointing space is filled with cement mortar in the proportion of 1:1, mixed sufficiently dry to remain in position when forced with a trowel or rammer.

16.1.10.8 Flush Joint (External)

This joint is suitable for pipes which are too small for jointing from inside. This joint is composed of specially shaped pipe ends. Each end shall be butted against the other and adjusted in correct position. The jointing space shall then be filled with cement mortar in the proportion of 1:1, sufficiently dried 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.

16.1.11 Cleaning of pipes

16.1.11.1 As soon as a stretch of RCC pipes has been laid complete from manhole to manhole or for a stretch as directed by Engineer, Contractor shall run through the pipes both backwards and forwards a double disc or solid or closed cylinder 75 mm less in diameter than the internal diameter of pipes. The open end of an incomplete stretch of pipe line shall be securely closed as may be directed by Engineer to prevent entry of mud or slit etc.

16.1.11.2 If as a result of the removal of any obstruction, Engineer considers that damages may have been caused to the pipe lines, he shall be entitled to order the stretch to be tested immediately. Should such test prove unsatisfactory Contractor shall amend the work and carry out such further tests as are required by Engineer.

16.1.11.3 It shall also be ascertained by Contractor that each stretch from manhole to manhole or the stretch as directed by Engineer is absolutely clear and without any obstruction by means of visual examination of the interior of the pipeline suitably enlightened by projected sunlight or otherwise.

16.1.12 Testing at work site

16.1.12.1 After laying and jointing of RCC pipes is completed the pipe line shall be tested at work site as per the following Specifications and as directed by Engineer. All equipment for

testing at work site shall be supplied and erected by the Contractor and shall be rectified by him / her to the full satisfaction of Engineer. Water used for test shall be removed from pipes and not released to the excavated trenches.

- 16.1.12.2 After the joints have thoroughly set and have been checked by Engineer and before backfilling the trenches, the entire section of the sewer (or storm water drain) shall be proved by Contractor to be water tight by filling in pipes with water to the level of 1.50 m. above the top of the highest pipe in the stretch and heading the water up for the period of one hour. The apparatus used for the purpose of testing shall be approved by Engineer. Contractor if required by Engineer shall dewater the excavated pit and keep it dry during the period of testing. The loss of water over a period of 30 minutes should be measured by adding water from a measuring vessel at regular 10 minutes intervals and noting the quantity required to maintain the original water level. For the approval of this test the average quantity added should not exceed 1 litre / hour / 100 linear metres / 10 mm nominal internal diameter. Any leakage including excessive sweating which causes a drop in the test water level will be visible and the defective part of the work should be removed and made good.
- 16.1.12.3 In case of pressure pipeline the completed stretch of pipeline shall be tested for site test pressure of 0.15g/sq.cm. The site test pressure should not be less than the maximum operating pressure plus the calculated surge pressure, but in no case should it exceed the hydrostatic test pressure, as specified in IS: 458.
- 16.1.13 Measurement - Deleted
- 16.1.14 Rate - Deleted
- 16.1.15 Notes
- 16.1.15.1 If any damage is caused to the pipeline during the execution of work or while cleaning / testing the pipeline as specified, Contractor shall be held responsible for the same and shall replace the damaged pipeline and retest the same at his own cost to the full satisfaction of Engineer.
- 16.1.15.2 Water for testing of pipeline shall be arranged by Contractor at his own cost.
- 16.2 Salt Glazed Spigot & Socket Stoneware (GSW) Pipes (A Class with 1.5 Kg/cm<sup>2</sup>)**
- 16.2.1 Scope
- 16.2.1.1 This Specification covers the requirements for manufacturing, testing, supplying, jointing and, testing at work sites, of salt glazed spigot and socket stoneware pipes.
- 16.2.2 Applicable Codes
- The manufacturing, testing, supplying, jointing and testing at work sites of GSW pipes shall comply with all currently applicable statutes, regulations, standards and Codes. In particular, the following standards, unless otherwise specified herein, shall be referred. In all cases, the latest revision of the Codes shall be referred to. If requirements of this Specification conflict with the requirements of Codes and standards, this Specification shall govern.
- 16.2.2.1 Materials

IS: 651 and IS: 4127	Specification for GSW Pipes.
IS: 651 and IS: 4127	Method of Tests for GSW Pipes.

16.2.3 Design

- 16.2.3.1 Design of GSW pipes shall be in accordance with the relevant clauses of IS: 651 and IS: 4127.

16.2.4 Manufacturing

16.2.4.1 General

1. The stoneware pipe shall conform to IS: 651 and IS: 4127. The Contractor shall arrange to give at his own cost Hydraulic test, Absorption test, test for resistance to action of acid, test for crushing strength etc. in the manner described by the IS: 651 and IS: 4147. Number of pipes to be tested shall be as per relevant latest IS., separately for each diameter of pipe. All the above tests including the hydraulic test shall be carried out at the premises of manufacture of pipes and the necessary guages, apparatus and supply of labour etc. shall be arranged by the Contractor at his own cost. However, before delivery of pipes is made at the site, the Contractor shall arrange to give visual tests for damage or cracks etc. and the sound test, for whole of the lot received from time to time. The pipes for all the above tests shall be selected at random by the Engineer from the stock of the manufacturer from time to time. The length of pipe shall be 60 cm / 75 cm / 90 cm. Necessary test results to be given for pipes as per IS: 651 and test certificate results to be given for records.
2. The method of making the test shall be to the entire satisfaction of the Engineer, and all the cost of the designing, purchasing, setting up and using the apparatus required to make the test shall be borne by the Contractor.
3. No pipe shall be dispatched from the place of manufacture until the approval of the Engineer has been given in writing.

16.2.5 Loading and Unloading

- 16.2.5.1 At every point of loading or unloading, pipes or castings must be handled by approved lifting tackles. Unloading by rolling down planks or any other form of inclined ramp will not be allowed unless the written consent of the Engineer to the method proposed has been obtained. Pipes are to be carefully stacked on site with timber packing under and between the pipes. The pipes are to be laid up at the gradients beginning at the lower end. No pipe is to be laid until the trench has been excavated to its required depth for a distance of 20m, in front of the pipe to be laid. (This distance may vary as directed by the Engineer).

16.2.6 Laying

- 16.2.6.1 Laying of GSW pipes shall conform to **Clause 15.7**.

16.2.7 Measurement



- 16.2.7.1 The mode of payment shall be as per the running meter of pipes provided, laid, lowered and jointed. Retention money for testing to be kept at 10% of value of item of work. On giving test of the complete sewerage system to the satisfaction of the Engineer the same shall be released.

### **16.3 Centrifugally Cast Iron Pipes**

#### **16.3.1 Scope**

- 16.3.1.1 This Specification covers the requirements for manufacturing, supplying, laying, jointing and, testing at works site, of Centrifugally Cast Iron pipes (Spun Iron pipes) used for water supply, sewerage and storm water drains.

#### **16.3.2 Applicable Codes**

- 16.3.2.1 The laying of CI pipes and fittings / specials shall comply with all currently applicable statutes, regulations, standards and Codes. In particular, the following standards, unless otherwise specified herein, shall be referred. In all cases, the latest revision of the standards / Codes shall be referred to. If requirements of this Specification conflicts with the requirements of the standards / Codes, this Specification shall govern.

IS: 1536	Specification for Centrifugally Cast (Spun) Iron Pressure Pipes for Water, Gas and Sewage
IS: 1538	Specification for Cast Iron Fittings for Pressure Pipes for Water, Gas and Sewage
IS: 11606	Methods for Sampling of Cast Iron Pipes and Fittings
IS: 3114	Code of Practice for Laying of CI Pipes

- 16.3.2.2 Others I.S. Codes not specifically mentioned here but pertaining to the use of CI pipes form part of these Specifications.

#### **16.3.3 Manufacture**

- 16.3.3.1 The spun iron pipes shall be of CI, casted centrifugally and shall be of class LA, A, B or as specified.
- 16.3.3.2 The metal used for the manufacture of pipes shall be of quality not less than that of grade 15 of IS: 210-1970
- 16.3.3.3 The pipes shall be stripped with all necessary precautions necessary to avoid warping or shrinking defects. The pipes shall be free from defects, other than any unavoidable surface imperfections which result from the method of manufacture and which do not effect the use of the pipes.
- 16.3.3.4 All Cast Iron (spun) pipes and fittings shall be of approved brand conforming to IS: 1536 and IS: 1538 respectively and free from flaws, air bubbles, cracks, sand holes and other defects and truly cylindrical and of uniform thickness. These shall not be brittle but shall allow ready cutting, chipping and all joints shall be double flanged joints and shall be air and water tight.

16.3.4 Specials and fittings

16.3.4.1 CI specials and fittings used for CI pipes shall conform to IS: 1538. The methods for sampling of CI pipes and fittings shall conform to IS: 11606.

16.3.5 Dimensions and tolerances

16.3.5.1 The dimensions of pipes, sockets, spigots and flanges and their tolerances shall conform to the sizes specified in relevant clause of IS: 1536.

16.3.6 Inspection of pipes

16.3.6.1 The pipe and fittings shall be inspected for defects and be rung with a light hammer, preferably while suspended, to detect cracks. Smearing the outside with chalk dust helps the location of cracks. If doubt persists further confirmation may be obtained by pouring a little kerosene on the inside of the pipe at the suspected spot. If a crack is present the kerosene seeps through and shows on the outer surface.

16.3.6.2 Any pipe found unsuitable after inspection before laying shall be rejected.

16.3.7 Laying and Jointing of CI pipes and fittings

16.3.7.1 The laying of CI pipe lines shall, in general be in accordance with **Clause 15.7**. Specifications given in IS: 3114 shall also be followed as applicable.

16.3.7.2 Rubber ring Tyton joints shall be used for jointing of CI pipe lines outside the buildings and other external water supply installations. They shall be used strictly in accordance with the manufacturer's instructions. Wherever required, for internal water supply piping arrangements with CI pipes, pipes shall be connected by flanged joints.

16.3.8 Thrust Blocks

16.3.8.1 In case of bigger diameter pipes where the pressure is very high, thrust blocks of cement concrete (1 cement: 2 coarse sand: 4 graded stone aggregate of 20 mm nominal size) of adequate size and shape shall be provided on all bends / tees etc., to transmit the hydraulic thrust to the ground, spreading over a sufficient areas, depending upon the type of soil met with, as per the relevant Drawings or as directed by Engineer.

16.3.9 Testing

16.3.9.1 Mechanical Tests

Mechanical tests shall be carried out during the manufacture of the pipes as specified in IS: 1536.

16.3.9.2 Hydrostatic tests at works

1. For hydrostatic tests, the pipes shall be kept under pressure for 15 seconds, they may be struck moderately with a 700 g hammer. They shall withstand pressure test without showing any leakage or any other defect of any kind. As far as possible the hydrostatic test shall be conducted before giving any coating to the pipes. These pipes shall be used upto half the hydraulic test pressure as given in the following table. The hydraulic test pressure for Centrifugally Cast Iron pipes as per IS: 1536, shall be as given below:

Type of pipes	Test pressure in kg/cm <sup>2</sup> (meter head)		
	Class LA	Class A	Class B
Spigot and socket pipes in all diameters	12 (120)	18 (180)	24 (240)
Flanged pipes upto 600 mm diameter	-	18 (180)	24 (240)

2. The specials shall conform to IS: 1538. The hydraulic test pressure of each class of specials shall be as follows:

Nominal diameter	Test pressure in kg/cm <sup>2</sup> (meter head of water)	
	Specials without branches or with branches not greater than half the principal diameter	Specials with branches greater than half the principal diameter
Upto and including 300 mm	25 (250)	25 (250)
Over 300 mm to 600 mm	20 (200)	20 (200)
Over 600 mm upto 1500 mm	15 (150)	15 (150)

3. Water of approved quality for testing shall be arranged by the Contractor.

#### 16.3.10 Testing at site

The following tests are to be carried out after a new pipe is laid, jointed and partially back filled. Portions of the line shall be tested by subjecting the pressure test as the laying progresses before the entire line is completed (the test stretch should not generally exceed 500 m), to identify any error of workmanship which can be detected and corrected at minimum cost. For all these tests water of approved quality has to be arranged by the Contractor.

##### 16.3.10.1 Pressure test

Pressure test at a pressure of atleast double the maximum working pressure shall be carried out. Pipes and joints shall be absolutely water tight under the test. The procedure for pressure testing shall be as follows:

- Each valved section of the pipe shall be slowly filled with water and all air shall be expelled from the pipe through the hydrants and blowoffs. If these are not available at high places, necessary taping may be made at points of highest elevation before the test is made and plugs inserted after the tests have been completed.
- Sufficient backfill shall be placed on the pipe to resist the movement due to pressure while testing. Trench shall be partially backfilled such that the joints, couplings, valves, hydrants or any other fittings shall be left exposed for observations during testing. The specified pressure based on the elevation of the lowest point of the line or section under test and corrected to the elevation of the test guage, shall be applied by means of a pump connected to pipe in a manner satisfactory to the Engineer. The duration of the test shall not be less than 5 minutes.

3. During testing, all exposed pipes, fittings etc., should be carefully examined. When the joints are made with lead, all such joints showing visible leaks shall be recaulked until tight. When the joints are made with cement and show seepage or slight leakage, such joints shall be cut out and replaced as directed by the Engineer. Any cracked or defective pipes, fittings, valves or hydrants etc., discovered in consequence of this pressure test shall be removed and replaced by sound material and the test shall be repeated until satisfactory to the Engineer.

#### 16.3.10.2 Leakage test

After the successful completion of the pressure test, Leakage test shall be conducted at a pressure to be specified by the Engineer for a duration of two hours. The procedure for Leakage test shall be as follows:

1. Leakage is defined as the quantity of water to be supplied into the newly laid pipe, or any valved section thereof, necessary to maintain the specified leakage test pressure after the pipe has been filled with water and the air expelled.
2. No pipe installation shall be accepted until the leakage is less than the number of cm<sup>3</sup>/hr, as determined by the following formula:

$$ql = (ND\sqrt{P})/3.3$$

where

ql = the allowable leakage in cm<sup>3</sup>/hr

N = number of joints in the length of the pipe line,

D = diameter of pipe in mm, and

P = average test pressure during the leakage testing kg/cm<sup>2</sup>

3. Should any test of the pipe laid in position disclosed leakage greater than that obtained by the above formula, the defective joints shall be replaced until the leakage is within the specified allowance.

#### 16.3.11 Markings

16.3.11.1 Each pipe shall have cast, stamped or indelibly painted on it the following appropriate marks.

1. Manufacturers name or identification mark
2. The nominal diameter
3. Class reference
4. Mass of pipe
5. The no. of the Indian standard and
6. The year of manufacture.

16.3.11.2 Marking may be done on the outsides of the sockets or towards the end of barrels of pipes.

#### 16.3.12 Measurements - Deleted

#### 16.3.13 Rate - Deleted

## 16.4 Galvanised Iron Pipes

### 16.4.1 Scope

16.4.1.1 This Specification covers the requirements for manufacturing, supplying, laying, jointing and testing at works and site of Galvanised Iron pipes used for water supply.

### 16.4.2 Applicable Codes

16.4.2.1 The laying GI pipes and fittings / specials shall comply with all currently applicable statutes, regulations, standards and Codes. In particular, the following standards, unless otherwise specified herein, shall be referred. In all cases, the latest revision of the standards / Codes shall be referred to. If requirements of this Specification conflict with the requirements of the standards / Codes, this Specification shall govern.

IS: 1239 (Part-I)	Specification for Medium Grade GI Pipes
IS: 1239 (Part-II)	MS Tubular or Wrought Steel Fittings for GI Pipes
IS: 4736	Specification for Galvanizing
IS: 554.	Specifications for Pipe Threads of Screwed Tubes and Sockets

16.4.2.2 Others I.S. Codes not specifically mentioned here but pertaining to the use of CI pipes form part of these Specifications.

### 16.4.3 Manufacture

16.4.3.1 The pipes shall be Galvanised mild steel hot finished seamless (HFS) or welded ERW, HRIW or HFW screwed and socketed conforming to IS: 1239 (Part-I) for medium grade. The zinc coating shall be uniform adherent, reasonably smooth and free from imperfections.

16.4.3.2 All screwed pipes and sockets shall have pipe threads conforming to the requirements of IS: 554. Screwed tubes shall have taper threads while the sockets shall have parallel threads.

16.4.3.3 Where the pipes have to be cut or threaded, the ends shall be carefully filed out so that no obstruction to bore is offered. The ends of the pipe shall then be carefully threaded conforming to the requirements of IS: 554 with pipe dies and tapes in such a manner that it will not result in slackness of joints when two pieces of pipes are screwed together. The taps and dies shall be used only for straightening screw threads which have become bent or damaged and shall not be used for turning of the threads as to make them slack, as the later procedure may not result in a water tight joint. The screw threads of the pipes and fittings shall be protected from damage until they are fitted.

### 16.4.4 Dimensions

16.4.4.1 The dimensions and weights of medium grade GI pipes and sockets and tolerances shall be as prescribed below:

Nominal bore (mm)	Dimension of pipes			Weight of pipe	
	Outside diameter (mm)		Thickness (mm)	Plain end	Screwed end socket
	Max.	Min.		Kg/m	Kg/m
6	10.6	9.8	2.0	0.427	0.430
8	14.0	13.2	2.35	0.667	0.681
10	17.5	16.7	2.35	0.886	0.892
15	21.8	21.0	2.65	1.27	1.28
20	27.3	26.5	2.65	1.64	1.65
25	34.2	33.3	3.24	2.51	2.53
32	42.9	42.0	3.25	3.23	3.26
40	48.8	47.9	3.25	3.72	3.76
50	60.8	59.7	3.65	5.24	5.31
65	76.6	75.3	3.65	6.69	6.81
80	89.9	88.0	4.05	8.68	8.85
100	115.0	113.1	4.50	12.40	12.70
125	140.8	138.5	4.85	16.50	17.00
150	166.5	163.9	4.85	19.60	20.20

16.4.5 Tolerance

16.4.5.1 Tolerance in Thickness

Butt welded medium tubes	+ not limited	- 10.0 %
Seamless tubes	+ not limited	- 12.5 %

16.4.5.2 Tolerance in Weight

Single tube (irrespective of quantity)	+ 10 %	- 8 %
For quantities of less than 150 m of one size	+ 10 %	- 8 %
For quantities of 150 m and over of one size	+ 4 %	- 4 %

16.4.6 Specials and fittings

16.4.6.1 The fittings for GI pipes shall be of mild steel tubular or wrought steel fittings conforming to IS: 1239 (Part-II). The fittings shall be designated by the respective nominal bores of the pipes for which they are intended.

16.4.7 Jointing

16.4.7.1 The pipes shall be cleaned and cleared of all foreign matter before being laid. While jointing the pipes, the inside of the socket and the screwed end of the pipes shall be oiled and

rubbed over with white lead and a few turns of spun yarn wrapped round the screwed end of the pipe. The end shall then be screwed in the socket, tee etc., with the pipe wrench. Care shall be taken that all pipes and fittings are properly jointed so as to make the joints completely water tight and pipes are kept at all times free from dust and dirt during fixing. Burr from the joint shall be removed after screwing. After laying, the open ends of the pipe shall be temporarily plugged to prevent access of water, soil or any other foreign matter.

#### 16.4.8 Laying of GI pipes and fittings

##### 16.4.8.1 External work

1. GI pipes if used for external work, shall be laid according to **Clause 15.7**. If they are laid in trenches, the widths and depths, for different diameters of the pipes shall be as follows:

Dia. of Pipe (mm)	Width of Trench (cm)	Depth of Trench (cm)
15 to 50	30	60
65 to 100	45	75

2. At joints the trench width shall be widened where necessary. The work of excavation and refilling shall be done true to line and gradient in accordance with the Specifications on laying of pipes given in this chapter.
3. Pipes shall be laid on a cushion of sand minimum 7.5 cm deep and filled upto 15 cm above the pipes. The remaining portion of the trench shall then be backfilled as described in Chapter 5.

##### 16.4.4.2 Internal work

1. For internal work, the Galvanised iron pipes and fittings shall run on the surface of the walls or ceiling (not in chase) unless otherwise specified. The fixing shall be done by means of standard pattern holder bat clamps, keeping the pipes about 1.5 cm clear of the wall. When it is found necessary to conceal the pipes, chasing may be adopted or pipes fixed on the ducts or recess etc., provided there is sufficient space to work on the pipes with the usual tools. The pipes shall not ordinarily be buried in walls or solid floors. Where unavoidable, pipes may be buried for short distances provided adequate protection is given against damage and where so required joints are not buried. Where directed by the Engineer, a MS tube sleeve shall be fixed at the place where the pipe is passing through a wall or floor, for reception of the pipe and to allow freedom for expansion and contraction and other movements. In case the pipe is embedded in walls or floors it should be painted with anticorrosive bitumastic paints of approved quality. The pipe shall not come in contact with lime mortar or lime concrete as the pipe is affected by lime. Under the floors the pipes shall be laid in layer of sand filling as done under concrete floors.
2. All pipes and fittings shall be fixed truly vertical and horizontal unless unavoidable. The pipes shall be fixed to walls with standard pattern holder bat clamps of required shape and size so as to fit tightly on the pipes when tightened with screwed bolts. These clamps shall be embedded in the brick work of the walls, and shall be spaced at regular intervals in straight lengths as shown in the table ahead:

Dia of Pipe (mm)	Horizontal length (m)	Vertical length (m)
15	2	2.5
20	2.5	3
25	2.5	3
32	2.5	3
40	3	3.5
50	3	3.5
65	3.5	5
80	3.5	5

3. The clamps shall be fixed at shorter lengths near the fittings as directed by the Engineer.
4. For G.I. pipes 15 mm diameter, the holes in the walls and floors shall be made by drilling with chisel or jumper and not by dismantling the brick work or concrete. However, for bigger dimension pipes the holes shall be carefully made of the smallest size as directed by the Engineer. After fixing the pipes the holes shall be made good with cement mortar 1:3 (1 cement: 3 coarse sand) and properly finished to match the adjacent surface.
5. Unions will be provided to facilitate connections, additions and alternations as well as for maintenance and for change of pipes. The locations where unions are to be provided will be decided with prior within approval of the Engineer.

#### 16.4.9 Thrust Blocks

16.4.9.1 In case of bigger diameter pipes where the pressure is very high, thrust blocks of cement concrete (1 cement: 2 coarse sand: 4 graded stone aggregate of 20 mm nominal size) of adequate size and shape shall be provided on all bends / tees etc., to transmit the hydraulic thrust to the ground, spreading over a sufficient areas, depending upon the type of soil met with, as per the relevant Drawings or as directed by Engineer.

#### 16.4.10 Paintings

16.4.10.1 The pipes shall be painted with two coats of anticorrosive bitumastic paint of approved quality.

#### 16.4.11 Testing

16.4.11.1 The pipes and fittings after they are being laid and jointed shall be tested to a hydraulic test pressure of 60 kg/cm<sup>2</sup> (600 m). The pipes shall be slowly and carefully charged with water allowing all air to escape and avoiding all shocks or water hammer, which may develop otherwise. The draw off taps and stop cocks shall then be closed and specified hydraulic pressure shall be applied gradually. A calibrated and accurate pressure gauge shall be used for testing the pressure. The test pump having been stopped, the test pressure should be maintained for at least half an hour. The pipes and fittings shall be tested in sections as the work of laying proceeds, having the joints exposed for inspection during the testing. Pipes or fittings which are found defective shall be replaced and joints found leaking shall be redone, without any extra payment.

16.4.11.2 The water for testing shall be provided by the Contractor. The quality of water should be approved by the Engineer.



16.4.12 Measurements (External and Internal works) - Deleted

16.4.13 Rates - Deleted

## 16.5 Electrically Welded Steel Pipes

### 16.5.1 Scope

16.5.1.1 This Specification covers the requirements for manufacturing, supplying, laying, jointing and, testing at works, and site of Electrically Welded Steel pipes, internally lined with cement concrete and externally coated with cement mortar, used for water supply mains.

### 16.5.2 Applicable Codes

16.5.2.1 The laying of pipes and fittings / specials shall comply with all currently applicable statutes, regulations, standards and Codes. In particular, the following standards, unless otherwise specified herein, shall be referred. In all cases, the latest revision of the standards / Codes shall be referred to. If requirements of this Specification conflict with the requirements of the standards / Codes, this Specification shall govern.

IS: 3589	Seamless/Electrically Welded Steel Pipes for Water, Gas, Sewage Specification
IS: 5822	Code of Practice for Laying of Electrically Welded Steel Pipes for Water Supply-
IS: 7322	Specification for Specials for Steel Cylinder Reinforced Concrete Pipes
IS: 432 Part I	Mild Steel and Medium Tensile Bars Reinforcement
IS: 432 Part II	Specifications for Mild Steel and Medium Tensile Bars and Hard Drawn Steel Wire (Third Revision)
IS: 2328	Flattening Test for Seamless Pipes
IS: 12269	Specification for 53 Grade Ordinary Portland Cement (OPC)
IS: 6452	Specification for High Alumina Cement for Structural Use (I Revision)
IS: 8112	Specifications for Curing of High Strength OPC
IS: 8041	Specifications for Curing of Rapid Hardening Cement
IS: 269	Specification for Ordinary Portland Cement (OPC)
IS: 455	Specification for Portland Slag Cement
IS: 1489	Specification for Portland Pozzolana Cement
IS: 8043	Specification for Hydrophobic Portland Cement
IS: 4853	Recommended Practice for Radiographic Inspection of Fusion Welded Butt Joints in Steel Pipes (First Revision)
IS: 4260	Recommended Practice for Ultrasonic Butt Welds in Ferritic Steel
IS: 3600 (Part I)	Methods of Testing Fusion Welded Joints and Weld Metal in Steel: Part I Cruciform Fillet Weld Tensile Test

16.5.2.2 Others I.S. Codes not specifically mentioned here but pertaining to the use of Electrically Welded Steel pipes shall form part of these Specifications.

### 16.5.3 Material

#### 16.5.3.1 Steel

The steel used for manufacturing the pipes and specials shall conform to IS: 2062. The quality of steel, chemical composition and tensile strength of the steel plates shall be as specified in IS: 3589. The thickness of steel plates used for manufacturing pipes shall conform to IS: 3589 or as specified. The thickness of steel plates used shall in no case be less than that specified in IS: 3589.

16.5.3.2 Cement Mortar and Cement Concrete

The Cement Mortar and Cement Concrete used for pipes and specials, shall conform to the Specifications mentioned in **Chapter 9**. The maximum size of aggregate shall be one third the thickness of concrete cover inside the steel pipe or 10 mm, whichever is less. The concrete mix shall have a minimum cement content of 450 kg/m<sup>3</sup> and a characteristic compressive strength of 25 N/mm<sup>2</sup> at 28 days. The cement mortar shall have a minimum cement content of 600 kg/m<sup>3</sup> and a characteristic compressive strength of 25 N/mm<sup>2</sup> at 28 days.

16.5.3.3 Reinforcement

All cage reinforcement used in the pipes and specials shall conform to IS: 432 (Part-1) or IS: 432 (Part-2).

16.5.3.4 Welding Electrodes

All electrodes used for welding of steel plates shall conform to IS: 814.

16.5.4 Length

16.5.4.1 The pipes shall be manufactured in lengths of 5m, unless otherwise specified or agreed to between the purchaser and the manufacturer, for ease in handling.

16.5.5 Joints and Ends

16.5.5.1 Pipe sections shall be of swelled and plain ends suitable for sleeve jointing. The dimensions of sleeves shall be as specified in IS: 3589. Other relevant Specifications with respect to joints and ends, as per IS: 3589, shall also be applicable.

16.5.6 Tolerances

16.5.6.1 The tolerances over dimensions of pipes for different diameters of pipes shall be as specified in IS: 3589.

16.5.7 Manufacture

16.5.7.1 Pipes shall be made from steel plates or strips by butt welding spirally. Pipes shall be of specified nominal diameter after internal lining with 25 mm thick cement concrete as per Specifications.

16.5.7.2 Prior to welding, edges of plates or strips shall be prepared suitably. Prior to welding, the plates shall be fitted closely and during welding they shall be held firmly. Welding shall be done so that there shall be thorough fusion and complete penetration.

16.5.7.3 The ends of the steel pipes shall be square with its longitudinal axis.

16.5.8 Welding

16.5.8.1 For manufacturing of the steel pipes, any of the following types of welding shall be adopted as per IS: 3589.

1. Automatic submerged arc welding.
2. Automatic metal arc welding with covered electrodes.
3. Automatic metal arc welding with bare electrode and carbon dioxide.
4. Electric resistance welding.

16.5.8.2 The welding of pipes in the field and testing should comply with IS: 816.

16.5.8.3 Plates shall be held in the correct position. Abutting edges shall be properly squared. Each deposited layer of the welded metal in the fusion welding process shall be thoroughly cleaned before additional weld metal is supplied to coincide with the centre line of joint and the finished joint shall be free from all defects.

16.5.8.4 All welds shall have complete fusion with the base metal and shall be free from cracks, oxides, slag inclusion and gas pockets.

16.5.8.5 If welding is stopped for any reason, special care shall be taken when welding is resumed to obtain complete penetration between weld metal, plate and weld metal previously deposited. Three percent of all seams of pipes welded in the fabrication shop shall be Radio graphed (as per IS: 4853) to render visible inspection of any internal defects such as blow holes, slag inclusion or cracks. If any defects are detected the metal at the location shall be chipped out and rewelded. In addition to Radiography of the joints, 100 percent testing by ultrasonic equipment (as per IS: 4260) shall also be included in welding tests. Any defects found out shall be rectified free of cost. Welds found deficient in quality shall be removed by chipping or melting and remade as per Specifications. Chipping or cutting the weld shall not extend to the base metal.

16.5.8.6 Sample welds shall be submitted for testing. The weld joints shall be tested in accordance with the procedure laid down in IS: 3600 (Part-I)-1985, as specified in IS: 5822. Approval of such tests shall be required prior to welding of the pipe.

16.5.8.7 Manual welding of special sections and fittings will be permitted when it is impracticable to use an automatic welding machine.

16.5.8.8 Final welding of closure gaps for buried pipes shall be done after intermediate pipes have been backfilled.

16.5.9 Fabrication of specials

16.5.9.1 Specials such as bends, tapers, tees shall conform to IS: 7322. Specials shall be fabricated by cutting plates of the specified thickness to the required shape obtained by developing the form of specials on ground. Stiffeners shall be provided wherever necessary. Abutting profiles shall be obtained using templates which guide the cutting torches as to obtain a uniform cut. No hand cutting shall be permitted. Specifications for the using and testing of the plates, electrodes, welding, cleaning etc., shall be the same as for the straight pipes.

1. Horizontal and vertical curves

Standard bends of deviations from 5 degree to 90 degrees shall be fabricated out of steel plates. The cut pieces shall as far as possible be placed at the end of pipes joined in the factory. The angle of the cut pieces shall be made so as to obtain the necessary curvature. In case of deviations differing from the standards, cut pieces shall be made to suit the particular site conditions. Length of the cut pieces shall be in line with standard specials. The vertical cuts, shall be so adjusted as to conform to the proposed longitudinal section. Distance pieces may be used to obtain the above conditions.

## 2. Tapers and Tees

Tapers and tees shall be fabricated with one or more stocks, each stock having a stiffening ring fixed circumferentially in the centre. The stiffener rings shall be made of M.S. Plate of approved thickness.

## 3. Provisions for valves

Provisions in the form of stubs of required diameter shall be fabricated by the Contractor and shall be fixed to the pipeline after cutting pipe with necessary pad plates.

### 16.5.10 Cement Concrete and Mortar Lining of Pipes and specials.

#### 16.5.10.1 Preparation of surface before lining or coating.

The surface of pipe to be lined or coated with cement mortar or cement concrete shall be clean. Any loose rust, loose millscale, dirt, debris, oil, grease and other detrimental materials present shall be removed by mechanical means.

#### 16.5.10.2 Cement Concrete lining for inside of steel pipes and specials and mortar coating outside

Cement Concrete shall be composed of cement, coarse and fine aggregates and water well mixed and of proper consistency to obtain a dense, homogeneous lining that will adhere firmly to the pipe surface. Thickness of cement concrete lining inside the pipe shell shall be of 25 mm and that of the mortar lining outside the pipe shell shall be 25 mm thick.

#### 16.5.10.3 Mixing

The concrete for internal lining shall be mixed as per provisions in **Chapter 9**.

#### 16.5.10.4 Cover

The clear cover to the reinforcement whether steel cylinder or cage shall not be less than 9 mm for lining and 12 mm for coating.

#### 16.5.10.5 Reinforcement

Wire fabric shall be used for external reinforcement. It shall be 50 x 50 mm steel wire mesh, 13 gauge each way, and conform to IS: 432 (Part-1) or IS: 432 (Part-2). The reinforcement cage for the pipes shall extend throughout the pipe barrel and shall consist of spirals or rings and straights. The spirals or rings shall be circular in shape and shall be either wound round the steel pipe shell itself or wound round collapsible frame or drums and then slipped on the steel pipe shell. The fabric shall be wrapped on

the shell by tack welding. The outer cage reinforcement for swelled end portions of the pipe shall be wound on them at the time of laying. Minimum reinforcement in the lining shall not be less than three percent of the quantity of steel pipe shell. Splices shall be made by welding or other suitable means. The fabric shall be wrapped on the shell by tack welding.

#### 16.5.10.6 Equipment for lining of Pipes

1. Straight sections of pipe shall be lined by use of a spinning machine specifically designed to suit for the purpose of rotating the section and centrifugally applying cement concrete lining to the interior of steel pipe. Mechanical feeding is preferable.
2. The Contractor shall plan for installation of sufficient number of spinning machines/equipment for inside lining and outside coating of pipes, and the proposed factories. If during the progress of works, it becomes necessary for transporting of plates/pipes from one factory to the other for fabrication/lining and or coating due to inadequate number of machines or breakdowns or to meet progress targets, the Contractor should arrange for such transportation of pipes from one factory to the other at his own cost.

#### 16.5.10.7 Concreting lining and mortar coating of pipes

1. This shall be done generally in two stages to give the required thickness of the barrel.
2. In the first stage concreting shall be done inside the pipe shell and in the second stage placing of the mortar is done outside the pipe shell. Placing of concrete inside the steel pipe shell shall always be done at the manufacturer's works and consolidated by spinning, vibrating, spinning combined with vibrations or other appropriate mechanical means whilst the placing of mortar outside the steel pipe shell shall be done later either at the manufacturer's works or at site.
3. Mortar coating outside the steel pipe shell shall not commence before the expiry of three days after the completion of concreting inside, unless otherwise it is established that the concrete lining inside has attained a works cube strength of not less than 110 kg/cm<sup>2</sup>, earlier than this period. During this entire period the concrete inside the steel pipe shell shall be under curing. The mortar outside the steel pipe shell shall be either vibrated or applied under pressure.
4. In the case of pipes with plain ends or slip-in type ends, the portions that should be left exposed without concreting or mortar lining shall be mutually agreed to between the purchaser and the manufacturer.

#### 16.5.10.8 Lining of specials

1. Whenever practicable, specials shall be made from cut lengths of matured lined straight pipes. The lining shall be cut back from the end to ends to be bevelled and welded for a sufficient distance to ensure that any of the concrete lining which is intended to remain as part of lining shall not suffer damage by the cutting or welding process. The concrete lining shall be made good by rendering by hand.
2. Hand rendering of specials shall consist of freshly mixed concrete of a mixture equivalent to that of the lining being repaired, and shall be thoroughly compacted and finished to a smooth surface of the correct form.

Cement concrete shall be used both for lining and coating of specials. The thickness of lining and coating shall be 25 mm. Specials shall have the nominal dia as that of the connecting pipe after lining. Specifications for lining and coating of specials shall be as that of the straight pipes.

3. The application of cement concrete lining to bends, or specials sections whose shapes preclude other process of lining shall be by mechanical placement, pneumatic placement or hand trowelling finished to produce a smooth dense surface. Debris shall be removed as necessary, permitting the application of the lining to a clear surface.
4. Thickness shall be as required for spun lining of straight sections except that it may be varied by feathering or filleting to affect system lining with adjoining sections of pipe and thickness of lining.

#### 16.5.10.9 Determination of thickness of lining

Lining thickness shall be determined on the freshly lined pipes, at intervals frequent enough to assure compliance. Thickness of lining may be determined by means of a steel pin not larger than 1.5 mm in diameter or on a hardened concrete or mortar by means of a non-destructive measurement process. The lining shall be measured at four equidistant points on two cross sections of the barrel at each end of the pipe or fittings. The first set shall be atleast 200 mm from the respective ends of the pipe or fitting. The second set shall be made as far into the interior of the pipe or fitting as can be readily reached without injuring the lining.

#### 16.5.10.10 Curing

1. After completion of concreting or mortar lining, the concrete or mortar shall be kept wet by any suitable means such as immersion in water, covering by wet gunny bags, or by mechanical sprinklers, for a period of not less than 14 days when cement conforming to IS: 269 or IS: 455 or IS: 1489 or IS: 8043 or IS: 6909 is used; not less than 7 days when cement conforming to IS: 8041 or IS: 8112 is used; not less than 3 days when cement conforming to IS: 6452 or IS: 12269 is used; and not less than 21 days when cement conforming to IS: 12330 is used.
2. Non-pressure steam curing may be permitted provided the requirement of non-pressure steam curing are fulfilled. For non pressure steam curing, the pipe shall be subjected to the action of thoroughly saturated steam at a temperature of 38 to 54 degree C for a period of not less than 24 hours or for such additional time as may be necessary to enable the pipe to meet the strength requirements.

#### 16.5.10.11 Repair of defective or Damaged Areas of lining

Defective or damaged areas of linings may be patched by cutting out the defective or damaged lining to the metal so that the edges of lining not removed are perpendicular or slightly undercut. A fresh mix of concrete or mortar equivalent to that of the lining being repaired shall be prepared. The cut-out area and the adjoining lining shall be thoroughly wetted, and the concrete or mortar applied to the inside or outside respectively, and trowelled smooth with the adjoining lining. After any surface water has evaporated, but while the patch is still moist, it shall be cured as specified.

#### 16.5.10.12 Protection of work

The lined pipe and fittings shall be protected from extreme heat due to direct sun rays, from impact of rainfall, and from freezing temperatures until the linings have cured sufficiently to withstand these conditions.

16.5.11 Workmanship

16.5.11.1 All pipes shall be cleanly finished free of cracks, surface flaws, laminations and all other defects. They shall be cylindrical, concentric and straight in axis. The ends shall be accurately cut and shaped for welds. The ends shall be square with the axis of the pipe. The repair of minor defects by welding or otherwise shall be permitted only after obtaining the prior permission from the Engineer in writing. No heating shall be permitted.

16.5.12 Handling of pipes and specials.

16.5.12.1 During manufacturing and during the entire period of the application of concrete or mortar lining protection and the curing thereof, the section shall be carefully supported and handled so as to avoid injury to the fresh lining. If a pipe section must be rolled or otherwise moved, such operation shall be done slowly and with every reasonable precaution against damage. Any portion of the lining, coating that may become damaged shall be cut and replaced.

16.5.12.2 During delivery, all sections shall be handled by such means and in such a manner that no distortion or damage is done to the protection or to the section as a whole.

16.5.13 Laying of pipes

16.5.13.1 Pipes shall be laid in accordance with **Clause 15.7**.

16.5.13.2 All pipes shall be laid true to line and level and on pedestals wherever required, the joints strictly conforming to welding Specifications. Joints shall be finished in a workman like manner and shall prove to be sound and water tight. The field welding shall be carefully carried out so as to induce the minimum heat distortion and local hardness in steel.

16.5.13.3 In addition, the provisions of IS: 5822 shall also be applicable.

16.5.14 Field Jointing of Insides and outsides of Concrete lined pipes

16.5.14.1 Cement mortar shall be used for lining of inside and outside lining of joints. It shall be of the same Specifications as those of outside mortar coating of pipes, cement mortar lining for inside and outside of field joints shall be done only after testing the pipe line as per Clause 15.5.17.3.

16.5.14.2 Jointing Inside

For the inside lining of field joints, wire fabric of 50 x 50 mm steel mesh, 13 gauge each way, shall be provided. Inside joints of mortar lined pipe shall be plastered with cement mortar and finished off smooth with the inside surface of the pipe by trowelling or by other equipment means. Before placing the joint mortar material against the surface of the lining, these surfaces shall be carefully cleaned and wetted to ensure good bond between the lining and joint mortar. The field joint shall be cured for a minimum of 14

days. In any case the pipe line shall not be put into serve until the mortar has cured for a minimum of 24 days. The joints shall be finished off smooth with the inside surface of the lining by trowelling.

#### 16.5.14.3 Jointing Outside

1. For this item, the joints have been classified into two groups:

- Those coming under water logged area
  - Those coming in other area.
2. Joints under waterlogged areas: These joints shall be done with Cement Mortar 1:2 with two layers of M.S. 50 mm x 50 mm x 13 gauge weld mesh and the thickness of mortar shall be 50 mm thick and a suitable water proofing compound shall also be used.
3. Joints coming in other areas: This shall be done with Cement mortar 1:2, 25 mm thick with one layer of 50 mm x 50 mm x 13 gauge wire fabric reinforcement.
4. Outside field joints shall be coated with cement mortar retained by suitable forms so as to bridge the joints. The mortar shall be compacted within the form to produce a dense coating without voids. The joint coating shall be kept moist for a minimum or 14 days.

#### 16.5.15 Fixing of fixtures

16.5.15.1 Contractor has to fix the required number of fixtures at proper locations as per the approved Drawings and the instructions of Engineer. The fixtures shall be fixed to the flanges by bolts, nuts and washers with necessary fireplay insertions etc. All types of fixtures and necessary equipment required for fixing these fixtures shall be arranged by the Contractor at his own cost.

#### 16.5.16 Testing of Pipe line

##### 16.5.16.1 Mechanical Test (Tensile Test)

Tensile test shall be carried out as specified in IS: 1894:1972. The tensile strength and percentage elongation of pipes shall not be less than the values specified in the table below. The percentage elongation shall be determined on a guage length of 5.65 times of square root of original cross sectional area of the specimen (So).

Steel grade	Tensile strength Mpa (min)	Percentage elongation (min)
Fe 330	330	20
Fe 410	410	18
Fe 450	450	12

##### 16.5.16.2 Hydrostatic Testing at Works

1. Each straight pipe section whose ends are in plane at right angle to the pipe axis shall be tested hydrostatically before the pipe is coated, wrapped or lined, as per IS: 3589. The pipes shall withstand the test pressure without showing any signs of weakness, leak or sweating. The test shall be carried out in the presence of the Engineer and as



per Specifications. The required pressure should be maintained for at least 2 minutes for inspection purposes. The pipes shall be fitted with an accurate pressure gauge approved by the Engineer.

2. The hydraulic test pressure shall be the pressure calculated from the formula  $P=2St/D$  except that the maximum test pressure shall not exceed 5 Mpa.

Where

P = Test pressure in Mpa

S = Stress in Mpa which shall be taken as 40 % of specified minimum tensile strength  
t = Specified thickness in mm  
D = Specified outside diameter in mm

3. In this test, no hammering shall be permitted. Any section showing more than one leak for each 1.5 metres of welded seam or more than 2.5 percent of the total lengths of welded seam will be rejected. Stopping leaks by means of caulking tools shall not be permitted. In sections showing less than one leak for each 1.5 meters of welded seam and not more than 2.5 percent of the total lengths of welded seam, the leaks shall be repaired by chipping the weld and rewelding, after obtaining the permission of the Engineer in writing. All such sections shall be clearly be indicated in the logbook for reference. The repaired pipe should be retested hydrostatically for specified pressures. If on retest a pipe shows any leak in the welded seams it will be rejected. Accepted pipe sections shall be marked with legible marks of identification. This test is compulsory on all straight pipes.

#### 16.5.16.3 Testing at site

1. After completing the installation of pipe line, or a section of the line and welding of joints, a hydrostatic pressure test of the line shall be made before giving the lining and coating to the exposed joints. The hydrostatic pressure shall be maintained as per **Clause 11.2.1** of IS: 5822:1994, during which time the pipe shall not show any sign of sweating or oozing or spotting of water at the joints or any part. If a drop in pressure occurs the quantity of water added in order to re-establish the test pressure, should be carefully measured. This should not exceed 0.1 litre per mm of pipe diameter per km of pipe line per day for each 30 m head of pressure applied.
2. If the pressure measurements are not made at the lowest section, an allowance should be made for the static head between the lowest point and the point of measurement to ensure that the maximum pressure is not exceeded at the lowest point. Any defective joint or part shall be repaired and retested in the presence of the Engineer. The Contractor shall make his own arrangements for water for field testing. Water if supplied by department will be charged at non-domestic rates prevalent at the time of supply. The pipe line shall be tested in stretches of not exceeding 2 km in length. This field hydraulic test is mandatory. This clause is not negotiable.

16.5.17 Measurements - Deleted

16.5.18 Rate - Deleted

**16.6 Prestressed Concrete (PSC) Pipes - Deleted**

**16.7 Laying of Pipes and Fittings / Specials**

16.7.1 Scope

16.7.1.1 This Specification covers the requirements for laying of pipes and fittings / specials below ground for water supply / sewerage / storm water drainage works.

16.7.2 Applicable Codes

16.7.2.1 The laying of pipes and fittings / specials shall comply with all currently applicable statutes, regulations, standards and Codes. In particular, the following standards, unless otherwise specified herein, shall be referred. In all cases, the latest revision of the standards / Codes shall be referred to. If requirements of this Specification conflict with the requirements of the standards / Codes, this Specification shall govern.

16.7.2.2 Codes of practice

IS: 783	Code of Practice for Laying of Concrete Pipes.
IS: 311	Code of Practice for Laying of Cast Iron Pipes.
IS: 376	Safety Code for Excavation Work.
IS: 127	Code of Practice for Laying of Glazed Stoneware Pipes.
IS: 5822	Code of Practice for Laying of Welded Steel Pipes for Water Supply.
IS: 6530	Code of Practice for Laying of Asbestos Cement Pressure Pipes.

16.7.3 Carting and Handling

16.7.3.1 Pipes and fittings / specials shall be transported from the factory to the work sites, at places along the alignment of pipe line as directed by Engineer. Contractor shall be responsible for the safety of pipes and fittings / specials in transit, loading / unloading. Every care shall be exercised in handling pipes and fittings / specials to avoid damage. While unloading, the pipes and fittings / specials shall not be thrown down from the truck on to hard surfaces. They should be unloaded on timber with steadying ropes or by any other approved means.

16.7.3.2 Padding shall be provided between coated pipes, fittings / specials and timber skids to avoid damage to the coating. Suitable gaps between pipes should be left at intervals in order to permit access from one side to the other. In case of spigot socket pipes while unloading, as far as possible pipes shall be unloaded on one side of the trench only. The pipes shall be checked for any visible damage (such as broken edges, cracking or splaying of pipe) while unloading and shall be sorted out for reclamation. Any pipe which shows sufficient damage to preclude it from being used shall be discarded. Dragging of pipes and fittings / specials along concrete and similar pavement with hard surfaces shall be prohibited.

16.7.3.3 Wherever a section of pipe, or a fitting is to be lifted or moved, it shall be handled carefully with belt slings. The belts shall be constructed so that no metal bears against the pipe and so that the bearing is uniform. The width of the belts shall be adequate to prevent any damage to the pipe coating. The pipe section may at no time be dropped but shall be lowered carefully into position and may not be slid along the ground. If it is to be rolled, it may be done only on slides or ground specially prepared so as to prevent any damage to the coating.

16.7.3.4 All State and local laws be observed during transportation. The Contractor shall secure permits and licences and provide all signals, guards and lights that may be required.

Upon delivery the pipe sections and fittings shall be placed on specially prepared ground to protect them from distortion and damage. The ground shall be prepared so that they will rest evenly and will have uniform bearing throughout their lengths. Valve and sluice gates shall be placed on blockings.

16.7.4 Storage

16.7.4.1 Each stack of pipes shall contain only pipes of same class and size, with consignment or batch number marked on it with particulars of suppliers wherever possible. Storage shall be done on firm level and clean ground and wedges shall be provided at the bottom layer to keep the stack stable. The stack shall be in pyramid shape or the pipes laid lengthwise and crosswise in alternate layers. The pyramid stack shall be made for smaller diameter pipes for conserving space in storing them. The height of the stack shall not exceed 1.5m.

16.7.4.2 Fittings / specials shall be stacked under cover and separated from pipes. Valves and sluice gates shall be placed on blockings.

16.7.4.3 Rubber rings shall be stored in a clean, cool store away from windows, boiler, electrical equipment and petrol, oils or other chemicals. Particularly in the field where the rubber rings are being used it is desirable that they should not be left out on the ground in the sun or overnight under heavy frost or snow conditions.

16.7.5 Laying

16.7.5.1 Excavation

1. Before excavating the trench the alignment of pipeline shall be approved by Engineer. The excavation of trenches and pits for manholes / chambers shall be carried out in accordance with the Specification and shall be done such that it does not get far ahead of the laying operation as approved by Engineer.
2. To protect persons from injury and to avoid damage to property, adequate barricades, construction signs, red lanterns and guards as required shall be placed and maintained during the progress of the construction work until it is safe for the traffic to use the roadways. The Contractor shall provide sign boards at salient points in streets and keep men to guide the traffic at his own cost. The relevant Indian Standards and the rules and regulations of local authorities in regard to safety provisions shall be observed.
3. Trial pits may be dug by the Contractor, without being directed to do so, along the lines of the trenches as shown on the drawings in advance of the excavations for the purpose of satisfying himself as to the location of under ground obstructions or conditions. The Contractor shall proceed with caution, in any excavation and shall use every means to determine the exact location of underground structures, pipelines, conduits etc., prior to excavation in the immediate vicinity thereof. The Contractor shall be solely responsible for the cost of protection or repair or replacement of any structure, pipeline, conduit etc., above or below ground which may be broken or otherwise damaged by his operations.
4. Suitable fencing shall be provided along the sides of trenches and pits. The posts of fencing shall be of timber securely fixed in the ground not more than 3 m apart and they shall not be less than 75 mm in diameter or less than 1.2 m above the surface

of the ground. There shall be two rails, one near the top of the posts and the other about 50 mm above the ground and each shall be of 50 mm to 70 mm in diameter and sufficiently long to run from post to post to which it shall be bound with strong rope. The method of projecting rails beyond the posts and tying them together where they meet will not be allowed on any account. All along the edges of the excavated trenches a bank of earth about 1.2 m high shall be formed where required by Engineer for further protection..

5. The lighting, barricading, guarding of the trenches and the maintenance of watchman shall be done by the Contractor at his cost. At every 30 meters interval and at every change in the gradient, sight rails shall be provided and fixed by the Contractor at his own cost. The sight rails and boning rods for checking the excavation and inverts of the pipes shall be of the quality approved by the Engineer. In all streets in the City/Town at every 15 meters interval, blank board shall be provided by the Contractor at his own cost, to facilitate crossing of the trench by the Public residing on the either side.
6. The road metal and also the rubble packing shall first be stripped off for the whole width of the trench / pit and separately deposited in such place or places as may be determined by Engineer.
7. During excavation, large stones and rubble shall be separated and removed from the excavated soil and stacked separately. The material from excavation shall be deposited on either side of the trench leaving adequate clear distance from the edges of the trench and pit or as may be necessary to prevent the sides of the trench / pit to slip or fall or at such a distance and in such a manner so as to avoid covering fire hydrants, sluice valves, manhole covers, etc. and so as to avoid abutting the wall or structure or causing inconvenience to the public and other service organization or otherwise as Engineer may direct.
8. Contractor shall take into account additional excavation if any as Engineer may require in order to locate the position of water pipes, drains, sewers, etc. or any other works which may be met with, in or about the excavation of trenches / pits while quoting the rates for excavation. Such service lines if met with during excavation shall be properly maintained by Contractor, by means of shoring, strutting, planking over, padding or otherwise as Engineer may direct, and shall be protected by Contractor from damage during the progress of the work.
9. Wherever extra width of excavation shall be necessary for shoring and strutting, of the trenches on account of the nature of the soil, such extra width required to accommodate the shoring boards shall not be paid for separately and the rates quoted for trench work are deemed to be inclusive of all such incidental work.
10. All precautions shall be taken during excavation and laying operations to guard against possible damage to any existing structures/pipelines of water, gas, sewage etc..
11. If the work for which the excavation has been made is not complete by the expected date of the setting in of monsoon which is **First week of June** or the setting in of rain whichever is earlier, or before the day fixed by Engineer for filling in any excavation on account of any festival or special occasion, Contractor shall backfill such excavation and consolidate the filling.

12. Utmost care shall be taken to see that the width of the trench at the top of pipe is not more than [External diameter of pipe in mm + 600 mm] + [400 mm for every 1500 mm Depth of cutting] or as specified in the Cross Section Drawing (in case there is any difference, the latter shall prevail). In case additional width is required it shall be provided only in the top portion from the ground level upto 300 mm above the crown of pipe. If any extra width is provided in the area below this portion, Contractor shall have to provide remedial measures in the form of lime concrete or rubble masonry or otherwise at the discretion and to the satisfaction of Engineer. If rock is met with, it shall be removed to 15 cm below the bottom of pipes and fittings / specials and the space resulting shall be refilled with lean cement concrete of adequate depth, properly consolidated to give the curved seating. The bottom of the trench shall be properly trimmed to permit even bedding of the pipeline. Bottom of trenches / pits shall be saturated with water and well rammed wherever Engineer may consider it necessary to do so. For laying of pipes larger than 1200 mm in diameter, in earth and moorum, the curvature of the bottom of the trench should match the curvature of the pipe as far as possible, subtending an angle of 120 degrees at the centre of the pipe.
13. Wherever a socket or collar of pipe or fitting / special occurs a grip is to be cut in the bottom of the trench or concrete bed to a depth of at least 75 mm below the bed of the pipe so that the pipe may have a fair bearing on its shaft and does not rest upon its socket. Such grip shall be of sufficient size in every respect to admit the hand, all around the socket in order to make the joint and the grip shall be maintained clear until the joint has been approved by Engineer.
14. When welding is to be carried out with the pipes and specials in the trench, additional excavation of not more than 60 cm in depth and 90 cm in length shall be made at joints in order to facilitate welding.
15. The excess excavated material shall be carried away from site of works to a place upto to a distance as directed by Engineer. This shall be done immediately so as not to cause any inconvenience to the public or traffic. If the instructions from Engineer are not implemented within seven days from the date of instructions to cart the materials and to clear the site, the same shall be carried out by Engineer at Contractor's risk and cost and any claim or dispute shall not be entertained in this respect.
16. Refilling of trenches, where the excavation is in rock shall be with the surplus soft soil from pits located within 200meters from the reach in question.
17. It is to be distinctly understood that no extra payment shall be made for the excavation from borrow pits located within 200 metres for obtaining earth for refilling, any instructions of the Engineer to bring earth from beyond 200 metres for refilling shall be detailed in writing and a separate extra payment shall be made for the additional conveyance. No payment shall be made for disposal of soil for excavation, surplus to or unsuitable for filling.

16.7.6 Work included in Excavation

16.7.6.1 Unless otherwise directed on the project Specifications, all of the following items are included in the excavation:

1. Removing all surface obstructions including shrubs, jungle etc.,

2. Making all necessary excavations true to line and grade,
3. Furnishing and installing all shoring and bracing as necessary or as directed,
4. Pumping and bailing out water to keep trenches free of water during pipe laying and jointing and thereafter until joints mature,
5. Providing for uninterrupted surface water flow during work in progress,
6. Providing for disposing off water flows from storm, drains, nallas or other sources, suitably,
7. Protecting all pipes, conduits, culverts, railway tracks, utility poles, wire fences, buildings, and other public and private property adjacent to or in the line of work,
8. Removing all shoring and bracing which is not ordered to be left in place or not required by the project plans or Specifications to remain in place,
9. Hauling away and disposing of excavated materials not necessary or else unsuitable for back filling purposes. The extra excavated soil will have to be properly dressed in soil banks along with the trench as directed,
10. Back filling the trenches as directed or as per Specifications,
11. Restoring all property injured or disturbed by these construction activities to the condition as near its original condition as possible,
12. Restoring the surfaces and repairing of all roads, streets, alleys, walks, drives, working spaces, and rights of way to a condition as good as prior to excavation

#### 16.7.7 Change of Trench Location

- 16.7.7.1 In case the Engineer orders that the location of trench be moved a reasonable distance, on account of the presence of an obstruction or due to such other cause or if a changed location is authorized at the Contractor's request, the Contractor shall not be entitled to extra compensation or to a claim for damage. If however such change is made at the orders of the Engineer, which involves abandonment of excavation together with the necessary back fill, will be measured, classified and paid for in the same manner as for other trench excavation and back fill of the same character. In case the trench is abandoned in favour of new location at the Contractor's request, after its approval, the abandoned excavation and back fill shall be at Contractor's expense.

#### 16.7.8 Minimum earth cover

- 16.7.8.1 If a profile is not furnished for a pipeline, the main will be constructed with a minimum earth cover of 1000 mm from the top of the pipeline, unless otherwise indicated on plans and ordered by the Engineer.

#### 16.7.9 Dewatering

- 16.7.9.1 During the excavation, if subsoil water is met with, Contractor shall provide necessary equipment and labourers for dewatering the trenches / pits by bailing out water or water mixed with clay. If pumping out subsoil water is found to be necessary, Contractor shall provide sufficient number of pumps for the same. In both the above cases the excavation shall be done to the required level and the pipes shall be laid to proper alignment and gradient. Contractor shall also make necessary arrangement for the disposal of drained water to nearby storm water drain or in a pit if allowed by Engineer. In no case the water shall be allowed to spread over the adjoining area. Before discharging this water into public sewer / drain, Contractor shall take necessary permission from the local authorities.
- 16.7.9.2 The Contractor shall be responsible for the adequate pumping, drainage and bailing out of water from the excavation. Failure to make such provisions which results in unsuitable

subgrade conditions, and which will require any special foundations as directed by the Engineer, such foundations shall be placed at the entire cost of the Contractor and will not be measured or paid for as separate pay items. If the Contractor selects to under cut the trench and use gravel or tile bailing, drainage of well pointing, the additional work will be considered as incidental work and additional compensation will not be allowed

16.7.10 Special foundation in poor soil

16.7.10.1 Where the bottom of the trench at subgrade is found to consist of material which is unstable to such a degree that in the opinion of Engineer, it cannot be removed and replaced with approved material thoroughly compacted in place to support the pipe properly, a suitable foundation for the pipes, consisting of piling, timbers or other materials, in accordance with relevant Drawings and as instructed by Engineer shall be constructed.

16.7.10.2 During the progress of the work, should the foundation for the pipeline be in soft, yielding or spongy materials which are unsuitable for the subgrade of the pipeline and which is not the result of the Contractor's negligence, to make proper provisions for adequate drainage of the excavation, the Contractor shall remove such unsuitable subgrade materials to the depth directed by the Engineer. The Contractor shall fill the excavated depth in the manner hereinafter described or as directed by the Engineer.

16.7.10.3 The Contract unit for foundation shall be one cubic metre. The foundations will be measured for payment complete in place. The contract unit price shall be the total compensation for furnishing all labour, tools, materials, equipment and incidentals necessary to complete the work, including all excavation and disposal of surplus material.

16.7.10.4 Rock Foundations

16.7.10.4.1 The space resulting from the removal of unsuitable materials shall be filled with crushed stone, local lime stone rock, free from loamy soil, clay and vegetable matter, graded in size from 25mm to 30mm in general.

16.7.10.5 Gravel Foundations

16.7.10.5.1 The space resulting from removal of unsuitable material shall be filled with gravel. No extra payments will be made on this account, except for lead charges if any beyond 50m.

16.7.10.6 Concrete Foundations

16.7.10.7 The space resulting from removal of unsuitable materials shall be filled with a concrete foundation and the concrete shall conform to relevant provisions of **Chapter 9** of these Specifications.

16.7.11 Wooden shoring

16.7.11.1 Contractor shall suitably design polling boards, walling and struts to meet different soil conditions that might be encountered in excavating trenches / pits. The horizontal and vertical spacing of struts shall be such that not only the sides of trenches shall be prevented from collapse but also easy lowering of pipe in trenches shall be ensured without creating undue obstructions for the excavation of the work. Any inconvenience

and / or delay that might be caused in lowering pipes in trenches as a result of adopting improper spacing of struts by Contractor shall be his sole responsibility. While taking out shoring planks the hollows of any form must simultaneously be filled in with soft earth well rammed with rammers and with water.

16.7.11.2 Engineer may order portions of shoring to be left in the trenches / pits at such places, where it is found absolutely necessary to do so as to avoid any damage which may be caused to buildings, cables, gas- mains, water-mains, sewers, etc. in close proximity of the excavation, by pulling out the shoring from the excavations. Contractor shall not claim, on any reason, whatsoever for the shoring which may have been left in.

16.7.12 Steel plate shoring

16.7.12.1 Where the subsoil conditions are expected to be of a soft and unstable character in trench / pit excavation the normal method of timbering may prove insufficient to avoid subsidence of the adjoining road surfaces and other services. In such circumstances Contractor will be required to use steel trench sheeting or sheet piling adequately supported by timber struts, walling, etc., as per the instructions, manner and method directed by Engineer. Contractor shall supply, pitch, drive and subsequently remove trench sheeting or piling in accordance with other items of the Specification.

16.7.13 Boning staves and sight rails

16.7.13.1 In laying the pipes and fittings / specials the centre for each manhole / chamber or pipe line shall be marked by a peg. Contractor shall dig holes for and set up two posts (about 100 mm X 100 mm X 1800 mm) at each manhole / chamber or junction of pipe lines at nearly equal distance from the peg and at sufficient equal distance therefrom to be well clear of all intended excavation, so arranged that a sight rail when fixed against the post will cross the centre of the manhole / chamber or pipe lines. The sight rail shall not in any case be more than 30m apart. Intermediate rails shall be put up if directed by Engineer.

16.7.13.2 Boning staves of 75 mm X 50 mm size shall be prepared by Contractor of various lengths, each length being of a certain whole number of metres and with a fixed tee-head and fixed intermediate cross pieces, each about 300 mm long. The top-edge of the cross piece must be fixed below the top-edge of this tee-head, at a distance equal to as the case may be, the outside diameter of the pipe or the thickness of the concrete bed to be laid. The top of cross

pieces shall indicate different levels such as excavation for pipe line, top of concrete bed, top of pipe, etc. as the case may be.

16.7.13.3 The sight rail of size 250 mm X 40 mm shall be screwed with the top edge resting against the level marks. The centre line of the pipe shall be marked on the rail and this mark shall denote also the meeting point of the centre lines of any converging pipes. A line drawn from the top edge of one rail to the top edge of the next rail shall be vertically parallel with the bed of the pipe and the depth of the bed of pipe at any intermediate point may be determined by letting down the selected boning staff until the tee head comes in the line of the sight from rail to rail.

16.7.13.4 The post and rails shall be perfectly square and planed smooth on all sides and edges. The rails shall be painted white on both sides, and the tee hands and cross piece of the boning staves shall be painted black.



- 16.7.13.5 For the pipes converging to a manhole / chamber at various levels, there shall be rail fixed for every different level. When a rail comes within 0.60 m of the surface of the ground, higher sight-rail shall be fixed for use with the rail over the next point.
- 16.7.13.6 The posts and rails shall in no case be removed until the trench is excavated, the pipes are laid and Engineer gives permission to proceed with the backfilling.
- 16.7.14 Bedding
  - 16.7.14.1 The bedding for pipe shall be provided as specified in the Drawings or as per direction of Engineer.
- 16.7.15 Concrete cushion, embedment and encasement
  - 16.7.15.1 Concrete embedment and encasement wherever required, shall be constructed as per the details given in approved Drawings or as directed by the Engineer. Where concrete bedding is to be placed beneath the pipeline, the sub-grade shall be prepared to dimensions as shown in the Drawings. The bottom of the trench may be sloped on the sides or kerbed, but the thickness of concrete shall be as specified in the Drawings or as directed by the Engineer. Dry mix will not be permitted.
  - 16.7.15.2 For earth, granular material or concrete embedment, each pipe section shall have uniform bearing on the subgrade for the full length of the pipe barrel, suitable excavation shall be made to receive the pipe, bell or collar and allow adequate room for proper workmanship in making the joint. Adjustment to line and grade shall be made by scraping away or filling in with gravel or concrete and not by wedging or blocking up the bell. Pipe sockets and barrels shall be clean and free from dirt at the time of jointing.
  - 16.7.15.3 The concrete for bedding portion will be mixed moist or damp to give a slump of not more than 25 mm and for sides and top portions of encasement, if specified, will be mixed to obtain a slump between 25 mm and 80 mm. All water in the trench must be disposed off prior to placing of concrete. There should be no cleavage line between the bedding concrete and the side embedment concrete. Clear out space shall be left for jointing and lowering pipe in place and bringing to grade by tamping under pipe or removing excess concrete under pipe. After the joint is made, the remainder of the concrete embedment may then be poured and thoroughly tamped to make bond with original concrete. Care must be exercised in tamping to prevent lifting of the pipe out of alignment or grade. Back filling shall be done in a careful manner and such time after the concrete cushion, embedment or encasement is placed, as not to damage the concrete in any way.
  - 16.7.15.4 All pipes shall be so laid that the contact in the joint between the two lengths of pipe shall be uniform throughout the circumference of the joint. Where curves in the alignment are indicated on the Drawing, and the curves are flat, standard pipe will be used with the outside edge of the joint pulled away from the seat to make a smooth joint. Where curves are sharp, standard or specially made bends will be used. Openings at end of day's work openings in tees, deep cut connections, shall be capped and sealed.
- 16.7.16 Laying of pipes and fittings / specials
  - 16.7.16.1 All precautions shall be taken during excavation and laying operations to guard against possible damage to any existing structure / pipe line of water, gas, sewage, etc. After excavation of trenches, pipes shall not be lowered unless the dimensions of trenches

and bedding work for pipes at the bottom of the trenches are approved and measured by Engineer. Pipes and fittings / specials shall be carefully lowered in the trenches.

- 16.7.16.2 The pipes and specials shall be stacked along the alignment in advance with utmost care during the transit so that they are not damaged. Any damage due to these reasons shall be Contractor's liability. The pipe shall be lowered and laid only after the trenches are finally ready and levels duly checked by the Engineer. It shall be seen that no damaged pipe is lowered in the trench. Every precaution shall be taken to prevent foreign materials from entering the pipes when they are being placed in the line. Normally the socket ends shall face the upstream. When any portion of the excavation shall have been carried down to the necessary depth, the Contractors shall obtain permission from the Engineer before commencing the laying of pipes or concrete or the construction of masonry.
- 16.7.16.3 Special arrangements such as cranes, tripods with chain pulley block for lowering the pipes and fittings / specials shall be made by Contractor. In no case pipes and fittings / specials shall be dropped. Slings of canvas or equally non abrasive material of suitable width or special attachment to fit the ends of pipes and fittings / specials shall be used to lift and lower the coated pipes and fittings / specials. The pipes and fittings / specials shall be inspected for defects and be rung with a light hammer preferably while suspended to detect crack, wherever applicable. If doubt persists, further confirmation shall be done by pouring a little paraffin on the inside of the pipe at the suspected spot. No sign of paraffin should appear on the outside surface. Pipes and fittings / specials damaged during lowering or aligning shall be rejected by Engineer.
- 16.7.16.4 All the pipes are to be laid perfectly true both in alignment and to gradient specified. Pipes in a trench shall be laid and fitted previous to the jointing being commenced. In case of spigot and socket pipe the socket end of the pipe shall face upstream, except when the pipe line runs uphill in which case the socket ends should face the upgrade of a slope. After placing a pipe in the trench, the spigot end shall be centered in the socket and the pipe forced home and aligned to required gradient. The pipes shall be secured in place with approved backfill material tamped under it except at the socket. Pipes and fittings / specials which do not allow a sufficient and uniform space for joints shall be removed and replaced with pipes and fittings / specials of proper dimensions to ensure such uniform space. Precaution shall be taken to prevent dirt from entering the jointing space. At times when pipe laying is not in progress, the open ends of pipe shall be closed by a watertight plug or other means approved by Engineer. during the period that plug is on, the Contractor shall take proper precautions against floatation of the pipe owing to entry of water into the trench. Wherever it is necessary to deflect pipe from a straight line, either in the vertical or horizontal plane, to avoid obstructions or where long radius curves are permitted, the deflection allowed at joints shall not exceed  $2\frac{1}{2}^{\circ}$ . In the case of pipes, with joint to be made with loose collars, the collars shall be slipped on before the next pipe is laid. The pipes shall be laid such that the marking on pipes appears at the top of the pipes.
- 16.7.16.5 Properly fitted temporary wooden stoppers shall be provided to close the ends of all incomplete pipe lines. The stoppers are only to be removed when pipes are being laid and jointed. Pipe laying and jointing shall be started and completed only section wise as per the instruction of the Engineer. During the progress of pipe laying the open ends of pipe shall be closed and water tight. Sight rails shall be provided at all change of direction or gradients at distance of @ 30 m along straight lengths. All the invert levels shall be confirmed from the sight rails with the help of proper boning rods as per the standard practice. The pipe shall be jointed with cement mortar 1:1 and proper caulking

- shall be done. After a particular section of the pipe is laid and jointed hydraulic testing shall be done section wise.
- 16.7.16.6 Just prior to placing each pipe section in the line, damaged coating shall be repaired and the interior shall be cleaned off all foreign materials. Cleaning shall be accomplished by brushing, blowing with compressed air and washing with water or as specified by the Engineer.
- 16.7.16.7 The item for laying of pipe line also includes labour work for lowering, laying and jointing various pipes including jointing with specials, levelling, etc. The Contractors shall transport pipes and specials from stores, for their various sections in such quantities as may be required for laying. Ordinarily no surplus stock shall remain on completion of any section. In case however, such pipe etc. become surplus in any sections, the Contractor shall remove the same to the next section for use in the work. It is likely that on completion of the whole work, some pipes and specials etc. may become surplus at the site and the Contractors shall arrange to hand over the same in good condition to the Engineer at the Owner's store as may be directed if required by Owner. The Contractor shall supply a list of stock so returned to the Engineer. No extra payment shall be made to the Contractors for these works. The rates for laying the pipes shall cover the cost of loading, transporting and unloading as may be required. The fortnight report for pipes collected and laid should be sent to the Engineer.
- 16.7.16.8 The cutting of pipe for inserting valves, fittings or specials shall be done in a neat and workman like manner without damage to the pipe so as to leave a smooth end at right angles to the axis of the pipe. For this purpose, pipe cutting machine shall be used.
- 16.7.17 Jointing
- 16.7.17.1 Pipes shall be laid to the lines and grades given in the plans, with the ends abutting to form a even joint without shoulders or unevenness of any kind along the invert of the pipes. No joint shall be made under water. The ends of the pipes shall be dry and kept clean before and during laying and jointing operations.
- 16.7.17.2 All joint work shall be done in an approved manner by skilled workmen so that the completed pipeline shall have a continuous, smooth and uniform interior surface. Extruded joint material shall be removed from the interior of the pipe. In cold weather protective measures must be taken to ensure a satisfactory joint.
- 16.7.17.3 Jointing for pipes and fittings / specials shall be done in accordance with the relevant Specifications depending on type of pipes being used.
- 16.7.18 Valve Rooms, Manholes, Head Walls, Thrust Blocks, Anchor Blocks, Saddle supports etc.
- 16.7.18.1 The Contractor shall build manholes, inlet manholes, inlets, junction chambers, headwalls, culverts, anchor blocks, thrust blocks and such other miscellaneous structures that may be required at the locations shown by the Engineer and of such forms, dimensions and materials as are shown in the standard details or as may be specified or directed. These structures shall also include the installation of such specials and connections to pipes and other structures as may be required to complete the constructions as shown in the Drawings.
- 16.7.19 Closure sections and connections to structures

- 16.7.19.1 Closure sections shall be constructed where required by the Contractor's operations. Connections to pipe specials shall be made as approved by the Engineer. Lining and coating of the pipe lines, which must be cut to provide for closure pieces or to permit the proper location of valves structure shall be repaired by the Contractor. No separate payment will be made for closure pieces installed, but the same will be measured as it is a pipe in place and along the pipeline.
- 16.7.19.2 The cutting of pipe for inserting valves, fittings or specials shall be done in a neat and workman like manner without damage to the pipe so as to leave a smooth end at right angles to the axis of the pipe. For this purpose, pipe cutting machine shall be used.
- 16.7.20 Temporary stoppages of work
  - 16.7.20.1 At times when pipe laying is not in progress, or at the end of the day's work, the open ends of pipe shall be closed by a watertight plug or other means approved by Engineer. During the period that plug is on, the Contractor shall take proper precautions against floatation of the pipe owing to entry of water into the trench.
- 16.7.21 Testing and commissioning
  - 16.7.21.1 Testing and Commissioning of pipes shall be done in accordance with the relevant Specifications.
- 16.7.22 Water Tightness test
  - 16.7.22.1 All hydraulic structures, either water supply or drainage etc., such as sewer lines, joints etc., or any other liquid containers shall have to be tested for water tightness. The Contractor shall give all such hydraulic tests by making his own arrangements for water filling and disposal of water after the test and shall repeat this test, if necessary, until the requisite test results are obtained without any claim for extra cost or compensation. The water tightness test shall be conducted as specified in IS: 4127- 1967. The tendered rates for hydraulic structures shall include all costs incurred by the Contractor for water tightness test. If any such hydraulic structure or fixture is found to be unsatisfactory at the time of giving this test the Contractor shall either repair or demolish and construct the same as directed such that the structure is made absolutely water tight and declared as satisfactory by the Engineer. The decision of the Engineer will be taken as final. The Contractor may use at the time of construction, for increasing the water tightness, approved proprietary chemicals only with the express permission of the Engineer to serve the purpose of the Contractor to facilitate such type of work for his own convenience and advantage. But in all such cases, the Contractor will not be entitled to any extra rate. The Contractor shall see that every effort is made to make structures and fixtures water tight, by resorting to such chemicals and making efficient use of proportion and grading of materials etc., as provided originally in the Specifications.
- 16.7.23 Backfilling
  - 16.7.23.1 Trenches shall be backfilled with approved selected excavated material only after the successful testing of the pipe line. The tamping around the pipe shall be done by hand or other hand operated mechanical means. The water content of the soil shall be as near to the optimum moisture content as possible. Filling of the trench shall be carried out simultaneously on both sides of the pipe in such a manner that unequal pressure does not occur. Back filling shall be consolidated by watering, ramming, care being taken to

avoid damage to the pipe line. In case of mild steel pipes / specials, the spiders provided during assembly and welding shall be retained until the trench is refilled and consolidated. Where timbers are placed under the pipe line to aid alignment, these timbers shall be removed before backfilling.

16.7.24 Reinstatement of road / footpath

Reinstatement of road / footpath shall be done as per the requirements of local authorities and the relevant Specifications after the completion of work.

16.7.24.1 Clearing of site

All surplus materials, and all tools and temporary structures shall be removed from the site as directed by Engineer and the construction site left clean to the satisfaction of Engineer.

16.7.25 Disinfection of water mains

16.7.25.1 The mains intended for potable water supplies should be disinfected before commissioning them for use.

16.7.25.2 The mains shall be chlorinated with a liquid chlorine solution (that is liquid chlorine gas and water mixture). The disinfection shall be considered to have been achieved if a chlorine residual of not less than 10 ppm remains in the water after 24 hours standing in the pipe. If this requirement is met with, the main should be thoroughly flushed with clean water.

16.7.25.3 If the treatment specified in **Clause 15.7.25.2** is not possible, enough chlorinate lime, calcium or sodium hypochlorite should be introduced to produce the required concentration of chlorine in the solution. The solution should then be allowed to stand for not less than 24 hours, after which it should be tested for residual chlorine, which should not be less than 10 ppm. If found satisfactory, the mains should be thoroughly flushed with clean water.

16.7.26 Measurement - Deleted

16.7.27 Notes

16.7.27.1 Fencing provided along the sides of trenches and pits shall not be paid for separately and Contractor shall take into account the costs of such works and quote accordingly.

16.7.27.2 In case of the metal packing or dressed stones not being deposited as specified or being mixed up with excavated materials and not available for the reinstatement of road / pavement, the cost of the new metal packing or dressed stones required shall be charges to Contractor by Engineer.

16.7.27.3 Service lines if damaged during excavation shall be made good either by Contractor or by other agency as Engineer may decide and the cost of the same shall be borne by the Contractor wholly in either case.

16.7.27.4 Contractor shall not be paid any additional compensation for excess excavation over what is specified as well as for any remedial measures that are specified.

16.7.27.5 The excess excavated material shall be carried away from site of works as specified, failing which in view of public safety and traffic convenience Engineer may carry out the work by any other agency at Contractor's risk and cost.

**17 SUPPLY OF UPVC AND DUCTILE IRON PIPES, SPECIALS, VALVES AND LAYING OF PIPES FOR WATER SUPPLY - Deleted**

**18 MANHOLES AND VENT SHAFTS - Deleted**

**19 PIPELINE APPURTENANCES - Deleted**

**20 WOOD WORK AND JOINERY - Deleted**

**21 HOLLOW CONCRETE BLOCKS - Deleted**

**22 METAL DOORS, WINDOWS AND VENTILATORS**

**22.1 Scope**

22.1.1 This specifications the requirements of metal doors, windows and ventilators.

**22.2 Applicable Codes:**

22.2.1 The provisions of the latest Indian Standards mentioned below shall form a part of these specifications. Other IS Codes not specifically mentioned here but pertaining to Metal Doors, Windows & Ventilators form part of these specifications.

IS: 1956	Glossary of terms relating to iron and steel
IS: 814 (Part I)	Specifications for covered electrodes for metal are welding of structural steel.
IS: 814 (Part II)	1.For welding products other than sheets, Specifications for covered electrodes for metal are welding of structural steel. 2.For welding sheets
IS: 815	Classification and coding of covered electrodes for metal are welding and cutting operation.
IS: 1948	Aluminium doors, windows & ventilators.
IS: 6227	Code of Practice for use of metal are welding in tubular structure
IS: 6248	Specifications for metal rolling shutters and rolling grill
IS: 1081	Code of Practice for fixing and glazing of metal (steel and aluminium) doors, windows and ventilators.
IS: 2062	Weldable Structural Steel
IS: 1361	Specifications for steel windows for Industrial Buildings
IS: : 1200 (Part VIII)	Measurements for steel work and iron work
IS: 1038	Specifications for steel doors, windows, and ventilators.
IS: 226	Specifications for structural steel (Standard quality)
IS: 823	Code of procedure for manual metal arc welding of metal steel
IS: 102	Ready mixed paint, brushing, red lead non sitting, priming.
IS: 1363	For black hexagon bolts, nut and lock nuts (dia 6 to 39 mm) and black hexagon screws (dia 6 to 24 mm)
IS: 813	Scheme of symbols for welding.

## **22.3 Materials**

### **22.3.1 Structural Steel**

22.3.1.1 Standard quality mild steel of various varieties and designations shall be used for different works as mentioned below:

22.3.1.2 St. 42 - S.: This variety of steel (standard quality) shall conform to specifications given in IS: 2062 (latest) and shall be used for (i) Reveted steel work (ii) bolted steel work (iii) steel work where welding is employed for fabrication provided that the thickness of material does not exceed 20 mm. When material conforming to this standard is over 20 mm thick special precautions may be required in case the material is to be welded (see IS: 823 - latest).

22.3.1.3 St. 30 - 0: This variety of steel (ordinary quality) shall conform to specifications given in IS: 1977 and is intended for general purposes such as door and window frames, window bars, grills steel gates, hand railing, builder's hardware, fencing post, tie bars, etc. All finished steel material shall be properly and neatly rolled to dimensions, sections and weights as specified. The finished material shall be free from visible as well as hidden defects and excessive rusting. The ends of the tubes shall be cut square, unless otherwise specified.

22.3.1.4 Steel sections and tubes shall be well protected and kept free from excessive rust and scaling. In this regard, decision of Engineer shall be final and binding on the Contractor.

### **22.3.2 Black Bolts:**

22.3.2.1 Also known as machine bolts, these bolts shall be made from rods and they come from the rolling mills and are not finished to exact size. A lower working stress is taken for these types of bolts than those of rivets and 'turned fitted bolts'.

### **22.3.3 Rolling Grills:**

22.3.3.1 The grills shall conform to specifications given in IS: 6248. Rolling grills shall be supplied in the following alternative types as specified. The grills shall be complete with accessories. The fixing arrangement shall be as per the Drawing with regard to whether it shall be fixed on the inside or outside between jamb of opening on or below the lintel etc.

1. Gear operated type (push and pull type or manually operated type): It shall be used upto a maximum of about 8 sqm. clear area without ball bearings and upto a clear area of about 12 sq. m with ball bearings.
2. Gear Operated Type (Mechanical Type): It shall be fitted with ball bearings. It shall be used upto a maximum of about 25 sq. M. Clear area, if the rolling grill is operated by a bevel gear box and crank handle upto a maximum of about 35 sqm. clear area, if the rolling grill is operated by chair wheel and hand chain, mounted directly on the work shaft.

22.3.3.2 Grills shall be manufactured out of 8 mm dia. Mild steel round bars. Rolling grills shall be of mid bar type or of any other approved design.

22.3.3.3 The guide channels shall be of mild steel deep channel section and of rolled pressed or built up (fabricated) jointless construction. The thickness of sheet used shall not be less than 3.15 mm. Hood covers shall be made of mild steel sheet not less than 0.90 mm thick. For grills having width 3.5 mm and above thickness of M.S. sheet for the hood cover shall be not less than 1.25 mm.

22.3.4 Steel Doors, Windows and Ventilators:

22.3.4.1 Steel doors, windows and ventilators and sashes shall be manufactured from fusion welding quality steel (St. 42 W) sections conforming to specifications given in IS: 2062.

22.3.4.2 In case of composite units consisting of a combination of two or more units of doors, windows and ventilators, etc. As the case may be, different shall be coupled by using coupling sections made from M S sheet 3.15 mm thick as per IS: 1038 para 5.2. the weight of different rolled steel sections use for manufacture of doors, windows and ventilators shall be as per those specified in IS: 1038, unless other wise specified.

22.3.5 Painting

22.3.5.1 Where a coat of red lead paint is specified approved quality of red lead paint conforming to IS: 102 shall be used.

22.3.6 Welding Equipment:

22.3.6.1 The welding plant and equipment shall be of modern design and shall be got approved by the Engineer.

22.3.6.2 The electrodes required for metal arc welding shall be 'covered electrodes' and shall conform to IS: 814 (Part I) for welding products other than sheets and IS: 814 (Part II) for welding sheets.

22.3.6.3 The type of covering shall be as per IS: 815 for classification and coding of covered electrodes for metal welding of structural sheets.

**22.4 Workmanship**

22.4.1 Structural Steel Work

22.4.1.1 The steel sections as specified or required shall be out, square and to correct lengths, as per Drawing and design. The cuts ends exposed to view shall be finished smooth. No two pieces shall be welded or otherwise jointed to make up the required length of a member, except as indicated in the Drawings or directed by the Engineer. All straightening and shaping to form shall be done by application of pressure and not by hammering. Any bending or cutting shall be carried out in such a manner as not to impair the strength of the metal. All operations shall be done in cold state unless otherwise directed/permitted.

22.4.1.2 All holes shall be generally drilled to the required size and at the required position. Subpunching shall be permitted, provided it is done 3 mm less in diameter and reared thereafter to the required size.

22.4.1.3 Holes for rivets and black bolts shall be larger by 0.4 to 0.6 mm than the nominal diameter of the rivets of black-bolts depending upon the dia of rivets.



- 22.4.1.4 Holes for counter-sunk bolts shall be made in such manner that their heads fit flush with the surface after fixing.
- 22.4.1.5 All bolt heads and nuts shall be hexagonal and of equal size, unless specified otherwise. The screwed threads shall conform to IS: 1363 and the threaded surface shall not be tapered. The bolts shall be of such length as to project two clear threads beyond the nuts when fixed in position and these shall fit in the bolts without any shake. The nuts shall fit in the threaded ends of bolts properly. Tapered washers shall be provided for all heads and nuts bearing the leveled surfaces. The threaded portion of the bolt shall not be within the thickness of the parts bolted together. The faces of bolt heads and nuts shutting against steel members shall be machine finished.
- 22.4.2 Welding
- 22.4.2.1 Welding shall generally be done by electric process. The electric arc method being economical, is usually adopted. Where public electricity is not available a suitable generator shall be arranged. Gas welding shall be resorted to using oxyacetylene flame with specific prior approval of the Engineer.
- 22.4.2.2 Types of welding
- 22.4.2.2.1 Welds used for joining structural members are generally of the following two types as under:
1. Fillet weld: The cross section of fillet weld is triangular and it is used to join two surfaces normally at right angles to each other. This type of weld is used more frequently in structural connections than any other type, and is usually in the form of isosceles triangle. The fillet welds shall be continuous or in intermittent as specified in the design.
  2. Butt welds: These are classified according to the method of grooving or preparing of the base metal. The metal pieces shall be filled or bevelled to the required shape for butt welding at the throat for which no extra payment shall be made.
- 22.4.2.3 Fillet and Butt welds shall conform to IS: 816. Special type of welds as slot-welds shall be used where so specified. Either direct or alternating current (but not both types) may be used throughout the whole work. An ammeter shall be provided to each arc and so situated that the Engineer can easily check the current being used by the operator. Each welder shall be supplied with a portable current regulator to enable him to adjust the welding current within the approved limits without leaving his work. Only qualified operators shall be employed for welding and they shall have been trained and shall be tested after every three months as per provisions of IS: 817 for "Code of Practice for training and testing of Metal Arc Welders".
- 22.4.2.4 In welded structure holes are necessary for service bolts required during erection. These holes shall be made as specified above. The holes in the various sections shall be filled with punches and welded properly to form a composite section.
- 22.4.2.5 Surfaces which are to be welded together, shall be free from loose mill-scale, rust, paint, grease or other foreign matter. A coating of boiled linseed oil shall be permitted.

- 22.4.2.6 Before welding is commenced, the plates shall first be brought together and firmly clamped or spot welded at specified distance. This temporary connection has to be strong enough to hold the parts accurately in place without displacement.
- 22.4.2.7 All operators connected with welding and cutting equipment conform to the safety requirement given in IS: 818 for "Safety and health requirements in Electric and Gas welding and cutting operations".
- 22.4.2.8 The following points shall be borne in mind during the process of welding:
1. Welds shall be made in the flat position, wherever applicable.
  2. Arc length, voltage and amperage shall be suited to the thickness of material, type of groove and other circumstances of the work.
  3. The sequence of welding shall be such that where possible the members which offers the least resistance to compression are welded first.
- 22.4.2.9 Process of Welding:
- 22.4.2.9.1 The electrode manipulation during welding shall be such as to ensure that:
1. The base metal is in a fused state when the filler metal makes contact with it
  2. The filler metal does not overflow upon any unfused based metal
  3. The base metal is not under-cut along the weld edges.
  4. The flowing metal floats the slags, the oxides, and the gas bubbles to the surface behind the advancing pool.
- In case any of these requirements is unattainable by manipulation, the current shall be adjusted or the electrode size changed. Each time the arc is started, the electrode shall be moved in such a way that the fusion of base metal at the starting point is assured. At the completion of a run the movement of electrode shall be slowed down to fill the arc crater. After every interruption of the arc except at completion of a run the arc shall be restarted ahead of the previous deposit and then moved back to fill the crater, or such alternative technique shall be used as will ensure complete filling of the crater or complete fusion between the new and old deposits and the base metal at the point of junction and result in continuity of weld. Before welding operation is completed, all traces of slag shall be removed from the deposit, by chipping if necessary and the deposited and adjoining base metal be wire brushed and cleaned at all points. The requirements shall apply not only to successive layers but also to successive beats, and to the overlapping area whatever a junction is made on starting a new electrode:
5. The welds shall be free from cracks, discontinuity in welding and other defects such as
    - I. under size
    - II. over size
    - III. undercutting
    - IV. overcuttingin case of fillet welds and defects (II), (III) and (IV) in the case of butt welds.,
- 22.4.2.10 All defective welds which shall be considered harmful to the structural strength shall be cut out and re-welded.

22.4.2.11 Finished welds and adjacent parts shall be protected with clean boiled linseed oil and after all slag has been removed, welds and adjacent parts shall be painted after the same are approved by the Engineer.

22.4.2.12 Inspection and testing of welds:

22.4.2.12.1 The method of inspection and testing shall be as under:

1. Dimensions of weld deposit: The size of the weld shall be as specified and it may be slightly over but not under.
2. Shape of profile: The profile of the weld is affected by the position of the joint, but it shall be uniform. In the case of butt and corner welds, the profile shall be slightly convex and in the case fillet welds it shall be usually slightly concave.
3. Uniformity of Surface: The height and spacing of the ripple shall be uniform; these being indicative of workmanship.
4. Degree of under cut: Undercutting is undesirable. The weld joint shall be free from undercut but slight intermittent occurrences may be disregarded.
5. Smoothness of joints: The joints in the weld run where welding has been adopted, shall be as uniform and smooth as possible and shall show no pronounced bump or crater in the weld surface.
6. Freedom from surface defects: The surface of the weld shall be free from porosity, cavities and burnt on scale.
7. Penetration bead in Butt welds: A slight penetration bead shall be present and it should be reasonably uniform in width and appearance. Intermittent occurrences of lack of penetration bead may be disregarded.
8. Degree of fusion: Fusion shall be complete over the whole area of the joint surface.
9. Degree of Root Penetration: These defects are most likely to occur at the root of the weld and in this position they are liable to have the maximum effects in reducing the strength of the weld. A close examination of the root shall, therefore, be made. In butt-welds, the penetration should extend to the underside of the plates producing a penetration bead of the right size. In fillet welds with good root penetration, the weld metal should reach the corner.

*Note:*

1. *In case of fusion welding or non-fusion weld and fillet welds will appear in joint, fillets being at the creches.*
2. *In case of non-fusion welding of cast iron the joints shall show satisfactory penetration and adhesion.*
3. *Gas Cavities and Flux Entrapments: Unless they are caused by the use of unsuitable material, they are attributable to the quality of workmanship, the desired result being to achieve uniform appearance and freedom from cavities and flux entrapments (where flux is used). In fusion welding of mild-steel, cast iron and aluminium where neutral flame is used, and in fusion welding of brass or braze welding of cast iron where oxidising flame is used in current welding technique may result in rough, porous, discolored and lusterless appearance in the fracture.*
4. *In case of fusion welding or non-fusion welding of cast iron isolated blow holes or concentration of pinholes in the weld metal shall be regarded as grounds for rejection but isolated pinholes shall not be so regarded.*
5. *Bending Testing (for ductility): The elongation shall be not less than 30 percent for stress relieved welds and not less than 25 percent for non-stress relieve welds.*
6. *Tensile Testing: (Reduced Section Tensile Testing): The tensile strength shall be not less than minimum of the specified tensile range of the parent metal.*
7. *Radiographic Examination: This shall be done as given in IS: 6227.*

22.4.3 Rolling Grills:

- 22.4.3.1 The springs shall be of best quality and shall be manufactured from tested high tensile spring steel wire or strip of adequate strength to balance the shutters in all positions. The spring pipe shaft etc. shall be supported on strong mild steel or malleable cast iron brackets. Brackets shall be fixed on the or under the lintel as specified with rawl plugs, and screw bolts, etc.
- 22.4.3.2 Both the side guides and bottom rail shall be jointless and of single piece of a pressed steel.
- 22.4.3.3 Grill shall be laid on ground and the side-guide channels shall be bound with it with ropes, etc. The shutter shall then be placed in position and top fixed with suspension shaft with bolts and nuts. The side guide channels and the cover frame shall then be fixed by means of screw bolts, end rawl plugs drilled in the wall. The plates and screw bolts shall be concealed in plaster to make their location invisible. Fixing shall be done accurately in a workmen like manner so as to ensure easy and smooth operation of the grill.

22.4.4 Rolling Shutter

- 22.4.4.1 Same as above for Rolling Grills but with 18 gauge x 65 mm steel laths of deep convex corrugation. The rolling steel shutters shall be of approved make and design.

22.4.5 Steel Doors, Windows and Ventilators ;

22.4.5.1 General

- 22.4.5.1.1 The type, over all sizes, side opening position of steel doors, Windows and ventilators, shall be specified as per details given in IS: 1038, specifications for steel doors, windows and ventilators.

22.4.5.2 Fabrication

- 22.4.5.2.1 Both the fixed and opening frame shall be constructed of sections which have been cut to length and mitered. The corners of fixed and opening frames shall be electrically flash butt welded to form a solid and true right angle and all frames shall square and flat.

- 22.4.5.2.2 Sub-dividing bars of the units shall be tensioned and riveted into the frame. No face welding at the joint of sub-dividing bars and frame is required. The horizontal glazing bars shall pass through the vertical bars and the joints closed by hydraulic pressure.

- 22.4.5.2.3 The sizes of door, windows or ventilators frames shall not be more than + 1.3 mm.

- 22.4.5.2.4 The size of opening of steel doors, windows, and ventilators will be on a 10 mm module, i.e. the width as well as height will be in multiple to 10 cm.

22.4.5.3 Side-hung shutter windows

- 22.4.5.3.1 Window shutters shall be hung on projecting type hinges (not less than 65 mm and not more than 75 mm wide). One leaf of the hinge shall be welded into a slot in the outer frame and the other leaf of the hinge riveted to the opening shutters. Friction hinges may

be provided for side-hung shutter windows in which case peg-stay may not be required. In cases where nonfriction type hinges are provided, the windows shall be fitted with per-stays which shall be either of hot pressed brass, aluminium or steel protected against rusting and shall be 100 mm long with steel peg and locking bracket. The peg stay shall have three holes to open the side hung casements in three different angles.

22.4.5.3.2 The handle for side hung shutters shall be of hot pressed brass, aluminium or steel protected against rusting and shall be mounted on a steel or aluminium handle plate molded, screwed or riveted to the opening frame in such a manner that it could be fixed before the shutter in glazed and may not be removed after glazing. The handle shall have a two point nose, which shall engage with a brass or aluminium striking plate on the fixed frame in a slightly open position as well as in a fast position.

#### 22.4.6 Ventilator

22.4.6.1 A brass or aluminium spring catch shall be fitted in the center of the top bar of the ventilator. A brass or aluminium cord pulley wheel in galvanised mild steel on malleable iron bracket shall

be fitted at the sill of the ventilator with mild steel screws or alternatively welded together with a mild steel or malleable iron cord eye riveted or welded to the bottom inner frame bar of the ventilator in a position corresponding to that of the pulley.

##### 22.4.6.2 Top Hung Ventilator

22.4.6.2.1 The steel butt hinges for top hung ventilators shall be riveted to the fixed frame or welded to it after cutting a slot in it. Hinges to the opening frame shall be riveted or welded and cleaned off. Top hung casements shall be provided with a peg stay three holes which when closed shall tightly by the locking bracket. The locking bracket shall either be fitted to the fixed frames or to the window.

##### 22.4.6.3 Center Hung Ventilator

22.4.6.3.1 This shall be hung on two pairs of brass or aluminium cup pivots riveted to the inner and outer frames of the ventilator to permit it to swing to an angle of approximately 85 Degree. The opening portion of the ventilator shall be so balanced that it remains open at any desired angle under normal weather conditions.

##### 22.4.6.4 Position of Holes, fixing Screws and Lugs:

22.4.6.4.1 Outer frames shall be provided with fixing holes, screws and lugs centrally in the web of the section as directed.

##### 22.4.6.5 Fixing of Steel Doors, Windows and Ventilators:

22.4.6.5.1 General Steel doors and windows shall be stacked in upright position on level ground, preferably on wooden battens to keep them in true shape without damage.

22.4.6.5.2 Steel work opening shall be so designed that the outer flange of the door, window or ventilator from section overlaps the steel surface by 10 mm.

## **22.5 Fixing Procedure (Masonry Opening)**

- 22.5.1.1 Where large units shall be bound by coupling individual units together (with coupling sections) the mullions and transoms shall be bedded in mastic to ensure water tightness. Mastic shall be applied liberally to the channels of the outside frame sections before assembling and other coupling. All oozing mastic shall be trimmed out neatly.
- 22.5.1.2 MULLIONS normally project 2.5 cm at head and sills are fixed in pockets made into the masonry timber or steel with opening. But where it is at cross joint with a transom the shorter coupling unit shall run through unbroken and other coupling until shall be cut square to form a butt joint with other members.

## **22.6 Finish**

### **22.6.1 Door and windows**

- 22.6.1.1 Doors, windows or composite units shall be either hot dip galvanised or painted. All the steel surfaces shall be thoroughly cleaned free of rust, mill-scale, dirt, oil, etc., either by mechanical means e.g. sand of shot blasting or by chemical means e.g. pickling and then painted or hotdip galvanised as given in IS: 1038. Final finishing coats shall be given after the doors, windows and ventilators are erected and fixed in final position. Non-ferrous parts and working parts such as handles, stays, catches handle pins, hinge-pins, etc. Shall not be painted.

### **22.6.2 Precautions**

- 22.6.2.1 Steel doors, windows, etc. shall not be used for centering or scaffolding and shall not be rested on the steel door and window frames or glazing bars.
- 22.6.2.2 All fitting and hinges shall be covered with Hessain cloth so that these may not be damaged during construction.
- 22.6.2.3 The doors, windows and ventilators shall be measured in square meters of finished opening and item shall include painting, glazing and all necessary fixtures and fittings.

### **22.6.3 Weld Mesh**

- 22.6.3.1 The welded mesh shall be of 10 gauge of standard wire products or equivalent. The measurements of weld mesh shall be taken from inside of MS angle and shall be in square meters. The method of fixing will be either by tack welding or by using a MS strip which shall then be welded. The weight of MS strip/angle etc. used shall be measured and paid for separately in the MS structural item.

### **22.6.4 M S Fabricated Gates and Wicket Gate**

- 22.6.4.1 M S Fabricates gates etc. will be as per the design and Drawings and shall include all hold fasts, hinges (either roller bearing or otherwise) of any type, locking arrangements as specified, strap and stoppers, guide wheels and embedded runners for guide wheels all as specified. It shall include all necessary costs for fixing in position to RCC columns including all necessary temporary supports etc. and involve for one coat of primer and two coats of synthetic enamel paint of approved makes quality and shade.

## 22.6.5 Heavy Duty Sliding Windows

22.6.5.1 Aluminium windows and doors to be used in the work shall be manufactured using suitable heavy gauge (3.2 mm) Aluminium extruded sections of Indal or Jindal anodised to natural satin finish for 18 to 20 micron. For any work whose purpose made steel windows are specified., the same shall be obtained from Alumilite or Jindal or any other approved manufacturer. The Engineers and the Architect's approval for windows to be supplied by nonspecified manufacturer shall be obtained in writing on the Contractor furnishing him at his own cost a sample of each window or door type., Only then a firm order shall be placed with the approved manufacturer. All windows and doors shall conform to the samples so approved.

### 22.6.5.2 Materials

#### 22.6.5.2.1 Windows

Heavy duty sliding windows shall be made from extruded aluminium sections of alloy HF: 9WF of IS: 733 - 1956. Height of the windows shall not be more than 1900 mm.

#### 22.6.5.2.2 Frames

Frames shall be 2 or 3 track as required having in-built grooves to accept weather strip for weather sealing.

#### 22.6.5.2.3 Shutters

The shutter vertical, interlock sections shall be hollow sections and horizontal sections shall be non-hollow and suitable for glazing with PVC gaskets. Interlock section shall have in-built grooves for weather stripping.

#### 22.6.5.2.4 Gutter and valves

In heavy rainfall areas, the sill member shall be hollow section with special gutter section clipped on to the bottom track so as to have hollow chamber of minimum cross-sectional area of 1000 sqm. for 2 track and 1500 sq. Mm. For 3 track. The slots of size 75 x 5 mm shall be provided in the bottom track and gutter sections for vertical drainage of rain water. PVC valves shall be provided in the gutter sections acting as pressure equalization cum non-return valves.

## 22.7 Section Sizes and Other Requirements

### 22.7.1 Doors and windows

<u>Item</u>	<u>Size</u>
Frame - 2 track on the slides, top and bottom	63.5 x 34.4 x 1.4 mm
Frame - 3 track on the sides, top and bottom	94.6 x 34.4 x 1.5 mm
Shutter - vertical, interlock and horizontals	43 x 20 x 1.4 mm

Glazing gaskets: Soft PVC glazing gaskets shall be used for glazing the shutters. Rubber gaskets shall not be allowed.

Weather strips: Soft PVC weather strips shall be provided in the in-built grooves of the sections and rubber weather strips shall not be allowed. Use of pile weather strips in lieu of PVC is optional.

Hardware: The sliding shutters shall be provided with:

- (a) Needle bearing nylon rollers, encased in plated MS brackets.
- (b) Flush type handle-cum-lock having aluminium body and stainless steel spring/receiving latch.
- (c) Nylon and cover-cum-guide on the top and bottom of the shutters.
- (d) Nylon anti-lift with pile insert to prevent lifting and tilting of the shutters.

Construction: The frames shall be mechanically jointed with 3 mm thick aluminium angle cleats. The shutters shall be mechanically jointed with plated self tapping screws and aluminium safety plate or aluminium alloy blind rivets and nickel plated self tapping.... two shall be used for the joints and fittings.

Anodising: The aluminium sections shall be brushed and anodised to natural matte finish or electro colour anodised to any shade of bronze as per IS: 1868 - 1968. For general interior and exterior use the anodising shall be average 18 to 20 microns. For highly corrosive environment, anodising shall be average 18 to 20 microns. Gummed paper tapes shall be provided on the exposed surface of the sections as protective coating.

#### 22.7.2 Openable Louvered Windows

Material : Heavy duty made from Aluminium extruded section HE-9-WP of I.S. 733  
Frame : 40 x 23 x 1.4 MM in-built top and bottom repeated sections 40 x 23 x 1.2 mm.  
Coupling : Coupling bar panel shape 12.5 x 6 x 2 mm Bar  
Louvers blade : One piece 18 gauge above sheets riveted to jambs by 89 mm clip c/c, after fixing the blade from inside and attached to coupling bar.  
Ground Glass : 4 mm thick for louver upto width of 760 mm and 5.5 mm thick for louvers above 760 mm.  
Weather Strip : Soft P.V.C. Weather strip  
Hardware : Louvers window with self locking type handle.  
Construction & : Shall be average 18 to 20 micron and gum paper tape provided Anodising to sections as protective coating.

#### 22.7.3 Medium Range Openable and Fixed Windows

Material : Heavy duty made from Aluminium extruded section He-9-WP of I.S. 733  
Frame : Frames shall have in-built grooves to accept the weather strip for weather sealing.  
Shutters : Vertical interlock will be hollow section Horizontal shall nonhollow suitable for glazing with suitable gaskets.  
Sections: :  
Frame :  
E  
qual Log :  
63  
.5 x 43.0 x 1.6 mm Shutter :



ollow section			H
.4 x 40.0 x 1.6 mm Mullion			57
ollow section			H
.0 x 40.0 x 1.6 mm			62
Glazing	: Beading	30.0 x 19.0 x 1.1 mm 4 mm thick clear glass	
Hardware	(Openable Shutter)		
a)	Heavy duty alum butt hinges having stainless steel pins, dowels and P.C. Washers.		
b)	Peg Stay - Aluminium extruded section.		
c)	Aluminium fasteners angle with nylons striking plate.		
Construction & as General Specifications for Sliding Windows Anodising			Same

#### 22.7.4 Doors

Material	: Heavy duty made from Aluminium extruded section HE-9-WP of I.S. 733
Frame	: Outer frame including intermediate vertical and horizontal members shall be rectangular extruded section for weather shipping.
Shutter	: Shutter horizontal and vertical section provision for snap on glazing. Vertical section have mullion groove beading shipping.
Glazing	: Screwless snap on square aluminium above beading with PVC glazing gasket, - 5.5 mm thick clear glass.
Section	: Outer frames including intermediate, horizontal and vertical members - Size 101.6 x 44.5 x 2 mm.

Shutter Vertical 57 x 44.5 x 2.2 mm  
 Shutter Top 48 x 44.5 x 2.2 mm  
 Shutter Bottom 100 x 44.5 x 2.2 mm  
 Square above beading 16 x 15.5 x 1.2 mm

Hardware	:
a)	Lever lock, brass body, key operating from both sides.
b)	Standard push and pull horizontal full length.
c)	Double action hydraulic floor spring of approved make and quality with G.I. top and bottom pivots.

Construction  
 Frame : Frame shall be mechanically jointed with 3 mm thick aluminium cleat.  
 Shutters : Mechanically jointed with plated self tapping screws and aluminium safety plates, blind rivets and nickel plated self tapping for joints and fittings.  
 Anodising : Shall be average 18 to 20 micron and gumbed paper tape provided opt sections as protective coating.

**23 ALUMINUM SHEET IN ROOFING / SIDE CLADDING - Deleted**

**24 FLOORING**

**24.1 Scope**

24.1.1 These Specifications cover the general requirements of different kinds of floor finishes.

**24.2 Applicable Codes**

24.2.1 The following Indian Standard Codes, unless otherwise specified herein, shall be applicable. In all cases, the latest revision of the codes shall be referred to.

IS: 210-1978 (210-1993*)	Grey Iron Castings (4th Revision)
IS: 269-1989	Specification for 33 Grade Ordinary Portland Cement (4th Revision) (Amendments 3)
IS: 401-1982	Code of Practice for Preservation of Timber (3rd Revision) (Amendments 2) (Reaffirmed 1990)
IS: 451-1972	Technical Supply Conditions for Wood Screws (2nd Revision) (Amendments 1) (Reaffirmed 1991)
IS: 455-1989	Specification for Portland Slag Cement (4th Revision) (Amendments 3)
IS: 653-1992	Specification for Linoleum Sheets and Tiles (3rd Revision)
IS: 661-1972 (661-1974)*	Code of Practice for Thermal Insulation of Cold Storage's (2nd Revision) (Amendments 2)
IS: 702-1988	Specification for Industrial Bitumen (2nd Revision)(Amendment 1)
IS: 777-1988	Specification for Glazed Earthenware Wall Tiles (2nd Revision) (Superseded By IS: 13753, 13754, 13755, 13756)
IS: 809-1992	Specification for Rubber Flooring Materials for General Purposes (2nd Revision)
IS: 1124-1974	Method of Test of Determination of Water Absorption, Apparent Specific Gravity and Porosity of Natural Building Stones (1st Revision) (Reaffirmed 1990)
IS: 1130-1969	Specification for Marble (Blocks, Slabs and Tiles) (Reaffirmed 1993)
IS: 1141-1973 (1141-1993)*	Code of Practice - Seasoning of Timber (2nd Revision)
IS: 1197-1970	Code of Practice for Laying Rubber Floors (1st Revision)(Reaffirmed 1990)
IS: 1198-1982	Code of Practice for Laying, Fixing Ad Maintenance of Linoleum Floor (1st Revision)(Reaffirmed 1990)
IS: 1200 (Part XI) 1977	Method of Measurement of Building and Civil Engineering Work (Part XI) Paving, Floor Finishes, Dado and Skirting)(3rd Revision) (Amendment 1) (Reaffirmed 1992)
IS: 1237-1980	Specification for Cement Concrete Flooring Tiles (1st Revision)(Reaffirmed 1990)
IS: 1322-1982 (1322-1993)	Specification for Bitumen Felts for Water Proofing and Damp-Proofing (4th Revision)
IS: 1443-1972	Code or Practice for Laying and Finishing of Cement Concrete Flooring Tiles (1st Revision)(Reaffirmed 1991)
IS: 1489 (Part-1) 1991	Specification for Portland Pozzolana Cement (Part - 1) Flyash Based (3rd Revision)

IS: 1489- (Part II) 1991	Specification for Portland Pozzolana Cement (Part II) Calcined Clay Based (3rd Revision)(Amendment 1)
IS: 1580-1991	Specification for Bituminous Compounds of Water Proofing and Caulking Purpose (3rd Revision)
IS: 2078-1979	Method of Tensile Testing of Grey Cast Iron (1st Revision)(Reaffirmed 1991)
IS: 2114-1984	Code of Practice for Laying In-Situ Terrazzo Floor Finish (2nd Revision)(Amendment 1)(Reaffirmed 1990)
IS: 2571-1970	Code of Practice for Laying In-Situ Cement Concrete Flooring (1st Revision) (Reaffirmed 1991)
IS: 3400 (Part.1 to 22)	Method of Test for Vulcanized Rubbers
IS: 3400-(Part III) 1980	Methods of Test for Vulcanized Rubbers (Part Iii) Hardness (1st Revision) (Reaffirmed 1991)
IS: 3400 - (Part X) 1977	Method of Test for Vulcanized Rubbers (Part X) Compression Set At Constant Strain (1st Revision)(Reaffirmed 1990)
IS: 3461-1980	Specification for PVC-Asbestos Floor Tiles (1st Revision)(Amendments 2) (Reaffirmed 1990)
IS: 3462-1986	Specification for Unbaked Flexible PVC Flooring (2nd Revision)(Amendment 1)(Reaffirmed 1991)
IS: 3622-1977	Specification for Sand Stone (Slab & Tiles)(1st Revision)(Reaffirmed 1993)
IS: 3670-1989	Code of Practice for Construction of Timber Floors (1st Revision)
IS: 5318-1969	Code of Practice for Laying of Flexible PVC Sheet and Tile Flooring (Reaffirmed 1990)
IS: 5766-1970	Code of Practice for Laying of Burnt Clay Brick Flooring (Reaffirmed 1991)
IS: 8041-1990	Specification Rapid Hardening Portland Cement (2nd Revision)(Amendments 2)
IS: 8042-1989	Specification for White Portland Cement (2nd Revision)(Amendments 4)
IS: 8043-1991	Specification for Hydrophobic Portland Cement (2nd Revision) (Amendment 2)
IS: 8112-1989	Specification for 43 Grade Ordinary Portland Cement (1st Revision(Amendments 3))
IS: 12330-1988	Specification for Sulphate Resisting Portland Cement. (Amendments 3)
IS: 1195	Bitumen Mastic for Flooring
IS: 3384	Bitumen Primer for Use in Waterproofing and Damp Proofing
IS: 4832 (Part - 1)	Acid Resistant Mortars - Silicate Type
IS: 4832 (Part - 2)	Acid Resistant Mortars - Resin Type
IS: 4457	Ceramic Unglazed Vitreous Acid Resisting Tiles

### 24.3 List of Mandatory Tests

Material	Clause	Test	Field/ Laboratory	Test Procedure	Min. Quantity of material for carrying out the test	Frequency of testing
Terrazzo Tiles	22.14.1	1. Transverse strength 2. Water absorption 3. Abrasion test	IS: 1237-1980 Laboratory	IS: 12371980	5000 Nos. (no testing need be done if total number tiles of all types of all sizes form all manufacture rs used in a work is less than 5000 Nos.)	One test for every 10,000 Nos. or part thereof for each type and size from a single manufacturer. (One test to be done even if the number of terrazzo tiles of any type and size from a single manufacturers is less than 50,000 Nos. provided the number of terrazzo tiles of all types and sizes from all manufacturers used in work exceed 5000 Nos.
White Glazed tiles (for floor & wall)	22.18.1	1. Water absorption 2. Crazing test 3. Impact strength test 4. Chemical resistant test	Laboratory	IS: 7771988	3000 Nos.	3000 Nos. or part thereof

24.4 **Brick on Edge Flooring** - Deleted

24.5 **Cement Concrete Flooring** - Deleted

24.6 **Cement Concrete Flooring with Topping of Red Oxide of Iron** - Deleted

24.7 **Cement Concrete Flooring with Metallic Hardener Topping** - Deleted

24.8 **Cement Plaster in Risers of Steps, Skirting, Dado** - Deleted

24.9 **Cement Plaster Skirting Finished with Red Oxide of Iron** - Deleted

24.10 **Cement Concrete Pavement in Courtyard and Terrace Etc.** - Deleted

24.11 **Terrazzo (Marble Chips) Flooring Laid In Situ** - Deleted

- 24.12 **Terrazzo (Marble Chips) Skirting In Situ** - Deleted
- 24.13 **Crazy Marble Flooring** - Deleted
- 24.14 **Terrazzo Tile Flooring** - Deleted
- 24.15 **Terrazzo Tiles in Risers of Steps, Skirting and Dado** - Deleted
- 24.16 **Chequered Tile Flooring** - Deleted
- 24.17 **Chequered Tiles in Stair Treads** - Deleted
- 24.18 **Glazed Tile Flooring** - Deleted
- 24.19 **Glazed Tiles in Skirting and Dado** - Deleted
- 24.19.5 Measurements - Deleted
- 24.19.6 Rates - Deleted
- 24.20 **Marble Flooring** - Deleted
- 24.21 **Marble Stone in Risers of Steps and Skirting** - Deleted
- 24.22 **Kota Stone Flooring** - Deleted
- 24.23 **Kota Stone in Risers of Steps, Skirting and Dado** - Deleted
- 24.24 **Red or White Rough Dressed Sand Stone Flooring** - Deleted
- 24.25 **Red or White Fine Dressed Sand Stone Flooring** - Deleted
- 24.26 **Red or White Fine Dressed and Rubbed Sand Stone Flooring**
  - 24.26.1 Stone slabs shall be as specified in **Clause 22.24.1**.
  - 24.26.2 Dressing
    - 24.26.2.1 The Specifications for dressing the top surface and the sides shall be as described in **Clause 22.24.2** In addition the dressed top and sides shall be table rubbed with coarse grade carborundum stone before paving, to obtain a perfectly true and smooth surface free from chisel marks.
    - 24.26.2.2 The thickness of the slabs after dressing shall as specified with a permissible tolerance of  $\pm 2$  mm
  - 24.26.3 Laying
    - 24.26.3.1 The slab shall be laid with 3mm/5mm thick joint or as specified in the item.

24.26.3.2 Where the joints are to be limited to 5 mm thickness, the slabs shall be laid as specified in **Clause 22.20.3** except that the bedding mortar shall be as specified in **Clause 22.24.3** and sides of the slabs to be jointed shall be buttered with cement mortar 1:2 (1 cement: 2 stone dust) admixed with pigment to match the shade of the slab.

24.26.3.3 Where the slabs are to be laid with 5 mm thick joints, the Specifications for laying shall be as described in **Clause 22.24.3**.

24.26.4 Finishing

24.26.4.1 Finishing shall be specified in **Clause 22.24.4** except that chisel marks and unevenness shall be removed by rubbing with coarse grade carborundum stone.

24.26.5 Measurement and Rate -Deleted

**24.27 Cast Iron Grid Tiles Flooring** - Deleted

**24.28 Acid Proof Flooring** - Deleted

## **APPENDIX - A**

### **ABRASION TEST FOR CONCRETE HARDENING COMPOUNDS (Clause 22.7.1.)**

#### **A-1. Preparation of Sample**

25 mm cylinder shall be prepared in ratio 1:2 (1 cement: 2 graded stone) aggregate 6 mm nominal size by weight one each with and without the admixture of concrete hardening compound. The concrete hardening compound shall be used in the proportion by weight of cement as recommended by the firm. The cylinder shall be placed inside a damp box for 24 hours and then cured in water for 27 days. After that, they shall be subject to abrasion test on 'Dorry Type Avery Abrasion Testing Machine, using Emery Powder No.80 as the abrading medium under the condition given in A2 below:

#### **A-2. Conditions of Test**

Area of rubbing surface shall be same in both cylinders.

Age of cylinder 28 days

Duration of Test 60 minutes

Total distance transversed during rubbing About 2.4 km

Pressure on rubbing surface 0.04 kg/cm<sup>2</sup>

#### **A-3. Results of Tests**

The following observations shall be made in both the cases:

Composition of the Test specimen

Mean thickness rubbed away

Percentage loss in weight

#### **A-4. Remarks**

Percentage loss in weight in the case of cylinders with concrete hardening compound, should not be more than 40 % of the percentage loss in the case of cylinder without concrete hardening compound.

## APPENDIX - B

### TEST REQUIREMENTS AND PROCEDURE FOR TESTING

#### “PRECAST CEMENT CONCRETE/TERRAZZO TILES” (Clause 22.14.1 & 22.15.1)

##### B-1. Sampling

The tiles required for carrying out test described below shall be taken by 'random sampling'. Each tile sample shall be marked to identify the consignment from which it was selected.

Minimum quantity of tiles for carrying out the test and frequency of test shall be as specified in the list of Mandatory Test. The number of tiles selected for each mandatory test shall be as follows:

1.	For conformity to requirements on shape and dimensions, wearing layer, and general quality	12 tiles
2.	For wet transverse strength test	6 tiles
3.	For resistance to wear test	6 tiles
4.	For water absorption	6 tiles

*Note 1: The test on the tiles shall not be carried out earlier than 28 days from the date of manufacture.*

*Note 2: The tiles selected for 1 may as well after verification of requirements, be used for 2.*

##### B-2. Wet transverse Strength Test

Six full size tiles shall be test for the determination of wet transverse strength. When tested according to the procedure laid down in Appendix 'E' if IS: 1237-1980, the average wet transverse strength shall not be less than 3 N/mm<sup>2</sup> (30 kgf/cm<sup>2</sup>).

##### B-3. Resistance to Wear Test

B-3-1. Not less than twelve specimens shall be prepared as described in B.3.2 from the tiles selected in accordance with B.1. When tested in the manner specified in B.3.3.1. to B. 3.3.4 their average wear shall not exceed 3.5 mm and the wear on any individual specimen shall not exceed 4 mm.

##### B.3.2. Preparation of Test Specimens

The test specimens shall be square in shape and of size 7.06 cm x 7.06 cm (i.e., 50 sq. Cm in area) They shall be sawn off one only from each tile, preferably from the central part of the file.

The deviation in the length of the specimen shall be within  $\pm 2$  per cent. The surface to be tested shall be ground smooth and filling removed.

##### B.3.3. Apparatus and Accessories.

##### B.3.3.1 Abrasion Testing Machine

The abrasion test of specimens shall be carried out in a machine conforming essentially to the requirements described in IS: 1237 -1980. The abrasive powder used for the test shall conform to the Specification given below:



The abrasive shall have an aluminium oxide content of not less than 95 per cent by weight. The grains shall be rounded shape and shall generally pass through IS Test Sieve 25 and be retained on IS test Sieve 20. The combined content of larger grains whose finest is not limited, shall not exceed 10 per cent. The specific gravity of the grains shall be between 3.9 and 4.1. The grains shall generally have hardness of 9 in Mohr's scale.

#### B.3.3.2. Measuring Instruments

A suitable instrument capable of measurements to an accuracy of 0.01 mm shall be used for determining the change in the thickness of the specimen after abrasion.

#### B.3.3.3. Procedure of Test

The specimen shall be dried at 110 degree centigrade for 24 hours and then weighed to the nearest 0.1 gm. The specimen after initial drying and weighing shall be placed in the thickness measuring apparatus with its wearing surface upper most and the reading of the measuring instrument taken.

The grinding path of the disc of the abrasion testing machine shall be evenly strewn with 20 gm of the abrasive powder. The specimen shall then be fixed in the holding device with the surface to be ground facing the disc and loaded at the centre with 30 kg. The grinding disc shall then be put in motion at a speed of 30 rpm. After every 22 revolutions, the disc shall be stopped, the abraded tile powder and the remainder of the abrasive powder shall be removed from the disc and fresh abrasive powder in quantities of 20 gm applied each time. After 110 revolutions, the specimen shall be turned about the vertical axis through an angle of 90 degree and then the test continued under the same conditions until 220 revolutions have been completed altogether. The disc, the abrasive powder and the specimen shall be kept dry throughout the duration of the test. After the abrasion is over, the specimen shall be reweighed to the nearest 0.1 gm. It shall then be placed in the thickness measuring apparatus once again in the identical manner and the reading taken with the same position and setting of the dial guage as for the measurement before abrasion.

#### B.3.3.4. Determination of Wear

The wear shall be determined from the difference in readings obtained by the measuring instrument before and after the abrasion of the specimen. The value shall be checked up with the average loss in thickness of the specimen obtained by the following formula.

$$t = 10 \times (W_1 - W_2) \times V_1 / (W_1 \times A)$$

where:

t = Average loss in thickness, in mm;  
W<sub>1</sub> = Initial weight, in gm of the specimen;  
W<sub>2</sub> = Final weight, in gm of the abraded specimen  
V<sub>1</sub> = Initial volume, in C.C., of the specimen, and  
A = Surface area, in sqcm of the specimen.

#### B-4. Water Absorption

B-4.1. At the time of delivery to the site of the work, not less than six full tile specimens, selected in accordance with B<sub>1</sub>, shall be prepared and then tested as described below, their average percentage of water absorption shall not exceed ten.

#### B.4.4.2. Preparation of Specimen.

Full size tiles shall be used for this test. They shall be immersed in water for 24 hours., then taken out, wiped dry and tested for water absorption.

#### B.4.3. Procedure of Test

Each tile shall be weighed immediately after saturation and wiping as in B.3.2. The tile shall be oven dried a temperature of  $65 \pm 1$  degree centigrade for a period of 24 hours, cooled to room temperature and reweighed.

#### B.4.4. Determination of Water Absorption

The water absorption pre cent by weight for each tile shall be determined as follows:

On oven dry basis water absorption per cent by

$$\text{Weight} = (W_1 - W_2) \times 100 / W_2$$

Where

W1 = Weight in gm of the saturated specimen:  
and

W2 = Weight in gm of the oven dried specimen

The average value for percentage water absorption shall be calculated for the whole number of tiles tested.

## ROOFING

### 25.1 Scope

25.1.1 These Specifications cover the general requirements of different kinds of roofing.

### 25.2 Applicable Codes

25.2.1 The following Indian Standard Codes, unless otherwise specified herein, shall be applicable. In all cases, the latest revision of the Codes shall be referred to.

IS: 73-1992	Specification for Paving Bitumen (2 <sup>nd</sup> Revision)
IS: 277-1992	Galvanised Steel Sheets (Plain and Corrugated) (5 <sup>th</sup> Revision)
IS: 458-1988	Specification for Precast Concrete Pipes (with and Without Reinforcement) (3 <sup>rd</sup> Revision)
IS: 459-1992	Corrugated and Semi Corrugated Asbestos Cement Sheets (3 <sup>rd</sup> Revision)
IS: 651-1992	Salt Glazed Stone Ware Pipes and Fittings (5 <sup>th</sup> Revision)
IS: 702-1988	Specification for Industrial Bitumen (2 <sup>nd</sup> Revision)
IS: 1199-1959	Methods of Sampling and Analysis of Concrete (Reaffirmed 1991)
IS: 1200-1973 (Part:IX)	Method of Measurement of Building and Civil Engineering Works Part IX: Roof Covering (including Cladding) (Reaffirmed 1992) (2 <sup>nd</sup> Revision)
IS: 1200-1973 (Part:X)	Method of Measurement of Building and Civil Engineering Works Part 10 Ceiling and Lining (Reaffirmed 1992) (2 <sup>nd</sup> Revision)
IS: 1202-1978	Determination of Specific Gravity (Reaffirmed 1990)
IS: 1203-1978	Determination of Penetration (Reaffirmed 1990)
IS: 1205-1978	Determination of Softening Point (Reaffirmed 1988)
IS: 1208-1978	Determination of Ductility (Reaffirmed 1988)
IS: 1209-1978	Determination of Flash Point and Free Point (Reaffirmed 1988)
IS: 1211-1978	Determination of Water Content (Dean and Stark Method) (Reaffirmed 1988)
IS: 1212-1978	Determination of Loss On Heating (Reaffirmed 1988)
IS: 1230-1979	Cast Iron Rain Water Pipes and Fitting (Reaffirmed 1991) (2 <sup>nd</sup> Revision)
IS: 1322-1982 (1322-1993)	Specifications for Bitumen Felts for Water Proofing and Damp Proofing (4 <sup>th</sup> Revision)
IS: 1367-1983 (Part:XIII)	Technical Supply Conditions for Threaded Steel Fasteners Part: XIII: Hot Dip Galvanized Coatings On Threaded Fasteners (Reaffirmed 1991) (2 <sup>nd</sup> Revision)
IS: 1609-1991	Code of Practice for Laying Damp Proofing Treatment Using Bitumen Felts (2 <sup>nd</sup> Revision)
IS: 1626-1994 (Part:I)	Specification for Asbestos Cement Building Pipes and Pipe Fittings, gutters and Gutter Fittings and Roofing Fittings: Part: I: Pipe and Pipe Fittings (2 <sup>nd</sup> Revision)

IS: 1626-1994 (Part:II)	Specification for Asbestos Cement Building Pipes and Pipe Fittings, gutters and Gutter Fittings and Roofing Fittings: Part: II: Gutter and Gutter Fittings (2nd Revision)
IS: 1626-1994 (Part:III)	Specification for Asbestos Cement Building Pipes and Pipe Fittings, gutters and Gutter Fittings and Roofing Fittings: Part: III: Roofing Accessories (2nd Revision)
IS: 2115-1980	Code of Practice for Flat Roof Finish: Mud Phuska (Reaffirmed 1992) (2nd Revision)
IS: 2633-1986	Methods of Testing Uniformity of Coating on Zinc Coating Articles (Reaffirmed 1992) (2nd Revision)
IS: 2645-1975	Specifications for Integral Cement Water Proofing Compounds (Reaffirmed 1992) (1st Revision)
IS: 3007-1964 (Part:I)	Code of Practice for Laying of Asbestos Cement Sheets: Part-I: Corrugated Sheets (Reaffirmed 1991)
IS: 3007-1965 (Part:II)	Code of Practice for Laying of Asbestos Cement Sheets: Part-II: Semicorrugated Sheets (Reaffirmed 1991)
3384-1986	Specifications for Bitumen Primer for Water Proofing and Damp Proofing (Reaffirmed 1990) (1st Revision)
7193-1974 7193-1994	Specifications for Glass Fibre Base Coal Tar Pitch & Bitumen Felts (1 <sup>st</sup> Revision)

- 25.3 Corrugated Galvanised Steel (CGS) Sheet Roofing - Deleted**
- 25.4 Ridges and Hips of Plain Galvanised Steel Sheets - Deleted**
- 25.5 Valley and Flashing of Plain Galvanised Steel sheets - Deleted**
- 25.6 Gutter of Plain Galvanised Steel Sheets - Deleted**
- 25.7 Asbestos Cement Corrugated Sheet Roofing - Deleted**
- 25.8 Ridges and Hips of Asbestos Cement - Deleted**
- 25.9 Other Roofing Accessories of Asbestos Cement - Deleted**
- 25.10 Eaves and Valley Gutters of Asbestos Cement - Deleted**
- 25.11 Painting of Roof slab with Hot Bitumen - Deleted**
- 25.12 Mud Phuska Terracing with Tile Brick Paving - Deleted**
- 25.13 Cement Concrete Gola - Deleted**
- 25.14 Khurras - Deleted**
- 25.15 Water Proofing with Bitumen Felts - Deleted**
- 25.16 Rain Water Spouts - Deleted**
- 25.17 Cast Iron Rain Water Pipes - Deleted**

**25.18 Cast Iron Fitting for Rain Water Pipes - Deleted**

**25.19 Asbestos Cement Rain Water Pipes**

25.19.1 A.C. rain water pipes shall be fixed with standard holder bat clamps.

25.19.2 A.C. Pipes

25.19.2.1 The pipes shall conform to IS: 1626 (PT. 1). These shall be straight, true and smooth and regular in thickness. To determine the straightness of a pipe it shall be rolled along a plane surface in such a manner that the socket over hangs on one edge of the plain surface. The gap between the barrel of the pipe and the plane surface shall not exceed the limits indicated below:

Length of pipe in metre	Gap in mm
0.5	3
1.0	3
1.5	5
2.0	5
3.0	6

25.19.2.2 They should be sound, homogeneous and free from cracks and other flaws.

25.19.3 Dimensions

25.19.3.1 A.C. rain water pipes shall be of the diameter specified in the item. The pipes are available in lengths of 0.5m, 1 m, 1.5 m, 2 m and 3 m excluding the depth of socket. The pipe shall be fixed in lengths of 3 metres as far as possible. The thickness of pipes and tolerances on their thickness shall be as shown in table below:

**Thickness of Pipes and Pipe Fittings and Tolerances On Thickness**

Nominal diameter of pipe and pipe fittings in mm	Thickness of pipe or pipe fittings in mm	Tolerances on thickness in mm
50	6.5	± 1.0
60	6.5	± 1.0
80	8.0	± 1.0
100	8.0	± 1.0
150	9.5	± 1.5

25.19.4 Fixing and Jointing

25.19.4.1 Pipes shall be secured to face of the wall, below all joints by standard holder bat G.I. clamps. The bat clamps shall consist of a cast iron base with a projecting "I" shaped lug, to the web of which the two semi circular halves of the 1.8 mm thick G.I. sheet clamp or 3 mm thick M.S. clamps are bolted. The base of the holder bat clamp shall be screwed on a pair of wooden plugs fixed in the wall with screws of designation No. 18 of slotted counter sunk head wood screws driven through the holes in the base. The screws shall be not less than 75 mm long for 80 mm diameter pipes and 100 mm long for 100 mm diameter pipes. The plugs shall be fixed in the wall to a depth of 15 cm, in cement mortar 1:2 (1 cement: 2 fine sand) centrally to the holes. In the base of the bat clamps and with

their front face projecting to such a length from the brick face that when the bat clamp is fixed, the outer face of its base shall be 11 x 5 cm wide at face increasing to 16 x 7 cm width at rear and shall be 7 cm deep throughout. The bat clamps shall be well galvanised.

25.19.4.2 The spigot of the upper pipe shall be properly fitted into the socket of the lower pipe, such that there is uniform, annular space for filling with the jointing material. One-third depth of this annular space between socket and spigot shall be filled in with spun approved quality and properly pressed with caulking tool. The remaining 2/3rd depth of the joint shall be filled in the stiff cement mortar 1:2 (1 cement: 2 coarse sand) and shall be pressed with caulking tool and finished smooth at top at an angle of 45 degree slopping up. This will be cured for a period of 7 days by tying a piece of gunny bag, four fold, to the pipes and keeping it wet.

25.19.5 Finish

25.19.5.1 The finished pipe line shall be truly vertical or to lines and slopes as directed and shall be at a uniform distance of 40 mm from the finished face of the wall.

25.19.6 Measurements - Deleted

25.19.7 Rate – Deleted

## **25.20 Asbestos Cement Pipe Fittings**

25.20.1 A.C. Fittings

25.20.1.1 By the term fittings are meant A.C. specials such as bends of various degrees, heads, offsets of different projections, branches and shoes. The general Specifications for these shall conform to those described in **Clause 23.19**. These shall conform to IS: 1626 (Pt.1) and shall be of approved manufacture.

25.20.2 Dimensions

25.20.2.1 The fittings shall be of the type, diameter and size specified in the description of the item. The thickness of the fittings and details of spigots and sockets shall be the same as those of the corresponding size of straight pipes. The fittings shall be of standard size and their individual thickness and tolerance on thickness shall be as given in the earlier table. The fittings shall also conform to IS: 1626(Pt.1).

25.20.3 Fixing and Jointing

25.20.3.1 The Specifications for A.C. pipes in **Clause 23.19.4** shall also apply to fittings.

25.20.4 Measurements - Deleted

25.20.5 Rate - Deleted

**26 GENERAL BUILDING SERVICES - Deleted**

**27 FENCING - Deleted**

## **RIVER TRAINING WORK AND PROTECTION WORK**

## 27.1 Scope

River training and protection work shall include construction of guide bunds, guide walls, bank protection, flooring and approach embankment protection as required for ensuring safety of the structures and their approaches against damage by flood / flowing water. Construction of various components shall conform to IRC:89 and these Specifications or as directed by the Engineer.

## 27.2 Guide Bund

- 27.2.1 This work shall consist of construction of embankment of guide bund and provision of pitching / rivetment of slopes, apron, toe protection, curtain walls etc. As indicated on the Drawing in accordance with these Specifications or as approved by the Engineer.
- 27.2.2 The provisions given hereunder are applicable only to guide bunds for structures across alluvial rivers. Guide bunds for structures across submontane rivers shall call for supplemental Specifications.
- 27.2.3 The alignment and layout of guide bund shall be as indicated on the Drawing or as approved by the Engineer. The construction of embankment for guide bund shall conform to provisions of Chapter 5 of these Specifications. Pitching, filter underneath pitching and turfing, apron, toe protection, curtain walls, etc., shall be as per these Specifications.
- 27.2.4 Guide bunds shall generally be made of locally available materials from the river bed preferably cohesionless materials. Trial pits shall be taken in borrow holes to examine suitability of soil for construction and also to decide the types of earth moving machinery to be arranged. The borrow pits should be sufficiently away from the location of the launching apron. No borrow pits should be dug on the river side of the guide bunds.
- 27.2.5 Construction of guide bund shall be taken in hand along with the construction of the bridge. Every effort shall be made to complete the work of the guide bund in one working season. Where there is any doubt about completion of the whole guide bund within one working season, suitable measures shall be planned and executed for protection of completed work. In such cases the construction of guide bund shall be started from abutment towards upstream.
- 27.2.6 Construction of apron and pitching of the guide bunds shall generally conform to **Clause 26.3 and 26.4** of these Specifications. Sufficient length of pit along the guide bund shall be ready within one to two months of commencement of work so that the placing of stones in the apron and in the slope pitching can be commenced. As a guideline, earthwork should be completed within 80 percent of working season and about 70 per cent working season shall be available for laying apron and pitching. No portion of the guide bund should be left below HFL before the onset of monsoon. Bottom of apron pit shall be as low as permitted by sub-soil water/lowest water level. Sufficient labour and appropriate earth moving machinery and trained staff shall be deployed in construction.
- 27.2.7 The Contractor shall furnish his planning for approval of the Engineer regarding transport of stones from the quarries to the site of work taking into account the quantities of stone required to be transported every day, train/truck, etc., deployed, available ferry or boats and labour available for loading and unloading and for laying within the time frame for construction of guide bund. Adequate reserve of stones should be maintained for major works as decided by the Engineer. Reserve stones shall be stacked far away from the main channel of the river.

27.2.8 Where the alignment of guide bund or the approach embankment crosses a branch channel of the river, the branch channel may be either diverted to the main channel of the river with the help of spurs, etc. or closed by a properly designed closing dyke or closure bund before taking up construction of guide bund.

### 27.3 Apron

#### 27.3.1 General

27.3.1.1 This work shall consist of laying boulders directly or in wire crates on the bed of rivers for protection against scour.

27.3.1.2 Where the required size of boulders are not available economically, cement concrete blocks of equivalent weight shall be used. The grade of concrete shall be M 15 nominal mix. (This holds good for pitching on slopes and flooring also). Cement concrete blocks shall be preferred where practicable.

27.3.1.3 The stones used in apron shall be sound, hard, durable and fairly regular in shape. Stone subject to marked deterioration by water or weather shall not be used.

27.3.1.4 Quarry stones are preferable to round boulders as the latter roll off easily. Angular stones fit into each other better and have good interlocking characteristics.

27.3.1.5 Where the required size stones are not economically available, cement concrete blocks in M15 grade conforming to **Chapter 9** or stones in wire crates in combination may be used in place of isolated stones of equivalent weight. Cement concrete blocks will be preferred, wherever practicable.

#### 27.3.2 Laying Boulder Apron

27.3.2.1 The size of stone should conform to **Clause 5.3.7.2 of IRC:89**.

27.3.2.2 The size of stone shall be as large as possible. In no case any fragment shall weigh less than 40 kg. The specific gravity of stones shall be as high as possible and it shall not be less than 2.65.

27.3.2.3 To ensure regular and orderly disposition of the full intended quantity of stone in a the apron, template cross walls in dry masonry shall be built about a metre thick and to the full height of the specified thickness of the apron at intervals of 30 m all along the length and width of the apron. Within these walls, the stone then shall be hand packed.

27.3.2.4 The surface on which the apron is to be laid shall be leveled and prepared for the length and width as shown on the Drawings. In case the surface on which apron is to be laid is below the low water level, the ground level may be raised upto low water level by dumping earth and the apron laid thereon. The quantity of stone required in the apron shall be re-worked out by taking the toe of pitching at higher level.

#### 27.3.3 Laying Wire Creates and Mattresses in the Apron

27.3.3.1 Wire crates shall be made from hot dipped galvanised mild steel wire of diameter not less than 4 mm in annealed condition having tensile strength of 300-450 MPa conforming to IS: 280. The galvanizing coating shall be heavy coating for soft condition conforming to IS: 4826.



- 27.3.3.2 The mesh of the crate shall not be more than 150 mm.
- 27.3.3.3 Wire crates for shallow or accessible situations shall be 3 metre X 1.5 metre x 1.25 metre in size. Where these have to be deposited and there is a chance of overturning, the crate shall be divided into 1.5 meter compartments by cross netting.
- 27.3.3.4 For deep or inaccessible situations, wire crates can be made smaller subject to the approval of the Engineer.
- 27.3.3.5 Wire crates built in-situ, shall not be larger than 7.5 metres X 3 metres x 0.6 metre, nor smaller than 2 metres x 1 metre x 0.3 metre. Sides of large crates shall be securely stayed at intervals of not more than 1.50 metres to prevent bulging.
- 27.3.3.6 The netting shall be made by fixing a row of spikes on a beam at a spacing equal to the mesh. The beam must be a little longer than the width of netting required. The wire is to be cut to lengths about three times the length of the net required. Each piece shall be bent at the middle around one of the spikes and the weaving commenced from one corner.
- 27.3.3.7 A double twist shall be given at each intersection. This twisting shall be carefully done by means of a strong iron bar, five and half turns being given to the bar at each splice.
- 27.3.3.8 The bottom and two ends of the crate or mattress shall be made at one time. The other two sides shall be made separately and shall be secured to the bottom and the ends by twisting adjacent wires together. The top shall be made separately and shall be fixed in the same manner as the sides after the crates or mattress have been filled.
- 27.3.3.9 Wherever possible, crates shall be placed in position before filling with boulders. The crates shall be filled by carefully hand-packing the boulders as tightly as possible and not by merely throwing in stones or boulders.
- 27.3.3.10 For laying of wire crates in aprons of bridges, two situations arise:
1. Where the crates are to be laid in deep water and have to be dumped and then joined together.
  2. Where depth of water is low or dry bed is available. In such cases, the crates can be laid at site.

## **27.4 Pitching / Revetment on Slopes**

### 27.4.1 Description

- 27.4.1.1 This work shall consist of covering the slopes of guide bunds, training works and road embankments with stone, boulders, cement concrete blocks or stones in wire crates over a layer or granular material called filter. While river side slopes are given this protection against river action, the rear slopes, not subjected to direct attack of the river, may be protected against ordinary wave splashing by 0.3-0.6 metre thick cover of clayey or silty earth and turfed.

### 27.4.2 Pitching

- 27.4.2.1 Pitching: The pitching shall be provided as indicated in the Drawings. The thickness and the shape of stone pitching shall be shown on the Drawing.
- 27.4.2.2 The stone shall be sound, hard, durable and fairly regular in shape. Quarry stone should be used. Round boulders shall not be allowed. The stones subject to marked deterioration by water or weather shall not be accepted.
- 27.4.2.3 The size and weight of stone shall conform to **Clause 5.3.5.1 of IRC:89**. No stone, weighing less than 40 kg shall, however, be used. The sizes of spalls shall be a minimum of 25 mm and shall be suitable to fill the voids in the pitching.
- 27.4.2.4 Where the required size stones are not economically available cement concrete blocks in M15 grade conforming to **Chapter 9** or stones in wire crates may be used in place of isolated stones of equivalent weight. Cement concrete blocks will be preferred wherever practicable.

27.4.3 Filter media

- 27.4.3.1 The material for the filter shall consist of sand, gravel, stone or coarse sand. To prevent escape of the embankment material through the voids the stone pitching / cement concrete blocks as well as to allow free movement of water without creating any uplift head on the pitching, one or more layers of graded materials, commonly known as a filter medium, shall be provided underneath the pitching.
- 27.4.3.2 The gradation of the filter material shall satisfy the following requirements:

Provision of a suitably designed filter is necessary under the slope pitching to prevent the escape of underlying embankment material through the voids of stone pitching/cement concrete blocks when subjected to the attack of flowing water and wave action, etc. In order to achieve this requirement, the filter may be provided in one or more layers satisfying the following criteria:

- Ratio of D 15 (Filter) to D 85 (Base) shall be less than 5;
- Ratio of D 15 (Filter) to D 15 (Base) shall be within the limits of 4 and 20; and
- Ratio of D 50 (Filter) to D 50 (Base) shall be less than 25;

*Notes:*

1. *Filter design may not be required if embankment consists of CH or Ch soils with liquid limit greater than 30, resistant to surface erosion. In this case, if a layer of material is used as bedding for pitching, it shall be well graded and its D 85 size shall be at least twice the maximum void size in pitching.*
2. *In the foregoing, D 15 means the size of that sieve which allows 15 per cent by weight of the filter material to pass through it and similar is the meaning of D 50 and D 85.*
3. *If more than one filter layer is required, the same requirement as above shall be followed for each layer. The finer filter shall be considered as a base material for selection of coarser filter.*
4. *The filter shall be compacted to a firm condition. The thickness of filter is generally of the order of 200 mm to 300 mm. Where filter is provided in two layers, thickness of each layer shall be 150 mm.*

#### 27.4.4 Construction Operations

- 27.4.4.1 Before laying the pitching, the sides of banks shall be trimmed to the required slope and profiles put up by means of line and pegs at intervals of 3 metres to ensure regular straight work and a uniform slope throughout. Depressions shall be filled and thoroughly compacted.
- 27.4.4.2 The filter granular material shall be laid over the prepared base and suitably compacted to the thickness specified on the Drawings.
- 27.4.4.3 The lowest course of pitching shall be started from the toe wall and built up in courses upwards. The toe wall shall be in dry rubble masonry (uncoursed) conforming to **Clause 11.5.3**, in case of dry rubble pitching and shall be in nominal mix cement concrete (M 15) conforming to **Chapter 9** in case of cement concrete block pitching.
- 27.4.4.4 The stone pitching shall commence in a trench below the tow of the slope. Stone shall be placed by derrick or by hand to the required length, thickness and depth conforming to the Drawings. Stones shall be set normal to the slope, and placed so that the largest dimension is perpendicular to the face of the slope, unless such dimension is greater than the specified thickness of pitching.
- 27.4.4.5 The largest stones shall be placed in the bottom courses and for use as headers for subsequent courses.
- 27.4.4.6 In hand placed pitching, the stone of flat stratified nature should be placed with the principal bedding plane normal to the slope. The pattern of laying shall be such that the joints are broken and voids are minimum by packing with spalls, wherever necessary, and the top surface is as smooth as possible.
- 27.4.4.7 When full depth of pitching can be formed with a single stone, the stones shall be laid breaking joints and all interstices between adjacent stones shall be filled in with spalls of the proper size and wedged in with hammers to ensure tight packing.
- 27.4.4.8 When two or more layers of stones must be laid to obtain the design thickness of pitching, dry masonry shall be used and stones shall be well bonded. To ensure regular and orderly disposition of the full intended quantity of stone as shown, template cross walls in dry masonry shall be built about a metre wide and to the full height of the specified thickness at suitable intervals and all along the length and width of the pitching. Within these walls the stones shall be hand packed as specified.

#### 27.4.5 Toe Protection

- 27.4.5.1 In conformity with **Clause 5.3.7. of IRC:89**, a toe wall shall be provided at the junction of slope pitching and launching apron of a guide bund so as to protect the slope pitching from falling even when the apron is not laid at low water level. The toe wall shall be in dry rubble masonry (uncoursed) conforming to **Clause 11.5.3** in case of dry rubble pitching or pitching/revetment with stones in wire crates and in nominal mix cement concrete (M 15) conforming to **Chapter 9** in case cement concrete blocks have been used in pitching. For protection of toes of bank slopes terminating either in short aprons at bed levels or anchored in flooring / rocky bed, the provisions of **Clause 8.2.2. of IRC:89** may be complied with. The relevant Specifications of the protective works for individual components will be followed.

- 27.5 **Rubble Stone/Cement Concrete Block Flooring Over Cement Concrete Bedding - Deleted**
- 27.6 **Dry Rubble Flooring - Deleted**
- 27.7 **Curtain Wall and Flexible Apron - Deleted**
- 27.8 **Tests and Standards of Acceptance - Deleted**
- 27.9 **Measurements for Payment - Deleted**
- 27.10 **Rate - Deleted**

RUIDP SOR reference number –

**40.19 & 40.17 Kara and Khamira**

40.17 Providing & applying Lime Kara 1:2 (1lime crea : 2 Zikki powder) grinding mortar with grinding mill/manually on lime base, on ceiling and all flat surface in two coats. First coat applying 3 mm to 4 mm thick and curing properly at least 7 days, second finishing coat done after 7 days of previous coat as per traditional practice.(thickness not more than 6 mm.)

40.19 Khamira Colour Washing as per old traditional practice. To prepare the Khamira, the lime should be slaked at least for 7-10 days and regularly. It should be stirred by adding cured, Gugal, for nonsynthetic colour adding gum (babool gum) as per specification. Then applying prepared solution on walls three to four thin coats as desired finishing.





**Volume - I**

**Section VB:**

**Technical Specifications for**

**Electrical Works**

### **General :**

This section deals with specification of only a few electrical works which are relevant to the scope of works under the Contract. For all other electrical works not given herein, the work shall generally be carried out as per CPWD/RUIDP technical specification or as per instruction of the Engineer.

## **TECHNICAL SPECIFICATION FOR ELECTRICAL WIRING / PANELS / SWITCHGEAR**

### **1.0 GENERAL REQUIREMENTS**

The installation shall generally be carried out in conforming with the requirements of the Indian Electricity Act, 1910 as amended up to date and the Indian Electricity Rules, 1956 framed there under, the relevant regulations of the Electric Supply Authority concerned, and also with the specifications laid down in the Indian Standard I.S. 732 - 1963 Code of Practice (revised) for Electrical Wiring Installations (system voltage not exceeding 650 volts) and I.S. 2309-1969 Code of Practice for the protection of Buildings and Allied Structure against Lightning and IS 3043 - Indian code of Practice for Earthing. The wiring shall also be according to the I.S specifications, NEC, Local Government Body.

Only the contractor having valid Electrical Contractor Licence of the State shall be eligible to execute the same. The contractor shall be responsible for renewal of the same at the appropriate time.

### **2.0 MATERIALS**

All materials, fittings, appliances, used in electrical installations, shall conform to Indian Standard Specifications wherever these exist. A list of approved materials is attached afterwards. Materials not included in the list shall be got approved by the Engineer-in-Charge/Owner prior to actual use.

### **3.0 MAIN SWITCH GEAR**

Iron clad switch fuse and isolator units should conform to relevant I.S. Standard. The quick make and break mechanism shall be self interlocked with the cover. In "Off" position there must be two breaks per pole.

Main switch gear shall be properly earthed with two numbers conductors if M.V and one number of L.V.

### **4.0 BUSBAR CHAMBER (B.B.C)**

This shall be totally enclosed, metal clad type fabricated from rust proofed 16 SWG sheet steel on angle iron frame and provided with sheet steel or cast iron detachable front cover and undrilled detachable end plates, suitable for mounting on wall or angle iron floor stand and painted with high quality enamel paint. G.I. bolts and nuts shall be used for assembly with suitable packing materials to ensure dust proof finish. Meters shall be provided on suitable sheet steel boxes. Switch shall be provided with cable end boxes as required.

The depth of B.B.C. shall be 250 mm (minimum). Minimum clearance of phase bars to earth shall be 26 mm and between bus bars shall be minimum 32 mm.

H.C. (High conductivity) copper bus bars properly tinned are to be rated at 1000 Amps. per sq. in and Aluminium bus bars (wrought aluminium alloy strip) conforming to relevant I.S. specification at 800 Amps per sq.in.

Neutral Busbars are to be rated to carry 100% of phase current up to 200A and 60% for higher. These shall be mounted on DMC/SMC supports of proper dielectric and mechanical strength and shall be appropriately colour coded for identification of Phase with PVC sleeves of 1.1 KV grade throughout the length.



Lettering shall be done for identification of switches as directed. The contractor shall submit fully dimensioned drawing of the board with the physical position of the switches and other components to the Owner for their approval before the same is fabricated.

There shall be two nos. of Earth Terminals. Suitable Danger Board shall be provided.

#### 5.0 INTERCONNECTION IN B.B.C, SWITCH FUSE, METERS

For ratings above 150 Amps these shall consist of insulated copper strips of adequate section considering current density as specified in Clause 4 above. For rating below 150 Amps PVC copper cable tails of appropriate size, terminating in tinned copper sockets may be used considering 1.5 Amp/sq.mm for copper & 1.0 Amp/sq.mm for aluminium.

The above are to be enclosed either in sheet metal trunking or conduits so that no part is exposed.

#### 6.0 DISTRIBUTION BOARDS

These totally enclosed metal clad type Distribution Boards with hinged lids shall be in accordance with I.S. 2147 - 1952 and 2675 - 1966 and B.S. 214 and shall be of welded construction and fabricated from rust proofed sheet steel and finished with anticorrosive stove enamel paint and have provision for fixing on wall and have earthing terminals / terminals.

Power Distribution Boards (415 volts TPN) shall be constructed from 16 SWG sheet steel and Branch Distribution Boards (230 volts SPN from 18 SWG sheet steel).

The MCB shall be mounted on Din rails supports of proper dielectric & mechanical strength. If fuses/fuse banks are used these shall be mounted on moulded DMC/SMC or ebonite supports of proper dielectric and mechanical strength. TPN units should have phase separation barriers.

Cables shall be connected to a terminal by crimped lugs.

Where two or more B.D.B's feeding low voltage circuits are fed from different phases of a medium voltage supply, these B.D.B's shall be installed at least two metres apart or otherwise in a different direction to prevent access to the both DBs at a time.

All three phase power distribution boards shall be properly earthed as per relevant I.E. rules and provided with suitable Danger Board. All SPN B.D.B's shall be properly earthed with one number 10 SWG galvanized iron wire each or with insulated copper PVC wire of adequate ratings in case of concealed wiring as per the specifications.

#### 7.0 SWITCHES

All switches for lights, fans and plug points shall be piano type switches, unless specified otherwise.

#### 8.0 CABLES AND CONDUCTORS

All cables shall conform to I.S-692, IS-7098, IS-1554 (Part-I) 1964 and IS 694-1990 or latest. Conductors of all cables except for flexible cables shall be of aluminium, unless specified otherwise.

#### 9.0 FLEXIBLE CABLES

Conductors of flexible cables shall be of copper. The minimum size of core acceptable is 1.5 sq.mm.

#### 10.0 INSTALLATION OF MAIN SWITCH BOARD, BDB'S MAINS, SUBMAINS, DISTRIBUTION WIRING TO INDIVIDUAL POINTS

The exact positions of all main switch board, BDB's and all runs of mains and sub mains, and distribution wirings to individual points including the exact position of all light fittings and switch boards shall be first marked on the buildings and shall be approved by the Engineer-in-Charge before actual commencement of the work.

The D.Bs shall generally be installed at a height of minimum 1.00 mtrs (3'.28" ft) from floor level.

#### 11.0 INSTALLATION OF SWITCH BOARDS

These shall be installed at a height of 1.3 mtrs (4'-3") and above the floor level.

#### 12.0 INSTALLATION OF LIGHT FIXTURES:

Where these are suspended from ceiling by two down rods, or fixed to ceiling / beam directly, at least one fixing to the ceiling/beam shall be made with Mechanical / Metal fasteners. Electrical drill only shall be used while making holes for the fasteners which shall be capable of sustaining at least 15 kg of dead weight.

The down rods and accessories shall be painted with approved paint without involving extra cost.

Unless otherwise specified these should be suspended 2.60 M (8'-6") above the floor or as per direction of Owner to match interiors.

#### 13.0 INSTALLATION OF SOCKET OUTLETS

No socket outlet shall be provided in the Rest / bath room at the height less than 130 cms (4'-3") from the floor.

No switches shall be provided inside the bath rooms, unless approved by the Engineer-in- Charge.

Socket outlet at locations other than Rest / bath rooms shall be either 25 cms (10") or 130 cms (4'-3") from the floor.

#### 14.0 ELECTRICAL PANELS

- a) Before fabrication, drawings of electrical panels will have to be got approved by the Employer / Architects.
- b) Panels will be inspected at works and approved by the Employer/Architect's prior to dispatch.
- c) Panel fabricator should be ISO certified or having test certificates from CPRI for panels built in their work shop.
- d) Panels should be tested for insulation resistance and HV withstand test. Factory test certificates should be provided.

#### 15.0 TESTING OF INSTALLATION

Before a completed installation or an addition to an existing installation is put into service, the following tests shall be carried out by the contractor in presence of the Engineer-in-Charge/Owner's/Architect's representative.

- a) Polarity of switches

It must be ensured by test that all single pole switches have been fitted on the live side of the circuits they control.

b) Insulation Test:

- i) By applying a 500 volt megger between earth and the whole system of conductors or any section thereof, with all fuses in place and all switches closed, all lamps in position or both poles of installation otherwise electrically connected together :- The result in mega-ohm shall not be less than 50 divided by the number of points on the circuit, and should not be less than 1 mega-ohm.
- ii) Between all conductors connected to one phase and all such conductors connected to the neutral or to the other phase conductors of the supply after removing all metallic connections between the two poles of the installation and switching on all switches. The insulation resistance shall be as in (i) above.

c) Earth continuity Test

The earth continuity conductor including metal conduits and metal sheaths of cables in all cases shall be tested for electrical continuity. Electrical resistance of the above along with the earthing lead but excluding any resistance of earth leakage circuit breaker, measured from the connection with the earth electrode to any point in the earth continuity conductor in the completed installation shall not exceed one ohm.

d) Earth Resistance Test

To ensure effectiveness of installation earth, the value of earth resistance shall be within 5 ohm for installation capacity upto 5 KW and one ohm for installation of higher capacity.

- 16.0 The completed work will be taken over only if the results obtained in above tests are within the limits mentioned above, and in accordance with I.E. Rules.

On completion of the installation work, a certificate shall be furnished by the contractor, countersigned by the certified supervisor under whose direct supervision the installation was carried out. This certificate shall be in a prescribed form as required by the local Electric Supply Authority. The installation shall not be considered as complete unless the installation is got inspected and passed by the Directorate of Electrical Safety/ appropriate authority, of the local State Govt. /Authority. The contractor shall have to take all initiatives and follow up the matter at his own cost for early approval of the installation for permanent energisation of the installation from the Directorate of Electrical Safety/ appropriate authority, of the local State Govt. /Authority. No extra amount will be paid on this account. However statutory fees, if any, will be reimbursed to the contractor on production of documentary evidences / official money receipts.

17.0 SPECIAL SPECIFICATIONS

- a) Before fixing all switches, fittings etc. these should be produced before Engineer-in- Charge and get approved.
- b) All metal switch boards and switch /regulator boxes to be used in work shall be painted with two coats of anti rust primer (red oxide paint) prior to erection. After erection these shall be again painted with two coats of enamel paint of approved quality and shade.
- c) Before execution of any portion of conduit work for wiring a neat proper layout should be made out by the contractor and got approved from the Engineer-in- Charge. For this purpose contractor is advised to get acquainted with the layout drawings of the Consultant/Interior Decoration Contractor.
- d) While laying the conduits for concealed wiring in the ceilings / beams / columns / walls / partitions / modular furniture etc, the contractor must ensure that all the inlets and both ends of the conduits are plugged to stop entry of foreign materials so that no difficulty arises during drawing of wires later.

- e) Damage to any fitting during erection and before handing over the installation by contractor shall be set right or replaced by the contractor at his own cost.
- f) Caution Board of proper size wherever required, shall be provided, as per I.E.E. regulations for which no extra payment will be admissible.
- g) Any repairs done to wall etc. should match with the surrounding surface otherwise same will be got done through Building Contractor at the cost of the Electrical Contractor.
- h) Earthing Installation shall be done in the presence of Engineer-in-Charge or his representative.
- i) The installations should not be energized without adequate earthing.
- j) Distribution Fuse Boards shall be provided with neat lettering in block letters with paint and for the points connected to each fuse way of the D.B's for which no extra payment will be admissible.
- k) Completion Drawings

The contractor shall be required to submit the under noted drawings in the form CD, along with three copies of Ammonia print each.

1. Plan (as per structural drawing) of each floor (not less than 1:100 metric scale) showing :-
  - i) Location of Main Switch Board, Distribution boards (with the circuit numbers controlled by them).
  - ii) The runs of mains and sub mains.
  - iii) Location of lights, wall sockets, other power consuming devices together with type of fittings and fixtures including circuit numbers.
  - iv) Position of Lightning Conductors and route of running conductor.
  - v) Position of Earthing Stations for light and power and Lightning Conductor Installation.
  - vi) Following information is to be given on all the drawings:
    - a) Name of work with job no. Accepted Tender No.
    - b) Date of completion
    - c) Name of Place
    - d) Name and Signature of Contractor
    - e) Scale of Drawings.
- 2 Schematic lines layout diagram of each floor showing;
  - (i) Layout and connections of Main and Sub-board, B.D.B. having descriptions of the size, capacity, type and their numbers, the system and the source of supply,
  - (ii) Location, Size, Type, length of main and sub main cables
  - (iii) Loading of each B.D.B. indication of phases, Departmental mark on each B.D.B and switchgear.

The drawings shall be very neatly drawn and submitted properly without folding them.

3. Cable route should be marked on site plan with measurements from permanent structures.

## **TECHNICAL SPECIFICATION FOR M.S. CONDUIT WIRING SYSTEM**

### 1.0 TYPE AND SIZE OF CONDUIT

All conduit pipe shall be screwed type, solid drawn or welded and with black stove enameled surface or galvanized and of thickness conforming to IS : 9537 Part II of 1981 (or latest revision) in all respects. The conduits are to be free from burrs and internal roughness. No conduits less than 20 mm in dia shall be used, unless specified.

### 2.0 ACCESSORIES

Only screwed type of accessories are to be used.

### 3.0 CONDUIT JOINTS

The conduit shall be properly earthed. In long distance straight runs of conduit inspection type screwed couplers are to be provided at reasonable intervals on running threads with couplers and jam nuts. Threads on conduit pipes in all cases shall be between 13 mm to 27 mm long sufficient to accommodate pipes to full threaded portion of couplers or accessories. Cut end of conduit pipes shall have no sharp edges or any burrs left to avoid damage to insulation of conductor while pulling them through such pipes.

### 4.0 PROTECTION AGAINST DAMPNESS AND RUST

In order to minimize condensation and sweating inside the tube, all outlets of pipes system shall be properly drained and ventilated, but in such a manner as to prevent entry to insects inside the conduit.

To protect against rust the outer surface of the conduit and accessories shall be painted and the bare thread portion is to be painted with anti-corrosive preservative.

### 5.0 FIXING OF CONDUITS

Conduit pipes shall be fixed by heavy gauge saddles or metal bars, secured to wall / ceiling by screws driven into wood plugs or rawl plugs or Phil plugs at an interval of not more than 76 cm apart for vertical run and 60 cm apart for horizontal run. But on either side of couplers or bend of similar fittings-saddle shall be fixed at a distance of 30 cm from the centre of such fittings. The minimum thickness for saddles shall be 24 SWG for conduits upto 25 mm dia, and 20 SWG for larger sizes.

### 6.0 BENDS IN CONDUITS

All necessary bends in the system including diversion shall be done by bending the pipes, or by inserting suitable inspection type bends, elbows or similar fittings, or by fixing cast iron inspection boxes whichever is most suitable.

### 7.0 OUTLETS

All outlets for fittings, switches etc. shall be fixed on boxes of suitable metal for either surface mounting system or flush mounting system. In case of cast iron boxes the wall thickness shall be at least 3 mm and in case of welded mild steel sheet box the wall thickness shall not be less than 16 gauge. Except where otherwise stated 3 mm thick insulated laminated sheets shall be fixed on the front with screws. Where conduits are terminated special care shall be taken in employing double jam nuts, for securely fixing conduits to outlets so as to prevent any possibility of damages to cables when drawn.

### 8.0 CABLES TO BE USED

Unless stated otherwise only single core PVC insulated cables of approved manufactures shall

be used for wiring in conduit system. The number of single core cables drawn in one conduit shall not be greater than maximum set out in Table II of Indian Standard (I.S. 732-1963) Code of Practice (revised) for electrical wiring installation (system voltage not exceeding 650 volts).

## 9.0 LOOPING IN SYSTEM

Distribution wiring in conduit to light, fan plug points etc. shall be done in looping system. In this system no joints or connections shall be made anywhere of the system except at terminating points such as at terminals of switches, ceiling roses, etc and in case of socket outlets at the socket terminals.

## 10.0 EARTHING CONTINUITY WIRES

All three pin 6 Amps plug points and metallic fan regulator cover should be provided with earthing attachment by NO. 14 SWG G.I. wires for surface wiring and 1 no. 1.5 Sq.mm PVC insulated copper wire for concealed wiring, unless specified otherwise.

Three pin 16 Amps power plug point should be provided with earthing attachment by No. 14 SWG G.I. wire for surface wiring and 1 no. 2.5 sq.mm PVC insulated copper wire for concealed wiring, unless specified otherwise.

Conduits and accessories for surface distribution wiring should be provided with earthing attachment by 14 SWG G.I. wire, unless specified otherwise.

For looping earthing G.I. wire shall be run on conduits being fixed with saddles. This wire shall not be normally visible after installation when run with the conduit. Where the wire has to be taken without the conduits this will be fixed with 'U' nails at 2' feet intervals.

### **TECHNICAL SPECIFICATION FOR NON METALLIC CONDUIT WIRING SYSTEM**

## 1.0 SCOPE

This specification covers the detailed requirements for wiring work in non-metallic conduits. This specification covers both surface and recessed types of wiring work.

## 1.1 APPLICATION

1.1.1 Recessed conduit work is generally suitable for all applications. Surface conduit work may be adopted in places like workshops etc and where recessed work may not be possible to be done. The type of work shall be as specified in individual works.

1.1.2 Flexible non-metallic conduits shall be used only at terminations, wherever specified.

### 1.1.3 Special Precautions

- i) If the pipes are liable to mechanical damages, they should be adequately protected.
- ii) Non-metallic conduit shall not be used for the following applications:
  - a) In concealed / inaccessible places of combustible construction where ambient temperature exceeds 60 degrees C.
  - b) In places where ambient temperature is less than 5 degrees C.
  - c) For suspension of fluorescent fittings and other fixtures.
  - d) In areas exposed to sunlight.

## 1.2 MATERIALS

### 1.2.1 Conduits

- i) All non-metallic conduit pipes and accessories shall be of suitable material complying with IS:2509-1973 and IS:3419-1989 for rigid conduits and IS:9537 (Part 5) 2000 for flexible conduits. The interior of the conduits shall be free from obstructions. The rigid conduit pipes shall be ISI marked.
- ii) The conduits shall be circular in cross-section. The conduits shall be designated by their nominal outside diameter. The dimensional details of rigid non-metallic conduits are given in Table-II.
- iii) No non-metallic conduit less than 20 mm in diameter shall be used.
- iv) Wiring capacity

Maximum capacity of conduits for drawing in of PVC insulated cables shall be as follows:

650/1100V PVC copper wire	In 20 mm dia conduit	In 25 mm dia conduit	In 32 mm dia
1.5 sq.mm	4 Nos	8 Nos	12 Nos
2.5 sq.mm	3 Nos	6 Nos	10 Nos
4.0 sq.mm	2 Nos	6 Nos	8
6.0 sq.mm	-	5 Nos	7
10.0 sq.mm	-	3 Nos	5 Nos

Maximum number of PVC insulated 650/1100V grade aluminium /copper conductor cable are as per latest CPWD /RUIDP General Specification of Electrical Works

#### 1.2.2 Conduit Accessories

- i) The conduit wiring system shall be complete in all respect including accessories.
- ii) Rigid conduit accessories shall be normally of grip type.
- iii) Flexible conduit accessories shall be of threaded type.
- iv) Bends, couplers etc shall be solid type in recessed type of works, and may be solid or inspection type as required, in surface type of works.
- v) Saddles for fixing conduits shall be heavy gauge non-metallic type with base.
- vi) The minimum width and the thickness of the ordinary clips or girder clips shall be as per Table-III.
- vii) For all sizes of conduit, the size of clamping rod shall be 4.5 mm (7 SWG) diameter.

TABLE-I

Maximum number of PVC insulated 650/1100V grade aluminum /copper conductor cable conforming to IS 694-1990

Nominal Cross Sectional Area of Conductor in sq.mm	20 mm		25 mm		32 mm		38 mm		51 mm		64 mm	
	S	B	S	B	S	B	S	B	S	B	S	B
1.50	5	4	10	8	18	12	-	-	-	-	-	-
2.50	5	3	8	6	12	10	-	-	-	-	-	-
4	3	2	6	5	10	8	-	-	-	-	-	-
6	2	-	5	4	8	7	-	-	-	-	-	-
10	2	-	4	3	6	5	8	6	-	-	-	-
16	-	-	2	2	3	3	6	5	10	7	12	8
25	-	-	-	-	3	2	5	3	8	6	9	7
35	-	-	-	-	-	-	3	2	6	5	8	6
50	-	-	-	-	-	-	-	-	5	3	6	5
70	-	-	-	-	-	-	-	-	4	3	5	4

Note	1.	The above tables show the maximum capacity of conduits for a simultaneous drawing in of cables.
	2.	The columns headed 'S' apply to runs of conduits which have distance not exceeding 4.25 m between draw in boxes and which do not deflect from the straight by an angle of more than 15 degrees. The columns headed 'B' apply to runs of conduit which deflect from the straight by an angle of more than 15 degrees.
	3.	Conduit sizes are the nominal external diameters.



TABLE-II

Dimensional details of rigid non-metallic conduits  
(All dimensions in mm)

S.No.	Nominal outside diameter (in mm)	Maximum outside diameter (in mm)	Minimum inside diameter (in mm)	Maximum permissible eccentricity (in mm)	Maximum permissible ovality (in mm)
1	20	20 <sup>+0.3</sup>	17.2	0.2	0.5
2	25	25 <sup>+0.3</sup>	21.6	0.2	0.5
3	32	32 <sup>+0.3</sup>	28.2	0.2	0.5
4	40	40 <sup>+0.3</sup>	35.8	0.2	0.5
5	50	50 <sup>+0.3</sup>	45.0	0.4	0.6

TABLE-III

Ordinary clips or girder clips

Sr. No.	Size of Conduit	Width	Thickness
1)	20 mm & 25 mm	19 mm	20 SWG (0.9144 mm)
2)	32 mm & above	25 mm	18 SWG (1.219 mm)

#### 2.0 FISH WIRE

18 S.W.G. G.I. wire shall be used and it shall protrude the conduit ends by 9 inches.

#### 3.0 CONDUCTOR BOXES, DRAW-IN-BOXES : JUNCTION BOXES :

These shall be constructed from 16 SWG M.S. sheet and have M.S. cover. Minimum size for connector boxes is 6" x 4" and for Draw-in-Boxes 4" x 4".

#### 4.0 PAINTING

Outside of wall switch boards, connector boxes & draw-in-boxes and other C.I./M.S. accessories shall be painted with two coats of anti-rust paint in addition to other painting instruction given elsewhere.

## **TECHNICAL SPECIFICATION FOR CABLE INSTALLATIONS**

### 1.0 GENERAL

All Medium Voltage and Low Voltage PVC insulated and armoured / unarmoured cables shall conform to IS 1554 Part-I-1964 and of 1,100 volt grade.

Old and used cables must not be used for installation. Only one make of cable shall be used. All cables brought to site must be tested and got approved by the Engineer-in-Charge before these can be laid. The cables shall be dispatched to site on wooden drums with ends sealed. Exact lengths shall be determined by the Contractor after measurement at site.

The underground installation of cables shall be generally conforming to I.S. 1255-1967, Code of Practice for installation and maintenance of underground cables (upto including 33 KV).

### 2.0 LAYING OF CABLES

#### a) Inside Building

Cables shall be laid on walls/ceiling/structure, unless specified otherwise, with M.S. brackets and suitable clamps or over claw type aluminium cleats fixed on M.S. brackets, spaced not more than 450 mm apart. G.I Bolts of suitable sizes are to be grouted on the wall properly for fixing the brackets.

- b) Minimum bending radius permissible is 12D for MV Cables and 20D for HV cables. At joints and terminations, the individual core of multi core cables should never be bent so that the radius is less than 15 times the diameter over the insulation.

Note: No cable jointing is allowed between two terminal points.

### 3.0 CABLE JOINTING

All cable joints shall be carried out by experienced and Licenced jointers under strict supervision. Electro plated brass cable glands, aluminium / tinned copper cable sockets and approved jointing materials must be used. The price for cable jointing and finishing the ends of the cable shall include all materials and shall also provide for tools and plants for the work. The cable armouring is to be properly terminated. All cable accessories and other associated materials shall conform to Indian Standard Specification where applicable. Proper earthing of cable glands and armouring shall be included in the job.

### 4.0 TESTING OF CABLES

All cables shall be tested for insulation resistance with megger - 5,000V constant pressure megger insulation tester for HT Cables and 1,000 V constant pressure megger for MV Cables, before installation.

After installation and end termination, the cables shall be again subjected to the above test. Insulation value for HT Cables shall not be less than 100 mega ohms and for MV Cables 1.0 mega ohm.

After laying and jointing, the HV Cables shall be subjected to high voltage pressure test before commissioning, the test voltage being as specified in I.S.1255-1967 or latest.

## 5.0 TESTING OF INSTALLATION

Before the completed installation is put into service or handed over to Owner, the installation is to be subjected to the above tests to the satisfaction of the Engineer-in-Charge. The completed work will be taken over only if the results are acceptable to the Owner / Architects / Consultant.

### **TECHNICAL SPECIFICATION FOR EARTHING INSTALLATION**

The installation shall generally conform to IS 3043 - Indian Standard Code of Practice for Earthing, as amended upto date.

#### 1.0 EARTHING

##### a) Plate Electrode

Where plate electrode for earthing is to be employed, the size of the plate shall not be less than 0.6 m x 0.6 m x 6 mm thickness for G.I plate and 0.6 m x 0.6 m x 3mm thickness in case of copper plate.

The plate shall be buried vertically with the top at a minimum of 4.0 M below the ground level for sandy soil and 2.0 M below the ground level for normal soil. In order to place the same at the prescribed depth, the dimension of pit to be excavated shall be 0.9 m x 0.9 m x 3 M deep. The plate shall be placed in position by the contractor only after the inspection of excavated pit and approval is obtained from the Engineer.

One no. 50 mm x 6 mm G.I flat (for electrical installation) or one no. 25 mm x 6 mm GI flat (for Lighting conductor) should be connected to the plate at two points by means of 65 mm long 12 mm dia galvanized bolts, nuts and galvanized washers. In case of copper plate copper flat of not less than 32 mm x 6.0 mm shall be used as the earth lead. Brass bolts, nuts and washers shall be used for fixing. All other details shall be in accordance with IS 3043-1987. No joint on the earth lead conductor is permitted. Every care is taken to ensure that the ends of the wire/flats have been securely clamped by the bolt on cleaned surface of the plate and established a good electrical contact.

After placing the plate the earth lead conductor shall be protected by means of a continuous length of G.I pipe (Class-B) having 50 mm dia bore or depending upon the size of the lead, right from the plate upto a height of 0.60 metre (2 ft) above ground level. The whole length of pipe shall be filled with bituminous compound of approved make and brand. The molten compound shall be poured from the top end the pipe and topped upto overflowing.

The plate electrode shall have a 50 mm galvanized iron water pipe buried vertically and adjacent to the electrode and reaching upto the center of the plate. The upper end of the pipe shall be atleast 5 cm above the bottom of the inspection pit and with wire mesh, funnel, etc as per IS specification.

#### 2.0 MASONRY INSPECTION PIT

The inspection pit for the earth station shall be approx 0.56 M x 0.56 M (1'-10"x1'-10") outside dimensions and approx 0.45 M (1'-6") deep when completed, having 5" thick cement brick work with 1st class bricks in cement mortar (6: 1) both inside and outside plastered 19 mm (3/4") thick and neatly cemented 1.60 mm (1/16") thick, both inside, outside and top. The opening on top shall be provided with a C.I. ring with lockable cover fixed flush with ground surface.

All the excavations shall be duly back filled, dressed and rammed.

### 3.0 LOCATION FOR EARTH ELECTRODES

Electrodes shall be buried at least 2 M (6'-6") away from the building pole or object to be earthed. However, earthing electrodes for L.C. Installations should be as close to the down conductors as possible.

Electrodes, when installed in parallel, shall not be placed less than 2 M (6'-6") apart and preferably placed at distances greater than twice their lengths.

### 4.0 EARTH BUSBAR

#### a) Galvanized M.S. Flat

The busbar shall be of suitable size and length, as specified in the Schedule of Items, heavily galvanized and having adequate number of drilled and tapped holes 30 mm apart, complete with G.I. bolts, nuts, washers for securely connecting the earth leads and earth continuity conductors. The busbar shall be fixed on wall, having clearance of 6 mm from wall with spacing insulators with at least 13 mm (1/2") G.I. rag bolts spaced about 0.46 M (1'-6") apart.

#### b) Copper Flats:

To be used, as specified, in the Schedule of Items (RUIDP), where earthing requirements are more stringent. Brass bolts, nuts washers shall be used for connections.

### 5.0 VALUE OF EARTH RESISTANCE

In case of installations where the load does not exceed 5 K.W. the resistance to earth shall on no account exceed 5 ohms. Where the load exceeds 5 K.W. The resistance shall not exceed 01 ohm.

For sub-stations, the value is 01 ohm.

General Technical Specification:

#### 1.0 Conformity to IE Act, IE Rules, and Standards:

- i) All electrical works shall be carried out in accordance with the provisions of Indian Electricity Act, 1910 and Indian Electricity Rules, 1956 amended up to date.
- ii) The works shall also conform to relevant Indian Standard Codes of Practice (COP) for the type of work involved.
- iii) In all electrical installation works, relevant safety codes of practice shall be followed.
- iv) Unless otherwise specified, the work shall be carried out as per RUIDP or CPWD General Specifications for Electrical Works (Internal & external) as applicable as per the instruction of the Engineer-in-Charge or his authorized representative.

#### 2.0 Workmanship :

- i) Good workmanship is an essential requirement to be complied with. The entire work of manufacture / fabrication, assembly and installation shall conform to sound engineering practice involving highly skilled workers.
- iii) The work shall be carried out under the direct supervision of a highly experienced licensed SUPERVISOR, i.e. a person holding a certificate of competency issued by the State Govt. for the type of work involved, employed by the contractor, who shall rectify the defects pointed out by the Engineer- in-charge during the progress of work.

3.0 General requirements and components: -

- i) Quality of Materials: -
  - a) All the materials and equipments supplied by the contractor shall be new. They shall be of such design, size and materials as to satisfactorily function under the rated condition of operation and to withstand the environmental conditions at site.
  - b) All the components shall conform to relevant IS specification wherever existing. Materials with ISI certification marked shall be preferred if not otherwise mentioned the tender.
  - c) For items of materials for which makes are approved by the Dept., only such approved makes shall be permitted in the work in accordance to the preference of the Engineer-in-Charge of the employer.
  - d) Commissioning on completion: Before the workman leaves the work finally, the contractor must be sure that the installation is ready for commissioning after due testing.

4.0 Completion plan and completion certificate

- i) For all the works, completion certificate after completion of work as given in 'Appendix-A' shall be submitted to the Engineer In-Charge.
- ii) 'As built' drawing to be submitted along-with Test/completion certificate which is an essential part for consideration of final bill.

5.0 Testing & Installation:

On completion of installation, the following tests shall be carried out:

- i) Insulation Resistance Test by appropriate class of Megger
- ii) Earth continuity test
- iii) Earth resistant test by earth Megger.

Testing shall be carried out for the completed installation in presence of the JSCL Electrical Engineer or his authorized representative to their satisfaction. All test result shall be recorded and submitted for record purposes. All necessary test instruments for the test shall be arranged by the Contractor if so required by the Engineer. Calibration certificates may require to be produced on demand by the Engineer.

6.0 Testing of Earth Continuity Path

The earth continuity conductor, including metal conduits and metallic enclosures of cables in all cases, shall be tested for electric continuity. The electrical resistance of the same along-with the earthing lead, but excluding any added resistance, or earth leakage circuit breaker, measured from the connection with the earth electrode to any point in the earth continuity conductor in the completed installation shall not exceed one ohm.

## Appendix A

### Form of Completion Certificate

I/We certify that the installation detailed below has been done by me/us and tested and that to the best of my/our knowledge belief it complies with the Indian Electricity Rules, 1956.

1. Particulars of work:

a) Internal Electrical Installation

	No.	Total Load	Type or system of wiring
i) Light point			
ii) Socket point			
a) 5pin 5 Amp.			
b) 6 pin 15 Amp.			
c) Others			

2. Earthing: -

- i) Description of earthing electrode ii) Number of earth electrode
- iii) Size of main earth lead

3. Test results:

a) Insulation resistance

- i) Insulation resistance of the whole system of conductors to earth MΩ
  
- ii) Insulation between the phase conductor and neutral
 

Between Phase R and neutral		Y	MΩ
Between neutral	Phase		and
ween			MΩ
Phase B and neutral			Bet
  
- iii) Insulation resistance between the phase conductors in case of polyphase supply.
 

Between Phase R and Phase Y			MΩ
Phase Y and Phase B			Between
			MΩ

Between Phase B and Phase R

MΩ

- b) Earth continuity test- Maximum resistance between any point of the earth continuity conductor including metal conduits and main earthing leads Ohm
  
- c) Earth Electrode Resistance of each earth electrode
  - i).....Ohm
  - ii).....Ohm
  - iii).....Ohm
  - iv).....Ohm

Signature and name of  
Supervisor along with  
no., SCC Part nos. & validity

Signature and Name of the the  
Contractor along with License license  
number & validity

## TECHNICAL SPECIFICATION FOR MOTOR

### 1.0 GENERAL INSTRUCTIONS TO BIDDER

- 1.1 Motor shall conform to Engineering Standard ES: 8102 and Specification Sheet enclosed.  
1.2 The motor shall be energy efficient type having efficiency class of 'eff 1' as per IS: 12615 and high power factor type.

### 1.3 Starting Current

- 1.3.1 The starting current i.e. breakaway current of 415V Motors shall not exceed the values indicated in IS 12615. Also there shall be no further positive tolerance on the values of breakaway current.  
1.3.2 The starting current of 3.3kV motors shall not exceed 550% (including positive tolerance) of rated current.  
1.3.3 The starting current of 11kV motors shall not exceed 600% (including positive tolerance) of rated current.  
1.4 Type test certificate of similar motor for use in specified hazardous area (if applicable) shall be furnished.  
1.5 Filled in Specification Sheet and Technical Particulars for each type and rating of motors shall be furnished.  
1.6 The rating of the motor shall be as per the sizes in the ISS. The margin between the installed power and absorbed power shall not be less than the following:

<u>Motor Rating</u>	<u>Margin above Driven M/C Absorbed Power</u>
Less than 22 KW	25%
22 KW to 55 KW	15%
75 KW and above	10%

- 1.7 The duty cycle of the motor shall meet the process and driven machine requirement.  
1.8 Voltage rating for the motors of different KW ratings shall be as below:  
Below 160 KW : 415 V, 3-phase, 50 Hz AC  
160 KW - 999 KW : 3.3 KV, 3-phase, 50 Hz AC  
1000 KW and above : 11 KV, 3-phase, 50 Hz AC  
1.9 In case of 11 KV & 3.3 KV motor, the terminal box shall be suitably designed for proper termination of XLPE insulated cables through heat shrink termination kit.  
1.10 Explosion proof motors with type of protection 'e' (increased safety) or 'n' (non-sparking) shall be provided with arrangement for pre-start ventilation as per stipulation of respective Indian Standards/IEC. Also suitable control unit for pre-start ventilation shall be in bidder's scope.  
1.11 Drawings and documents as per clause no. 13.0 and Annexure-I of ES: 8102 shall be supplied.  
1.12 Motor shall be of either of the following makes or Equivalent:



Sl. No.	L. T. Motor	H. T. Motor
1	ABB LTD., INDIA	BHEL LTD.
2	BHARAT BIJLEE LTD., INDIA	CROMPTON GREAVES LTD.
3	CROMPTON GREAVES LTD., INDIA	KIRLOSKAR ELECTRIC COMPANY LTD.
4	SIEMENS, INDIA	FUJI ELECTRIC INTERNATIONAL CORPORATION
5	ALSTHOM LIMITED, INDIA (AREVA T & D)	mitsubishi CORPORATION
6	KIRLOSKAR ELECTRIC COMPANY LTD., INDIA	TOSHIBA CORPORATION
7	ANSALDO ROBICON, ITALY	ANSALDO ROBICON
8	SIEMENS AG, GERMANY	SIEMENS AG, GERMANY (EARLIER SIEMENS DEMAG DE LAVAL)
9	BHEL LTD., INDIA	A.E.G., TELEFUKEN
10	FUJI ELECTRIC INTERNATIONAL CORPORATION, JAPAN	PEEBLES ELECTRICAL MACHINES
11	mitsubishi CORPORATION, JAPAN	BRUSH ELECTRICAL M/c LTD.
12	TOSHIBA COPORATION, JAPAN	ALSTHOM ALLANTIQUE
13	ASEA BROWN BOVERI, SWEDEN	JEUMONT SCHNEIDER
14	ALSTHOM ALLANTIQUE, FRANCE	G.E.C., U.S.A
15	A.E.G. TELEFUNCUN, GERMANY	WESTINGHOUSE ELECTRIC CORPORATION, U.S.A
16	BRUSH ELECTRICALS M/C. LTD., U.K.	
17	PEEBLES ELECTRICAL M/C., U.K.	
18	WESTINGHOUSE ELECTRIC CORP., U.S.A	
19	JEUMOUT INDUSTRIES FRANCE	
20	LAXMI HYDRAULICS PVT. LTD , INDIA	

## 2. Name Plates

- 2.1 The name plates shall be of stainless steel with letters embossed on them.
- 2.2 The name plate shall contain all the relevant details as per IS: 325 and in addition shall indicate the following:
- i) The description and code no. of motor
  - ii) Degree of protection of enclosure
  - iii) Temperature rise of windings under running condition
  - iv) Designation of bearings
  - v) Recommended type of lubricant and interval of lubrication vi) Direction of rotation
  - vii) Mounting Arrangement
- 2.3 Flameproof motors shall have additional name plate containing relevant particulars as per IS: 2148.
- 2.4 Increased safety motors shall have additional name plate containing relevant particulars as per IS: 6381.
- 2.5 Motors with type of protection “n” shall have additional name plate containing relevant particulars as per IS: 9628.

### 3. VIBRATIONS

The motor vibrations measured at the bearings must not exceed the limits specified in IS: 12075, unless otherwise stipulated in the specification sheet.

### 4. NOISE LEVEL

The motor noise level shall not exceed 85 dB measured at a distance of 1 meter from the motor.

### 5. PAINTING

Enclosures of the motor and its accessories shall be painted with two coats of anti-rust paint and two coats of anti-corrosive paint after suitable pre-treatment  
Epoxy paint, wherever specified, shall be used.

Unless otherwise specified, the finishing shade shall be light grey having shade No. 631 as per IS: 5.

### 6. TESTS AND INSPECTION

- a. All motors shall be routine tested as per relevant standards.
- b. Additional tests, wherever specified, shall be carried out on one motor of each rating.
- c. For high voltage motors of each rating, polarization index test shall also be carried out.
- d. All the above mentioned tests shall be carried out in the presence of purchaser's representative. In addition, the motor shall be subject to stage inspection at works and inspection at site for final acceptance.
- e. These inspections shall, however, not absolve the vendor from their responsibility for making good any defects which may be noticed subsequently.

### 7. DRAWINGS AND DOCUMENTS

7.1 Drawings and documents as per Annexure-II shall be supplied, unless otherwise specified.

7.2 All drawings and documents shall have the following descriptions written boldly:

- i) Name of client
- ii) Name of consultant
- iii) Enquiry / order number with plant / project name
- iv) Motor Code No. and Description

ANNEXURE - II

DOCUMENTATION FOR INDUCTION MOTORS

Sl. No.	Document Description	Documents Required (Y / N)		
		With Bid	For Approval	Final
1.	Specification Sheet and Technical Particulars completely filled-in	Y	Y	Y
2.	Dimensional Drawings	Y	Y	Y
3.	Drawings and data for air / water heat exchangers, if necessary	N	Y	Y
4.	Drawings and data for oil system, if necessary	N	Y	Y
5.	Characteristic curves			
	a) Thermal withstand curve b) Load Vs FL current	N	Y	Y
	c) Load Vs Efficiency	N	Y	Y
	d) Load Vs Power factor e) Load Vs Speed	N	Y	Y
	f) Voltage Vs Thermal Withstand time	N	Y	Y
	g) Starting current Vs Time	N	Y	Y
	Connection diagram for RTDs, thermometer etc.	N	Y	Y
6.	Terminal Box drawings	Y	Y	Y
	Illustrative and Descriptive catalogues	Y	N	Y
7.	Catalogues of bought out accessories Spare parts list	N	N	Y
8.	Installation, Operation and Maintenance manual	Y	N	Y
9.	Test certificates a) Routine	N	N	Y
10.	b) Type			
11.	c) For enclosure	N	N	Y
12.	Guarantee Certificates	N	N	Y
		Y	N	Y
		N	N	Y
13.				

8. SPARES

8.1 Spares for operation and maintenance

Item wise unit prices of spare parts with recommended quantity shall be quoted along with the motors as listed in the specification sheet.

8.2 Commissioning Spares

Commissioning spares, as required, shall be supplied with the main equipment. Item wise

list of recommended commissioning spares shall be furnished for approval.

8.3 Any other spare parts not specified, but required, shall also be quoted along with the offer.

8.4 All spare parts shall be identical to the parts used in the motors.

#### 9. DEVIATIONS

9.1 Deviations, if any, from this standard shall be clearly indicated in the offer with reasoning.

9.2 Deviations, if any, from the data furnished in specification sheet shall be indicated therein beside the data by encircling it.

**Section VC:**  
**Technical Specification**  
**for**  
**Waste Management**

**SECTION VII C - Technical Specification for Solid Waste Management:**

Item No. 1: Dust Bins:

Particulars	Specification
<b>Material</b>	HDPE
<b>Colour</b>	Green,
<b>Bin Capacity (Volume)</b>	60 Ltrs
<b>Load Carrying Capacity</b>	30 Kgs
<b>Wall</b>	Non- Perforated
<b>Lid</b>	Swing Type
<b>Approximate Dimension</b>	<b>Height</b> 590 mm
	<b>Length</b> 455 mm
	<b>Width</b> 315 mm
<b>UV Resistant</b>	Yes
Quality Assurance	100 Virgin HDPE/PP materials DIN-EN-840 International Certification ISO 9001-2015 Certified.
Brand/Make	Sintex/Nilkamal/Sheetal/Fiable/Supreme/Multi/Promark/ Shakti/ Singhania/Walkman or any other make as approved by Engineer In-charge

Item No. 2: Dust Bins:

Particulars	Specification
<b>Material</b>	HDPE
<b>Colour</b>	White,
<b>Bin Capacity (Volume)</b>	60 Ltrs
<b>Load Carrying Capacity</b>	30 Kgs
<b>Wall</b>	Non- Perforated
<b>Lid</b>	Swing Type
<b>Approximate Dimension</b>	<b>Height</b> 590 mm
	<b>Length</b> 455 mm
	<b>Width</b> 315 mm

<b>UV Resistant</b>	Yes
Quality Assurance	100 Virgin HDPE/PP materials DIN-EN-840 International Certification ISO 9001-2015 Certified.
Brand/Make	Sintex/Nilkamal/Sheetal/Fiable/Supreme/ Multi/Promark/ Shakti/ Singhania/ Walkman or any other make as approved by Engineer In-charge

Item No. 3: Twin Litter Bins:

<b>Particulars</b>	<b>Specification</b>
<b>Material</b>	Stainless Steel
<b>Colour</b>	Polished chrome -matt with Green and White
<b>Bin Capacity (Volume)</b>	40 liter each
<b>Gripping Provision</b>	Ventral
<b>Wall</b>	Perforated
<b>Lid</b>	Hinged
<b>Approximate Dimension</b>	450 mm height , length 1050 mm, width 330 mm
<b>UV Resistant</b>	Yes
ISI Marked	Yes
Brand/Make	Vaidik/ Finex/ Steelone/ Cleener/ Steelcem/ Maruti/Multi or any other make as approved by Engineer In-charge

Item No. 4: Hand Cart:

<b>Particulars</b>	<b>Specification</b>
<b>Material</b>	Heavy duty MS frame with dust bin stand
<b>Colour</b>	Black (Hand Cart)
<b>Bin Capacity (Volume)</b>	60 Ltrs - Blow moulded, High Density Polyethylene dustbins 4 nos. (2 for dry waste white colour and and 2 for wet waste green colour)
<b>Load Carrying Capacity</b>	60 Kgs
<b>Handle</b>	With
<b>Wheel</b>	With
<b>Wheel Lock</b>	With
<b>Wheel Dimension In (mm) (Diameter X Thickness )</b>	200 mm x mm
<b>Wheel Material</b>	Puncher less Rubberized Wheel
<b>Towage Provision</b>	Yes
<b>Gripping Provision</b>	Frontal
<b>Plugged Outlet For Washing &amp; Draining</b>	With
<b>Approximate Dimension</b>	Height of 669mm x 322 mm Length and 335mm Width
<b>UV Resistant</b>	Yes
<b>Utility</b>	Public (Mobile containers confirming IS: 12402)
<b>Brand/Make</b>	Nilkamal/Sands/Krishna/ GVM or any other make as approved by Engineer In-charge



Item No. 5: Refuse Compactor Bins:

<b>Particulars</b>	<b>Specification</b>
<b>Material</b>	Corrosion free sheet metal
<b>Colour</b>	Green
<b>Bin Capacity (Volume)</b>	1100 liters
<b>Load Carrying Capacity</b>	1000 kgs.
<b>Wall</b>	Non- Perforated
<b>Lid</b>	Hinged
<b>Handle</b>	With
<b>Wheel</b>	With 4 wheels of 360 degree rotational
<b>Wheel Lock</b>	Without
<b>Wheel Dimension In (mm) (Diameter X Thickness )</b>	203 mm x mm
<b>Wheel Material</b>	NYLON
<b>Wall</b>	Non- Perforated
<b>Approximate Dimension</b>	<b>Height</b> 1100 mm
	<b>Length</b> 1100 mm
	<b>Width</b> 1100 mm
<b>Shape</b>	Cubical
<b>Brand/Make</b>	Sheetal/Aristo/Walkman/KNK/DTS/Sintex/Unitex/Enviro Engineering/Speed/ Multi or any other make as approved by Engineer In-charge
<b>Utility</b>	Public dust bin mobile containers confirming IS: 12402,

Item No. 6: Refuse Compactor Bins :

Particulars	Specification	
<b>Material</b>	Stainless steel	
<b>Colour</b>	METALIC GREY	
<b>Bin Capacity (Volume)</b>	1100 ltrs	
<b>Load Carrying Capacity</b>	1000 kgs	
<b>Wall</b>	Non perforated	
<b>Lid</b>	Swing Type	
<b>Handle</b>	With	
<b>Wheel</b>	With 4 wheels of 360 degree rotational	
<b>Wheel Lock</b>	With	
<b>Wheel Dimension In (mm) (Diameter X Thickness )</b>	200 x 50 mm x mm	
<b>Wheel Material</b>	HEAVY DUTY FORGED STEEL	
<b>Towage Provision</b>	Yes	
<b>Gripping Provision</b>	Ventral	
<b>Plugged Outlet For Washing &amp; Draining</b>	With	
<b>UV Resistant</b>	Yes	
<b>Shape</b>	RECTANGULAR	
<b>Approximate Dimension</b>	<b>Height</b>	1200 mm
	<b>Length</b>	1375 mm
	<b>Width</b>	800 mm
<b>Brand/Make</b>	Vaidik/Sheetal/Aristo/Walkman /KNK/DTS/Sintex/ Unitex/Enviro Engineering/Speed/ Multi or any other make as approved by Engineer In-charge	
<b>Utility</b>	Public dust bin mobile containers confirming IS: 12402,	

**Volume - I**

**Section VIA**

**General Conditions of Contract**

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## Section VI-A- General Conditions of Contract

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## SECTION VI A: General Conditions of Contract

### A. General

<b>1. Definitions</b>	<p>1.1 Boldface type is used to identify defined terms.</p> <p>(a) The <b>Accepted Contract Amount</b> means the amount accepted in the Letter of Acceptance for the execution and completion of the Works and the remedying of any defects.</p> <p>(b) The <b>Activity Schedule</b> 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.</p> <p>(c) The <b>Adjudicator</b> 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.</p> <p>(d) <b>Bill of Quantities</b> means the priced and completed Bill of Quantities forming part of the Bid.</p> <p>(e) <b>Compensation Events</b> are those defined in GCC 41.1 hereunder.</p> <p>(f) The <b>Completion Date</b> is the date of completion of the Works as certified by the Engineer, in accordance with GCC 52.1.</p> <p>(g) The <b>Contract</b> 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.</p> <p>(h) The <b>Contractor</b> is the party whose Bid to carry out the Works has been accepted by the Employer.</p> <p>(i) The <b>Contractor's Bid</b> is the completed bidding document submitted by the Contractor to the Employer.</p> <p>(j) The <b>Contract Price</b> is the Accepted Contract Amount stated in the Letter of Acceptance and thereafter as adjusted in accordance with the Contract.</p> <p>(k) <b>Days</b> are calendar days; months are calendar months.</p> <p>(l) <b>Day works</b> 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.</p> <p>(m) A <b>Defect</b> is any part of the Works not completed in accordance with the Contract.</p> <p>(n) The <b>Defects Liability Certificate</b> is the certificate issued by Engineer upon correction of defects by the Contractor.</p> <p>(o) The <b>Defects Liability Period</b> is the period calculated from the Completion Date where the Contractor remains responsible for remedying defects.</p> <p>(p) <b>Drawings</b> include calculations and other information provided or approved by the Engineer for the execution of the Contract.</p> <p>(q) The <b>Employer or Procurement Entity</b> is the party who employs the Contractor to carry out the Works, as specified in the <b>SCC</b>.</p>
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	<p>(r) The <b>Engineer</b> is the person named in the <b>SCC</b> (or any other competent person appointed by the Employer and notified to the Contractor, to act in replacement of the Engineer) who is responsible for supervising the execution of the Works and administering the Contract.</p> <p>(s) <b>Equipment</b> is the Contractor's machinery and vehicles brought temporarily to the Site to construct the Works.</p> <p>(t) <b>Force Majeure</b> 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.</p> <p>(u) The <b>Initial Contract Price</b> is the Contract Price listed in the Employer's Letter of Acceptance.</p> <p>(v) The <b>Intended Completion Date</b> is the date on which it is intended that the Contractor shall complete the Works. The Intended Completion Date is specified in the <b>SCC</b>. The Intended Completion Date may be revised only by the Engineer by issuing an extension of time or an acceleration order.</p> <p>(w) <b>Letter of Acceptance</b> means the formal acceptance by the Employer of the Bid and denotes the formation of the Contract at the date of acceptance.</p> <p>(x) <b>Materials</b> are all supplies, including consumables, used by the Contractor for incorporation in the Works.</p> <p>(y) "<b>Party</b>" means the Employer or the Contractor, as the context requires.</p> <p>(z) <b>SCC</b> means Special Conditions of Contract</p> <p>(aa) <b>Plant</b> is any integral part of the Works that shall have a mechanical, electrical, chemical, or biological function.</p> <p>(bb) <b>Retention Money</b> means the aggregate of all monies retained by the Employer pursuant to GCC 45.1.</p> <p>(cc) The <b>Site</b> is the area defined as such in the <b>SCC</b>.</p> <p>(dd) <b>Site Investigation Reports</b> are those that were included in the bidding documents and are factual and interpretative reports about the surface and subsurface conditions at the Site.</p> <p>(ee) <b>Specification</b> means the Specification of the Works included in the Contract and any modification or addition made or approved by the Engineer.</p> <p>(ff) The <b>Start Date</b> is given in the <b>SCC</b>. 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.</p> <p>(gg) A <b>Sub-contractor</b> 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.</p> <p>(hh) <b>Temporary Works</b> are works designed, constructed, installed, and removed by the Contractor that are needed for construction or installation of the Works.</p> <p>(ii) A <b>Variation</b> is an instruction given by the Engineer which</p>
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	<p>varies the Works.</p> <p>(jj) The <b>Works</b> are what the Contract requires the Contractor to construct, install, and turn over to the Employer, as defined in the <b>SCC</b>.</p>
<b>2. Interpretation</b>	<p>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 Engineer shall provide instructions clarifying queries about these GCC.</p> <p>2.2 If sectional completion is specified in the <b>SCC</b>, 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).</p> <p>2.3 The documents forming the Contract shall be interpreted in the following order of priority:</p> <ul style="list-style-type: none"> <li>(a) Agreement,</li> <li>(b) Letter of Acceptance,</li> <li>(c) Contractor's Bid,</li> <li>(d) Special Conditions of Contract,</li> <li>(e) General Conditions of Contract,</li> <li>(f) Specifications,</li> <li>(g) Drawings,</li> <li>(h) Bill of Quantities (or Schedules of Prices for lump sum contracts), and</li> <li>(i) any other document listed in the <b>SCC</b> as forming part of the Contract.</li> </ul>
<b>3. Language and Law</b>	<p>3.1 The language of the Contract and the law governing the Contract are stated in the <b>SCC</b>.</p>
<b>4. Engineer's Decisions</b>	<p>4.1 Except where otherwise specifically stated, the Engineer shall decide contractual matters between the Employer and the Contractor in the role representing the Employer.</p>
<b>5. Delegation</b>	<p>5.1 The Engineer 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.</p>
<b>6. Communications</b>	<p>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.</p>
<b>7. Subcontracting</b>	<p>7.1 The Contractor may subcontract with the approval of the Engineer, but may not assign the Contract without the approval of the Employer in writing. Subcontracting shall not alter the Contractor's obligations.</p>
<b>8. Other Contractors</b>	<p>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 <b>referred to in the SCC</b>. 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.</p>



<p><b>9. Personnel and Equipment</b></p>	<p>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 Engineer. The Engineer 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.</p>
	<p>9.2 If the Engineer 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.</p>
<p><b>10. Employer's and Contractor's Risks</b></p>	<p>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.</p>
<p><b>11. Employer's Risks</b></p>	<p>11.1 From the Start Date until the Defects Liability Certificate has been issued, the following are Employer's risks:</p> <ul style="list-style-type: none"> <li>(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 <ul style="list-style-type: none"> <li>(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</li> <li>(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.</li> </ul> </li> <li>(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.</li> </ul>
	<p>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</p> <ul style="list-style-type: none"> <li>(a) a Defect which existed on the Completion Date,</li> <li>(b) an event occurring before the Completion Date, which was not itself an Employer's risk, or</li> <li>(c) The activities of the Contractor on the Site after the Completion Date.</li> </ul>
<p><b>12. Contractor's Risks</b></p>	<p>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.</p>
<p><b>13. Insurance</b></p>	<p>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 <b>SCC</b> for the following events which are due to the Contractor's risks:</p> <ul style="list-style-type: none"> <li>(a) loss of or damage to the Works, Plant, and Materials;</li> <li>(b) loss of or damage to Equipment;</li> <li>(c) loss of or damage to property (except the Works, Plant,</li> </ul>

	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 Engineer for the Engineer'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 affect 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 insurance shall not be made without the approval of the Engineer.
	13.5 Both parties shall comply with any conditions of the insurance policies.
<b>14. Site Investigation Reports</b>	14.1 The Contractor, in preparing the Bid, shall rely on any Site Investigation Reports referred to in the <b>SCC</b> , supplemented by any information available to the Bidder.
<b>15. Contractor to Construct the Works</b>	15.1 The Contractor shall construct and install the Works in accordance with the Specifications and Drawings.
<b>16. The Works to Be Completed by the Intended Completion Date</b>	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 Engineer, and complete them by the Intended Completion Date.
<b>17. Designs by Contractor and Approval by the Engineer</b>	17.1 The Contractor shall carry out design to the extent specified in the <b>SCC</b> . 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 Engineer, who is to approve them if they comply with the Specifications and Drawings.
	17.4 The Engineer'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

	Engineer before this use.
<b>18. Safety</b>	18.1 The Contractor shall be responsible for the safety of all activities on the Site.
<b>19. Discoveries</b>	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 Engineer of such discoveries and carry out the Engineer's instructions for dealing with them.
<b>20. Possession of the Site</b>	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 <b>SCC</b> , the Employer shall be deemed to have delayed the start of the relevant activities, and this shall be a Compensation Event.
<b>21. Access to the Site</b>	21.1 The Contractor shall allow the Engineer and any person authorized by the Engineer 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.
<b>22. Instructions, Inspections and Audits</b>	22.1 The Contractor shall carry out all instructions of the Engineer, which comply with the applicable laws where the Site is located.
	22.2 The Contractor shall permit the Employer 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 Employer. 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 Employer.
<b>23. Appointment of the Adjudicator</b>	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 <b>designated in the SCC</b> , 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.
<b>24. Procedure for Disputes</b>	24.1 If the Contractor believes that a decision taken by the Engineer was either outside the authority given to the Engineer 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 Engineer'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 <b>SCC</b> , together with reimbursable expenses of the types specified in the

	Contract Data, 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 <b>SCC</b> .

**B. Time Control**

<b>25. Program</b>	25.1 Within the time stated in the <b>SCC</b> , after the date of the Letter of Acceptance, the Contractor shall submit to the Engineer 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 Engineer for approval an updated Program at intervals no longer than the period stated in the <b>SCC</b> . If the Contractor does not submit an updated Program within this period, the Engineer may withhold the amount stated in the <b>SCC</b> 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 Engineer.
	25.4 The Engineer's approval of the Program shall not alter the Contractor's obligations. The Contractor may revise the Program and submit it to the Engineer again at any time. A revised Program shall show the effect of Variations and Compensation Events.
<b>26. Extension of the Intended Completion Date</b>	26.1 The Engineer 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 Engineer shall decide whether and by how much to extend the Intended Completion Date within 21 days of the Contractor asking the Engineer 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.
<b>27. Acceleration</b>	27.1 When the Employer wants the Contractor to finish before the Intended Completion Date, the Engineer 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.
<b>28. Delays Ordered by the Engineer</b>	28.1 The Engineer may instruct the Contractor to delay the start or progress of any activity within the Works.
<b>29. Management Meetings</b>	29.1 Either the Engineer 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 Engineer 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 Engineer either at the management meeting or after the management meeting and stated in writing to all who attended the meeting.
<b>30. Early Warning</b>	30.1 The Contractor shall warn the Engineer 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 Engineer 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 Engineer 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 Engineer.

### C. Quality Control

<b>31. Identifying Defects</b>	31.1 The Engineer 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 Engineer may instruct the Contractor to search for a Defect and to uncover and test any work that the Engineer considers may have a Defect.
<b>32. Tests</b>	32.1 If the Engineer 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.
<b>33. Correction of Defects</b>	33.1 The Engineer 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 <b>SCC</b> . 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 Engineer's notice.
<b>34. Uncorrected Defects</b>	34.1 If the Contractor has not corrected a Defect within the time specified in the Engineer's notice, the Engineer shall assess the cost of having the Defect corrected, and the Contractor shall pay this amount.

**D. Cost Control**

<p><b>35. Contract Price</b></p>	<p>35.1 In the case of an admeasurements 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.</p>
	<p>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.</p>
<p><b>36. Changes in the Contract Price</b></p>	<p>36.1 In the case of an admeasurements contract:</p> <ul style="list-style-type: none"> <li>(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 Engineer shall adjust the rate to allow for the change.</li> <li>(b) The Engineer shall not adjust rates from changes in quantities if thereby the Initial Contract Price is exceeded by more than 15 percent, except with the prior approval of the Employer.</li> <li>(c) If requested by the Engineer, the Contractor shall provide the Engineer with a detailed cost breakdown of any rate in the Bill of Quantities.</li> </ul>
	<p>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.</p>
<p><b>37. Variations</b></p>	<p>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.</p>
	<p>37.2 The Contractor shall provide the Engineer with a quotation for carrying out the Variation when requested to do so by the Engineer. The Engineer shall assess the quotation, which shall be given within seven (7) days of the request or within any longer period stated by the Engineer and before the Variation is ordered.</p>
	<p>37.3 If the Contractor's quotation is unreasonable, the Engineer may order the Variation and make a change to the Contract Price, which shall be based on the Engineer's own forecast of the effects of the Variation on the Contractor's costs.</p>
	<p>37.4 If the Engineer 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.</p>

	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 admeasurements contract, if the work in the Variation corresponds to an item description in the Bill of Quantities and if, in the opinion of the Engineer, 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.
<b>38. Cash Flow Forecasts</b>	38.1 When the Program, or, in the case of a lump sum contract, the Activity Schedule, is updated, the Contractor shall provide the Engineer 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.
<b>39. Payment Certificates</b>	39.1 The Contractor shall submit to the Engineer monthly statements of the estimated value of the work executed less the cumulative amount certified previously.
	39.2 The Engineer 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 Engineer.
	39.4 The value of work executed shall comprise: <ul style="list-style-type: none"> <li>(a) In the case of an admeasurements contract, the value of the quantities of work in the Bill of Quantities that have been completed; or</li> <li>(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.</li> </ul>
	39.5 The value of work executed shall include the valuation of Variations and Compensation Events.
	39.6 The Engineer may exclude any item certified in a previous certificate or reduce the proportion of any item previously certified in any certificate in the light of later information.
<b>40. Payments</b>	40.1 Payments shall be adjusted for deductions for advance payments and retention. The Employer shall pay the Contractor the amounts certified by the Engineer 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

	<p>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.</p>
	<p>40.3 Unless otherwise stated, all payments and deductions shall be paid or charged in the proportions of currencies comprising the Contract Price.</p>
	<p>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.</p>
<p><b>41. Compensation Events</b></p>	<p>41.1 The following shall be Compensation Events:</p> <ul style="list-style-type: none"> <li>(a) The Employer does not give access to a part of the Site by the Site Possession Date pursuant to GCC 20.1.</li> <li>(b) The Employer modifies the Schedule of Other Contractors in a way that affects the work of the Contractor under the Contract.</li> <li>(c) The Engineer orders a delay or does not issue Drawings, Specifications, or instructions required for execution of the Works on time.</li> <li>(d) The Engineer instructs the Contractor to uncover or to carry out additional tests upon work, which is then found to have no Defects.</li> <li>(e) The Engineer unreasonably does not approve a subcontract to be let.</li> <li>(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.</li> <li>(g) The Engineer gives an instruction for dealing with an unforeseen condition, caused by the Employer, or additional work required for safety or other reasons.</li> <li>(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.</li> <li>(i) The advance payment is delayed.</li> <li>(j) The effects on the Contractor of any of the Employer's Risks.</li> <li>(k) The Engineer unreasonably delays issuing a Certificate of Completion.</li> </ul>
	<p>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 Engineer 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.</p>
	<p>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 Engineer, and the Contract Price shall be adjusted accordingly. If the Contractor's forecast is deemed unreasonable, the Engineer shall adjust the Contract Price</p>



	based on his own forecast. The Engineer 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 Engineer.
<b>42. Tax</b>	42.1 The Engineer 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.
<b>43. Currencies</b>	43.1 Where payments are made in currencies other than the currency of the Employer's country specified in the <b>SCC</b> , the exchange rates used for calculating the amounts to be paid shall be the exchange rates stated in the Contractor's Bid.
<b>44. Price Adjustment</b>	<p>44.1 Prices shall be adjusted for fluctuations in the cost of inputs only if provided for in the <b>SCC</b>. 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:</p> <p><b><math>P_c = A_c + B_c \text{ Imc/loc}</math></b></p> <p>where:</p> <p><math>P_c</math> is the adjustment factor for the portion of the Contract Price payable in a specific currency "c."</p> <p><math>A_c</math> and <math>B_c</math> are coefficients specified in the <b>SCC</b>, representing the nonadjustable and adjustable portions, respectively, of the Contract Price payable in that specific currency "c;" and</p> <p><math>\text{Imc}</math> is a consolidated index prevailing at the end of the month being invoiced and <math>\text{loc}</math> is the same consolidated index prevailing 28 days before Bid opening for inputs payable; both in the specific currency "c."</p>
	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.
<b>45. Retention</b>	45.1 The Employer shall retain from each payment due to the Contractor the proportion stated in the <b>SCC</b> until Completion of the whole of the Works.
	45.2 Upon the issue of a Certificate of Completion of the Works by the Engineer, 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 Engineer has certified that all Defects notified by the Engineer to the Contractor before the end of this period have been corrected. The Contractor may substitute retention money with an "on demand" bank guarantee.
<b>46. Liquidated Damages</b>	46.1 The Contractor shall pay liquidated damages to the Employer at the rate per day stated in the <b>SCC</b> 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 <b>SCC</b> . 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 Engineer 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.
<b>47. Bonus</b>	47.1 The Contractor shall be paid a Bonus calculated at the rate per calendar day stated in the SCC 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 Engineer shall certify that the Works are complete, although they may not be due to be complete.
<b>48. Advance Payment</b>	48.1 The Employer shall make advance payment to the Contractor of the amounts stated in the <b>SCC</b> by the date stated in the <b>SCC</b> , 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 Engineer.
	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.
<b>49. Securities</b>	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 <b>SCC</b> , 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.
<b>50. Day works</b>	50.1 If applicable, the Day works rates in the Contractor's Bid shall be used for small additional amounts of work only when the Engineer 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 Day works shall be recorded by the Contractor on forms approved by the Engineer. Each completed form shall be verified and signed by the Engineer within two days of the work being done.
	50.3 The Contractor shall be paid for Day works subject to obtaining signed

	Day works forms.
<b>51. Cost of Repairs</b>	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

<b>52. Completion</b>	52.1 The Contractor shall request the Engineer to issue a certificate of Completion of the Works, and the Engineer shall do so upon deciding that the work is completed.
<b>53. Taking Over</b>	53.1 The Employer shall take over the Site and the Works within seven days of the Engineer's issuing a certificate of Completion.
<b>54. Final Account</b>	54.1 The Contractor shall supply the Engineer 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 Engineer 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 Engineer 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 Engineer shall decide on the amount payable to the Contractor and issue a payment certificate.
<b>55. Operating and Maintenance Manuals</b>	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 <b>SCC</b> .
	55.2 If the Contractor does not supply the Drawings and/or manuals by the dates <b>stated in the SCC</b> pursuant to GCC 55.1, or they do not receive the Engineer's approval, the Engineer shall withhold the amount <b>stated in the SCC</b> from payments due to the Contractor.
<b>56. Termination</b>	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: <ul style="list-style-type: none"> <li>(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 Engineer;</li> <li>(b) the Engineer instructs the Contractor to delay the progress of the Works, and the instruction is not withdrawn within 28 days;</li> <li>(c) the Employer or the Contractor is made bankrupt or goes into liquidation other than for a reconstruction or amalgamation;</li> <li>(d) a payment certified by the Engineer is not paid by the Employer to the Contractor within 84 days of the date of the Engineer's certificate;</li> <li>(e) the Engineer 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</li> </ul>

	<p>by the Engineer;</p> <p>(f) the Contractor does not maintain a Security, which is required; and</p> <p>(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 <b>SCC</b>.</p> <p>(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.</p>
	<p>56.3 When either party to the Contract gives notice of a breach of Contract to the Engineer for a cause other than those listed under GCC 56.2 above, the Engineer shall decide whether the breach is fundamental or not.</p>
	<p>56.4 Notwithstanding the above, the Employer may terminate the Contract for convenience.</p>
	<p>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.</p>
<p><b>57. Fraud and Corruption</b></p>	<p>57.1 Employer requires that Contractors, Subcontractors, manufacturers, and Consultants under Employer-financed contracts, observe the highest standard of ethics during the procurement and execution of such contracts. In pursuit of this policy, the Employer:</p> <p>(a) defines, for the purposes of this provision, the terms set forth below as follows:</p> <p>(i) “corrupt practice” means the offering, giving, receiving, or soliciting, directly or indirectly, anything of value to influence improperly the actions of another party;</p> <p>(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;</p> <p>(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;</p> <p>(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.</p> <p>(b) will cancel the portion of the allocated to a contract if it determines at any time of the engaged in corrupt, fraudulent, collusive or coercive practices during the procurement or the execution of that contract, without having taken timely and appropriate action satisfactory to the Employer to remedy the situation; and</p> <p>(c) will sanction a firm or individual, including declaring them ineligible, either indefinitely or for a stated period of time, to be awarded a Employer-financed contract if it at any time determines that they have, directly or through an agent, engaged</p>

	in corrupt, fraudulent, collusive or coercive practices in competing for, or in executing, a Employer-financed contract.
<b>58. Payment upon Termination</b>	58.1 If the Contract is terminated because of a fundamental breach of Contract by the Contractor, the Engineer 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 <b>SCC</b> . 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 Engineer 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.
<b>59. Property</b>	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.
<b>60. Release from Performance</b>	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 Engineer 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.

**VOLUME - I**  
**SECTION VIB**  
**SPECIAL CONDITIONS OF CONTRACT**

## SECTION VIB: Special Conditions of Contract

The following Special Conditions of Contract shall complement, amend, supplement the GCC and the Clause Numbers provided herein refer to the same Clause Numbers provided in the Conditions of Contract. Whenever there is a conflict, the provisions herein shall prevail over those in the GCC. This Section shall therefore be read in conjunction with Section VI A of the Bid Documents.

### Clause 1: Definitions

Clause **1.1 (q)**; the **Employer**(or Procuring Entity) is the Executing Agency, Jaipur smart City Limited represented by the Chief Executive Officer, Jaipur Smart City Limited.

Clause **1.1(aa)**; the Engineer is the Executive Engineer, Jaipur smart City Limited (or any other competent person appointed by the Employer and notified to the Contractor, to act in replacement of the Engineer) who is responsible for supervising the execution of the Works and administering the Contract.

Add Clause **1.1(kk)**; the **Notice to Proceed** is the notice issued by the Engineer to the Contractor to proceed with the Works. Whenever possible the Notice to Proceed will be issued by the Engineer immediately upon signing of the Contract, or as soon thereafter as is feasible considering the availability of the Site and other relevant factors.

Replace Clause **1.1(ff)**; the **Start Date** is the date as specified in the Notice to Proceed. This is the date when the Contractor can commence work on the Contract, but does not necessarily coincide with Possession Date of all the locations of Site.

Clause **1.1(jj)** The work is described in Section V Procurement Entity's Requirement.

### Clause 2: Interpretation

2.2 Sectional Completion will be not allowed.

### Clause 3: Language and Law

3.1 The law which shall govern the conduct of the Contract and according to which the Contract shall be construed is that in force in the State of Rajasthan, India. The language of the contract shall be in English.

### Clause 6: Communications

Add Sub Clause 6.2 as below: -

6.2 Any notification under this Contract shall be served on the party concerned when received by fax, hand delivery, courier delivery, or registered letter at the addresses listed in the Contract Data Any notification under this Contract shall be served at the addresses provided below:

Address of the Contractor:

Name: \_\_\_\_\_

Address: \_\_\_\_\_

\_\_\_\_\_

Address of the Engineer:

Executive Engineer,  
Jaipur Smart City limited  
Jaipur.

### Clause 7: Sub-Contracting

Add the following Paragraphs to Sub-clause 7.1:

"The Contractor shall not sub-contract more than 50% of the awarded work, other than related to supply of equipment and machinery under the contract. Sub-contracting shall not alter the Contractor's obligation. The Contractor shall submit a list of sub-contractors along with their

credentials about (a) Technical capacity, (b) Financial capability and (c) the Experience of similar work, which is proposed to be sub-contracted. The Engineer shall scrutinize the offers submitted by the Contractor, and shall approve the sub-contractors based on their overall capability to execute the proposed sub-contracted work. The agreement between the Contractor and each sub-contractor shall be submitted by the Contractor to the Engineer and would require approval of the Engineer. Such agreement between the Contractor and sub-contractor should be reasonable, workable and justified.

If at any stage during execution, a sub-contractor is found working at Site without prior approval of the Engineer, then the work being done by such Contractor shall be stopped at Site and payment to the Contractor for that particular work shall not be made by the Engineer.

It shall be responsibility of the Contractor to ensure that no unauthorized sub-contractor works on any work Site."

Provided that the Contractor shall not be required to obtain such consent for:

- a) The provision of labors,
- b) The purchase of materials which are in accordance with the standards specified in the Contract,  
or
- c) The subcontracting of any part of the works for which subcontractor is named in the Contract.

**Clause 8: Other Contractors**

**There will be an electrical Contractor and STP vendor on the Project.**

**Clause 9: Personnel & Equipment**

9.1 Add the following:

The Contractor shall provide the following details at the time of submission of Tender

- (i)Plants and Equipment to be mobilized at site.
- (ii)Site Organization giving detail of each key personal
- (iii)Organization HSE manual.

**Clause 11: Employer's Risks**

Replace Clause 11.1 with the following:

11.1 The Employer shall be responsible for excepted risks which are (a) insofar as they directly affect the execution of the Works in the Employer's country, the risks of war, hostilities, invasion, act of foreign enemies, rebellion, revolution, insurrection or military or usurped power, civil war, riot, commotion or disorder (unless restricted to the Contractor's employees), and contamination from any nuclear fuel or nuclear waste or radioactive toxic explosive, or (b) a cause due solely to the design of the Works, other than the Contractor's design

**Clause 13: Insurance**

Add 13.1.1

13.1 The minimum amount of Third Party Liability insurance cover shall be *Rs 10,00,000 (Rupees ten Lakhs only)* per occurrence or event, with the number of occurrences not less than four. The Contractor shall promptly notify the Engineer of each claim made under the Third Party Liability coverage, and shall renew the Third Party Insurance after each such occurrence in order to maintain the number of covered occurrences at not less than four.

The minimum coverage against damage to the Works and materials during construction shall be *Rs. 5,00,000 (Rupees Five Lakhs only)*.

**Clause 14: Site Investigation Reports**

14.1 Site Survey and sub soil investigation Reports are not available. The contractor shall establish the same as as detailed in Section V, Procuring Entity's Requirement.

**Clause 16: The Works to Be Completed by the Intended Completion: -**

Intended completion date is as given in the Bid Data Sheet.



**Clause 17: Designs by Contractor and Approval by the Engineer**

17.1 The extent of designs & drawings shall be as specified in Section V, Procuring Entity's Requirement.

**Clause 19: Discoveries**

19.2: All materials, including stone, bricks, steel, wood and any other material, obtainable in the work by dismantling, etc. will be the property of the Employer/ Procuring Entity and will be disposed off as directed by the Engineer. The contract price is deemed to have been included for collection, loading/unloading, carriage and disposal within a distance of 5 km radius and no additional payment will be allowed.

**Clause 20: Possession of Site**

**Replace clause as per following: -**

The employer will give possession of the sites as elaborated in the Notice to Proceed on the Date of Start as mentioned in NTP. The remaining sites shall be made available in accordance to the agreed "Program of Work" and in general, sites shall be kept available with the contractor for the works proposed to be carried out during the next three months. The contractor will not be entitled to any delay or compensation event unless his work as per the agreed "Program of Work" is actually held up because of delay in the Employer's hand over of the site to the contractor. Refer Section V - Procurement Entity's Requirements for further details.

**Clause 23.1 & 23.2: Appointment of the Adjudicator**

Delete clause 23.1 & 23.2 in its entirety.

**Clause 24: Procedure for Disputes**

Delete Clause 24 in its entirety and replace it with the following:

**24.1 Engineer's Decision:** If any dispute of any kind whatsoever arises between the Employer and the Contractor in connection with, or arising out of, the Contract or the execution of the Works, whether during the execution of Works or after their completion, and before or after repudiation or other termination of the Contract, including any dispute as to:

- a) the meaning of the specifications, designs, drawings and instructions herein before mentioned,
- b) the quality of the workman ship or materials,
- c) any opinion, instruction, determination, certificate or valuation of the Engineer, or
- d) any other question, claim, right matter or anything whatsoever in any way arising out of or relating to the contract, design, drawings, specifications, estimates, instructions, conditions, orders or the failure to execute the same,

The dispute shall, in the first place, be referred in writing to the Engineer who has jurisdiction over the Works specified in the Contract, with a copy to the other party. Such reference shall state that it is made pursuant to this Clause. Not later than 28 (twenty-eight) day after the day on which he received such reference the Engineer shall give written notice of his decision to the Employer and the Contractor. Such decision shall state that it is made pursuant to this Clause.

Subject to the other forms of settlement hereinafter provided, the Engineer's decision in respect of every dispute or difference so referred shall be final and binding upon the Contractor and the Employer. Unless the Contract has already been repudiated or terminated, the Contractor shall, in every case, continue to proceed with the Works with all due diligence and the Contractor and the Employer shall give effect forthwith to every such decision of the Engineer until or unless the same shall be revised in an amicable settlement or as hereinafter provided.

**24.2 Remedy When the Engineer's Decision is Not Accepted:** If either the Employer or the Contractor be dissatisfied with any decision of the Engineer, or if the Engineer fails to give notice of his decision on or before 28 (twenty eight) days after the day on which he received the reference, then either the Employer or the Contractor may, on or before the twenty eighth day after the day on which he received the notice of such decision, or on or before the twenty eighth day after the day on which

the said period of 28 days expired, as the case may be, give notice to the other party, with a copy to the Engineer, of his intention to commence arbitration for settlement of the dispute.

If the Engineer has given notice of his decision as to a matter in dispute to the Employer and the Contractor and no written notice to commence arbitration has been given by either the Employer or the Contractor on or before the twentyeighth day after the day on which the parties received notice as to such decision from the Engineer, the said decision shall become final and binding upon the Employer and the Contractor.

**24.3 Amicable Settlement:** Where notice of intention to commence arbitration has been given in accordance with Sub-Clause 24.2, arbitration shall not be commenced unless an attempt has first been made by the parties to settle the dispute amicably. Provided that, unless the parties otherwise agree, arbitration may be commenced on or after the fifty-sixth day after the day on which the notice of intention to commence arbitration was given, whether or not any attempt at amicable settlement thereof has been made.

**24.4 Arbitration:** Any dispute in respect of which:

a) the decision, if any, of the Engineer has not become final and binding pursuant to Sub-Clause 24.3, and

b) Amicable settlement has not been reached within the period stated in Sub-Clause 24.3, shall be finally resolved by arbitration. The arbitration will take place in accordance with The Arbitration and Conciliation Act 1996 of India (as amended to date) and the arbitration will take place at Jaipur. Arbitration may be commenced prior to or after completion of the Works, provided that the obligations of the Employer, the Engineer and the Contractor shall not be altered by reason of the arbitration being conducted during the progress of the Works.

c) In case of dispute arising out of the Arbitration Award, the courts in Jaipur shall have the exclusive jurisdiction.

**24.5 Contractor to Execute Work Pending Settlement:** Whether the dispute is referred to the Engineer, to Arbitrator, to amicable settlement, or to the law courts, as the case may be, the Contractor shall, unless the Contract has been repudiated or terminated, proceed to execute and complete the Works with all due diligence pending settlement of the said dispute or differences.

**Clause 25: Program:**

25.1 The Specified time is 15 Days

Clause 25.3

The updated Work Program shall be submitted by the last day of each Month, The withheld amount will be 10% of the payable / unified amount till approval of such delayed submission program.

**Clause 33: Correction of Defects:**

The Defect Liability Period shall be 01 Year.

**Clause 35: Contract Price**

Delete clause 35.1 in its entirety.

**Clause 36. Changes in the Contract Price**

Delete Clause 36.1 in its entirety.

**Clause 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 not be entitled to additional payment for costs that could have been avoided by giving early warning.

37.3 The Integrated Schedule of Rates (SOR) 2017 of RUIDP and in absence of such item in SOR of RUIDP any other SOR applicable for Jaipur District, shall be followed for excess BOQ items, for quantities other than mentioned in Clause 36, the basis of approval of variation will be as per following: -

- a. On the rates of SOR mentioned as above, with effect of overall bid premium for the BOQ and Non-BOQ SOR items in the Contract which are in the SOR. These items will be treated like item included in original BOQ and will be eligible for any price escalation in accordance with the contract provisions.
  - b. In the case of composite items consisting of non-SOR and/or SOR; the items contained in the SOR will be analyzed on the basis of SOR rates with tender premium and escalation effect in accordance with the RBI price index and the non-SOR on the rate analysis on the basis of market rates as approved by the Engineer plus 10% overhead charges against the fulfillment requirement of contract and 10% contractors profit on the above cost.
- 37.4 The effect of excise/ custom duty exemption, for which Project Authority Certificate will be issued, will be compensated in the rate of variation items.
- 37.5 For Clause 37.3 (b), the Contractor shall provide the Engineer with a quotation for carrying out the Variation when requested to do so by the Engineer. The Engineer shall assess the quotation, which shall be given within seven (7) days of the request or within any longer period stated by the Engineer and before the Variation is ordered.
- 37.6 If the Contractor's quotation is unreasonable, the Engineer may order the Variation and make a change to the Contract Price, which shall be based on the Engineer's own forecast of the effects of the Variation on the Contractor's costs.
- 37.7 The Engineer may require any variation of the form, quality or quantity of the Works of any part thereof that may in his opinion be necessary to satisfactorily complete the work or for any other reason in his opinion, be appropriate, He shall have the authority to instruct the Contractor to carry out the work accordingly. The variations can be:
- a) Increase or decrease the quantity of any work included in the Contract.
  - b) Omit any such work (but not if the omitted work is to be carried out by the Employer or by another contractor)
  - c) Change the character or quality or kind of any such work
  - d) Change of levels, lines, position and dimensions of any part of the works
  - e) Execute additional work of any kind necessary for the completion of the works,
  - f) Change of any specified sequence or timing of construction of any part of the works.
- 37.8 The contractor will be obliged to carry out the work and no such variation shall in any way vitiate or invalidate the Contract.

**Clause 38: Cash Flow Forecast**

No change in this clause.

**Clause 39: Payment Certificates**

Add the following Sub-Clauses

39.7 Deductions from the Payment Certificates will be made towards Income Tax, Sales Tax, Turnover Tax, and Royalties, as per provisions of the statutory authorities, in force from time to time in the State of Rajasthan.

**Clause 40: Payments**

Delete Clause 40 in its entirety and replace by the following:

40.1 The Authority shall make payments to the Contractor for the Works on the basis of the lump sum price accepted by the Authority in consideration of the obligations specified in this Agreement for an amount of Rs. ... .. (Rs. ... ..) (the "**Contract Price**"), which shall be subject to adjustments in accordance with the provisions of this Agreement. For the avoidance of doubt, the Parties expressly agree that the Contract Price shall include all expenses incurred by the Contractor during 1 year Defect Liability period. The Parties further agree that

save and except as provided in this Agreement, the Contract Price shall be valid and effective until issue of Completion Certificate.

40.1.1 The Contract Price includes all duties, taxes (excluding GST), royalty, and fees that may be levied in accordance with the laws and regulations in force as on the Base Date on the Contractor's equipment, Plant, Materials and supplies acquired for the purpose of this Agreement and on the services performed under this Agreement. Nothing in this Agreement shall relieve the Contractor from its responsibility to pay any tax including any tax that may be levied in India on profits made by it in respect of this Agreement. However, the GST will be paid to the Contractor as per prevailing rate.

40.1.2 The Contract Price shall not be adjusted for any change in costs stated in Clause 40.1.1 above, except as stated in Price adjustment.

40.1.3 The Contract Price shall not be adjusted to take account of any unforeseen difficulties or costs, unless otherwise provided for in this Agreement.

40.1.4 Unless otherwise stated in this Agreement, the Contract Price covers all the Contractor's obligations for the Works under this Agreement and all things necessary for the Construction and the remedying of any Defects in the Project .

40. 1.5 All payments under this Agreement shall be made in Indian Rupees.

#### 40.2 **Advance Payment**

No Advance Payment will be made

#### 40.3 **Procedure for estimating the payment for the Works**

40.3.1 The Authority shall make interim payments to the Contractor as certified by the Engineer on completion of a stage, in a length, number or area as specified, and valued in accordance with the proportion of the Contract Price assigned to each item and its stage. Contractor will be paid as per the following Payment Schedule:

	<b>Stages of Payment</b>	<b>Percentage of Contract Price to be paid</b>
1	On completion of Dismantling work	2.5
2	On Completion of Foundation Slab	15
3	On Completion of Columns	20
4	On Completion of RCC Deck	25
5	On completion of Stone work in Flooring and wall	10
6	On completion of Railing	10
7	On completion of Brackets and Planter	2.5
8	On completion of Painting and plaster works	10
9	On completion of Installation of pumps and water pipeline	5
10	TOTAL	100

40.3.2 The Contractor shall base its claim for interim payment for the stages completed till the end of the month for which the payment is claimed, supported with necessary particulars and documents in accordance with this Agreement.

40.3.3 Any reduction in the Contract Price arising out of Change of Scope or the works shall not affect the amounts payable for the items or stage payments there of which are not affected by such Change of Scope or withdrawal

#### **40.4 Stage Payment Statement for Works**

The Contractor shall submit a statement (the "Stage Payment Statement"), in 3 copies, by the 7<sup>th</sup> (seventh) day of the month to the Engineer in the form set forth, showing the amount calculated to which the Contractor considers himself entitled for completed stage(s) of the Works. The Stage Payment Statement shall be accompanied with the progress reports and any other supporting documents. The Contractor shall not submit any claim for payment of incomplete stages of work.

#### **40.5 Stage Payment for Works**

40.5.1 Within 10 (ten) days of receipt of the Stage Payment Statement from the Contractor, the Engineer shall broadly determine the amount due to the Contractor and recommend the release of 90 (ninety) percent of the amount so determined as part payment against the Stage Payment Statement, pending issue of the Interim Payment Certificate by the Engineer. Within 10 (ten) days of the receipt of recommendation of the Engineer, the Authority shall make electronic payment directly to the Contractor's bank account.

40.5.2 Within 15 (fifteen) days of the receipt of the Stage Payment Statement the Engineer shall determine and shall deliver to the Authority and the Contractor an IPC certifying the amount due and payable to the Contractor, after adjusting the payments already released to the Contractor against the said statement. For the avoidance of doubt, the Parties agree that the IPC shall specify all the amounts that have been deducted from the Stage Payment Statement and the reasons therefor.

40.5.3 In cases where there is a difference of opinion as to the value of any stage, the Engineer's view shall prevail and interim payments shall be made to the Contractor on this basis; provided that the foregoing shall be without prejudice to the Contractor's right to raise a Dispute.

40.5.4 The Engineer may, for reasons to be recorded, withhold from payment:

- (a) the estimated value of work or obligation that the Contractor has failed to perform in accordance with this Agreement and the Engineer had notified the Contractor; and
- (b) the estimated cost of rectification of work done being not in accordance with this Agreement.

40.5.5 Payment by the Authority shall not be deemed to indicate the Authority's acceptance, approval, consent or satisfaction with the work done.

#### **Clause 41: Compensation Events**

41.1 (f) This clause is deleted.

41.3 Delete the second last sentence in Sub-Clause 41.3 and replace it with the following:

“In case agreement on Contract Price adjustment or extension of the Intended Completion Date cannot be reached, the Contractor shall complete the Work on the basis of the Engineer’s estimate and the dispute can be settled in accordance with the provisions of Clause 24”.

**Clause 42: Tax**

Replace Clause 42 in its entirety with the following:

The rates and prices quoted by the bidder shall be inclusive of all taxes (excluding GST) and duties prevalent during the period of submission of Bid. GST will be paid to the Contractor as per prevailing rate.

The Engineer, however, shall adjust the Contract Price if Works Contract tax or any similar tax, levied on the contract as a whole and not on to the cost of any particular item or ingredient of contract being executed under the contract, 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.

**Clause 43: Currencies**

Replace Clause 43.1 by the following:

43.1 All payments will be made in Indian Rupees

**Clause 44: Price Adjustment**

Delete Clause 44 in its entirety and replace with following sub clauses

44.1 No price adjustment is allowed under this contract

**Clause 45: Retention**

Replace Clause 45.1 with as per following:

45.1 The proportion of payment retained from each payment shall be 10% (Ten percent) of the payment amount, up to a maximum of 5% of the contract price. The Retention money shall not be deducted from the running bills if the bidder gives bank guarantee in lieu of the Retention Money for the amount equal to 5% of the Contract value at the time of issue of NTP. If such unconditional Bank Guarantee is submitted during execution of the contract wherein some Retention Money has already been deducted, then such amount may be refunded if such Bank Guarantee is of the amount considered satisfactory by the Engineer. The format of the Bank Guarantee shall be as per Annexure in Forms. The Bank Guarantee shall be in name of Chief Executive officer; Jaipur Smart City limited issued by any Nationalized/ scheduled Bank payable at Jaipur. Such Bank Guarantee if invoked shall be en-cashable when presented in the specified branch office located in Jaipur.

**Clause 46: Liquidated Damages**

Delete Sub-Clause 46.1 in its entirety and replace it with the following:

46.1 In the event that the Contractor fails to comply with the Intended Time for Completion for the whole of the Works, or, if applicable, any Section within the relevant time, then the Contractor shall pay liquidated damages to the Employer. The rate of L.D. per day for each day that the Completion Date is later than the Intended Completion Date will be (10% of Contract Price/ D), where D is 100 Days or 25% of the Original Contract Period whichever is more. The Employer may deduct liquidated damages from payments due to the Contractor, but payment of liquidated damages does not affect the Contractor’s responsibilities under the Contract.

Add the following new Clause 46.2:

46.2 If at any time during implementation of the Contract, before the Intended Completion Date has been reached, the Contractor’s progress falls more than 20% (twenty percent) behind the scheduled progress as per the agreed Work Program between Contractor and Engineer at the time of NTP and it becomes apparent that the forecast completion date is likely to be later than the Intended Completion Date, then the Contractor shall pay liquidated damages to the Employer at the rate stated in Clause 46.1 for each day that the forecast completion date is later than the Intended Completion Date, and the Employer will be entitled to deduct such liquidated damages from the running account bill payments due to the Contractor. The final decision of LD will be at the discretion of JSCL.

**Re-number** Sub-Clauses 46.2 as 46.3.

Add the following new Clause 46.4:

46.4 Notwithstanding the above, the amount of liquidated damage paid by the Contractor to the Employer shall not exceed 10 per cent of the Contract Price.

**Clause 47: Bonus**

Delete Clauses 47

**Clause 48: Advance Payment**

Delete the clause in its entirety and add the following:

48.1 No advance payment will be made

**Clause 49 Securities**

Delete clause 49 in its entirety and replace with the following:-

49.1 A performance security shall be provided to the Employer in accordance with the Instructions to Bidders and shall be issued in a form acceptable to the Employer, and denominated in the types and proportions of the currencies in which the Contract Price is payable.

49.2 If there is no reason to withhold the performance security, the performance security shall be returned to the Contractor within 28 days of the last Defects Correction Period.

49.3 The Employer shall notify the Contractor of any claim made against the institution issuing the performance security.

49.4 The Employer may claim against the surety if any of the following occurs for 14 days or more:

- (a) the Contractor is in breach of the Contract and the Employer has notified him that he is; and
- (b) the Contractor has not paid an amount due to the Employer.

**Clause 52 Completion**

**Replace the Sub-Clause 52.1 with the following:**

“When whole of the work has been substantially completed and have satisfactory passed any Tests on Completion prescribed by the contractor, the Contractor may give a notice to that effect to the Engineer, with a copy to the Employer, accompanied by a written undertaking to finish with due expedition any outstanding work during the Defects Notice Period. The Engineer shall issue a certificate complying completion of the works to the contractor.”

**Add the following Sub-Clause 52.2:**

52.2 “If any part of the permanent work has been substantially completed and has satisfactorily passed any Tests on Completion prescribed by the Contract, the Engineer may issue a Completion Certificate in respect of the part of the Permanent Work before completion of the whole of the Works and, upon the issue of such Certificate, the Contractor shall be deemed to have undertaken to complete with due expedition any outstanding work in the part of the Permanent Work during the Defects Notice Period.” Hence the defect liability period starts on the date on which part/ substantial completion certificate is issued, for that particular part of the permanent work has been substantially completed.

**Clause 53: Taking Over**

**Replace the Sub-Clause 53.1:**

53.1 “The Employer shall take over the whole works or section of works within Seven (7) days of issuance of Completion Certificate, as per Clause no 52.1 and 52.2.”

**Add the following Sub-Clause 53.2:**

53.2 Similarly in accordance with the procedure set out in sub clause 53.1, the Employer may issue a taking – over certificate in respect of:

Any substantial part of the Permanent Work which has been both completed to the satisfaction of the Engineer and, otherwise than as provided for in the Contract, occupied or used by the Employer, or any part of the Permanent Works which the Employer has elected to occupy or use prior to

completion (where such prior occupation or use is not provided for in the Contract or has not been agreed by the Contractor as a temporary measure).

### **53.3 Interference with Tests on Completion**

If the Contractor is prevented from carrying out the Tests on Completion by a cause for which the Employer (or another contractor employed by the Employer) is responsible, the Employer shall be deemed to have taken over the Works or Section (as the case may be) on the date when the Tests on Completion, as defined in the Specification, would otherwise have been completed. The Engineer shall then issue a Taking-Over Certificate accordingly, and the Contractor shall carry out the Tests on Completion as soon as practicable, before the expiry of the Contract Period. The Engineer shall require the Tests on Completion to be carried out by 14 days' notice and in accordance with the relevant provisions of the Contract. If the Contractor incurs additional Cost as a result of this delay in carrying out the Tests on Completion, such Cost plus reasonable profit shall be determined by the Engineer in accordance with the provisions of Sub-Clause 3.5 and shall be added to the Contract Price.

Replace Clause 55.2 as per following:-

### **As-Built Drawings**

The Contractor shall prepare, and keep up-to-date, a complete set of "as-built" records of the execution of the Works, showing the exact "as-built" locations, sizes and details of the work as executed, with cross references to relevant specifications and data sheets. These records shall be kept on the Site and shall be used exclusively for the purposes of this Sub-Clause. Two copies shall be submitted to the Engineer prior to the commencement of the Tests on Completion.

In addition, the Contractor shall prepare and submit to the Engineer "as-built drawings" of the Works, showing all Works as executed. The drawings shall be prepared as the Works proceed, and shall be submitted to the Engineer for his inspection. The Contractor shall obtain the consent of the Engineer as to their size, the referencing system, and other pertinent details.

Prior to the issue of any Taking-Over Certificate, the Contractor shall submit to the Engineer one softcopy in CD, one full-size original copy and six printed copies of the relevant "as-built drawings" duly signed and sealed, and any further Construction Documents specified in the Contract. The Works shall not be considered to be completed for the purposes of taking-over under Sub-Clause 52 until such documents have been submitted to the Engineer.

### **Clause 58: Payment upon Termination**

58.1 If the Contract is terminated because of a breach of Contract by the Contractor, the deduction to be made by the Employer which represents the Employer's additional cost for completing the Works shall be 50% (fifty percent) of the value of the Works not completed.

**Following clauses need to be added in addition to above clauses-**

### **Clause 61: Water Supply and Electric Power**

The Contractor shall make his own arrangements at his own expense for water supply and electric power supply for construction, testing and other purposes. Only clean water free from deleterious materials and of appropriate quality for its intended use shall be used.

### **Clause 62: Fair Wages**

62.1 The Contractor shall pay not less than fair wage/minimum wages to labourers engaged by him on the work as revised from time to time by the Government of Rajasthan, but the Government shall not be liable to pay anything extra for it except as stipulated in price adjustment clause (Clause 41) of the Contract.

(Explanation: "Fair wage" means minimum wages for time or piece work, fixed or revised, as established by the State Government under the Minimum Wages Act, 1948.)

62.2 The Contractor shall, notwithstanding the provisions of any Contract to the contrary, cause to be paid fair wages to laborers indirectly engaged on the work, including any labour engaged by his sub-Contractors in connection with the said work, as if the laborers have been immediately or directly employed by him.



62.3 In respect of all laborers, immediately or directly employed on the work, for the purpose of the Contractor's part of this agreement, the Contractor shall comply with or cause to be complied with, the Public Works Department Contract Labour Regulations' made, or that may be made, by the Government, from time to time, in regard to payment of wages, wage period, deductions from wages, recovery of wages not paid, and unauthorized deductions, maintenance of wages register, wage card, publication of scale of wages and other terms of employment, inspection and submission of periodical returns, and all other matters of a like nature.

62.4 The Engineer shall have the right to deduct, from the money due to the Contractor, any sum required or estimated to be required for making good the loss suffered by a worker or workers by reasons of non-fulfillment of the conditions of the Contract for the benefit of the worker or workers, non-payment of wages or of deductions made there from, which are not justified by the terms of the Contract or as a result of non-observance of the aforesaid regulations.

62.5 The Contractor shall be primarily liable for all payments to be made and for the observance of the regulations aforesaid, without prejudice to his right to claim indemnity from his sub-Contractors.

62.6 The regulations, aforesaid, shall be deemed to be part of this Contract and any breach thereof, shall be deemed to be breach of the Contract.

#### **Clause 63:Housing for Labour**

63.1 The Contractor at his own expense shall provide and maintain, in a clean and sanitary condition, living accommodations for those employed by him on the project. Each building for living accommodation shall be provided with lights, water supply, and sanitary facilities and be properly furnished.

#### **Clause 64:Safety and Accident Prevention Officer**

64.1 Due precautions shall be taken by the Contractor, at his own cost, to ensure the safety and protection against accidents of all staff and labour engaged on the Works, local residents in the vicinity of the Works, and the public travelling through the Works. The Contractor shall have on his staff on Site a designated officer qualified to promote and maintain safe working practices. This officer shall have authority to issue instructions and shall take protective measures to prevent accidents, including but not limited to the establishment of safe working practices and the training of staff and labour in their implementation.

#### **Clause 65:Protective Clothing and Footwear**

65.1 The Contractor shall, at his own expense, provide protective clothing and equipment to all staff and labour engaged on the Works to the satisfaction of the Engineer, and on his failure to do so the Employer shall be entitled to provide the same and recover the cost from the Contractor. Such clothing and equipment shall include, at a minimum, protective footwear for workmen undertaking concrete mixing work, protective footwear and gloves for any workmen performing bituminous paving works, protective footwear, clothing, cream, gauntlet-type gloves, hats, safety glasses or goggles and filter masks for workmen undertaking lime stabilisation works, hard hats for workmen engaged on bridge construction, and otherwise as appropriate to the job in hand and to the Engineer's satisfaction.

65.2 Ensuring that all workers are provided with and use appropriate Personal Protective Equipment (PPE), Health and safety training should be conducted for all site personnel; availability of documented procedures to be followed for all site activities; and documentation of work-related accidents;

#### **Clause 65: First-Aid Services**

65.1 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.

#### **Clause 66: Health and Pests**

66.1 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 labour, 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 labour of the dangers of communicable diseases including those transmitted by insects, water, faecal/oral contact and sexual activity. The Contractor shall take the precautions necessary to protect all staff and labour employed on the Site from insect nuisance, rats and other pests and minimise 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 labour 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.

**Clause 67. Supply of Drinking Water, Sanitation**

67.1 The Contractor shall so far as 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 Engineer.

**Clause 68. Festivals and Religious Customs**

68.1 The Contractor shall in all dealings with labour in his employment have due regard to all recognised festivals, days of rest and religious or other customs.

**ii. Disorderly Conduct**

The Contractor shall at all times take reasonable precautions to prevent any unlawful, riotous or disorderly conduct by or amongst his employees and for the preservation of peace and protection of persons and property in the neighbourhood of the Works against the same. "Disorderly conduct" shall include but not be limited to harvesting of natural resources such as firewood or fish by the Contractor's labour when this is done to the detriment of pre-existing local interests.

**iii. Records of Labour and Accidents**

The Contractor shall maintain full records of numbers, working hours and wages of labour, safety, health and welfare of persons, accidents, and damage to property and make such reports on these matters to the Engineer as he may from time to time prescribe.

**iv. General**

Unless otherwise indicated elsewhere in the Contract, The General Specification for civil works and the Quality Assurance and Quality Control (QAQC) document, as issued by the PMU of RUIDP, shall be followed. The QAQC document of JSCL is an integral part of the document and it will be provided with the bid document. A copy of the same shall be made available at the site by the contractor.

**v. Site Office for Engineer and Other Supervisory Staff**

The Contractor shall arrange to provide office of minimum 100 sq. ft. size as per specification with two tables, four chairs, one steel almirah, sufficient number of display board, telephone etc. fully furnished office accommodation within 15 days from the date of commencement of same and shall become property of the Contractor at the completion of the work. The electrical charges / water charges and all other charges shall be arranged within the area of the work. Approval shall be taken from Engineer prior to making arrangement of the office. The construction of site office and its or maintenance are incidental to the work. The office shall be functional until work is completed. If Engineer found that office arranged by the contractor is not being maintained properly then Engineer has right to deduct a reasonable amount from that payment. In case adequate space is not available for setting up of such office, the Engineer may waive such requirement on being requested by the Contractor, in writing.

**vi. Field Laboratory**

1. Within 15 (Fifteen) days from the date of commencement of the work, the Contractor shall arrange to provide a 250 sqft. fully furnished and adequately equipped field laboratory as per Specifications and directions of the Engineer, including maintenance of the same. This shall be removed at the completion of the work. All dismantled items of field laboratory and all equipment shall be property of the Contractor at the completion of the work. The Laboratory shall be functional till the work is completed. If Engineer found that Laboratory arranged by the Contractor is not being maintained properly then Engineer has right to deduct a reasonable amount from payment. The construction of Field Laboratory & its maintenance are incidental to the work. Notwithstanding the above, the Engineer may agree to the Contractor's proposal to use facilities of accredited/ Government laboratories, upon scrutinising the details of such laboratories, submitted by the Contractor. Even in that case also, the

Contractor will keep and maintain certain basic equipment at site as mentioned under Section V: Procuring Entity's Requirement.

2. The calibration of the laboratory equipments and instruments shall at the initial stage to be certified by agencies approved by the Engineer. Laboratory equipments shall be properly maintained and calibrated throughout the period of the Contract by the Contractor at his own expense. The Contractor shall notify the Engineer in sufficient advance prior to conducting any tests for the materials and work. The Engineer will also inspect the laboratory and the contractor shall provide adequate facilities to the Engineers for his independent verification of the accuracy and adequacy of the facilities.

#### **vii. Pre-Construction Inspection, Testing & Review of Data for Materials, Plant & Equipment**

1. The contractor shall place order for the material and the equipment only after the approval of the Engineer. The Contractor shall submit the detailed drawings for the approved manufacturer and the procedure of submission, review and revision shall be specified herein below.

2. The Contractor shall inform the Engineer about the likely dates of manufacturing, testing and dispatching. The Contractor shall notify the Engineer for Inspection and Testing, at least twenty eight days prior to packing and shipping and shall supply the manufacturer's test results and quality control certificates. The Engineer will decide whether he or his representative will inspect and test the material/ equipment or whether he will approve it on the basis of manufacturer's certificate.

3. The inspection and test categories shall be applied prior to delivery of the equipment, of various categories as indicated in the technical specifications for each type of the equipment.

**Category A:** - The Drawing has to be approved by the Engineer before manufacturing and Testing. The material has to be inspected by the Engineer or by an Inspecting agency approved by the Engineer at the manufacturer's premise before packing and dispatching. The Inspection charges of the agency will be borne by the Employer but the contractor has to pay the inspection charges. The Contractor shall include in their next bill the inspection charges and the same will be reimbursed by the Employer from the provisional Sum. The Contractor shall provide the necessary equipment and facilities for tests and the cost, thereof, shall be borne by the Contractor. In case of failure of any item during third party inspection no charges shall be reimbursed to the contractor for the same.

**Category B:-** The drawings of the Equipment have to be submitted and to be approved by the Engineer prior to manufacture. The material has to be tested by the manufacturer and the manufacturer's test certificates are to be submitted and approved by the Engineer before dispatching of the Equipment. Notwithstanding the above, the Engineer, after examination of the test certificates, reserves the right to instruct the Contractor for retesting, if required, in the presence of Contractor's representative.

**Category C:** The material may be manufactured as per standard and delivered to the site.

For material / Equipment under category "A" and "B", the Engineer will provide an authorization for packing and shipping after inspection.

The testing, approval for dispatching shall not absolve of the Contractor's obligation for satisfactory performance of the plant."

#### **Indicative list of Inspection Items with Category**

Sr. No.	Item	Category of inspection
1	Retaining wall	Category A
2	Electric Cable , Conductors	Category A
3	Electric poles	Category A
4	Expansion Joint	Category A
5	Underground pipes	Category A
6	Others as directed by Engineer & as mentioned in QAQC manual	

#### **viii. Supply of Colored Record Photographs**

The Contractor shall, at his own cost, arrange to take colour photographs at various stages / facets of the work including interesting and novel features of the work as directed by the Engineer and

supply two copies of colour record photographs mounted in the albums including negatives with specification and these shall be kept by Employer.

**ix. Public Awareness / Information Display**

The Contractor shall, at his own cost, arrange to provide, erect and maintain necessary display boards/ banners etc. at selection points of project site giving such information as considered necessary for public awareness/ information/ safety as directed by the Engineer.

**x. Contractor's Responsibilities**

The contractor shall promptly inform the Employer and the Engineer of any error, omission, fault, or any other defect in the design or drawings or specification for the works, which he discovers when reviewing the contract documents, or in the process of execution of the works. The Engineer will resolve the ambiguity or correct the error and will notify the contractor of the interpretation to be adopted.

**xi. Services**

1 Underground and overhead services are likely to be met with during construction. These are to be protected against damage by the Contractor at his own cost.

2 The contractor shall be required to carry out removal / shifting of existing utilities as itemized in the BOQ. The contractor work program shall include this activity. The work shall be carried out under supervision of concerned department. The supervision charges of the line agencies shall be paid by the contractor and shall be reimbursed on actual on submission of receipt.

3 Shifting of underground and overhead services other than itemized in the BOQ, but falling in the alignment of pipe line will have to be done by Contractor. The employer would provide full support to contractor in coordinating with line agencies; however, no claim on account of delay in shifting of utilities by line department will be admissible.

**xii. Setting Out**

1 The Contractor(s) shall set out the whole of the work in conjunction with an officer to be deputed by the Engineer and during the progress of the work to amend on the requisition of the Engineer any errors which may arise therein and provide all the necessary labour materials and equipments for so doing. The contractor(s) is/are to provide all tools, plant, machinery, labour and materials (with the exceptions noted in the relevant clauses for issue of departmental materials as per schedule attached) which may be necessary and required for the work. All materials and workmanship shall conform to the relevant specifications mentioned in the tender documents.

2 During execution of pile foundation, if there is any variation in soil strata which was not anticipated earlier, the matter shall be referred to Engineer – in – charge for review and modification of design by the competent authority, if considered necessary. Time taken in this process is consider in the original completion period, however no claim on account of delay in getting the sanction from competent authority will be admissible.

3 The contractor shall carryout the detailed topographic survey at site and prepare the pre-commencement survey map for approval of the Engineer's representatives. Based on the approved Pre-commencement survey map, the contractor will prepare the necessary working drawings for the purpose of execution.

4 Contractor shall be responsible for taking all traffic block and shutdowns etc. from west central railway authority for execution in railway land / spans. Contractor will get all designs and drawings approved from west central railway authority for all temporary and permanent works of railway land / spans. This will be all incidental to the work. No separate claim on this account shall be payable.

**xiii. Labor****a. Engagement of Staff and Labor**

- (i) Except as otherwise stated in the Specification, the Contractor shall make arrangements for the engagement of all staff and labor, local or otherwise, and for their payment, housing, feeding and transport.
- (ii) The contractor shall pay equal wages for men and women for work of equal value or type.
- (iii) The Contractor shall provide and employ on the Site in the installation of the Facilities such skilled, semi-skilled and unskilled labor as is necessary for the proper and timely execution of the Contract. The Contractor is encouraged to use local labor that has the necessary skills.

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- (iv) The Contractor shall be responsible for obtaining all necessary permit(s) and/or Vsa(s) from the appropriate authorities for the entry of all labor and personnel to be employed on the Site into the country where the Site is located. The Employer will, if requested by the Contractor, use his best endeavors in a timely and expeditious manner to assist the Contractor in obtaining any local, state, national or government permission required for bringing in the Contractor's personnel.
- (v) The Contractor shall at its own expense provide the means of repatriation to all of its and its Subcontractor's personnel employed on the Contract at the Site to the place where they were recruited or to their domicile. It shall also provide suitable temporary maintenance of all such persons from the cessation of their employment on the Contract to the date programmed for their departure. In the event that the Contractor defaults in providing such means of transportation and temporary maintenance, the Employer may provide the same to such personnel and recover the cost of doing so from the Contractor.
- (vi) Be required to employ atleast 50% of the labour force from communities within a radius of 2kms from the site, if sufficient people are available.

b. Persons in the Service of Employer

The Contractor shall not recruit, or attempt to recruit, staff and labor from amongst the Employer's Personnel.

c. Labor Laws

- (a) The Contractor shall comply with all the relevant labor Laws applicable to the Contractor's Personnel, including Laws relating to their employment, health, safety, welfare, immigration and emigration, and shall allow them all their legal rights.
- (b) The Contractor shall at all times during the progress of the Contract use its best endeavors to prevent any unlawful, riotous or disorderly conduct or behavior by or amongst its employees and the labor of its Subcontractors.
- (c) The Contractor shall, in all dealings with its labor and the labor of its Subcontractors currently employed on or connected with the Contract, pay due regard to all recognized festivals, official holidays, religious or other customs and all local laws and regulations pertaining to the employment of labor.

d. Rates of Wages and Conditions of Labour

- (a) The Contractor shall pay rates of wages, and observe conditions of labor, which are not lower than those established for the trade or industry where the work is carried out. If no established rates or conditions are applicable, the Contractor shall pay rates of wages and observe conditions which are not lower than the general level of wages and conditions observed locally by employers whose trade or industry is similar to that of the Contractor.
- (b) The Contractor shall inform the Contractor's Personnel about their liability to pay personal income taxes in the Country in respect of such of their salaries, wages and allowances as are chargeable under the Laws for the time being in force, and the Contractor shall perform such duties in regard to such deductions thereof as may be imposed on him by such Laws.

e. Working Hours

- (a) No work shall be carried out on the Site on locally recognized days of rest, or outside the Normal working hours, which shall be 9.00 AM to 5.00 PM on all days of the week., unless:
  - (i) otherwise stated in the Contract,
  - (ii) the Engineer gives consent, or
  - (iii) the work is unavoidable, or necessary for the protection of life or property or for the safety of the Works, in which case the Contractor shall immediately advise the Engineer.
- (b) If and when the Contractor considers it necessary to carry out work at night or on public holidays so as to meet the Time for Completion and requests the Engineer's consent thereto, the Engineer shall not unreasonably withhold such consent.

- (c) This Sub-Clause shall not apply to any work, which is customarily carried out by rotary or double-shifts.
- f. Facilities for Staff and Labor
- (a) Except as otherwise stated in the Specification, the Contractor shall provide and maintain all necessary accommodation and welfare facilities for the Contractor's Personnel. The Contractor shall also provide facilities for the Employer's Personnel as stated in the Specification.
- (b) The Contractor shall not permit any of the Contractor's Personnel to maintain any temporary or permanent living quarters within the structures forming part of the Permanent Works.
- g. Health and Safety
- (a) The Contractor shall at all times take all reasonable precautions to maintain the health and safety of the Contractor's Personnel. In collaboration with local health authorities, the Contractor shall ensure that medical staff, first aid facilities, sick bay and ambulance service are available at all times at the Site and at any accommodation for Contractor's and Employer's Personnel, and that suitable arrangements are made for all necessary welfare and hygiene requirements and for the prevention of epidemics.
- (b) The Contractor shall appoint an accident prevention officer at the Site, responsible for maintaining safety and protection against accidents. This person shall be qualified for this responsibility, and shall have the authority to issue instructions and take protective measures to prevent accidents. Throughout the performance of the Contract, the Contractor shall provide whatever is required by this person to exercise this responsibility and authority.
- (c) The Contractor shall send, to the Engineer, details of any accident as soon as practicable after its occurrence. The Contractor shall maintain records and make reports concerning health, safety and welfare of persons, and damage to property, as the Engineer may reasonably require.
- (d) The Contractor shall throughout the contract (including the Defect Liability Period):
- (i) conduct Information, Education and Consultation Communication (IEC) campaigns, at least every other month, addressed to all the Site staff and labor (including all the Contractor's employees, all Sub-Contractors and Employer's and Engineer's employees, and all truck drivers and crew making deliveries to Site for construction activities) and to the immediate local communities, concerning the risks, dangers and impact, and appropriate avoidance behavior with respect to of Sexually Transmitted Diseases (STD)—or Sexually Transmitted Infections (STI) in general and HIV/AIDS in particular;
  - (ii) provide male or female condoms for all Site staff and labor as appropriate; and
  - (iii) provide for STI and HIV/AIDS screening, diagnosis, counseling and referral to a dedicated national STI and HIV/AIDS program, (unless otherwise agreed) of all Site staff and labor.

The Contractor shall include in the program to be submitted for the execution of the Facilities under Sub-Clause 18.2 an alleviation program for Site staff and labor and their families in respect of Sexually Transmitted Infections (STI) and Sexually Transmitted Diseases (STD) including HIV/AIDS. The STI, STD and HIV/AIDS alleviation program shall indicate when, how and at what cost the Contractor plans to satisfy the requirements of this Sub-Clause and the related specification. For each component, the program shall detail the resources to be provided or utilized and any related sub-contracting proposed. The program shall also include provision of a detailed cost estimate with supporting documentation. Payment to the Contractor for preparation and implementation of this program shall not exceed the Provisional Sum dedicated for this purpose

h. Funeral Arrangements

In the event of the death of any of the Contractor's personnel or accompanying members of their families, the Contractor shall be responsible for making the appropriate arrangements for their return or burial, unless otherwise specified in the SCC.

i. Records of Contractor's Personnel

The Contractor shall keep accurate records of the Contractor's personnel, including the number of each class of Contractor's Personnel on the Site and the names, ages, genders, hours worked and wages paid to all workers. These records shall be summarized on a monthly basis in a form approved by the Engineer and shall be available for inspection by the Engineer. Until the Contractor has completed all work.

j. Supply of Foodstuffs

The Contractor shall arrange for the provision of a sufficient supply of suitable food as may be stated in the Specification at reasonable prices for the Contractor's Personnel for the purposes of or in connection with the Contract.

k. Supply of Water

The Contractor shall, having regard to local conditions, provide on the Site an adequate supply of drinking and other water for the use of the Contractor's Personnel.

l. Measures against Insect and Pest Nuisance

The Contractor shall at all times take the necessary precautions to protect the Contractor's Personnel employed on the Site from insect and pest nuisance, and to reduce their danger to health. The Contractor shall comply with all the regulations of the local health authorities, including use of appropriate insecticide.

m. Alcoholic Liquor or Drugs

The Contractor shall not, otherwise than in accordance with the Laws of the Country, import, sell, give barter or otherwise dispose of any alcoholic liquor or drugs, or permit or allow importation, sale, gift barter or disposal by Contractor's Personnel.

n. Arms and Ammunition

The Contractor shall not give, barter, or otherwise dispose of, to any person, any arms or ammunition of any kind, or allow Contractor's Personnel to do so.

o. Prohibition of All Forms of Forced or Compulsory Labour

The contractor shall not employ "forced or compulsory labor" in any form. "Forced or compulsory labor" consists of all work or service, not voluntarily performed, that is extracted from an individual under threat of force or penalty.

p. Prohibition of Harmful Child Labor

The Contractor shall not employ any child to perform any work that is economically exploitative, or is likely to be hazardous to, or to interfere with, the child's education, or to be harmful to the child's health or physical, mental, spiritual, moral, or social development. "Child" means a child below the statutory minimum age of 14 years.

**Volume - I**

**Section VI C**

**Contract Forms**



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**Letter of Acceptance**

**[on letter head paper of the Procuring Entity]**

No. ....

**Dated** .....

To: ..... **[name and address of the Contractor]** .....

Subject: ..... **[Notification of Award for the Works]** .....

This is to notify you that your Bid dated .... **[date]** .... for execution of the .....  
**[name of the contract and identification number, as given in the 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 negotiations and in  
accordance with the Instructions to Bidders has been accepted by **[designation of the  
Procuring Entity]** ..... The date of commencement and completion of the Works  
shall be: .....

You are requested to furnish the Performance Security/ Performance Security Declaration  
within ..... Days in the form given in the Contract Forms for the same for an amount  
equivalent to Rupees ..... within ..... days of notification of the award valid up to 60  
days after the date of expiry of Defects Liability Period and maintenance period, if applicable,  
and sign the Contract, failing which action as stated in sub-section 2 of section 42 of the  
Rajasthan Transparency in Public Procurement Act, 2012 and Instructions to Bidders shall be  
taken.

Authorized Signature: .....

Name and Title of Signatory: Chief Executive Officer, JSCL, Jaipur.

Designation: .....

### Contract Agreement

THIS AGREEMENT made the . . . . .day of . . . . ., . . . . ., between the Governor of Rajasthan/ . . . . . **[Jaipur Smart City Limited]**. . . . . (hereinafter "the Procuring Entity") which expression shall, where the context so admits, be deemed to include his successors in office and assigns, of the one part, and . . . . . **[name of the Contractor]** . . . . .(hereinafter "the Contractor"), which expression shall, where the context so admits, be deemed to include his heirs, successors, executors and administrators, of the other part:

WHEREAS the *Procuring Entity* 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, and for which the Contractor has submitted Performance Security for Rupees ----- in the form of -----  
------(For Jaipur Smart City Limited)

The Procuring Entity 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.
  - a)the Letter of Acceptance;
  - b)the Bid of the Contractor as accepted alongwith the correspondence done on it, if any;
  - c)the Special Conditions of Contract/ Contract Data;
  - d)the General Conditions of Contract;
  - e)the Specifications;
  - f) the Drawings; and
  - g)the Instructions to Bidders and Notice Inviting Bids.
3. In consideration of the payments to be made by the Procuring Entity to the Contractor as indicated in this Agreement, the Contractor hereby covenants with the Procuring Entity to execute the Works and to remedy defects therein (and, if applicable, maintain the Works for a period of -----) in conformity in all respects with the provisions of the Contract.
4. The Procuring Entity hereby covenants to pay the Contractor in consideration of the execution and completion of the Works and the remedying of defects therein (and,if applicable, maintain the Works for a period of -----), 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 India and Rajasthan on the day, month and year indicated above.

Signed by .....  
for and on behalf of the Governor/ Palika Entity  
(Chief Executive Officer, JSCL)  
in the presence of

Signed by.....  
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 Procuring Entity (Chief Executive Officer, Jaipur Smart City Limited)]*** .....

**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 security 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 Rupees\* . . . . . ***[amount in figures]*** . . . . . (Rupees..... ***[amount in words]*** . . . . .) such sum being 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.

The Guarantor agrees to extend this guarantee for a specified period in response to the Procuring Entity's written request for such extension for that specified period, provided that such request is presented to the Guarantor before the expiry of the guarantee.

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.

.....  
**Seal of Bank and Authorised Signature(s)**

**\* The Guarantor shall insert an amount representing the percentage of the Contract Price specified in the Contract**

**\*\* Insert the date sixty days after the expected completion date, including defect liability period and maintenance period, if any.**

**Notes: 1. All italicized text is for guidance on how to prepare this advance payment guarantee and shall be deleted from the final document.**

**2. The Procuring Entity should note that in the event of an extension of the time for completion of the Contract, the Procuring Entity 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.**

**Form of Performance Security Declaration**

Date: \_\_\_\_\_ **[insert date (as day, month and year)]**

Contract Name and No.: \_\_\_\_\_ **[insert name and number of Contract]**

To: \_\_\_\_\_ **[insert Designation and complete address of Procuring Entity]**

We, the undersigned, declare that:

We understand that, according to your conditions, the Contract must be supported by a Performance Security Declaration as a guarantee to ensure fulfillment of our all performance obligations under the Contract for \_\_\_\_\_ **[insert name of subject matter of procurement]**.

We accept that we will automatically be suspended from being eligible for bidding in any contract with you for the period of time of \_\_\_\_\_ **[Procuring Entity to indicate here the period of time for which the Procuring Entity will declare a Bidder ineligible to be awarded a Contract if the performance Security Declaration is to be executed]** starting on the date that we receive a notification from you, the \_\_\_\_\_ **[Designation of the Procuring Entity]** that our Performance Security Declaration is executed, if we are in breach of any of our performance obligation under the conditions of the Contract,

We understand this Performance Security Declaration shall expire after 60 days of completion of our all obligations under the Contract including Defect Liability, warranty/ Guarantee, operation, maintenance, etc. in accordance with the conditions of the Contract.

Signed: \_\_\_\_\_

**[insert signature of person whose name and capacity are shown]**

In the capacity of: \_\_\_\_\_

**[insert legal capacity of person signing the Performance Security Declaration]**

Name: \_\_\_\_\_

**[insert complete name of person signing the Declaration]**

Duly authorized to sign the Contract for and on behalf of: \_\_\_\_\_

**[insert complete name and address of the Bidder]**

Dated on \_\_\_\_\_ day of \_\_\_\_\_, \_\_\_\_\_ **[insert date of signing]**

Corporate Seal \_\_\_\_\_

**Contract Agreement Works**

THIS AGREEMENT made this.....day of.....2017., between Government of Rajasthan, represented by the Chief Executive Officer, JSCL (Jaipur Smart City Limited ) JMC Building,Pt Deendayal Upadhyay Bhawan LalKothi,Tonk Road,Jaipur-302016 Phone No. 0414-2741346/2741347 ,E-Mail ID: jscljaipur@gmail.com (hereinafter “the Employer”), of the one part and M/S ..... (hereinafter “the Contractor”), of the other part:

WHEREAS the *Employer* desires that the Works known as Work 1: Development of Smart Roads (Package 1: Civil Works) in ABD Area of Jaipur 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 for three years in conformity with the provisions of the contract in all respect.

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.
  - a) Notice to Proceed
  - b) the Letter of Acceptance;
  - c) the Bid
  - d) the Addenda and Corrigendum
  - e) the Special Conditions
  - f) the General Conditions
  - g) the Specifications;
  - h) the Drawings;
  - i) Instructions to Bidders and Notice Inviting Bids
  - j) the Priced Bill of Quantities and
  - k) The Schedule of Supplementary information,
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 India on the day, month and year indicated above.

Signed by  Chief Executive Officer Jaipur Smart City Limited for and on behalf of the Employer	Signed by  for and on behalf the Contractor
Witness, Name, Signature, Address	Witness, Name, Signature, Address
Signed by	

**VOLUME – I**

**SECTION-VII A**

**SITE ENVIRONMENT REQUIREMENTS  
& MONITORING PLAN**



## 1. Site Environmental Plan (SEP)

- 1.1 The Contractor should prepare a detailed Site Environmental Plan (SEP) as per the Environmental and Social Management Framework and EMP format attached for location/s identified to be potentially impacted such as but not limited to the work site, base camp. The SEP should include arrangement for disposal of sites for excavated materials, sanitary and other waste, storage location for fuel, oil and lubricants, facilities for equipment, labour and housing, among others. The SEP should be reviewed and approved prior to construction activities by the Engineer.

## 2. Safety, Security and Protection of the Environment

### 2.1 General

- i. This section of the Specification sets out limitations on the Contractor's activities specifically intended to protect the environment.
- ii. The Contractor shall take all necessary measures and precautions and otherwise ensure that the execution of the works and all associated operations on site or off-site are carried out in conformity with statutory and regulatory environmental requirements including those prescribed elsewhere in this document.
- iii. The Contractor shall take all measures and precautions to avoid any nuisance or disturbance arising from the execution of the Works. This shall wherever possible be achieved by suppression of the nuisance at source rather than abatement of the nuisance once generated.
- iv. In the event of any spoil, debris, waste or any deleterious substance from the Site being deposited on any adjacent land, the Contractor shall immediately remove all such material and restore the affected area to its original state to the satisfaction of the Engineer. This should be monitored regularly in accordance with the Environmental Management Plan.
- v. Consent for establishment (CFE) and consent for operation (CFO) for WTP and STP-need to be identify with the consultation with Local authorities and contractor shall be responsible for annual renewal of CFE and CFO.
- vi. During construction, the area should be to avoid trespassing of animals and people. Unauthorized persons should not be allowed within the construction area.
- vii. During construction, there should be signs to inform public of on-going work, warning on dangers due to trenches along roads, excavations on different sites.
- viii. Contact town authorities to arrange for the use of excavated material where possible, such as in construction projects, to raise the level of land prior to construction of roads or buildings, or to fill previously excavated areas.
- ix. Especially for cleaning, desilting, and dredging of drainages: Contact town authorities to arrange for testing and analysis of sludge/excavated materials for hazardous components. If material are hazardous, coordinate with authorities for approve disposal sites;
- x. Prevent generation of dust by removing excavated materials as soon as it is excavated, by loading directly onto trucks and covering with tarpaulins to prevent dust during transportation.
- xi. All excavation should be done in the dry seasons to avoid any impacts on surface water drainage if water collects in any quantity, it will need to be pumped out, and it should be then be donated to neighboring farmers to provide a beneficial use to the communities most affected by this aspect of the work.
- xii. Plant three (3) trees for every tree to be cut.
- xiii. Consult town authorities to identify any buildings at risk from vibration damage and avoiding use of pneumatic drills or heavy vehicles in the vicinity.
- xiv. Providing wooden bridges for pedestrians and metal sheets for vehicles to allow access across open trenches where required (including access to houses).
- xv. Carefully planning of transportation routes with the municipal authorities to avoid sensitive areas as far as possible, including narrow streets, congested roads, important or fragile buildings and key sites of religious, cultural or tourism importance.
- xvi. Consulting historical and archaeological authorities at both national and state level to obtain an expert assessment of the archaeological potential of the site. Alternate location should be considered if the area is medium or high risk.
- xvii. Developing a protocol in conducting any excavation work to ensure that any chance finds are recognized and measured are take to ensure they are protected and conserved this should involve having excavation observed by a person with archaeological field training, stopping work immediately to allow further investigation if any finds are suspected; and calling the state archaeological authority if a find is expected and taking any action they acquire ensuring its

removal or protection in situ.

- xviii. Living spaces for access between mounds of excavated soil and providing footbridges so that pedestrians can cross open trenches;
- xix. Increasing the workforce in these areas to ensure that work is completed quickly;

## **2.2. Water Quality**

- i. The Contractor shall prevent any interference with the supply to or abstraction from, and prevent any pollution of, water resources (including underground percolating water) as a result of the execution of the Works.
- ii. Areas where water is regularly or repetitively used for dust suppression purposes shall be laid to fall to specially constructed settlement tanks to permit sedimentation of particulate matter. After settlement, the water may be re-used for dust suppression and rinsing.
- iii. All water and other liquid waste products arising on the Site shall be collected and disposed of at a location on or off the Site and in a manner that shall not cause either nuisance or pollution.
- iv. The Contractor shall not discharge or deposit any matter arising from the execution of the Works into any waters except with the permission of the Engineer and the regulatory authorities concerned.
- v. The Contractor shall at all times ensure that all existing stream courses and drains within, and adjacent to, the Site are kept safe and free from any debris and any materials arising from the Works.
- vi. The Contractor shall protect all watercourses, waterways, ditches, canals, drains, lakes and the like from pollution as a result of the execution of the Works.

## **2.3. Air Quality**

- i. The Contractor shall devise and arrange methods of working to minimize dust, gaseous or other air-borne emissions and carry out the Works in such a manner as to minimize adverse impacts on air quality.
- ii. The Contractor shall utilize effective water sprays during delivery manufacture, processing and handling of materials when dust is likely to be created, and to dampen stored materials during dry and windy weather. Stockpiles of friable materials shall be covered with clean tarpaulins, with application of sprayed water during dry and windy weather. Stockpiles of material or debris shall be dampened prior to their movement, except where this is contrary to the Specification.
- iii. Any vehicle with an open load-carrying area used for transporting potentially dust producing material shall have properly fitting side and tail boards. Materials having the potential to produce dust shall not be loaded to a level higher than the side and tail boards, and shall be covered with a clean tarpaulin in good condition. The tarpaulin shall be properly secured and extend at least 300 mm over the edges of the side and tail boards.
- iv. In the event that the Contractor is permitted to use gravel or earth roads for haulage, he shall provide suitable measures for dust palliation, if these are, in the opinion of the Engineer, necessary. Such measures may include spraying the road surface with water at regular intervals.

## **2.4 Noise**

- i. The Contractor shall consider noise as an environmental constraint in his planning and execution of the Works.
- ii. The Contractor shall take all necessary measures so that the operation of all mechanical equipment and construction processes on and off the Site shall not cause any unnecessary or excessive noise, taking into account applicable environmental requirements. The Contractor shall use all necessary measures and shall maintain all plant and silencing equipment in good condition so as to minimise the noise emission during construction works.
- iii. Using modern vehicles and machinery with standard adaptations to reduce noise and exhaust emissions and ensuring they are maintained to manufactures' specifications.

## **2.5. Control of Wastes**

- i. The Contractor shall control the disposal of all forms of waste generated by the construction operations and in all associated activities. No uncontrolled deposition or dumping shall be permitted. Wastes to be controlled shall include, but shall not be limited to, all forms of fuel and engine oils, all types of bitumen, cement, surplus aggregates, gravels, bituminous mixtures, etc. The Contractor shall make specific provision for the proper disposal of these and any other waste products, conforming to local regulations and acceptable to the Engineer.

## **2.6. Emergency Response**

- i. The Contractor shall plan and provide for remedial measures to be implemented in the event of occurrence of emergencies such as spillages of oil or bitumen or chemicals.
- ii. The Contractor shall provide the Engineer with a statement of the measures he intends to implement in the event of such an emergency which shall include a statement of how he intends to provide personnel adequately trained to implement such measures.
- iii. 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 party.

### **3. Protection of Trees and Vegetation**

3.1 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.

### **4. Use of Wood as Fuel**

4.1 The Contractor shall not use wood as a fuel for the execution of any part of the Works, including but not limited to the heating of bitumen and bitumen mixtures and 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.

### **5. Hot Mix Plants**

**5.1** The Contractor shall not locate any hot-mix or similar potentially polluting plant closer than 500 m to any settlement. Any such plant shall be fitted with dust suppression equipment and shall be operated and maintained at all times in conformity with the manufacturer's specifications, instructions and manuals.

### **6. Relations with Local Communities and Authorities**

**6.1** In sitting and operating his plant and facilities and in executing the Works the Contractor shall at all times bear in mind and to the extent practicable minimise the impact of his activities on existing communities. Where communities are likely to be affected by major activities such as road widening or the establishment of a camp, large borrow pit or haul road, he shall liaise closely with the concerned communities and their representatives and if so directed, shall attend meetings arranged by the Engineer or Employer to resolve issues and minimise impacts on local communities.

### **7. Fire Prevention**

7.1 The Contractor shall take all precautions necessary to ensure that no vegetation along the line of the road outside the area of the permanent works is affected by fires arising from the execution of the Works. The Contractor shall obtain and follow any instructions of the competent authorities with respect to fire hazard when working in the vicinity of gas installations. Should a fire occur in the natural vegetation or plantations adjacent to the road for any reason the Contractor shall immediately suppress it. In the event of any other fire emergency in the vicinity of the Works the Contractor shall render assistance to the civil authorities to the best of his ability. Areas of forest, scrub or plantation damaged by fire considered by the Engineer to have been initiated by the Contractor's staff or labour shall be replanted and otherwise restored to the satisfaction of the Engineer at the Contractor's expense.

### **8. Fossils**

8.1 The Contractor shall make his staff available for briefing on archaeological matters as directed by the Engineer.

### **9. Interference with Traffic and Adjoining Properties**

9.1 In case any operation connected with the works necessitates diversion, obstruction or closure of any road, railway, waterway or any other right of way, the approval of the Engineer or the Engineer's Representative and the respective competent authorities shall be obtained well in advance by the Contractor. In case the Contractor's operations obstruct access to adjacent properties, the Contractor shall be responsible to provide reasonable temporary access to the affected parties. In case the

Contractor fails to provide adequate temporary facilities, this shall be deemed to be an uncorrected Defect under the terms of Clause 31 and the Employer shall have the right to engage a third party to correct the Defect and the cost of such correction will be deducted from the Contract Price.

#### **10. Transport of Contractor's Equipment or Temporary Works**

10.1 Where the Contractor intends to use a particular route for the haulage of large quantities of materials he shall consult well in advance with any affected communities and submit in advance for the Engineer's approval a plan including but not limited to the proposed route, the existing condition of the pavement and bridges, the estimated number and type of vehicle movements per day, a programme for monitoring the condition of the pavement and structures, and measures for limiting vehicle speeds and dust nuisance in built-up areas. The Engineer reserves the right to disallow certain haul routes should these in his opinion cause or be likely to cause unreasonable nuisance or hazards to the public. The Engineer's approval will not remove the Contractor's obligations under this Sub-Clause to prevent and repair damage to roads or his liability for compensation for any accidents caused by his vehicles.

#### **11. Clearance of Contractor's Facilities**

11.1 On or before expiry of the Defects Notice Period the Contractor shall clear away all his temporary facilities including but not limited to offices, camps, storage and holding yards, workshops, crushing and mixing plant, diversion and haul roads so that the land is returned to at least its previous condition and, in the case of agricultural land, potential productivity. Clearance shall include but not be limited to tasks such as the removal of unwanted structures, removal of metallic and concrete debris, removal and disposal of any soil contaminated by diesel, bitumen or other polluting material, ripping to relieve compaction, grading, replacement of topsoil, and turfing and grassing, as appropriate. Where improvements have been made such as land filling or installation of boreholes or construction of boat landings these may be retained subject to the agreement of the landowner. The Employer reserves the right to inspect the site of any facilities established or used by the Contractor in connection with the Works and to undertake any corrective measures necessary to restore the land, and to recover the cost from monies due or to become due to the Contractor.

#### **13. MONITORING**

Provision for regular monitoring will be made as per the Environmental Management Plan given here in after and actions will be taken in case of non-compliance.

### Standard EMP for Sub-Projects of Smart City

The Environmental Management Plan (EMP) is a site specific plan developed to ensure that the project is implemented in an environmental sustainable manner where all contractors and subcontractors, understand the potential environmental risks arising from the proposed project and take appropriate actions to properly manage that risk. EMP also ensures the project implementation is carried out in accordance with the design by taking appropriate mitigative actions to reduce or avoid adverse environmental impacts during its life cycle.

The plan outlines existing and potential problems that may adversely impact the environment and recommends corrective measures where required. Also, the plan outlines roles and responsibility of project proponent, supervision consultant and contractors who are charged with the responsibility to manage the smart city project of Jaipur. The EMP is proactive in nature and shall be upgraded if new facilities or modifications of existing facilities, with environment concerns, come up at a later stage.

The EMP is generally:

- Prepared in accordance with rules and requirements of the MoEFCC and the State Pollution Control Board;
- To ensure that the component of facility are operated in accordance with the design;
- Process that confirms proper operation through supervision and monitoring;
- System that addresses public inconvenience during construction and operation of the facility; and

Plan that ensure remedial measures are implemented immediately.

EMP includes four major elements:

**Commitment & Policy:** Jaipur Smart City Limited will strive to provide and implement the Environmental Management Plan that incorporates all social and environmental issues related to project.

**Planning:** This includes identification of environmental impacts, legal requirements and setting environmental objectives.

**Implementation:** This comprises of resources available to the developers, accountability of contractor, and training of operational staff associated with environmental control facilities and documentation of measures to be taken.

**Measurement & Evaluation:** This includes monitoring, corrective actions and record keeping.

The Environmental Management Plan (EMP) needs to be implemented right from the conception and should continue till the end. The Plan can be divided into three phases - (a) Design or pre-construction phase (b) Construction phase and (c) Operational phase.

The Environment Management Plan of Pre Construction, Construction and Operation phase is given in **Table -1**.

**Table-1**

<b>Attributes</b>	<b>Mitigation Measures</b>	<b>Location</b>	<b>Time Frame</b>	<b>Cost</b>	<b>Agency Responsible for Implementation</b>	<b>Agency Responsible for Monitoring</b>
<b>A: Pre Construction Phase</b>						
Finalisation of sub project	<ul style="list-style-type: none"> <li>• Consult with local people to finalize the sub-project especially to avoid any social obligation related to project.</li> <li>• Avoid excessive cut and fill and sub-project should follow natural topography of the area.</li> <li>• In flood prone areas, refer to hydrological data to finalize the provision for culvert drainage structures.</li> <li>• Avoid the requirement of forestland for sub-project. In case unavoidable, minimize it to extent possible by exploring alternative options.</li> <li>• In case, requirement of forestland is unavoidable, determine the legal status of forestland and initiate actions to seek permits for diversion of forestland for non-forest uses.</li> <li>• Forest clearance is to be obtained in accordance with the provisions of State Forest Act and MoEFCC, and all conditions related with the clearance has to be implemented.</li> <li>• In case sub-project has trees, which are known to be nesting/breeding places for migratory birds, contact the wildlife division of Department of Forest for seeking permits and details about non-breeding seasons. In any case, no tree shall be cut in such</li> </ul>	Throughout project area.	Prior to commencing any construction works.	Part of Project Cost.	Project Implementing Unit (PIU).	Supervision Consultant (SC).

	<p>location and construction works are to be strictly scheduled for non-breeding/nesting season and all permit conditions are to be complied.</p> <ul style="list-style-type: none"> <li>• Avoid or minimize tree felling, acquisition of agricultural land, shifting of shrines/temples, disturbance to community ponds, community resources, burial grounds, etc. to the extent possible through evolving alternate location options.</li> </ul>					
Land Acquisition	<p>Land acquisition, compensation packages, resettlement and rehabilitation, poverty alleviation programs for affected people and all other related issues are addressed in Social Impacts and Resettlement &amp; Rehabilitation report if land is acquired for the sub-project.</p>	Throughout project area.	Pre-Construction phase.	Encumbrance-free land to be made available by State Government.	State Government/PIU	SC
<b>B: Construction Phase</b>						
Land Clearing Operation	<ul style="list-style-type: none"> <li>• The sub-project area requiring clearing shall be clearly demarcated on ground.</li> <li>• During land clearing operations, topsoil shall be collected, preserved, and reused as a base for the development of unused/ barren areas near sub-project.</li> <li>• Trees falling within sub-project area and other vegetative cover are to be removed.</li> <li>• Small temples, shrines if any is within the sub-project, the same may be shifted to adjacent areas in consultation with local community leaders.</li> <li>• During clearing operations, any</li> </ul>	Throughout project area.	Pre-Construction Phase.	Encumbrance-free land to be made available by State Government. Relocation of utilities are to be undertaken by respective departments and costs are to be reimbursed	State Government/PIU	SC

	<p>treasure trove, slabs with epigraphical evidence or edicts, sculptural or any material found and appear to have historical importance, it should be brought to the notice of Department of Archaeology, and instructions of this Department must be followed.</p> <ul style="list-style-type: none"> <li>• All public utilities like power transmission cables, telephone cables, water/sewerage lines, drains, tube wells etc. falling within sub-project area shall be inventoried, and arrange for relocation /shifting to adjacent areas in consultation with the respective agencies/authorities.</li> <li>• Establish and maintain interaction with local community to ensure that no social resentment sets in due to operations.</li> </ul>					
<p>Establishment of temporary office and storage area</p>	<ul style="list-style-type: none"> <li>• The temporary office and storage area for construction works shall be located away from human settlement areas (minimum 500 m) and forest areas (minimum 1 km).</li> <li>• The office and storage areas shall preferably be located on barren/waste lands and conversion of agricultural/cultivable lands for office and storage areas shall not be allowed under any circumstances.</li> <li>• All fuel oil/lubricants loading, unloading and storage areas shall be paved (impermeable), and have separate storm water collection system with facility for separation of oil/lubricants prior to discharge.</li> <li>• The temporary office and storage area shall be provided with adequate</li> </ul>	<p>As determined by contractor under approval of PIU and SC</p>	<p>Pre-construction and Construction Phase</p>	<p>To be included in contractor's cost.</p>	<p>All facilities are to be planned and implemented by contractor under approval by PIU.</p>	<p>SC</p>



	<p>water supply, sanitation, septic tank/soak pit of adequate capacity so that it functions properly for the entire duration of its use.</p> <ul style="list-style-type: none"> <li>• After completion of construction works, the site shall be restored to its previous state by undertaking clean up operations.</li> </ul>					
Construction Camp Sites.	<ul style="list-style-type: none"> <li>• The construction campsites shall be located away from any local human settlement areas and preferably located on lands, which are barren/waste lands.</li> <li>• The camps shall be located, at a minimum, 5 km from forest areas to deter trespassing of construction labour.</li> <li>• The campsites shall be provided with adequate water supply, sanitation and all requisite infrastructure facilities. This would minimize dependence on outside resources, presently being used by local populace and minimize undesirable social friction thereof.</li> <li>• The camps shall have septic tank/soak pit of adequate capacity so that it can function properly for the entire duration of its use.</li> <li>• Construction camps shall be provided with kerosene/LPG to avoid dependence on firewood for cooking to the extent possible.</li> <li>• After completion of construction works, location of campsites shall be restored to its previous state by undertaking cleanup operations.</li> </ul>	As determined by contractor under approval of PIU and SC	Pre-construction and Construction Phase	To be included in contractor's cost.	All facilities are to be planned and implemented by contractor under approval by PIU / PIC	SC

<p>Mobilization of construction materials.</p>	<ul style="list-style-type: none"> <li>• Stone aggregates shall be sourced only from licensed existing quarries.</li> <li>• A list of such existing quarries is available from responsible department/ authority for mining related works in each state. In case new quarries are to be opened, quarry license/permits are to be obtained from this department/authority.</li> <li>• In case, only stone crushing plants are to be installed near work sites, required permits are to be obtained and all conditions of permits are to be complied.</li> <li>• Ensure stone quarries and crushing units have pollution control system; occupational safety procedures/practices in place and regular inspection shall be carried to ensure compliance. This shall be a pre-condition for sourcing of materials from quarries/crushing plants.</li> <li>• Earth borrow areas identified during DPR stage shall be revisited to assess its environmental sensitivity and ensure it is not an ecologically sensitive areas. Permits are to be obtained from authorities and all permit conditions are complied.</li> <li>• The borrow areas are to be demarcated with signboards and operational areas are to be access controlled.</li> <li>• Topsoil from borrow areas (first 30cm) are to be preserved and used for redevelopment of borrow areas.</li> <li>• The borrow areas as an option may be converted into ponds wherever possible, which can be used for</li> </ul>	<p>As determined by contractor under approval of PIU.</p>	<p>Pre-construction and Construction Phase.</p>	<p>To be included in contractor's cost.</p>	<p>All facilities are to be planned and implemented by contractor under approval by PIU / SC</p>	<p>SC</p>
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	<p>storage of rainwater.</p> <ul style="list-style-type: none"> <li>• Conversion of agricultural lands for borrowing earth is to be discouraged to the use possible unless warranted by local conditions. In such cases, written consent shall be obtained from the landowners.</li> <li>• Water for construction works shall NOT be drawn from sources, which serve routine needs of local people.</li> <li>• In case water is sourced from existing private tube wells, well owner shall be informed about the quantity and duration for which water draws will be carried out and possible implications. Written consent for use of groundwater shall be obtained. In case new tube wells are to be constructed, required permits are to be obtained from the State Ground Water Department and permit conditions, if any are to be complied.</li> <li>• In any case, care shall be taken not to source all requirements from one single source and no two sources (in case of tube wells) shall be less than 500 m from each other.</li> </ul>					
<p>Transportation of construction materials.</p>	<ul style="list-style-type: none"> <li>• Existing tracks/roads are to be used for hauling of materials to extent possible.</li> <li>• The alignment of haul roads (in case of new ones) shall be finalized to avoid agricultural lands to the extent possible. In unavoidable circumstances, suitable compensation shall be paid to people, whose land</li> </ul>	<p>As determined by contractor under approval of PIU.</p>	<p>Pre-construction and Construction Phase.</p>	<p>To be included in contractor's cost.</p>	<p>All facilities are to be planned and implemented by contractor under approval by PIU / SC</p>	<p>SC</p>

	<p>will be temporarily acquired for the duration of operations. The compensation shall cover for loss of income for the duration of acquisition and land restoration.</p> <ul style="list-style-type: none"> <li>•Prior to alignment of new haul roads, topsoil shall be preserved or at least shall be used for any other useful purposes.</li> <li>•Dust suppression along transportation links is to be ensured by deploying water tankers with sprinkling system are to be deployed along haul roads.</li> </ul> <p>The vehicles deployed for material transportation shall be spillage proof to avoid or minimize the spillage of the material during transportation.</p> <ul style="list-style-type: none"> <li>•Transportation links are to be inspected daily to clear accidental spillage, if any.</li> </ul> <p>Precaution shall be taken to avoid inconvenience to the local community due to movement of materials.</p>					
Diversion of traffic.	<ul style="list-style-type: none"> <li>• Frame appropriate traffic diversion schemes wherever required during construction.</li> <li>• The traffic diversion signs should be bold and clearly visible particularly at night.</li> <li>• Diversion schemes are required to ensure smooth traffic flow, minimize accidents to road users during construction works.</li> </ul>	As determined by contractor under approval of PIU.	Pre-construction and Construction Phase.	To be included in contractor's cost.	All facilities are to be planned and implemented by contractor under approval by PIU / SC	SC
Drainage Structures	In case of road construction will also require construction of several cross drainage structures, across	At all locations of CD structures	Construction Phase.	To be included in contractor's	The planning, and construction/ upgradation of	SC

	<p>streams/rivers flowing across the road.</p> <ul style="list-style-type: none"> <li>• Refer to hydrological studies to ensure that construction of drainage structures is not likely to alter drainage pattern, and discharge capacities of drainage structures are designed to facilitate smooth passage of water and heading up or flooding is avoided even in flood season.</li> <li>• Schedule the construction works to dry season so that impacts on water quality of stream/river is minimise or avoided.</li> <li>• Precaution shall be exercised to prevent oil/lubricant/ hydrocarbon contamination of channel bed during construction works. Spillage, if any, shall be immediately cleared with utmost caution to leave no traces.</li> <li>• Ensure all construction wastes are removed from work site and stream /river beds are to be cleaned up (at least 50 m on both upstream and downstream sides of water courses) after completion of construction but prior to onset of monsoon.</li> </ul>	along the rural roads		cost.	existing/new cross drainage structures roads are responsibilities of contractor under approval by PIU.	
Tree Planting	<ul style="list-style-type: none"> <li>• Tree planting operations shall be commenced immediately after the construction work.</li> <li>• The tree plantation shall be undertaken as per permit conditions issued by the Department of Forests, prior to tree felling.</li> <li>• The species shall be suitable for local climate and available. The concerned DFO can be consulted for selection of species and technical guidance, if required.</li> </ul>	The area allocated for tree plantation and or land provided by forest department.	Construction Phase.	To be included in contractor's cost.	The tree plantation work can be entrusted to forest department under the supervision of PIU.	SC

	<ul style="list-style-type: none"> <li>• Proper care shall be taken to increase survival rate of saplings like regular watering, pruning, provision of tree guards, manure for better nourishment, etc. including timely replacement of perished saplings.</li> </ul>					
Equipment/ vehicles deployed for Construction works.	<ul style="list-style-type: none"> <li>• All diesels run equipment/vehicles/ deployed for construction activities shall be regularly maintained for smooth operation, a measure contributing to air quality and noise.</li> <li>• Vehicles/equipment shall be periodically subjected for emission tests and shall have valid POLLUTION UNDER CONTROL certificates. Revalidation of certificates shall be done in every 3 months.</li> <li>• All vehicles deployed for material movement shall be spill proof to the extent possible. In any case, all material movement routes shall be inspected daily twice to clear off any accidental spills.</li> </ul>	As determined by contractor.	Construction Phase.	To be included in contractor's cost.	All facilities are to be planned and implemented by contractor under approval by PIU.	SC
Hot Mix Plants and Laying of bitumen.	<ul style="list-style-type: none"> <li>• Hot mix plants shall be at least 500 m away from human settlements and preferably located on leeward side of most dominant wind direction.</li> <li>• Consent/permits to establish and operate are to be obtained from State Pollution Control Board and all permit conditions are to be implemented/complied.</li> <li>• The hot mix plants shall be set up on barren/waste lands and conversion of agricultural/cultivable lands for this purpose shall not be allowed under any circumstances.</li> </ul>	As determined by contractor under approval of PIU.	Construction Phase.	To be included in contractor's cost.	All facilities are to be planned and implemented by contractor under approval by PIU.	SC

	<ul style="list-style-type: none"> <li>• All operational areas like storage, handling, loading, unloading areas shall be paved, and have separate storm water collection system with facility for separation of oil/lubricants prior to discharge.</li> <li>• The storm water from storage area shall not be directly discharged into any, nearby water courses/drains.</li> <li>• The hot mix plants shall be provided with adequate water supply, sanitation, septic tank/soak pit of adequate capacity so that it functions properly for the entire duration of its use.</li> <li>• After completion of construction works, the site shall be restored to its previous state by undertaking cleanup operations.</li> <li>• Hot mix plants shall have required measures for control of dust, air, and noise pollution as per regulatory limits of State Pollution Control Board measures.</li> </ul>					
<p>Clean up of construction work Sites and Disposal of waste.</p>	<ul style="list-style-type: none"> <li>• All operational areas under road construction works like work sites, office/storage area, and work force camps shall be cleaned up and restored to its previous state soon after operations are complete.</li> <li>• All construction waste shall be disposed in approved areas. Local district authorities shall be consulted to determine disposal site and implement any conditions imposed while issuing permits.</li> </ul>	<p>Throughout project area.</p>	<p>Prior claiming the final payment</p>	<p>To be included in contractor's cost.</p>	<p>Contractor with the approve plan from PIU.</p>	<p>SC</p>

<p>Occupational Safety and Health Hazards at Work and camp sites.</p>	<ul style="list-style-type: none"> <li>• All personnel at work sites shall be provided with protective gears like helmets, boots, etc. so that injuries to personnel are avoided or minimized.</li> <li>• Children (less than 18 years) and pregnant women shall not be allowed to work under any circumstances.</li> <li>• No personnel shall be allowed to work at site for more than 10 hours per day (8-hour makes one work shift).</li> <li>• The operational areas shall be access controlled and entry shall be allowed only under authorization.</li> </ul> <p>Workforce, likely to be exposed to noise levels beyond regulatory stipulated limits, shall be provided with protective gears like hear plugs etc. and regularly rotated.</p> <ul style="list-style-type: none"> <li>• Dust suppression measures like sprinkling of water shall be ensured at all operations areas.</li> <li>• The construction camps shall have health care facilities for adults, pregnant women and children.</li> <li>• All construction personnel shall be subjected to routine vaccinations and other preventive/healthcare measures.</li> <li>• The work and campsites shall have suitable facilities for handling any emergency situation like fire, explosion, etc.</li> <li>• All areas intended for storage of hazardous materials shall be quarantined and provided with adequate facilities to combat emergency situations. All required permits for storage of inflammable/hazardous materials are to be obtained.</li> </ul>	<p>As determined by contractor.</p>	<p>Construction Phase.</p>	<p>To be included in contractor's cost.</p>	<p>All facilities are to be planned and implemented by contractor under approval by PIU.</p>	<p>SC</p>
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	<ul style="list-style-type: none"> <li>• The personnel in charge of such areas shall be properly trained, licensed and with sufficient experience.</li> <li>• The construction camps shall have in-house community/common entertainment facilities. Dependence of local entertainment outlets by construction camps should be discouraged/prohibited to the extent possible.</li> </ul>					
Water Pollution from Construction Wastes.	<p>Take all precautionary measures to prevent the wastewater generated during construction from entering into streams, water bodies or the irrigation system. Avoid construction works close to the streams or water bodies during monsoon.</p> <p>All waste arising from the project is to be disposed off in the manner that is acceptable to the State Pollution Control Board or as directed by Environmental Expert of SC.</p> <p>The Environmental Expert of SC will certify that all liquid wastes disposed off from the sites meet the discharge standards.</p>	Throughout the project area.	Construction phase.	To be included in contractor's cost.	Contractor.	SC
Water Pollution from Fuel and Lubricants.	<p>Ensure that all construction vehicle parking location, fuel/lubricants storage sites, vehicle, machinery and equipment maintenance and refuelling sites will be located at least 500 m from rivers and irrigation canal/ponds.</p> <p>All location and layout plans of such sites will be submitted by the Contractor prior to their establishment and will be approved by the</p>	Throughout the project area.	Construction phase.	To be included in contractor's cost.	Contractor.	SC

	<p>Environmental Expert of SC.                  Also ensure that all vehicle/machinery and equipment operation, maintenance and refuelling will be carried out in such a fashion that spillage of fuels and lubricants does not contaminate the ground. Oil interceptors will be provided for vehicle parking, wash down and refuelling areas as per the design provided                  In all, fuel storage and refuelling areas, if located on agricultural land or areas supporting vegetation, the top soil will be stripped, stockpiled and returned after cessation of such storage.                  Make necessary arrangements for collection, storing and disposal of oily wastes to the pre-identified approved vendors (list to be submitted to SC). All spills and collected petroleum products will be disposed off in accordance with MoEFCC and state SPCB guidelines.                  Environmental Expert of SC will certify that all arrangements comply with the guidelines of PCB/ CPCB/ MoEF or any other relevant laws.</p>					
Dust Pollution.	<p>Take every precaution to reduce the level of dust from crushers/hot mix plants, construction sites involving earthwork by sprinkling of water, encapsulation of dust source and by erection of screen/barriers.                  All the plants will be sited at least 1 km in the downwind direction from the nearest human settlement.                  Provide necessary certificates to</p>	Throughout the project area.	Construction phase.	To be included in contractor's cost.	Contractor.	SC

	<p>confirm that all crushers used in construction conform to relevant dust emission control legislation.                  The suspended particulate matter value at a distance of 40m from a unit located in a cluster should be less than 500 g/m<sup>3</sup>. The pollution monitoring is to be conducted as per the monitoring plan.                  Alternatively, only crushers licensed by the SPCB shall be used. Required certificates and consents shall be submitted by the Contractor in such a case.</p>					
Emission from Construction Vehicles, Equipment and Machineries	<p>Ensure that all vehicles, equipment and machinery used for construction are regularly maintained and confirm that pollution emission levels comply with the relevant requirements of SPCB.                  The Contractor will submit PUC certificates for all vehicles/equipment/machinery used for the project.</p>	Throughout the project area.	Construction phase.	To be included in contractor's cost.	Contractor.	SC
Noise Pollution: Noise from Vehicles, Plants and Equipments	<ul style="list-style-type: none"> <li>• All plants and equipment used in construction shall strictly conform to the MoEF/CPCB noise standards.</li> <li>• All vehicles and equipment used in construction will be fitted with exhaust silencers.</li> <li>• Servicing of all construction vehicles and machinery will be done regularly and during routine servicing operations, the effectiveness of exhaust silencers will be checked and if found defective will be replaced.</li> <li>• Limits for construction equipment used in the project such as compactors, rollers, front loaders,</li> </ul>	Throughout the project area.	Construction phase.	To be included in contractor's cost.	Contractor.	SC

	<p>concrete mixers, cranes (moveable), vibrators and saws shall not exceed 75 dB (A) (measured at one meter from the edge of equipment in the free field), as specified in the Environment (Protection) rules, 1986.</p> <ul style="list-style-type: none"> <li>• Maintenance of vehicles, equipment and machinery shall be regular and up to the satisfaction of the Environmental Expert of JP Greens to keep noise levels at the minimum.</li> </ul> <p>At the construction sites within 150 m of the nearest habitation, noisy construction work such as crushing, concrete mixing, batching will be stopped during the night time between 10.00 pm to 6.00 am.</p> <p>No noisy construction activities will be permitted around educational institutes/health centers (silence zones) up to a distance of 100 m from the sensitive receptors i.e., school, health centers and hospitals between 9.00 am to 6.0 pm.</p>					
<p>Personal Safety Measures for Labour</p>	<ul style="list-style-type: none"> <li>• Protective footwear and protective goggles to all workers employed on mixing asphalt materials, cement batching plant, cement, lime mortars, concrete etc.</li> <li>• Welder's protective eye-shields to workers who are engaged in welding works</li> <li>• Protective goggles and clothing to workers engaged in Factories Act, 1948 stone breaking activities and workers will be seated at sufficiently safe intervals</li> <li>• Earplugs to workers exposed to loud</li> </ul>	<p>Throughout the project area.</p>	<p>Construction phase.</p>	<p>To be included in contractor's cost.</p>	<p>Contractor.</p>	<p>SC</p>

	<p>noise, and workers working in crushing, compaction, or concrete mixing operation.</p> <ul style="list-style-type: none"> <li>• Adequate safety measures for workers during handling of materials at site are taken up.</li> <li>• The contractor will comply with all regulations regarding safe scaffolding, ladders, working platforms, gangway, stairwells, excavations, trenches and safe means of entry and egress.</li> </ul> <p>The contractor will comply with all the precautions as required for ensuring the safety of the workmen as per the International Labor Organization (ILO) Convention No. 62 as far as those are applicable to this contract.</p> <p>Make sure that during the construction work all relevant provisions of the Factories Act, 1948 and the Building and other Construction Workers (regulation of Employment and Conditions of Services) Act, 1996 are adhered to.</p> <p>Not employ any person below the age of 14 years for any work and no woman will be employed on the work of painting with products containing lead in any form.</p> <p>Also ensure that no paint containing lead or lead products is used except in the form of paste or readymade paint.</p> <p>Provide facemasks for use to the workers when paint is applied in the form of spray or a surface having lead paint dry is rubbed and scrapped.</p> <p>Mark 'hard hat' and 'no smoking' and other 'high risk' areas and enforce non-compliance of use of PPE with</p>					
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	zero tolerance.					
Risk from Electrical Equipment(s)	<p>Take all required precautions to prevent danger from electrical equipment and ensure that -</p> <ul style="list-style-type: none"> <li>• No material will be so stacked or placed as to cause danger or inconvenience to any person or the public.</li> <li>• All necessary fencing and lights will be provided to protect the public in construction zones.</li> </ul> <p>All machines to be used in the construction will conform to the relevant Indian Standards (IS) codes, will be free from patent defect, will be kept in good working order, will be regularly inspected and properly maintained as per IS provision and to the satisfaction of the Environmental Expert.</p>	Throughout the project area.	Construction phase.	To be included in contractor's cost.	Contractor.	SC
First Aid	<ul style="list-style-type: none"> <li>• Readily available first aid unit including an adequate supply of sterilized dressing materials and appliances as per the Factories Rules in every work zone</li> <li>• Availability of suitable transport at all times to take injured or sick person(s) to the nearest hospital</li> <li>• Equipment and trained nursing staff at construction camp.</li> </ul>	Workers Camp and construction camps.	Construction phase.	To be included in contractor's cost.	Contractor.	SC
Waste Disposal	Provide garbage bins in the camps and ensure that these are regularly emptied and disposed off / treated in a hygienic manner as per the Comprehensive Solid Waste Management Plan approved by the Environmental Expert. Unless otherwise arranged by local sanitary authority, arrangements for disposal of	Workers Camp and construction camps.	Construction phase.	To be included in contractor's cost.	Contractor.	SC

	night soils (human excreta) suitably approved by the local medical health or municipal authorities or as directed by Environmental Expert.					
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**VOLUME – I**

**SECTION-VII B**

**ENVIRONMENT AND SOCIAL  
MANAGEMENT FRAMEWORK**



### Environmental and Social Management Framework for Smart City Sub-Projects

As per the Government of India and Government of Rajasthan, the project and its subprojects also must be prepared and implemented in full compliance with the national legislation, regulations and standards governing protection and management of the cultural and natural heritage of the country, social development, and environmental management. Specific state and local level standards and regulations also apply based on the project location and nature of its proposed investments and activities (subprojects). The key legislation and Policy applied to this project are further discussed below in Table-1. The contractor is responsible for the implementation of Environmental and Social Framework during work execution.

**Table-1**

Act/Policy	Year	Objective	Main Stipulations	Applicability to Project	Monitoring Agency
<b>Cultural Heritage Government of India</b>					
Ancient Monuments and Archaeological Sites and Remains Act  Amended	1958  2010	Declares certain monuments/sites as being of “national importance”.  Stipulates conservation of cultural and historical remains found in India.	Monuments are “protected” area.  100m radius is “prohibited” area – no construction or reconstruction. Repairs allowed.  200m radius is “regulated” area (structures can be constructed by archaeological officers with due sanctions from competent authority).  Protection, maintenance and conservation managed by Archaeological Survey of India (ASI)	Yes, as appropriate. Approximately 46 monuments/sites are protected monuments in Jaipur.	Ministry of Culture; with ASI/ Supervision Consultant.

Ancient Monuments Protection Act	1904	Gives central government the authority to protect and conserve monuments, particularly those privately owned, through acquisition of rights.	Specifies agreements to be made between Gol and monument/site owner for transfer of rights for protection.  Gives Gol right to intervene in potentially harmful activities near site (e.g. mining, quarrying).	Possibly, if any subproject supports privately owned monument.	Ministry of Culture/ Supervision Consultant.
The Antiquities and Art Treasures Act.	1972	To ensure registration of antiquarian remains in personal possession of individuals and institutions.	Registration of antiquities/remains/art is mandatory.	Possibly, if any subproject involves chance find.	Directorate of Culture. Govt. of Rajasthan// Supervision Consultant.
<b>Social</b>					
Right to Fair Compensation and Transparency in Land Acquisition, Rehabilitation and Resettlement Act.	2013	To ensure rights of displaced populations in the case of land acquisition.	Fair compensation for acquisition of immovable assets; Resettlement of displaced population due to land acquisition and economic rehabilitation of all those who are affected due to private land acquisition	Yes. In case of acquisition of land and /or resettlement.	Revenue Department. Govt. of Rajasthan/ Supervision Consultant.
Street Vendors (Protection of Livelihood and Regulation of Street Vending) Act	2014	To regulate street vending while ensuring rights and stating obligations of street vendors.	Local agencies must regulate vending through a Plan, including relocation/eviction rules, vendor rights (e.g. certificate of vending) and vendor obligations (e.g.	Yes. In case vending areas are close to or at the location of subprojects.	Town vending Committee/ Supervision Consultant.

			maintain cleanliness of area).		
Child Labour (Prohibition and Regulation) Amendment Bill,	2016	To completely ban on child labour.	The act has completely banned employment of children below 14 in all occupations and enterprises, except those run by his or her own family, provided that education does not hampered.	Yes, In case some contractor employs Child labour.	Labour Department/ Supervision Consultant.
Labour Act, Contract Labour (Regulation & Abolition) Act	1970	Act to regulate the employment of contract labor in certain establishments and to provide for its abolition in certain circumstances and for matters connected therewith.	To protect labour right.	To every establishment in which twenty or more workmen are employed or were employed on any day of the preceding twelve months as contract labour;	Labour Department/ Supervision Consultant.
Rajasthan Minimum Wages Act	2016	To regulate the wages.	To provide minimum wages.	To every Establishment.	Labour Department/ Supervision Consultant.
Payment of Wages Rule of Rajasthan.	1961	To regulate the time for wages distribution	To provide wages timely.	To every Establishment.	Labour Department/ Supervision Consultant.
<b>Safety</b>					
Manufacture, Storage and Import of Hazardous Chemical Rules and amendments	1989	Manufacture, Storage and Handling of Fuels and Explosive (Hazardous Chemical)	To regulate the manufacturing, storage, import and usage of explosives and hazardous chemicals.	Permission for use / storage;	SPCB, District Administration and Supervision Consultant
<b>Environment</b>					
Environment Protection Act	1989	To protect and improve the overall environment.	Prevention, control, and abatement of environmental pollution. Gives central government rights to monitor and test for	Yes, some specific permissions/ clearances may be required under the Act, e.g. permission for extraction of	Ministry of Environment and Forests; SEIAA/ Supervision Consultant

			environmental pollution, and if necessary penalize for infringements.	ground water for use in construction activities, from State Ground Water board.	
The Forest Conservation Act	1927	To check deforestation by restricting conversion of forested areas into non-forested areas.	If any forest land is proposed to be used for non-forest purposes, the user agency needs to get the clearances under the Forest (Conservation) Rules, 1981.	Yes, in case subprojects include pristine forest	State Forest Department. MoEFCC/ Supervision Consultant.
The Forest (Conservation) Act	1980				
The Forest (Conservation) Rules	1981				
The Forest (Conservation) Rules	2003				
Wild Life (Protection) Act.	1972	To protect wildlife through certain of National Parks and Sanctuaries.	The Act provides for protection of wild animals, birds and plants and related matters. The Act contains specific provisions and chapters on protection of specified plants, sanctuaries and national parks, etc.	Yes, in case there may be any activity against the wild animals.	Chief Conservator of Wildlife, Wildlife Wing, Forest Department, Govt. of Rajasthan, National Board For Wildlife, Govt. of India and Supervision consultant.

Water (Prevention and Control of Pollution) Act.	1974	To control water pollution by controlling discharge of pollutants as per the prescribed standards.	Provides for the prevention and control of water pollution and the maintaining or restoring of wholesomeness of water; creates Boards and assigns functions and powers for the prevention and control of water pollution.	Yes, for any subproject involving water bodies, e.g.kunds revitalization	Rajasthan State Pollution Control Board/ Supervision Consultant.
Air (Prevention and Control of Pollution) Act.	1981	To control air pollution by controlling emission of air pollutants as per the prescribed standards.	Act provides for prevention, control and abatement of air pollution and establishment of Boards for planning a comprehensive program for this task. Collect and disseminate information relating to air pollution, lay down standards for emission of air pollutants into the atmosphere from industrial plants, automobiles or other sources.	Yes, for any subproject involving impact of air pollution during construction/ rehabilitation phases.	Rajasthan State Pollution Control Board/ Supervision Consultant.
Central Motor Vehicle Act	1988	To check vehicular air and noise pollution	Vehicles to be used for construction and other purposes need to meet the standards and certificates prescribed as per the Rules, 1989	Yes. The impact of vehicular pollution during construction/ rehabilitation phases.	Motor Vehicle Department/Supervision Consultant
Central Motor Vehicle Rules and (Amendment) Rules	1989 2013 2014				

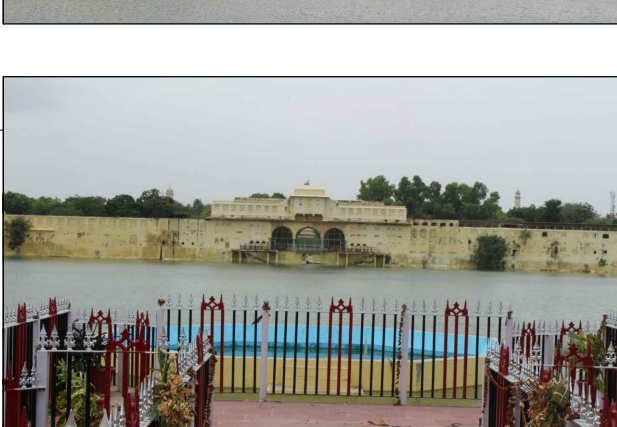
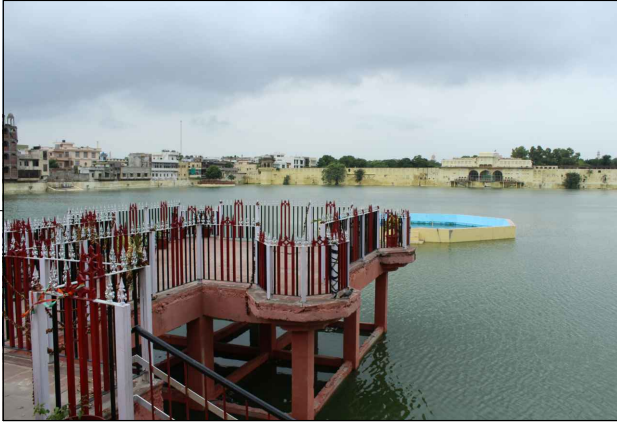
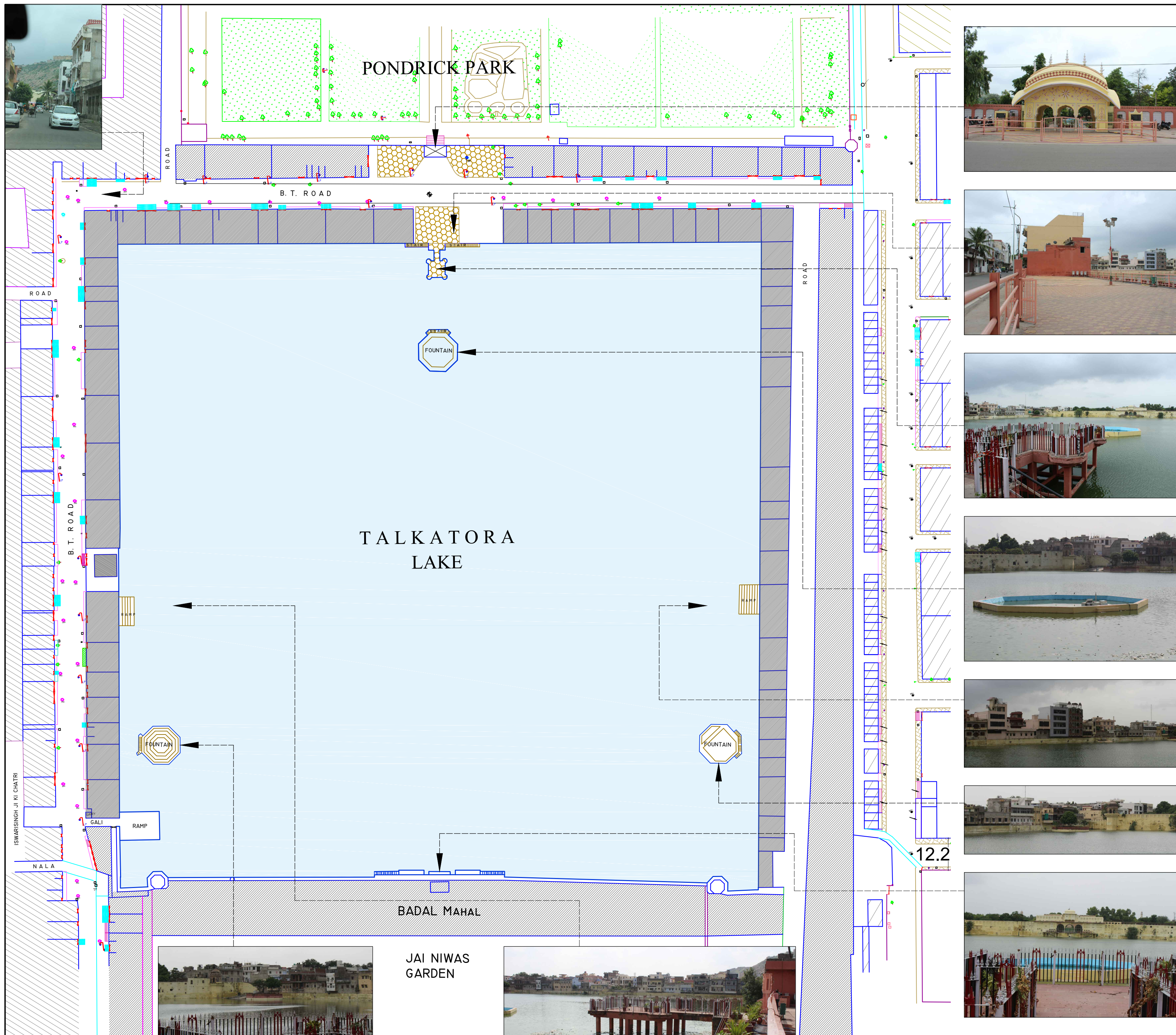
			to control noise, pollution, etc.		
Municipal Solid Waste (Management and Handling) Rule.	2016	To Manage Municipal Solid waste.	These rules shall apply to every urban local body, outgrowths in urban agglomerations, census towns as declared by the Registrar General and Census Commissioner of India.	Yes	Municipal Corporation of Jaipur/ Supervision Consultant
Noise Pollution (Regulation and Control) Act.	2000	To Control Noise Pollution.	Four Noise Zone specified by the Central Pollution Control Board.	Yes	Rajasthan State Pollution Control Board/ Supervision Consultant.

**SECTION-IX**

**DRAWINGS**

<b>Group</b>	<b>Description</b>	<b>S. No</b>	<b>Drawing Title</b>	<b>Drawing No (Print Size of Sheet)</b>
1	Existing Information	i)	Existing Plan of Talkatora Lake	JSCL-HC&IR-TLR-01A (A2)
		ii)	STP Proposal and Sewage Network Plan (as/Tender document)	JSCL-HC&IR-TLR-01B (A2)
2	Redevelopment Proposal	iii)	Proposed Site Plan	JSCL-HC&IR-TLR-02 (A2)
		iv)	Entrance Plaza and Octagonal Garden 1	JSCL-HC&IR-TLR-03 (A2)
		v)	Section of the Entrance Plaza	JSCL-HC&IR-TLR-04A (A4)
				JSCL-HC&IR-TLR-04B (A4)
vi)	Existing and Proposed Landform Profile	JSCL-HC&IR-TLR-04C (A4)		
3	Architectural & Landscape Details	vii)	Octagonal Garden 1	JSCL-HC&IR-TLR-05AD-D1 (A4)
		viii)	Octagonal Garden 2	JSCL-HC&IR-TLR-05AD-D2 (A4)
		ix)	Octagonal Garden 3	JSCL-HC&IR-TLR-05AD-D3 (A4)
		x)	Causeway around the Lake	JSCL-HC&IR-TLR-05AD-D4 (A2)
				JSCL-HC&IR-TLR-05AD-D4A (A2)
		xi)	Raised Causeway	JSCL-HC&IR-TLR-05AD-D5 (A2)
xii)	Entrance Plaza Area	JSCL-HC&IR-TLR-05 LD-D1 (A3)		
4	Structure	xii)	Indicative Layout of Column for the Causeway within the Lake	JSCL-HC&IR-TLR-06A (A2)
5	Solid Waste Management	xiii)	Solid Waste Management Scheme	JSCL-HC&IR-TLR-07 (A2)
6	Views of the Proposal	xiv)	Illustrative Views of Talkatora Lake Redevelopment Proposal	JSCL-HC&IR-TLR-09 (A2)





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DRAWN BY	CHECKED BY	SECTOR
RITAM	S P BISWAS	HERITAGE CONSERVATION & INNER CITY RENEWAL
APPROVED BY		
S P BISWAS		



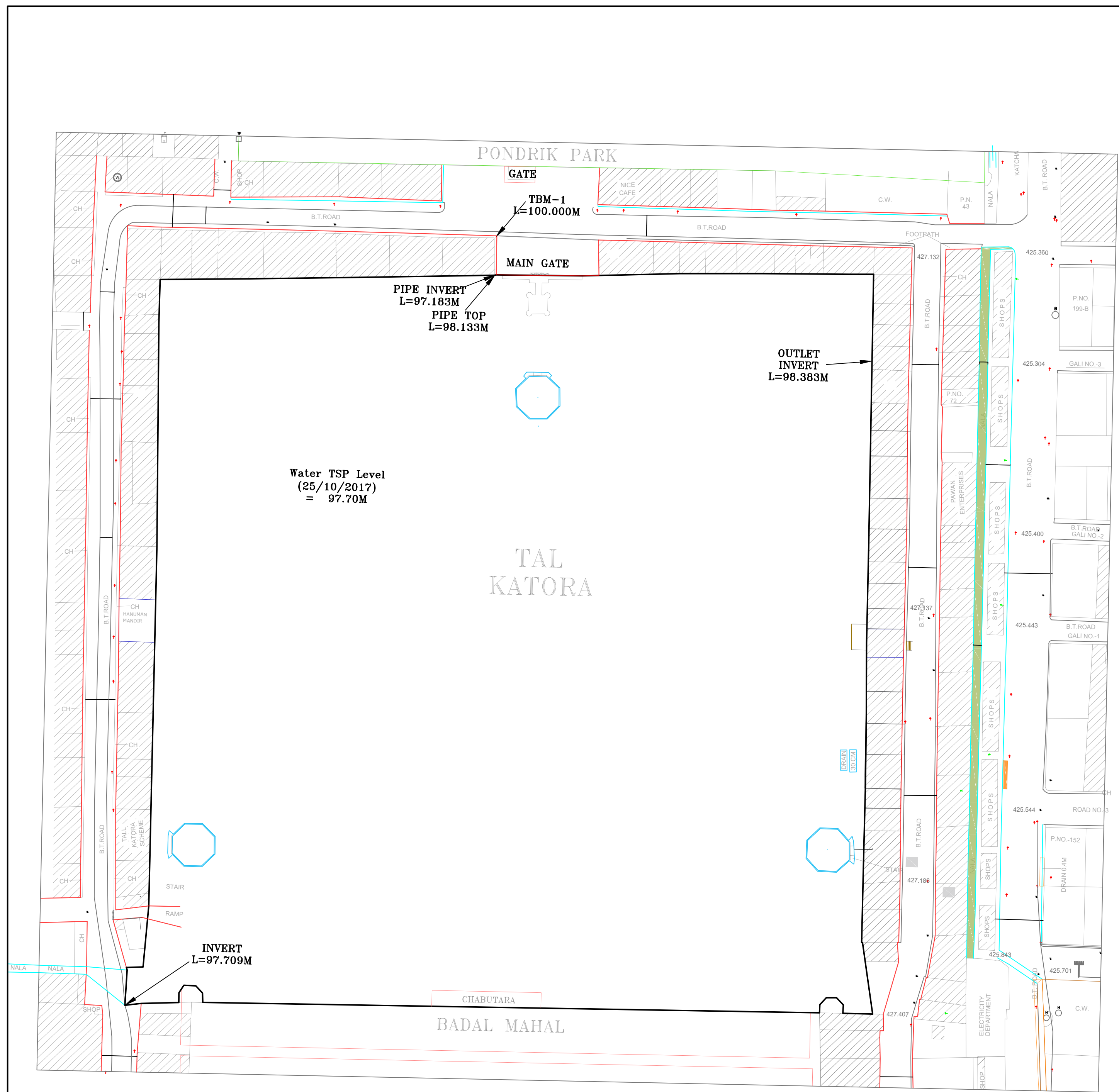
**Jaipur Smart City Limited**  
 Jaipur Municipal Corporation,  
 Pt. Deen Dayal Upadhyay Bhawan,  
 Lalkothi, Tonk Road, Jaipur - 302016

**PROJECT**  
 REDEVELOPMENT OF TALKATORA LAKE

DRAWING TITLE	SCALE
EXISTING PLAN OF TALKATORA LAKE	1:1000
	DATE
	30.10.2017

DRAWING No.	
JSCL-HC&IR-TLR-01A	





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APPROVED BY		

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 Jaipur Municipal Corporation,  
 Pt. Deen Dayal Upadhyay Bhawan,  
 Lalkothi, Tonk Road, Jaipur - 302016

**PROJECT**  
 REDEVELOPMENT OF TALKATORA LAKE

DRAWING TITLE	SCALE
STP PROPOSAL AND SEWAGE NETWORK PLAN (AS/TENDER DOCUMENT)	1:1000
	DATE
	30.10.2017

DRAWING No.	
JSCL-HC&IR-TLR-1B	





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DATE	REV. NO.	DETAILS	REV. BY	DRAWING ISSUED TO	BY	NO. OF COPIES
06.11.17	R1	OCTAGONAL GARDEN 2 & 3 POSITIONS HAVE BEEN SWAPPED AND MINOR DESIGN MODIFICATION HAS BEEN MADE IN GARDEN 2 AS PER CLIENT OBSERVATIONS.	RITAM			
17.11.17	R2	PROVISION FOR THE TREATMENT OF STORM WATER HAS BEEN PROVIDED IN THE EXISTING RITAM DRAIN IN SOUTH WEST CORNER OF THE LAKE.	RITAM			

<b>DRAWN BY</b> AR. RITAM CHAKRAVARTY	<b>CHECKED BY</b> DR. SP BISWAS	<b>APPROVED BY</b>	<b>SECTOR</b> HERITAGE CONSERVATION & INNER CITY RENEWAL
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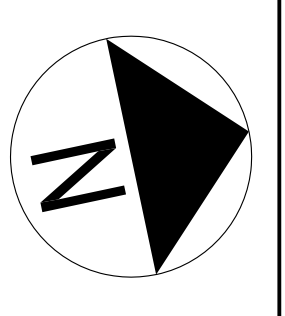
**PROJECT**  
REDEVELOPMENT OF TALKATORA LAKE

**DRAWING TITLE**  
PROPOSED SITE PLAN

**SCALE**  
1:1000

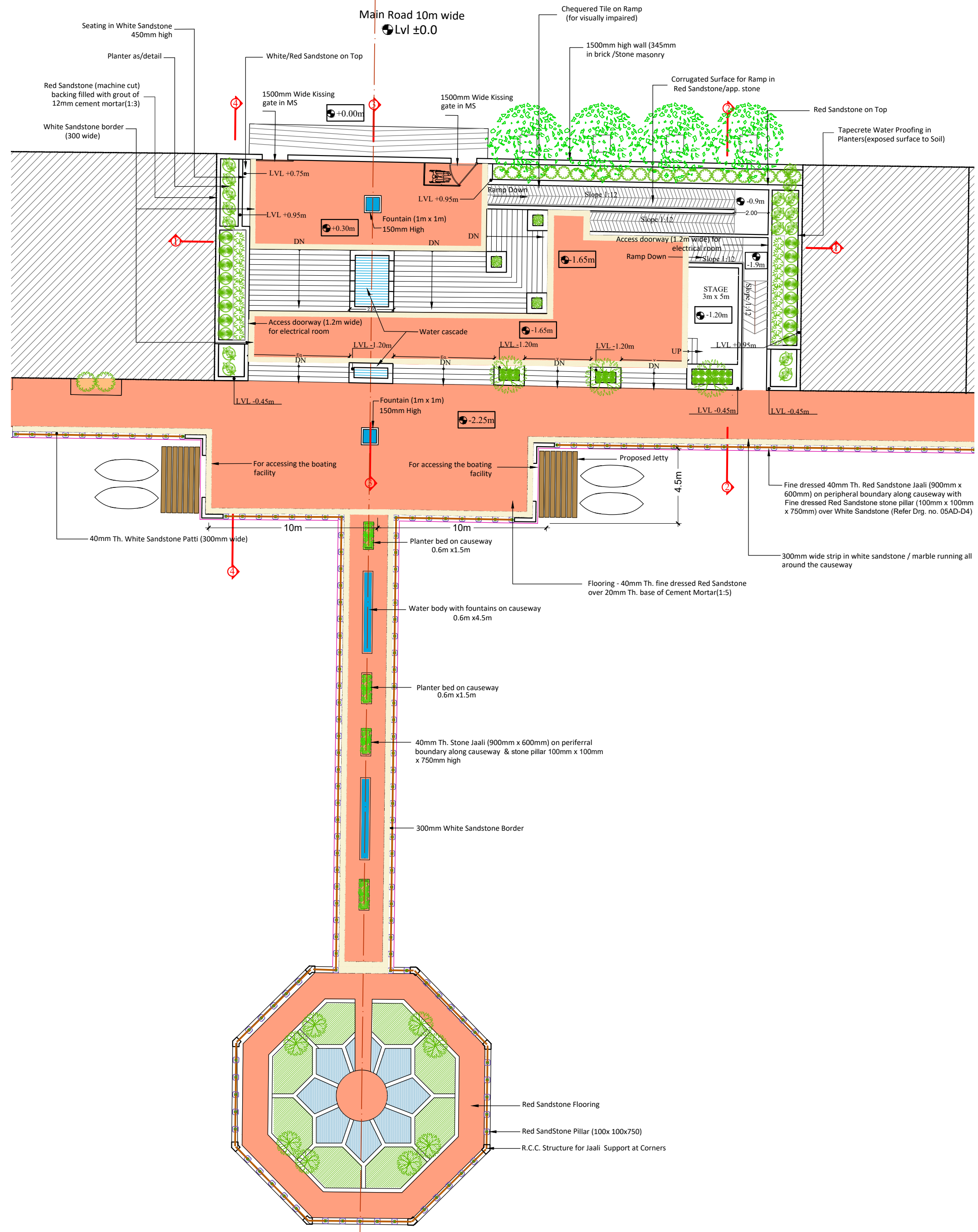
**DATE**  
06.11.2017

**DRAWING No.**  
JSCL-HC&IR-TLR-02



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**TECHNICAL SPECIFICATION**

- FLOORING:
  - 40 MM THICK FINE DRESSED RED SAND STONE OF MINIMUM LENGTH 900MM OVER 20 MM (AVERAGE) TH. BASE OF CEMENT MORTAR (1:5) [ITEM NO. 30.27.1]
  - 40 MM THICK, 300MM WIDE FINE DRESSED WHITE SAND STONE BAND OF MINIMUM LENGTH 1200MM OVER 20 MM (AVERAGE) TH. BASE OF CEMENT MORTAR (1:5) [ITEM NO. 30.27.2]
- WALL CLADDING:
  - 30 MM THICK FINE DRESSED RED SAND STONE OF MINIMUM LENGTH 900MM OVER 12 MM TH. (AVERAGE) BASE OF CEMENT MORTAR (1:3) [ITEM NO. 26.1]
- LIME KARA: PROVIDING & APPLYING LIME KARA 1:2 (1LIME CREAM : 2 ZIKKI POWDER) ON WALL FACIALS IN RCC/STONE/ BRICK SURFACE, IN TWO COATS FOLLOWING THE SPECS AS PER RUIDP. [ITEM NO. 40.19]
- KHAMIRA COLOUR WASH: KHAMIRA COLOUR WASHING ON WALL FACIALS IN RCC/STONE/ BRICK SURFACE, IN TWO COATS FOLLOWING THE SPECS AS PER RUIDP. [ITEM NO. 40.17]
- ALL RCC WALLS USED AROUND PLANTERS SHALL HAVE A 40MM TH. FINE DRESSED WHITE/RED SANDSTONE ON TOP CHAMFERED TO HALF THE THICKNESS OF THE STONE.
- RAILING AROUND CAUSEWAY IN 40MM TH. FINE DRESSED RED SANDSTONE JAALI OF SIZE 900MM X 600MM WITH FINE DRESSED RED SANDSTONE PILLARS OF SIZE 100MM X 100MM X 750MM FIXED ON RCC BLOCKS (320MM X 320MM X 200MM) SUPPORTING THE JAALIS AND 750MM X 165MM WHITE SANDSTONE BELOW WITH EMBEDDED GROOVES. [ITEM NO. 26.11.1 & NON-BSR]
- THE WATER CASCADES SHALL HAVE RED SANDSTONE FLOORING BED AND WATER BODIES SHALL BE INTERCONNECTED WITH CHANNELS/CONCEALED PIPELINES EMBEDDED UNDER THE RED SANDSTONE FLOORING.
- ENTRY GATE SHALL BE OF SLIDING/COLLAPSIBLE TYPE IN MS OF 1500MM HEIGHT AND OF REQUIRED LENGTH WITH 3 COATS OF SYNTHETIC ENAMEL PAINT. THE GATE HAVING WEIGHT NOT LESS THAN 250KG. [ITEM NO. 29.2]
- ANOTHER ENTRY GATE IN MS SHALL BE OF KISSING GATE TYPE AS MARKED IN DRAWING, WITH 3 COATS OF SYNTHETIC ENAMEL PAINT. [ITEM NO. 29.2]
- ALL EXPOSED SURFACES TO SOIL HAVING PLANTATION SHALL HAVE TAPECRETE WATERPROOFING COATING (TO BE EXECUTED AS PER RUIDP SPECS) [ITEM NO. 38.3]
- ALL EXPOSED CONCRETE SURFACES IN CONTACT WITH WATER SHALL BE TREATED WITH 3 COATS OF ANTI-CORROSIVE PAINT AS APPROVED BY ENGINEER. [NON-BSR]

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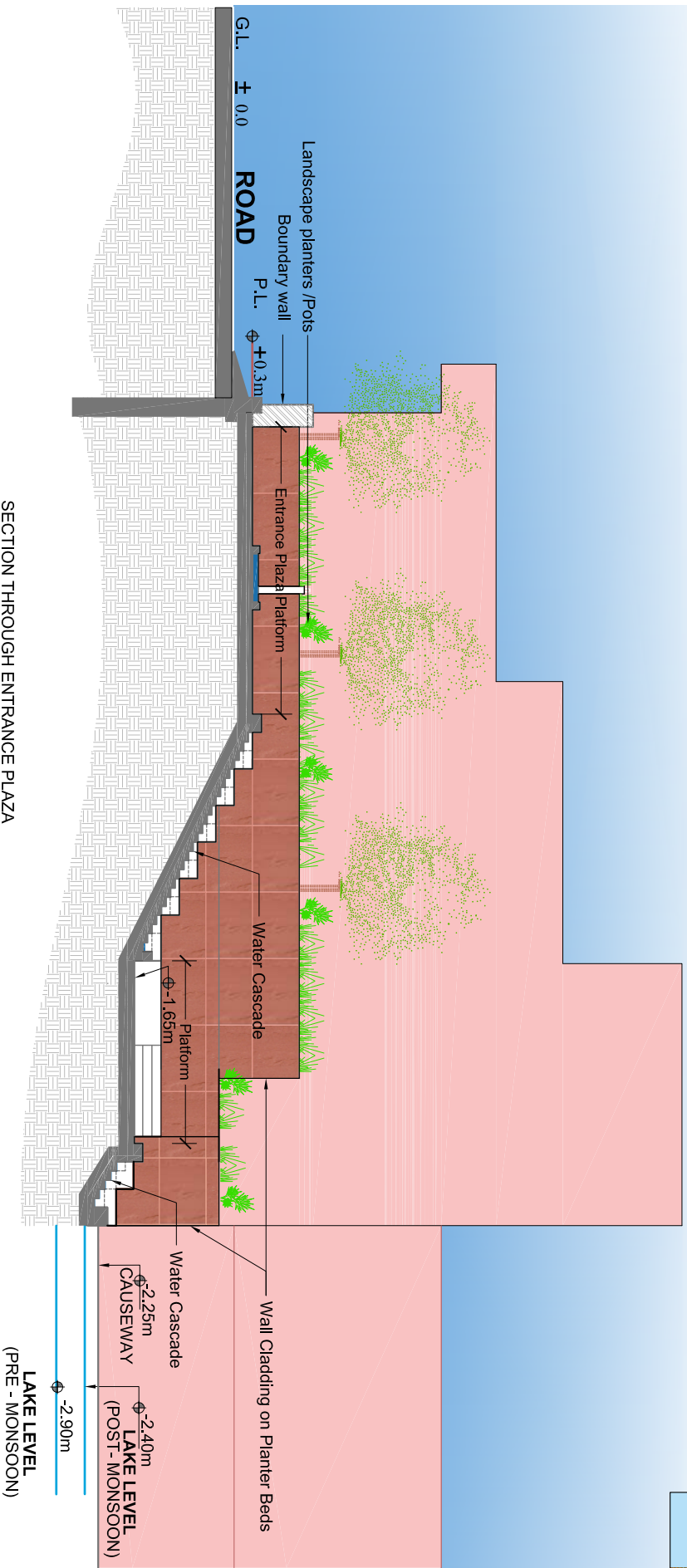
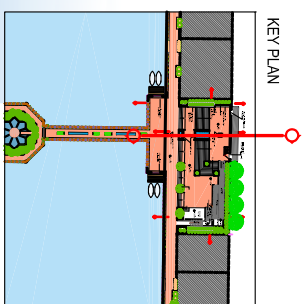
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AR. RITAM CHAKRAVARTY	DR. SP BISWAS	HERITAGE CONSERVATION & INNER CITY RENEWAL
APPROVED BY		

<b>PROJECT</b>	
REDEVELOPMENT OF TALKATORA LAKE	
<b>DRAWING TITLE</b>	<b>SCALE</b>
ENTRANCE PLAZA AND OCTAGONAL GARDEN 1	1:200
<b>DRAWING No.</b>	<b>DATE</b>
JSCL-HC&IR-TLR-03	30.10.2017

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SECTION THROUGH ENTRANCE PLAZA

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**Jaijpur Smart City Limited**  
 Jaijpur Municipal Corporation,  
 P.O. Deep Darvel, Udaypur, Bhubaneswar,  
 Odisha, India. Phone No. - 0674-232016

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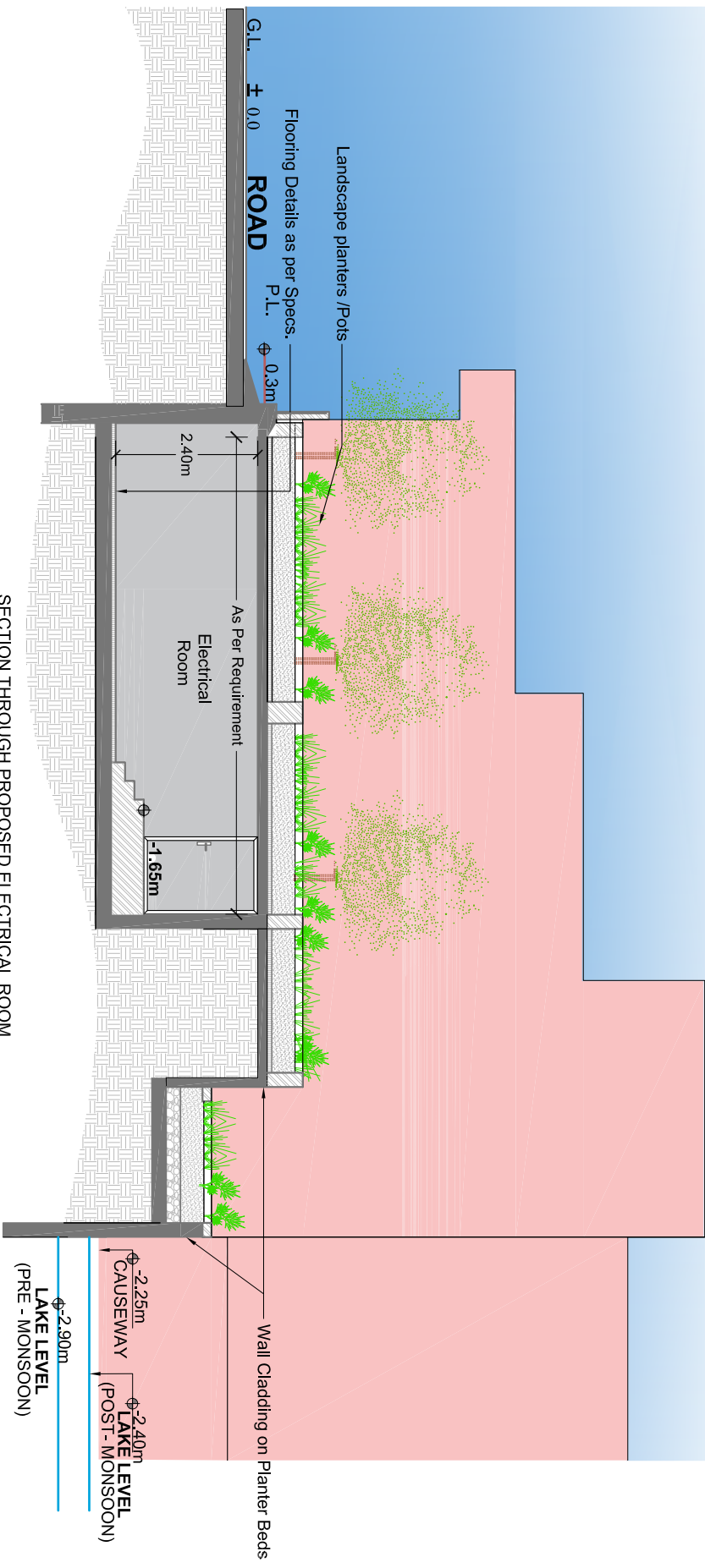
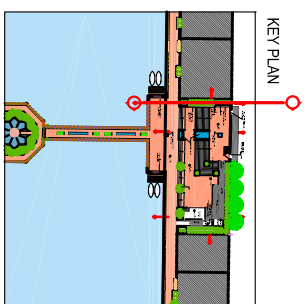
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APPROVED BY		
S.P. BISWAS		

SECTOR	PROJECT
HERITAGE CONSERVATION KINNER CITY RENEWAL	REDEVELOPMENT OF TALKATORA LAKE
	DRAWING TITLE
	SECTION OF THE ENTRANCE PLAZA
	DRAWING No. - JSCCL-HC&IR-TLR04A

SCALE  
1 : 100





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 Jaijpur Municipal Corporation,  
 Pt. Deen Dayal Upadhyay Bhawan,  
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**DRAWN BY** RTMAM  
**CHECKED BY** S.P. BISWAS  
**APPROVED BY** S.P. BISWAS  
**SECTOR** HERITAGE CONSERVATION KINNER CITY RENEWAL  
**PROJECT** REDEVELOPMENT OF TALKATORA LAKE  
**DRAWING TITLE** SECTION OF THE ENTRANCE PLAZA  
**DRAWING No.** - JSCC-HIC&R-TLR404B

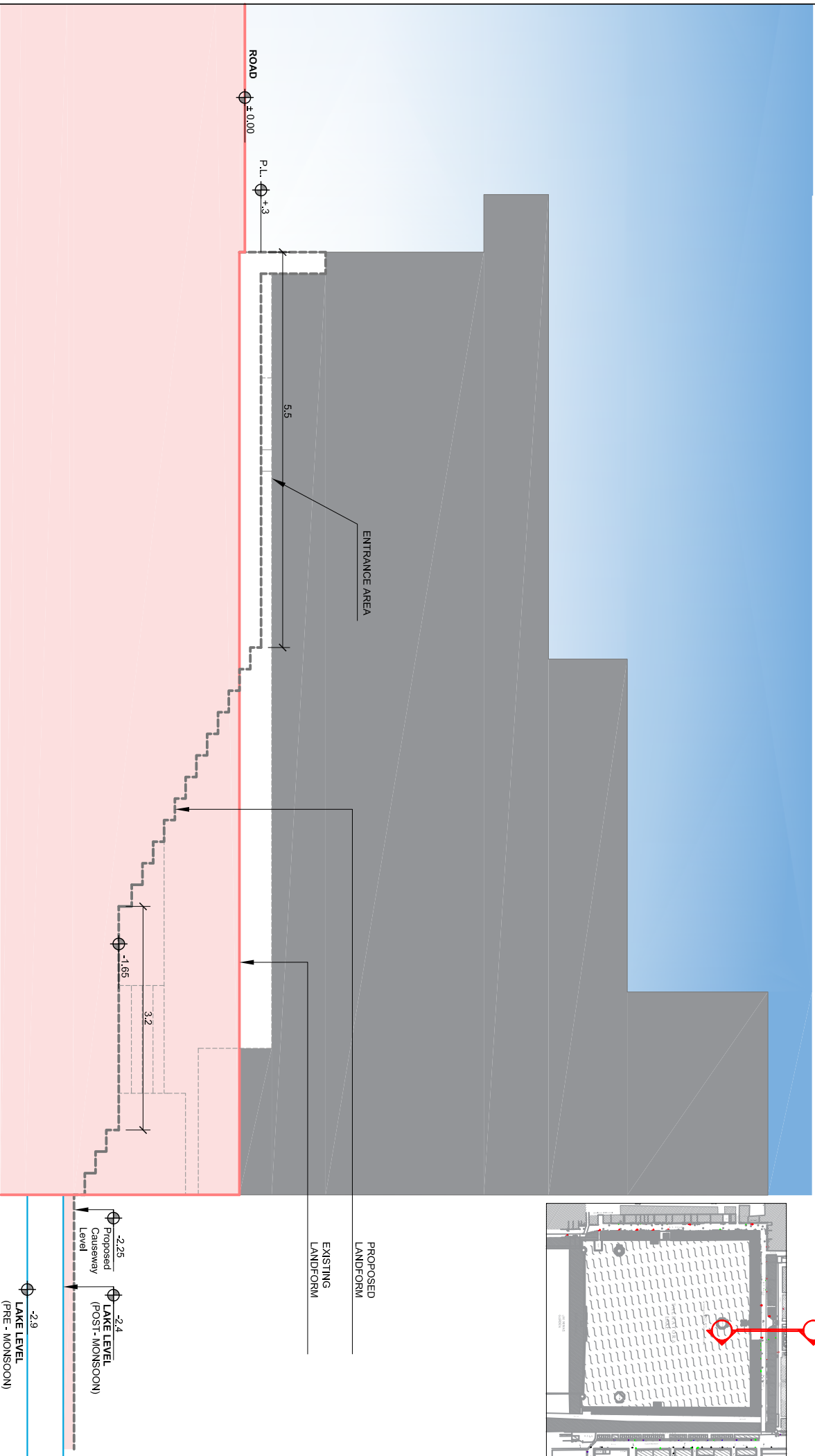
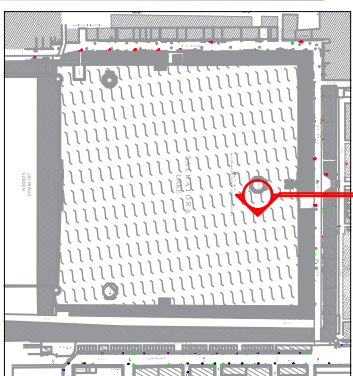
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SCALE  
 1 : 100





KEY PLAN



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 Jajpur Municipal Corporation,  
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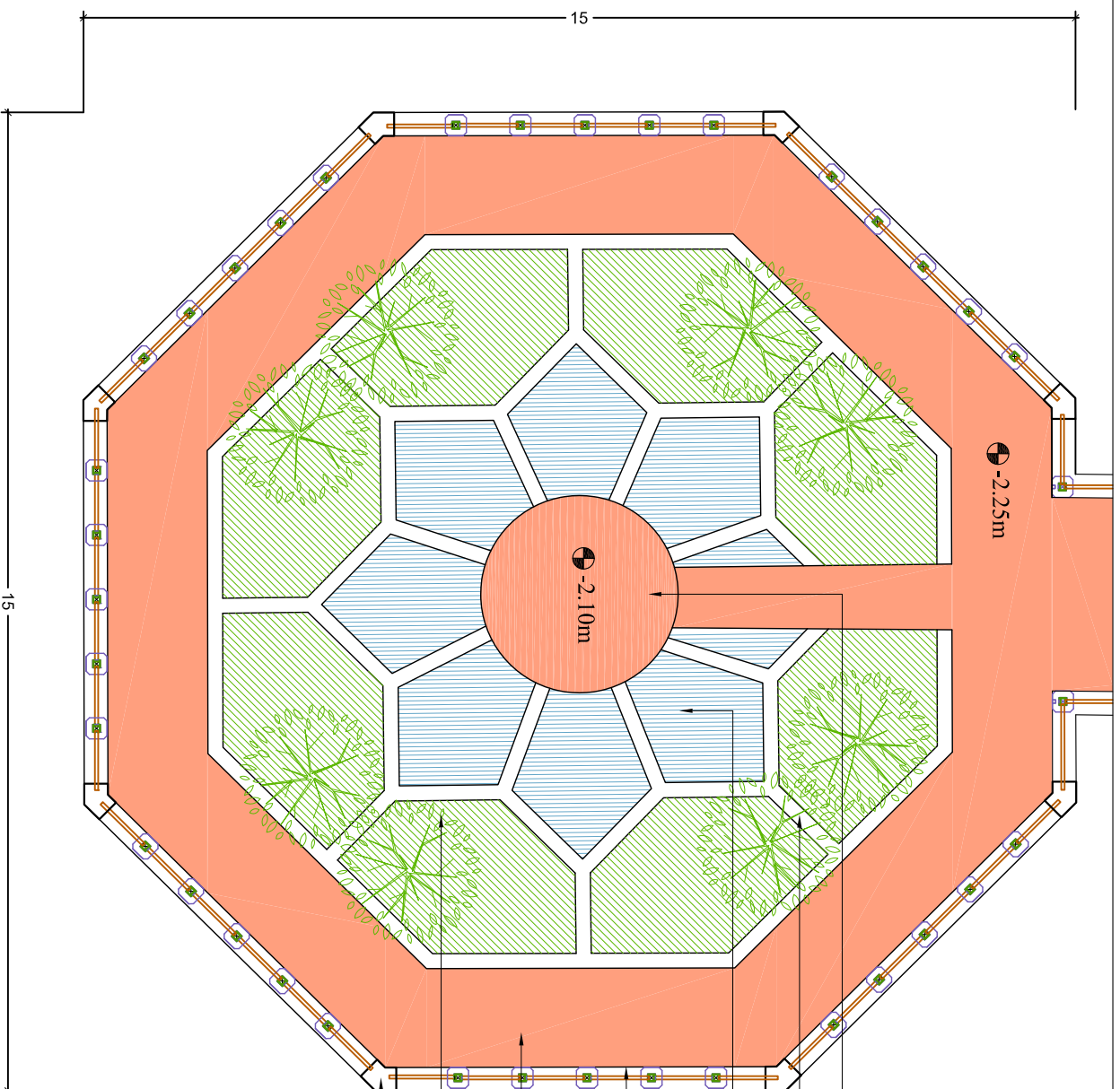
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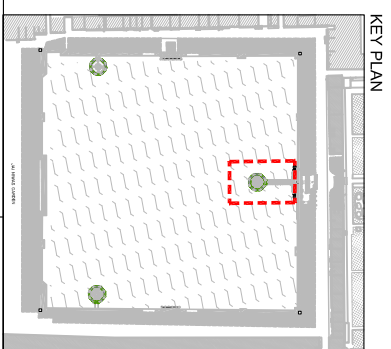
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30.10.2017			-	-	-			SUSHANT	S.P. BISWAS	HERITAGE CONSERVATION KINNER CITY RENEWAL	REDEVELOPMENT OF TALKATORA LAKE	ANALYSIS OF EXISTING AND PROPOSED LANDFORM	1 : 50
								APPROVED BY	S.P. BISWAS				
									S.P. BISWAS				



LEGEND		
BOTANICAL NAME	COMMON NAME	SYMBOL
PLUMERIA OBTUSA	CHAMPA	



- 3M DIA CIRCULAR PLATFORM PLANNED AS ACTIVITY STAGE
- 200MM WIDE STRIP IN WHITE SANDSTONE RUNNING ALL AROUND THE CAUSEWAY
- WATER BODY WITH FOUNTAIN
- STONE JAALI (900MM X 600MM) ON PERIPHERAL BOUNDARY ALONG CAUSEWAY & STONE PILLAR 100MM X 100MM X 750MM HIGH
- 1.5M PATHWAY ALL AROUND FOR MOVEMENT. FINISH IN RED SANDSTONE
- LANDSCAPE IN GRASS
- RCC STRUCTURE FOR JAALI SUPPORT AT CORNERS (DIMENSIONS TO BE CONSIDERED AS PER STRUCTURAL GUIDANCE)



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  3. ALL WORK SHALL BE DONE IN ACCORDANCE WITH THE JAIJPUR SMART CITY REGULATIONS AND THE JAIJPUR MUNICIPAL CORPORATION REGULATIONS.
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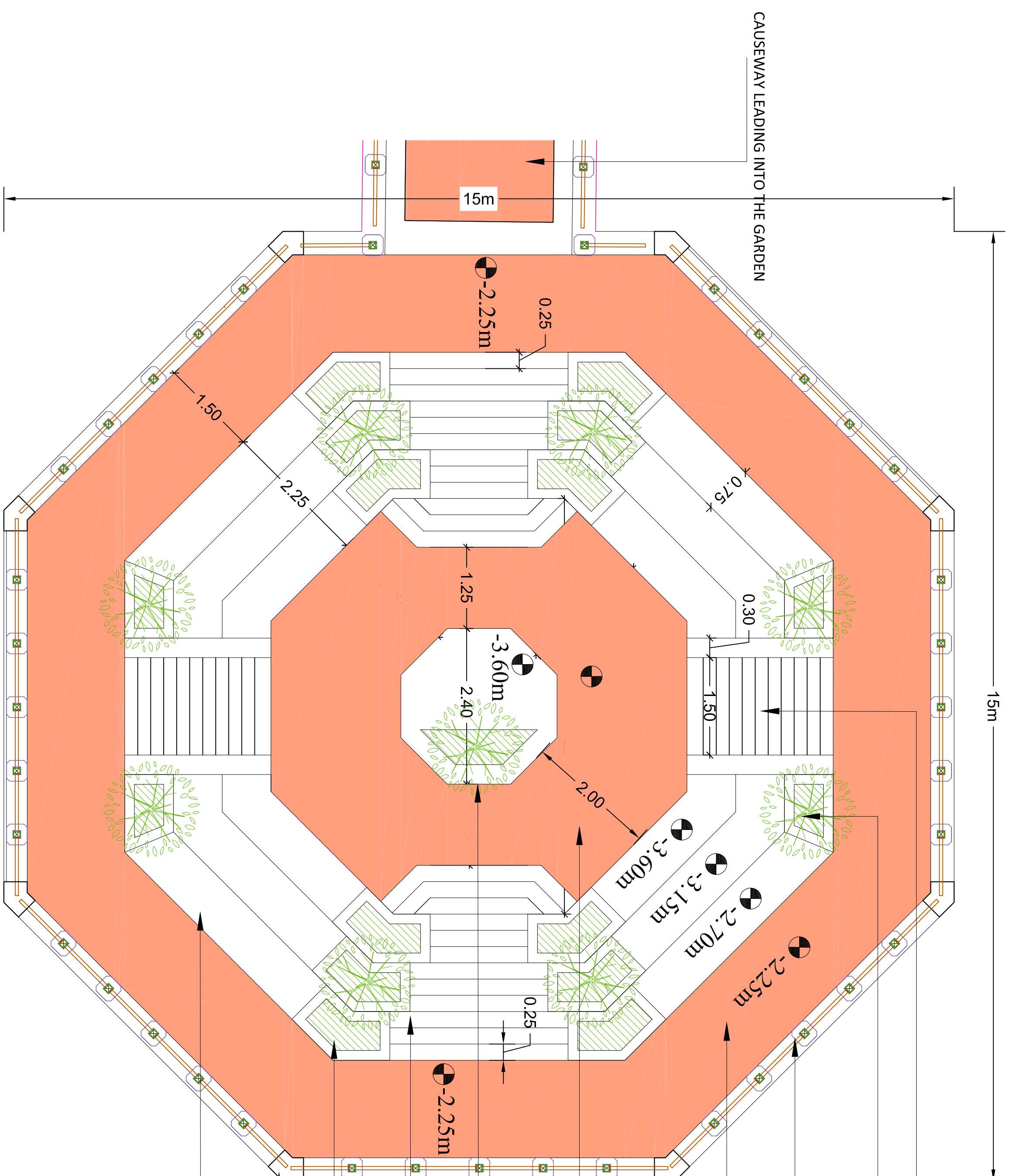
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RITAM	RICHA	
APPROVED BY		
S P BISWAS		

PROJECT	SCALE
REDEVELOPMENT OF TALKatora LAKE	1 : 100
DRAWING TITLE	
OCTAGONAL GARDEN I	
DRAWING No. - JSC-14C&R-TLR-Q5AD-01	

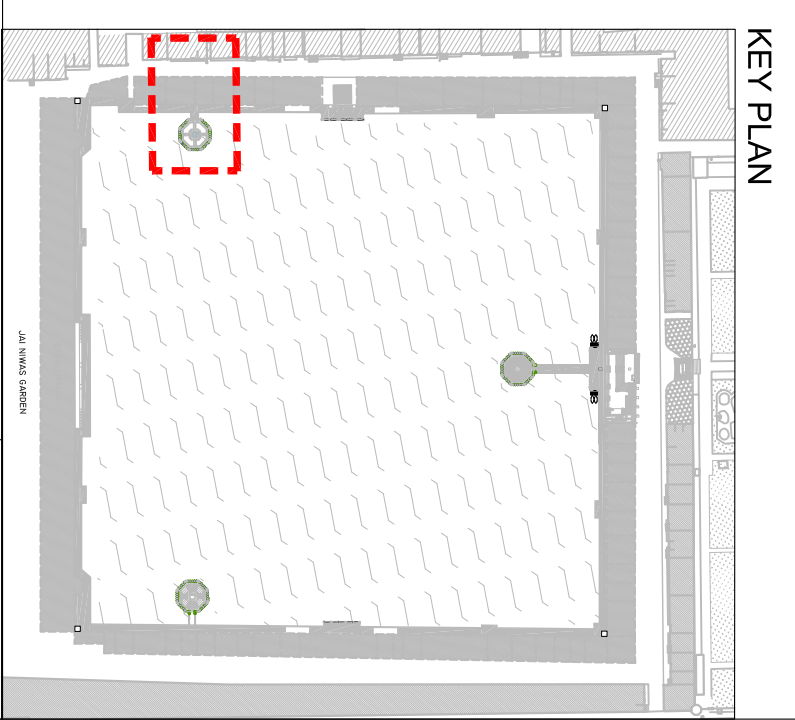




LEGEND		
BOTANICAL NAME	COMMON NAME	SYMBOL
PLUMERIA OBTUSA	CHAMPA	



- WATER CASCADE AS PER DETAIL
- PLANTER BED
- STONE JAALI (900mm X 600mm) RAILING ALONG CAUSEWAY WITH STONE PILLAR 100MM X 100MM X 750MM HIGH
- 1.5M WIDE PATHWAY ALL AROUND FOR MOVEMENT. FINISHED IN RED SANDSTONE
- PATHWAY ALL AROUND FOR MOVEMENT. FINISHED IN RED SANDSTONE
- 450MM RAISED PLATFORM TO BE FINISHED IN SANDSTONE AS/DETAIL DESIGN
- STAIRCASE AS PER DETAIL
- STEPPED PLANTERS AS/DETAIL
- RCC STRUCTURE FOR JAALI SUPPORT AT CORNERS (DIMENSIONS TO BE CONSIDERED AS PER STRUCTURAL GUIDANCE)
- STEPPED SEATING IN SANDSTONE



**Jaipur Smart City Limited**
  
 Jaipur Municipal Corporation,
   
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30/10/2017				06.11.17	R1	OCTAGONAL GARDEN 2 & 3 POSITIONS HAVE BEEN SWAPPED AND MINOR DESIGN MODIFICATION HAS BEEN MADE IN GARDEN 2 AS PER CLIENT OBSERVATIONS.	RITAM

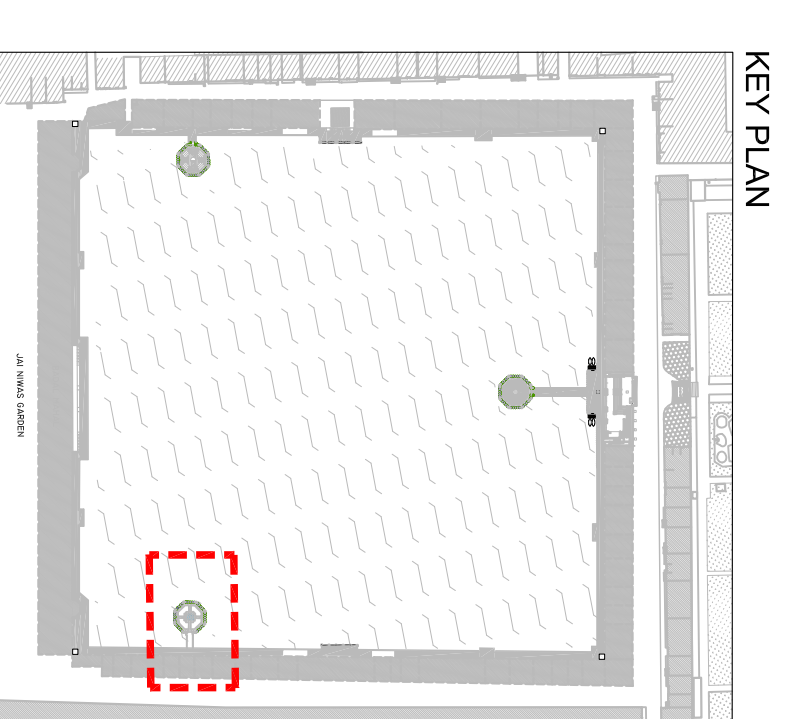
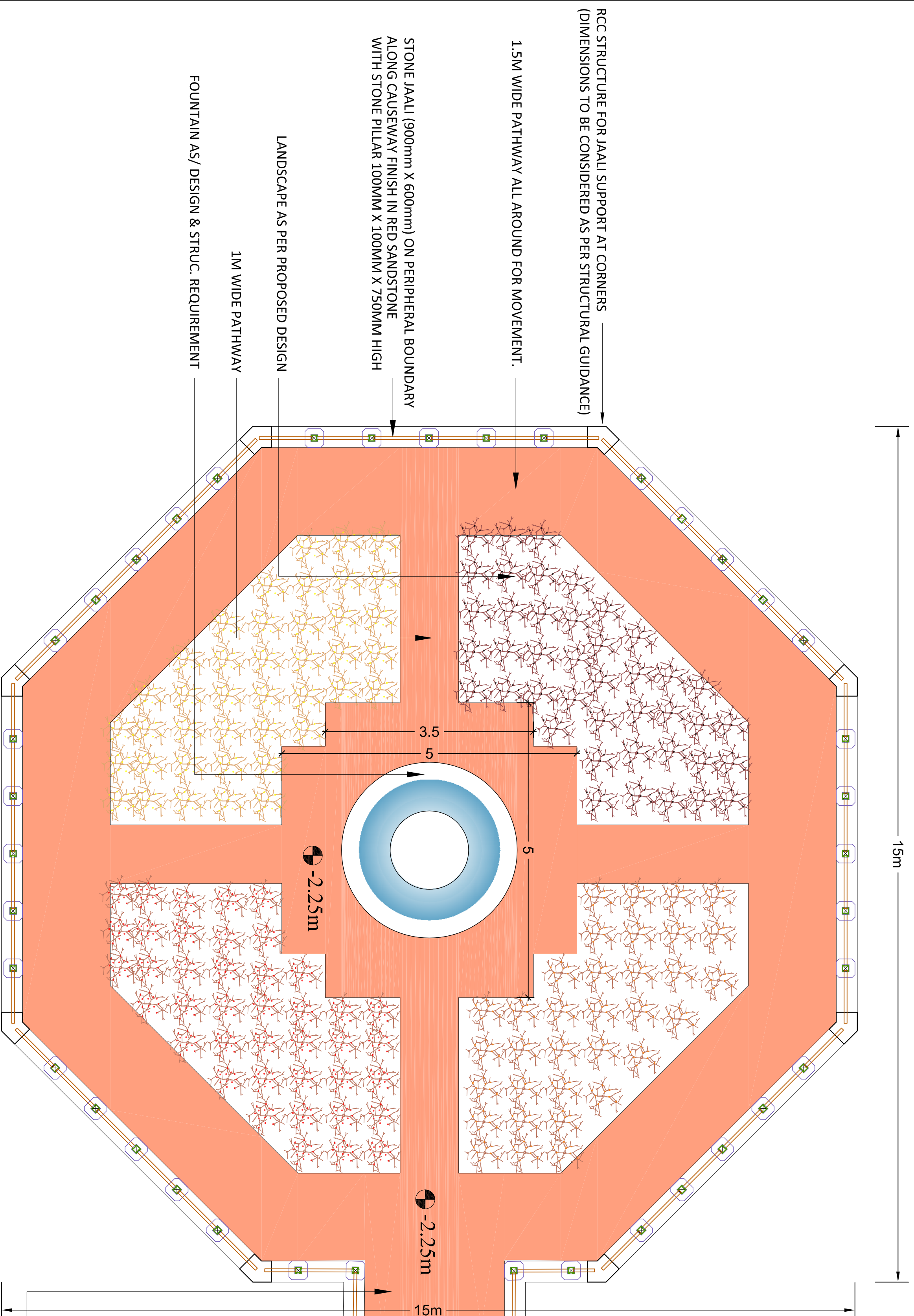
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SP BISWAS	RICHA GARG	HERITAGE CONSERVATION & INNER CITY RENEWAL

PROJECT	DRAWING TITLE	SCALE
REDEVELOPMENT OF TALKatora LAKE	OCTAGONAL GARDEN 2	1 : 100
DRAWING No. - JSCIL-HC&IR-TLR-05AD-D2		



BOTANICAL NAME	COMMON NAME	SYMBOL
LANTANA CAMARA	LANTANA	

LEGEND



KEY PLAN

**epfisa**  
Smart City  
Jaipur Smart City Limited  
Jaipur Municipal Corporation,  
Pl. Deen Dayal Upadhyay Bhawan,  
Lal Kotah, Tonk Road, Jaipur - 302016

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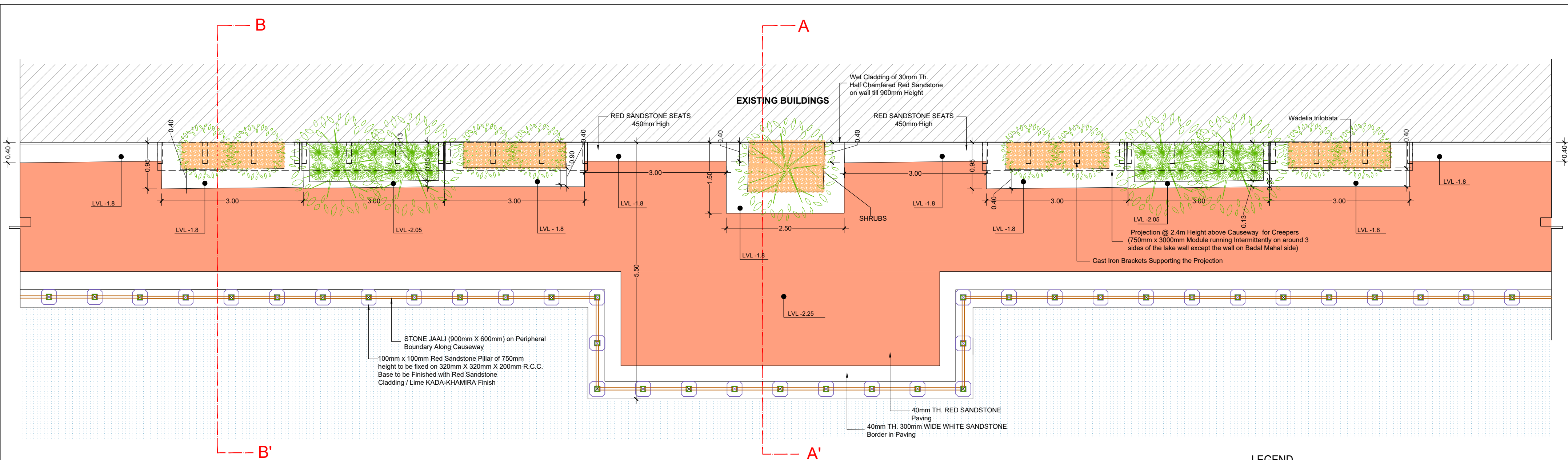
DATE	DRAWING ISSUED TO	BY	NO. OF COPIES	DATE	REV. NO.	DETAILS
30/10/2017						

REV. BY	DRAWN BY	CHECKED BY	SECTOR
	RITAM	RICHA	HERITAGE CONSERVATION & INNER CITY RENEWAL
	APPROVED BY		
	SP BISWAS		

**PROJECT** REDEVELOPMENT OF TALKATORA LAKE  
**DRAWING TITLE** OCTAGONAL GARDEN 3  
**DRAWING No.** - JSCCL-HC&IR-TLR-05AD-D3

**SCALE** 1 : 100

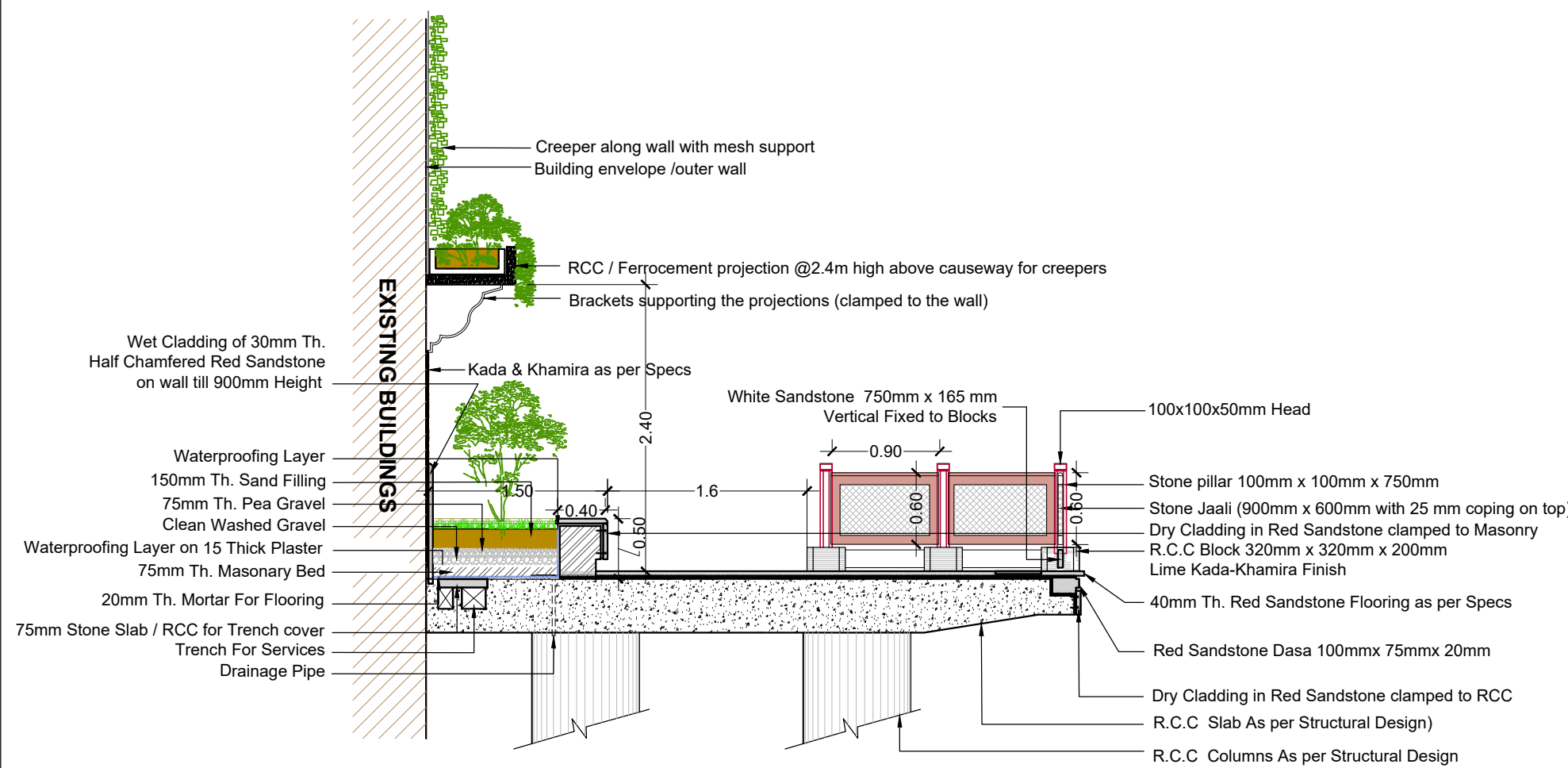




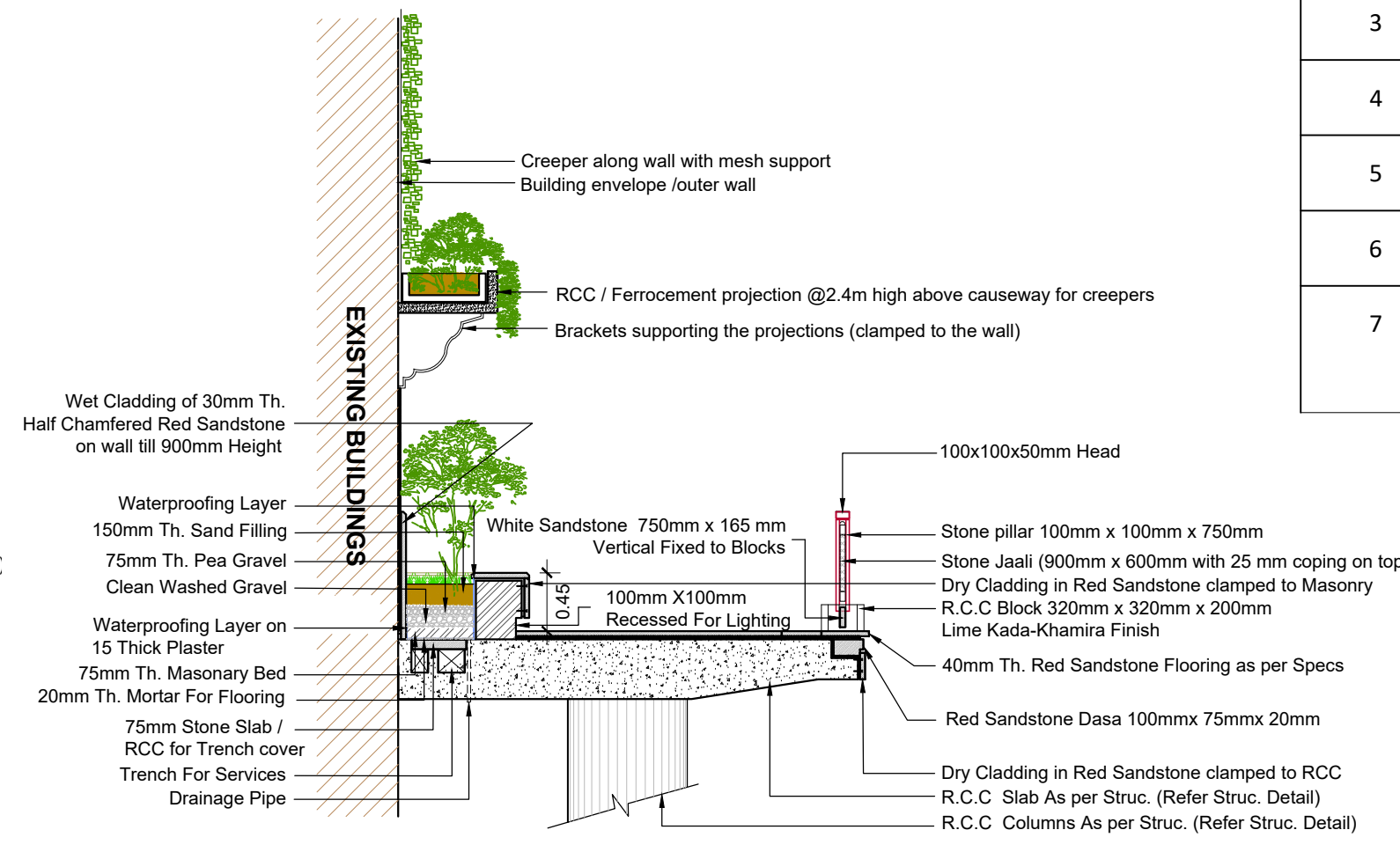
### PLAN OF THE PROJECTED CAUSEWAY

#### LEGEND

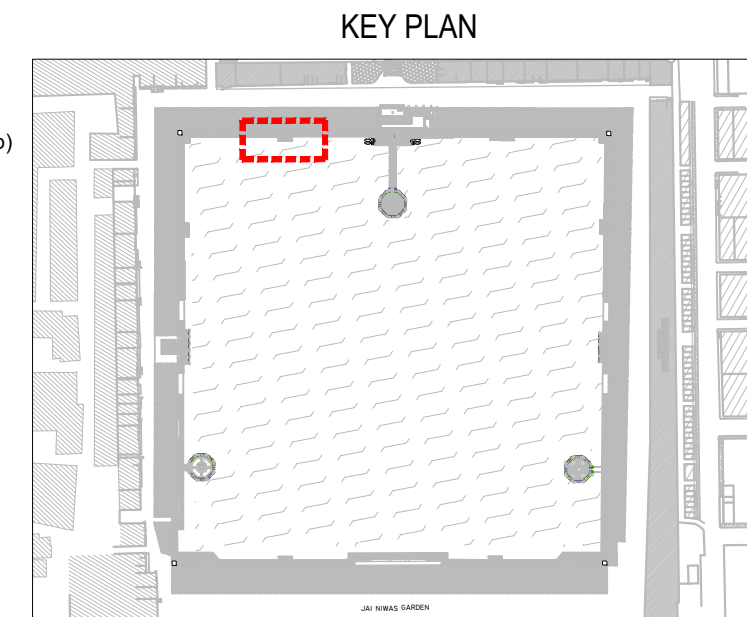
S.NO.	PLANT NAME (Botanical Name)	SYMBOL
1	Ficus	
2	Plumeria alba	
3	Asparagus pyramidalis	
4	Allamanda Creeper	
5	Jasminum sambac	
6	Wadelia trilobata	
7	Potted plants (raat rani, mogra, jasmine madhugamani)	



#### SECTION AA'



#### SECTION BB'



FOR TENDER PURPOSE ONLY

**Jaipur Smart City Limited**  
 Jaipur Municipal Corporation,  
 Pt. Deen Dayal Upadhyay Bhawan,  
 Lalkothi, Tonk Road, Jaipur - 302016

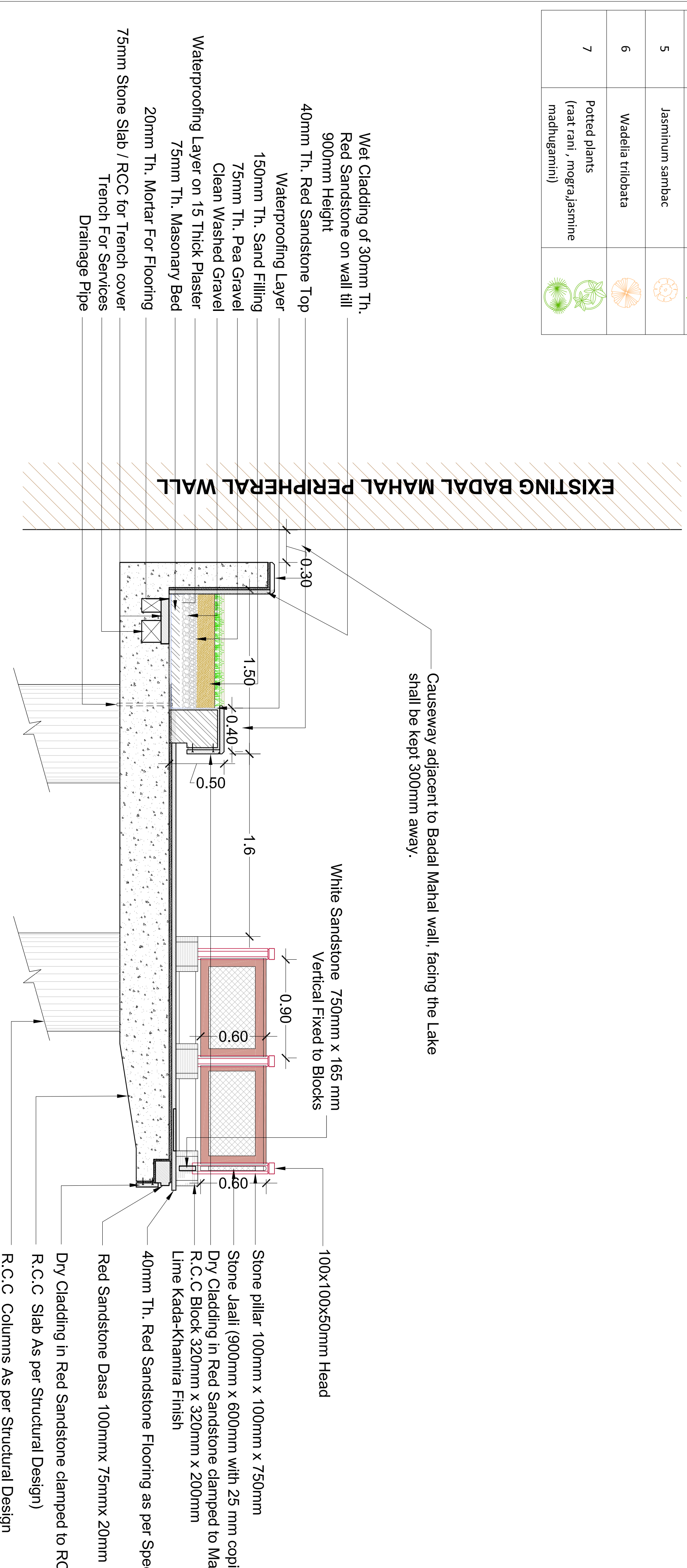
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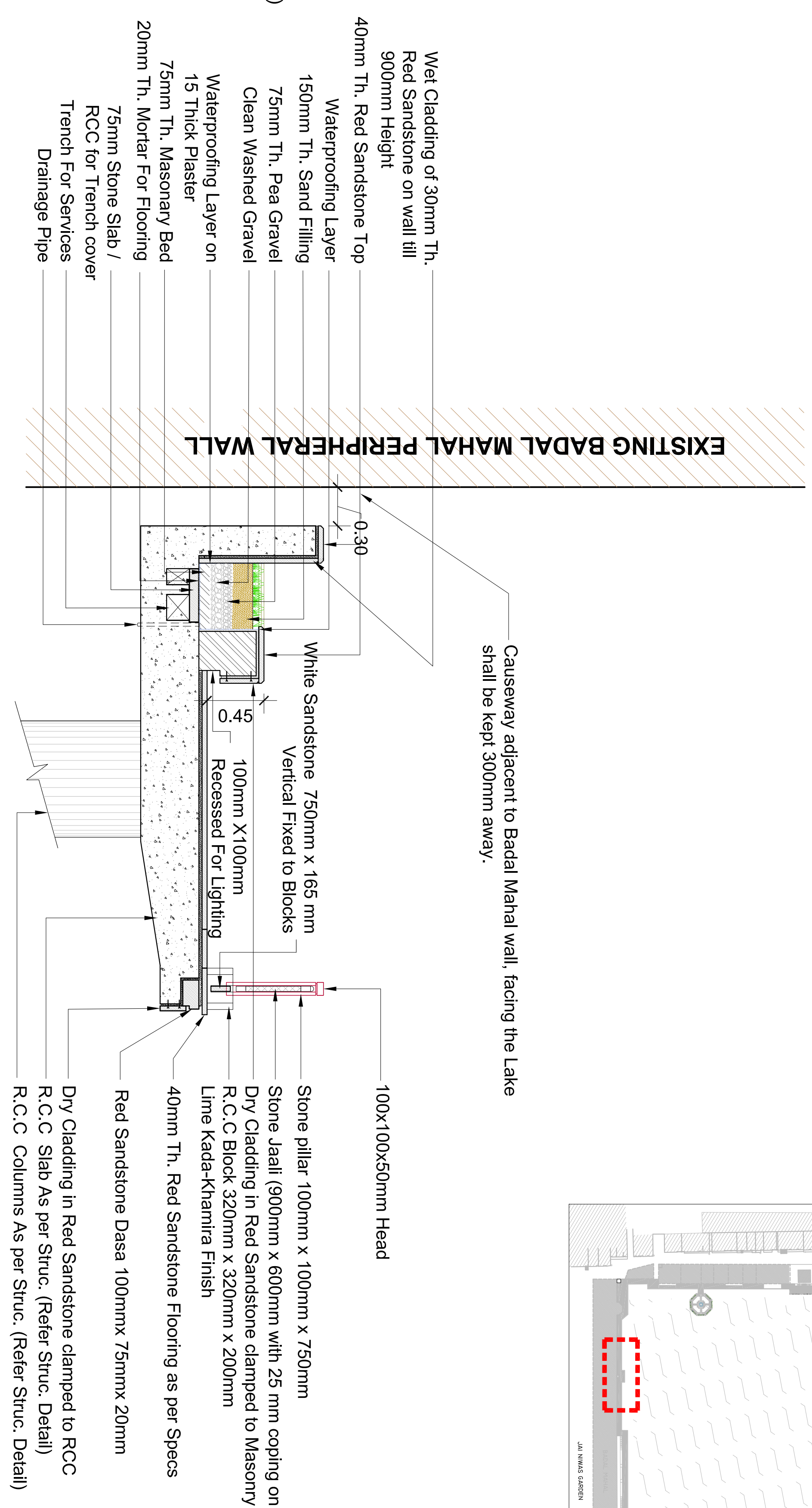
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	TO	BY										
30.10.2017								RITAM	RICHA GARG	HERITAGE CONSERVATION & INNER CITY RENEWAL	REDEVELOPMENT OF TALKATORA LAKE	1 : 50
								APPROVED BY			DRAWING TITLE	
								S P BISWAS			CAUSEWAY AROUND THE LAKE	
											DRAWING No. - JSCL-HC&IR-TLR-05AD-D4	



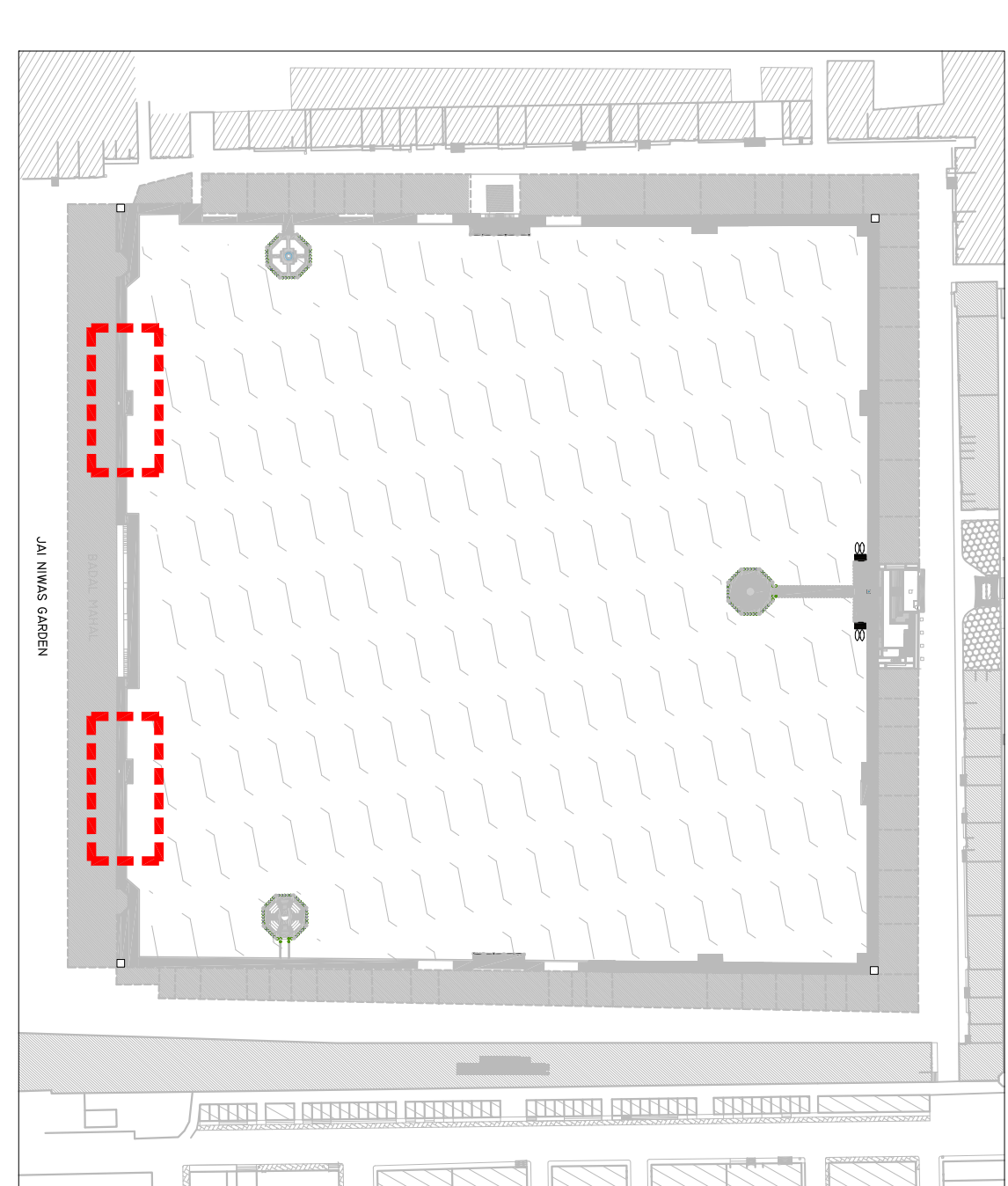
S.NO.	PLANT NAME (Botanical Name)	SYMBOL
1	Ficus	
2	Plumeria alba	
3	Asparagus pyramidalis	
4	Allamanda Creeper	
5	Jasminum sambac	
6	Wadella trilobata	
7	Protected plants (raat rani, mogra, jasmine madhugamini)	



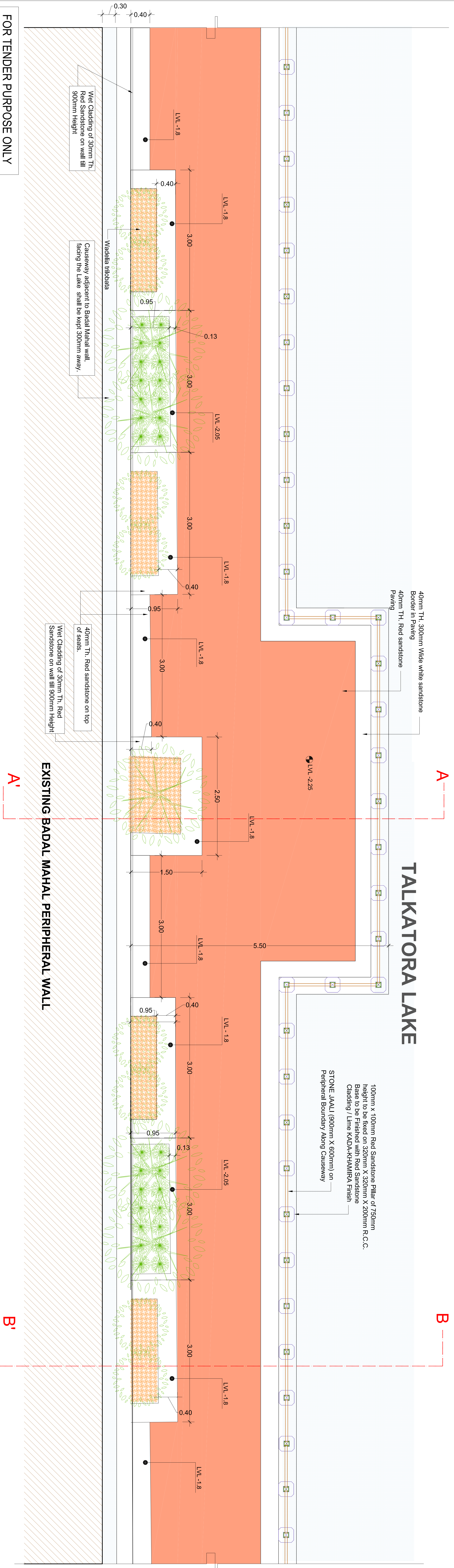
SECTION AA'



SECTION BB'



KEY PLAN



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**epfisa**  
Smart City  
Jaipur Smart City Limited

Jaipur Municipal Corporation,  
Pt. Deen Dayal Upadhyay Bhawan,  
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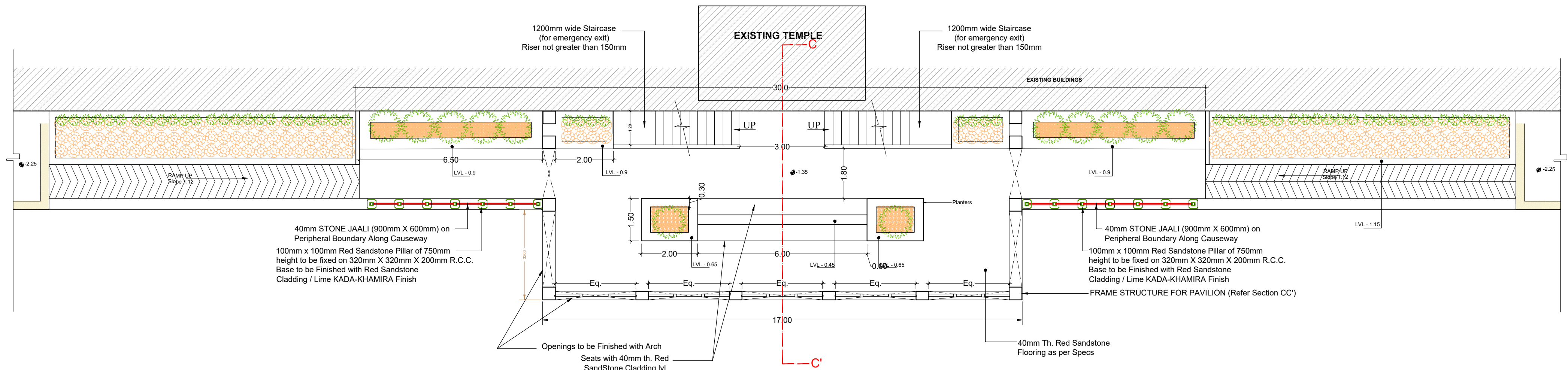
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	TO	BY										
15.11.2017								AR. RITAM		HERITAGE CONSERVATION & INNER CITY RENEWAL	REDEVELOPMENT OF TALKATORA LAKE CAUSEWAY NEAR BADAL MAHAL	1 : 50
								APPROVED BY				
								S P BISWAS				

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Smart City  
Jaipur Smart City Limited

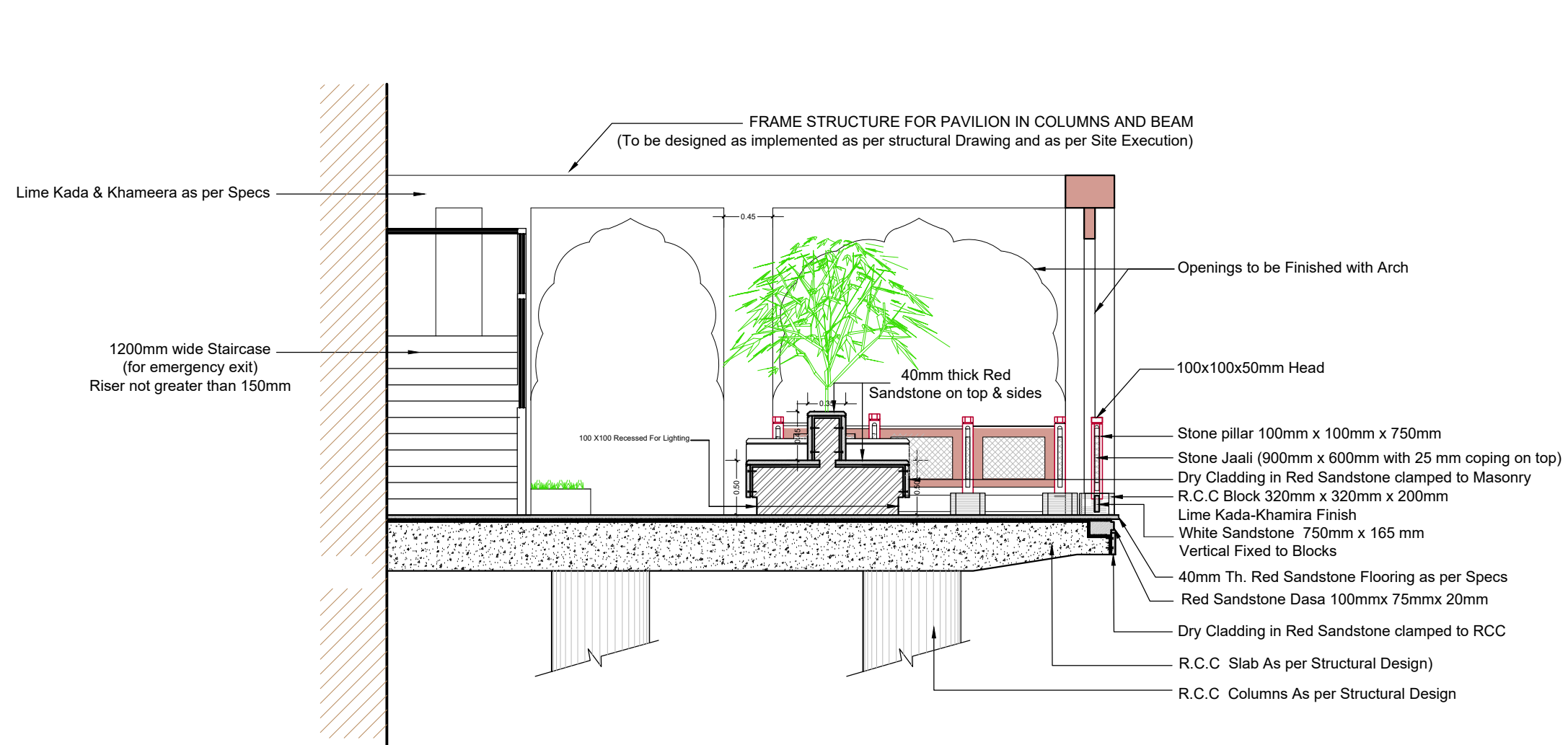
Jaipur Municipal Corporation,  
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Lal Kotah, Tonk Road, Jaipur - 302016

DRAWING No. - JSCCL-HC&IR-TLR-05AD-D4A

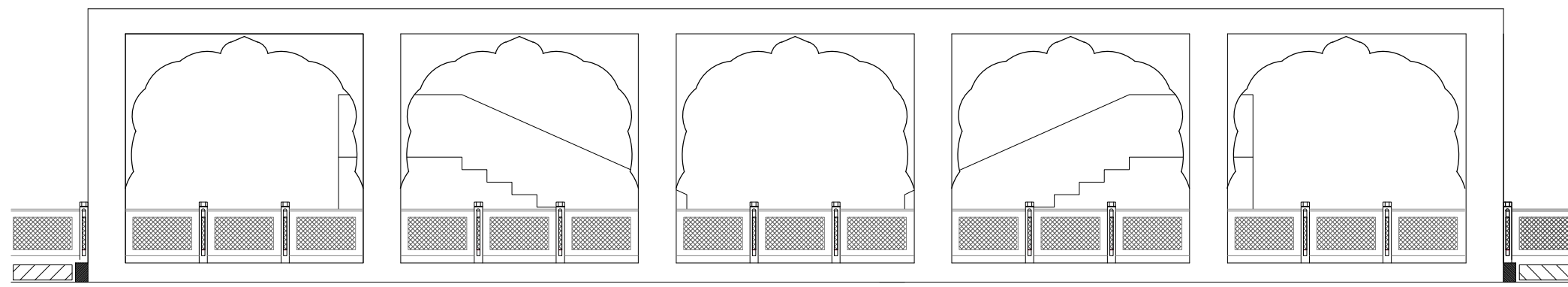




PLAN OF THE RAISED CAUSEWAY

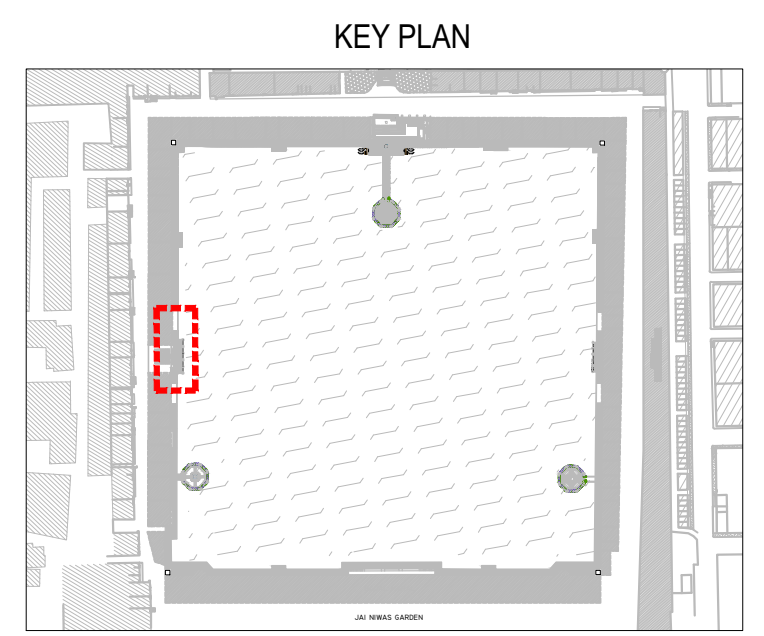


SECTION CC'



ELEVATION OF THE PAVILION (Illustrative)

S.NO.	PLANT NAME (Botanical Name)	SYMBOL
1	Ficus	
2	Plumeria alba	
3	Asparagus pyramidalis	
4	Allamanda Creeper	
5	Jasminum sambac	
6	Wadelia trilobata	
7	Potted plants (raat rani, mogra, jasmine madhugamani)	



KEY PLAN

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 Jaipur Municipal Corporation,  
 Pt. Deen Dayal Upadhyay Bhawan,  
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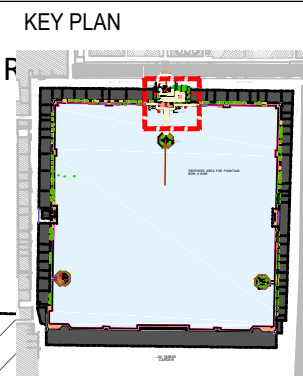
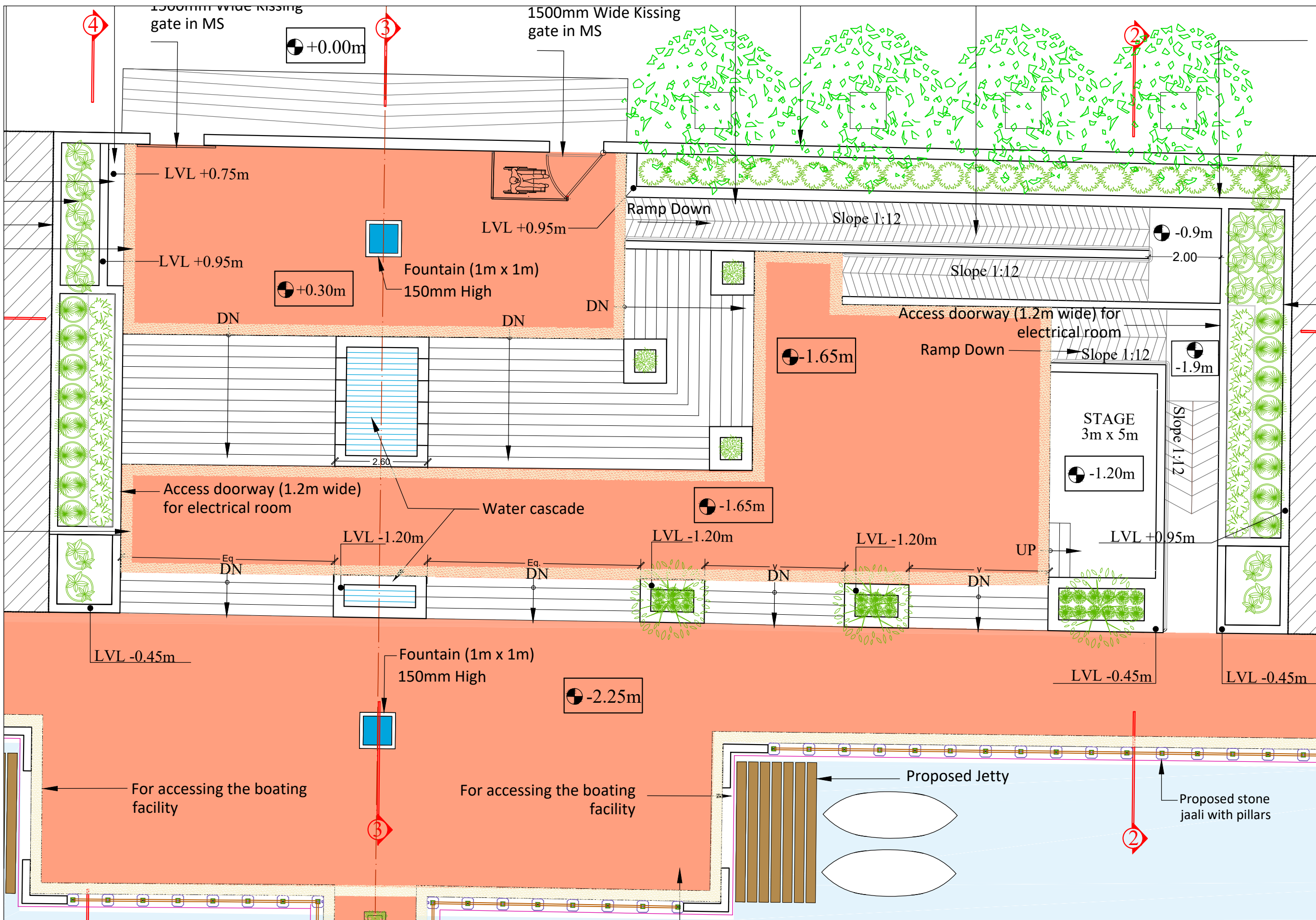
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	TO	BY						RITAM	RICHA GARG			
30.10.2017				-	-	-	-	RITAM	RICHA GARG	HERITAGE CONSERVATION & INNER CITY RENEWAL	REDEVELOPMENT OF TALKATORA LAKE	1 : 50
								APPROVED BY			DRAWING TITLE	DRAWING No. - JSCL-HC&IR-TLR-05AD-D5
								S P BISWAS			RAISED CAUSEWAY	







**LEGEND**

S.NO.	PLANT NAME (Botanical Name)	SYM
1	Delonix regia	
2	Ficus	
3	Adenium	
4	Plumeria Alba	
5	Asparagus Pyramidalis	
6	Allamanda Creeper	
7	Potted plants (raat rani, mogra, jasmine, madhugamani)	

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**ep<sub>t</sub>isa**  
 Jaipur Smart City Limited  
 Jaipur Municipal Corporation,  
 Pt. Deen Dayal Upadhyay Bhawan,  
 Lalkothi, Tonk Road, Jaipur - 302016

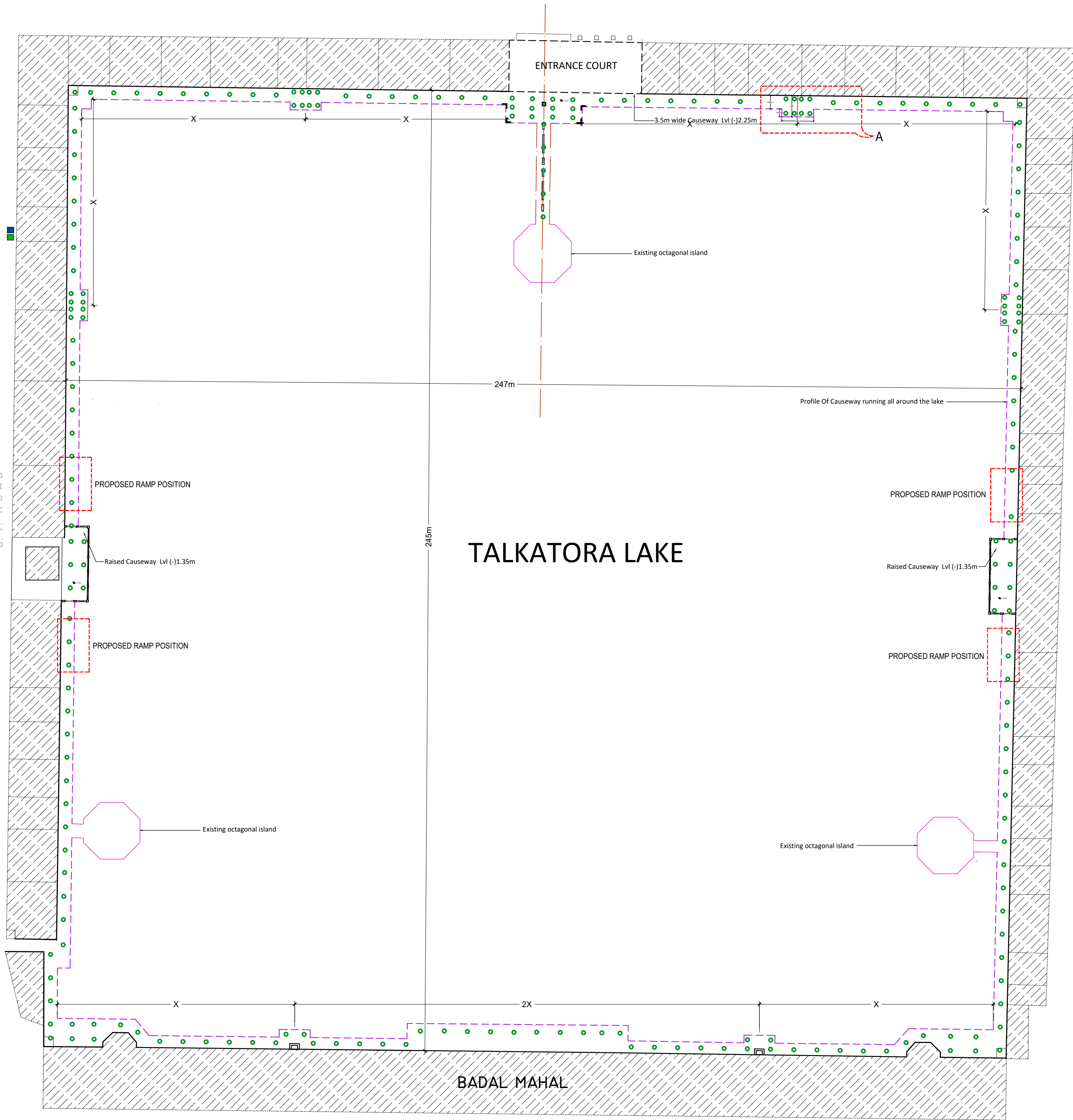
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	TO	BY					
30.10.2017							

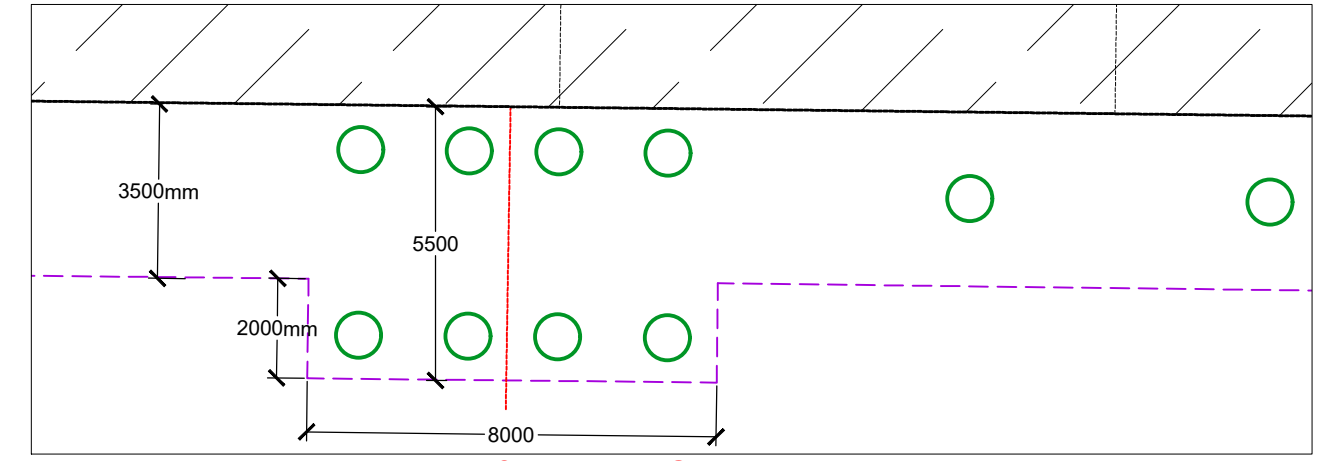
DRAWN BY: RITAM  
 CHECKED BY: RICHA GARG  
 APPROVED BY: S P BISWAS

SECTOR: HERITAGE CONSERVATION & INNER CITY RENEWAL  
 PROJECT: REDEVELOPMENT OF TALKATORA LAKE  
 DRAWING TITLE: DETAIL D - LANDSCAPE PLAN ENTRANCE PLAZA  
 DRAWING No. - JSCL-HC&IR-TLR-05LD-D1  
 SCALE: 1 : 100



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**TYPICAL DETAIL @ A**  
 (The column layout is indicative only. Spacing and size of columns shall be decided only after the structural design and detailing.)

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	TO	BY	

DATE	REV. NO.	DETAILS	REV. BY
-	-	-	-

DRAWN BY	CHECKED BY	SECTOR
AR. RITAM CHAKRAVARTY	D.K. CHAKRABARTY	HERITAGE CONSERVATION & INNER CITY RENEWAL
APPROVED BY		

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 Pt. Deen Dayal Upadhyay Bhawan,  
 Lalkothi, Tonk Road, Jaipur - 302016

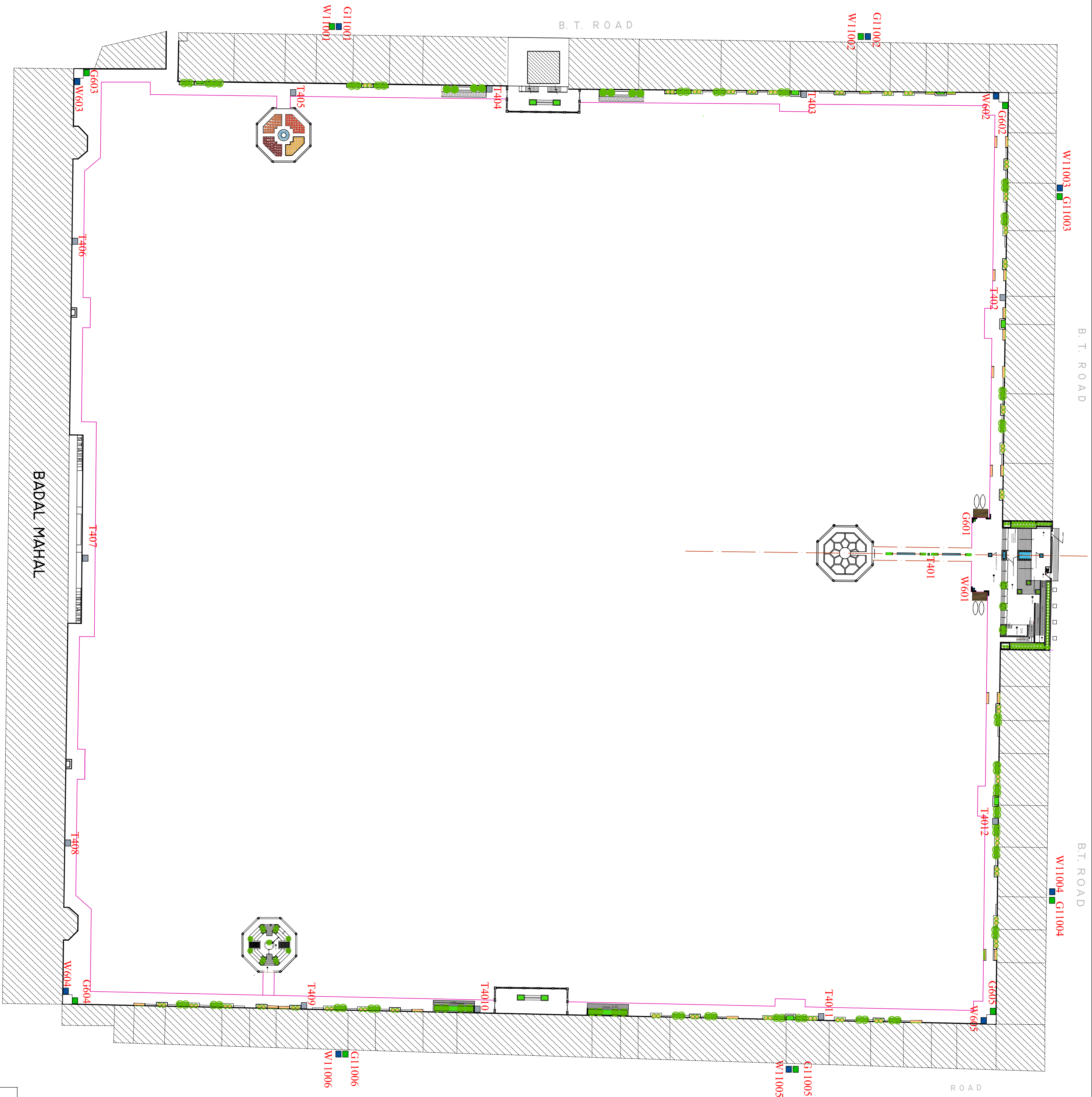
**PROJECT**  
 REDEVELOPMENT OF TALKATORA LAKE

DRAWING TITLE	SCALE
INDICATIVE LAYOUT OF COLUMN FOR THE CAUSEWAY WITHIN THE LAKE	1:750
	DATE
	30.10.2017

DRAWING No.	
JSCL-HC&IR-TLR-06A	

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INDEX	
G601	
W601	
T401	
HCL	
G11001	
W11001	

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- 1. WET WASTE
- 2. DRY WASTE
- 3. TWIN COLLECTION BINS (DRY & WET WASTE)

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DATE	REV. NO.	DETAILS	REV. BY

DRAWN BY	CHECKED BY	SECTOR
AR. RITAM CHAKRAVARTY		HERITAGE CONSERVATION & INNER CITY RENEWAL
APPROVED BY		

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<b>PROJECT</b>	
REDEVELOPMENT OF TALKATORA LAKE	
<b>DRAWING TITLE</b>	<b>SCALE</b>
SOLID WASTE MANAGEMENT SCHEME	1:750
<b>DRAWING No.</b>	<b>DATE</b>
JSCL-HC&IR-TLR-07	30.10.2017

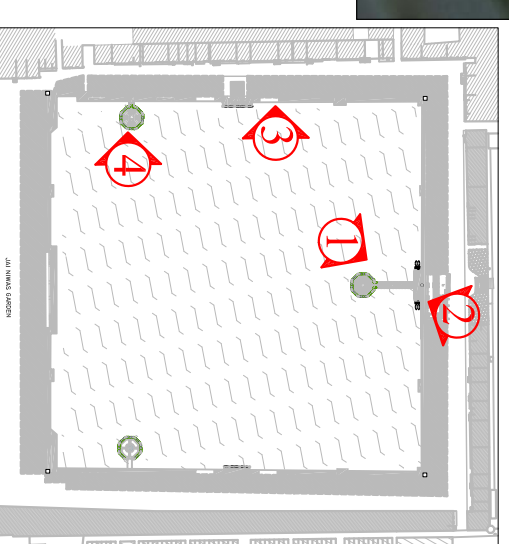
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- LEGEND**
- ① VIEW OF PROPOSED ENTRANCE PLAZA
  - ② VIEW OF LAKE FROM PROPOSED ENTRANCE PLAZA
  - ③ VIEW OF PROPOSED RAISED CAUSEWAY (WEST SIDE)
  - ④ VIEW OF PROPOSED OCTAGONAL GARDEN (EAST SIDE)



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<b>Jaipur Smart City Limited</b> Jaipur Municipal Corporation, P. Deen Dayal Upadhyay Bhawan, Lal Kotli, Tonk Road, Jaipur - 302016																