Solapur City Development Corporation Limited

TENDER DOCUMENT FOR EXECUTION

Revision: Nil

Particulars	Details
Client	Solapur City Development Corporation Limited, Solapur, INDIA
Project Name	Implementation of Projects under Smart Cities Mission in Solapur City
Name of Work	Appointment of Contractor for Redevelopment of Ranga Bhavan Chowk, Part of Smart Road Project (Phase 1), Solapur under Smart Cities Mission
Cost of Blank Tender Form	Rs. 10,000.00 (Rupees Ten Thousand Only)
Estimated Amount	Rs. 4,77,53,520.00 Cr (Rupees Four Crores Seventy Seven Lakhs Fifty Three Thousand Five Hundred and Twenty Only)
Earnest Money Deposit	Rs. 4,80,000.00 (Rupees Four Lakhs and Eighty Thousand Only)
Initial Security Deposit	Rs. 9,60,000.00 (Rupees Nine Lakhs and Sixty Thousand Only)
Tender / Execution Period	Six (06) Calendar Months (including monsoon)
Document Issue Date	28-June-2017
Document Number	2017-18/08

Solapur City Development Corporation Limited,

New Planning Office, Near Milk Dairy, Saat Rasta, Solapur, 413003, Maharashtra, India.

June 2017

VOLUME I

CONTENTS

1. DETAILED E-TENDER NOTICE

Online Digitally Signed **Percentage Rate Basis Tender** of below mentioned work is invited By SOLAPUR CITY DEVELOPMENT CORPORATION LIMITED (SCDCL), SOLAPUR from reputed and experienced and registered contractors with PWD GoM, CPWD or such govt. organization. The Bid Documents are available on the official website of SCDCL from 28/06/2017, 6.00pm to 24/07/2017, 3:00pm.

1	Description of work	Redevelopment of Ranga Bhavan Chowk, Part of Smart Road Project Solapur under Smart Cities Mission
2	Estimated cost	Rs. 4,77,53,520.00 Cr (Rupees Four Crores Seventy Seven Lakhs Fifty Three Thousand Five Hundred and Twenty Only)
3	Cost of Blank Bid form / Tender Fee (Non-Refundable)	Rs. 10,000/- per set (Tender Document can only be downloaded from https://mahatenders.gov.in using Credit / Debit Card / Net Banking)
4	Period of Contract	Six (06) Calendar Months including monsoon.
6	SCDCL Contact Details	SOLAPUR CITY DEVELOPMENT CORPORATION LIMITED, New Planning Office, Near Milk Dairy, Saat Rasta, Solapur-413003. Tel:-0217-2740300, Fax:-0217-2740306 E-mail:- solapurcitydcl@gmail.com
7	Bid Validity	The proposal shall remain valid for a Period of 90 Days From the Last Date of Submission
8	Bid Security Earnest Money Deposit	The EMD is Rs. 4,80,000.00 (Rupees Four Lakhs Eighty Thousand Only) EMD to be deposited electronically online at https://mahatenders.gov.in **OR** Demand Draft to be drawn from Nationalized Bank in favour of "Solapur City Development Corporation Limited", payable at Solapur.
9	Consortium / Joint Venture	Joint Venture not allowed. A Consortium of not more than Three entities is allowed. The Lead Member shall have a Civil Works / Fabrication Works / Electrical Works experience.

2. TENDER SCHEDULE

Seq. No.	SCDCL Stage	Vendor Stage	Start Date & Time	Expiry Date & Time
1	Release Tender	-	28/06/2017 06:00 PM	24/07/2017 03:00 PM
2A		Tender Download	28/06/2017 06:01 PM	24/07/2017 02:00 PM
2B	-	Receipt update on e-Tendering portal	28/06/2017 06:01 PM	24/07/2017 03:00 PM
3	-	Online Bid Preparation & Submission	28/06/2017 06:01 PM	24/07/2017 03:00 PM
4	Pre-Bid Meeting		11-July-2017 03:00 PM	11-July-2017 04:00 PM
5	Close for Technical Bid	-	28-June-2017 06:01 PM	24-July-2017 03:00 PM
7	Close for Financial Bid	-	28-June-2017 06:01 PM	24-July-2017 03:00 PM
8	Technical Bid Opening	-	25-July-2017 04:00 PM	25-July-2017 05:00 PM
9	Financial Bid Opening	-	To be intimated later	

Notes:

- The changes / corrigendum, if any will only be published on official website of SCDCL.
- Right to reject any or all bids without assigning any reasons thereof are reserved by the SCDCL.
- Bidders are required to make payment of Rs.1038/- as service provider fees at the time of bid submission. Bidders have to submit Technical Bid and Financial Bid online and technical bid offline as well.
- All requisite information required for the submission of documents is available in the above said website.
- For any queries related to tender documents, please contact to SCDCL.

Chief Executive Officer,
SCDCL, Solapur

DISCLAIMER

The information contained in this Tender Document or subsequently provided to Bidders, whether verbally or in documentary or any other form by or on behalf of the Authority or any of its employees or advisers, is provided to Bidders on the terms and conditions set out in this Tender Document and such other terms and conditions subject to which such information is provided.

This Tender Document is not an agreement and is neither an offer nor invitation by the Authority to the prospective Bidders or any other person. The purpose of this Tender document is to provide interested Bidders with information that may be useful to them in the formulation of their Proposals pursuant to this Tender Document. This Tender Document includes statements, which reflect various assumptions and assessments arrived at by the Authority in relation to the Work. Such assumptions, assessments and statements do not purport to contain all the information that each Bidder may require. This Tender Document may not be appropriate for all persons, and it is not possible for the Authority, its employees or advisers to consider the objectives, technical expertise and particular needs of each party who reads or uses this Tender Document. The assumptions, assessments, statements and information contained in this Tender Document, may not be complete, accurate, adequate or correct. Each Bidder should, therefore, conduct its own investigations and analysis and should check the accuracy, adequacy, correctness, reliability and completeness of the assumptions, assessments and information contained in this Tender Document and obtain independent advice from appropriate sources.

Information provided in this Tender Document to the Bidder is on a wide range of matters, some of which depends upon interpretation of law. The information given is not an exhaustive account of statutory requirements and should not be regarded as a complete or authoritative statement of law. The Authority accepts no responsibility for the accuracy or otherwise for any interpretation or opinion on the law expressed herein.

The Authority, its employees and advisers make no representation or warranty and shall have no liability to any person including any Bidder under any law, statute, rules or regulations or tort, principles of restitution or unjust enrichment or otherwise for any loss, damages, cost or expense which may arise from or be incurred or suffered on account of anything contained in this Tender Document or otherwise, including the accuracy, adequacy, correctness, reliability or completeness of the Tender Document and any assessment, assumption, statement or information contained therein or deemed to form part of this Tender Document or arising in any way in this Selection Process.

The Authority also accepts no liability of any nature whether resulting from negligence or otherwise however caused arising from reliance of any Bidder upon the statements contained in this Tender Document.

The Authority may in its absolute discretion, but without being under any obligation to do so, update, amend or supplement the information, assessment or assumption contained in this Tender Document.

The issue of this Tender Document does not imply that the Authority is bound to select a Bidder or to appoint the Selected Bidder, as the case may be, and the Authority reserves the right to reject all or any of the Proposals without assigning any reasons whatsoever.

The Bidder shall bear all its costs associated with or relating to the preparation and submission of its Proposal including but not limited to preparation, copying, postage, delivery fees, expenses associated with any demonstrations or presentations which may be required by the Authority or any other costs incurred in connection with or relating to its Proposal. All such costs and expenses will remain with the Bidder and the Authority shall not be liable in any manner whatsoever for the same or for any other costs or other expenses incurred by a Bidder in preparation or submission of the Proposal, regardless of the conduct or outcome of the Selection Process.

DEFINITIONS

(a) "Affiliate(s)" means an individual or an entity that directly or indirectly controls, is controlled by, or is under common control with the Bidder.

(b) "Applicable Law" means the laws and any other instruments having the force of law in India, as they may be issued and in force from time to time.

(c) "CBUD" means Capacity Building for Urban Development

(d) "CEO" means the Chief Executive Officer of the Solapur City Development Corporation Limited.

(e) "Client" means Chief Executive officer of Solapur City Development Corporation Limited (SCDCL), the implementing agency that signs the Contract for the Services with the selected Bidder.

(f) "Consultant" means the Urban Designer, appointed by SCDCL for designing the Smart Road Project.

(g) "Contractor" means a person or firm that undertakes a Contract to provide Materials or Labour to perform a service or to do a job

(h) "Contract" means a legally binding written agreement signed between the Client and the Bidder and includes all the attached documents listed in its Clause 1 (the General Conditions of Contract (GCC), the Special Conditions of Contract (SCC), and the Appendices).

(i) "Data Sheet" means an integral part of the Instructions to Bidders (ITB) that is used to reflect specific country and assignment conditions to supplement, but not to over-write, the provisions of the ITC.

(j) "Day" means a calendar day.

(k) "Personnel" means, collectively, Key Personnel, Non-Key Personnel, or any other personnel of the Bidder).

(l) "GOM" means the Government of Maharashtra

(m) "GoI" means the Government of India.

(n) "Joint Venture (JV)" means an association with or without a legal personality distinct from that of its members, of more than one Bidder where one member has the authority to conduct all business for and on behalf of any and all the members of the JV, and where the members of the JV are jointly and severally liable to the Client for the performance of the Contract.

(o) "Key Expert(s)" means an individual professional (Expert Pool, and Deputy Team Leader) whose skills, qualifications, knowledge and experience are critical to the performance of the Services under the Contract and whose CV is taken into account in the technical evaluation of the Bidder's proposal.

(p) "SCDCL " Solapur City Development Corporation Limited

(q) "ITB" means the Instructions to Bidders that provide the Bidders with all information needed to prepare their Proposals.

(r) "LOI" means the Letter of Invitation being sent by the Client to the Bidders.

(s) "MD" means Managing Director of Solapur City Development Corporation Limited (SCDCL).

(t) "MoUD" means Ministry of Urban Development

(u) "Module" means group of projects

(v) "Non-Key Expert(s)" means an individual professional and support staff provided by the Bidder and who is assigned to perform the Services or any part thereof under the Contract and whose CVs are not evaluated individually.

(w) "Proposal" means the Technical Proposal and the Financial Proposal of the Bidder.

(x) "RfS" means the Request for Services to be prepared by the Client for the selection of Contractor, based on the SRFP.

(y) "SRFP" means the Standard Request for Proposals, which must be used by the Client as the basis for the preparation of the RFP.

(z) "Services" means the work to be performed by the Bidder pursuant to the Contract.

(aa) "Sub-contractor" means an entity to whom the Contractor intends to subcontract any part of the Services while remaining responsible to the Client during the performance of the Contract.

(bb) "SPV" means Special Purpose vehicle which is Solapur City Development Corporation Limited.

3. LETTER OF INVITATION

28/ June /2017

RFP No. 2017-18/08;

Project Name: Redevelopment of Ranga Bhavan Chowk, Part of Smart Road Project Solapur under Smart Cities Mission

Name of the SPV : Solapur City Development Corporation Limited

Title of the Services: Appointment of Contractor/s for carrying out Civil and Fabrication Works for Redevelopment of Ranga Bhavan Chowk

Dear Mr. /Ms.

1. The Solapur City Development Corporation Limited (hereinafter called "Authority" or "Client") is implementing Smart City Proposal in Solapur City under Smart City Mission.
2. The Client now invites proposals to provide the following services, "Appointment of Contractor/s for carrying out Civil and Fabrication Works for Redevelopment of Ranga Bhavan Chowk" (hereinafter called "Services") in Solapur City.
3. A bidder will be selected under Percentage Rate Basis Tender method and in a Proposal format as described in this Tender Document.
4. Bidders are advised that the selection of Contractor/s shall be on the basis of an evaluation by the Authority through the Selection Process specified in this Tender Document. Applicants shall be deemed to have understood and agreed that no explanation or justification for any aspect of the Selection Process will be given and that the Authority's decisions are without any right of appeal whatsoever.
5. The Bids shall be accepted through Hard Copy as well as Soft Copy submission process.

   Hard Copy to be submitted - Envelope A and B – Technical Bid

   Soft Copy to be submitted – Envelope A, B and C - Technical and Financial bid
6. The Bid will be rejected in case the Bidder has submitted the conditional bid and/or the specifications of the terms to be supplied are not complied with the Tender Document.
7. The Bidders will submit the proposal by the date & time indicated in Tender Schedule and as per the Instructions to Bidders.
8. The Tender Document includes the following documents:

   Volume 1 – Instructions to Bidders

   Volume 2 – Scope of Work, Sample Formats

   Volume 3 – General Conditions of Contract

Special Conditions of Contract

Volume 4 – Bill of Quantities

Volume 5 – Technical Specifications

Yours sincerely,

Chief Executive Officer

Solapur City Development Corporation Limited

Solapur (Maharashtra), India

Pin- 413004

4. PROJECT INFORMATION

4.1 Background

Ministry of Urban Development, Government of India (MoUD) launched the Smart City Mission, the Mission Transform-Nation, on 25th June 2015. It was declared that 100 Smart Cities will be developed in the country through a competitive challenge. A two stage selection process was adopted for selecting 100 cities across the country to participate in the Smart Cities Challenge. Number of cities to be developed as Smart Cities from the States were fixed based on a pre-determined formula by the MoUD. Under the Stage I of the selection process, States Governments were requested to nominate cities (pre-determined number of cities) from the respective states to participate in the Stage-II of the selection process which is competitive i.e. the Smart Cities Challenge. During the Smart Cities Challenge, 100 cities, as nominated by the respective state governments, were required to prepare the Smart City Proposal (SCP) and compete among themselves. At the end of the Smart Cities Challenge (Round-1), the top 20 proposals from the cities shall be funded by the MoUD in the first year of the Mission.

The Government of Maharashtra following a due selection process, nominated Solapur as one of the 10 cities from the State to participate in this Smart Cities Challenge, the Stage-II of the selection process. The proposal preparation process for Solapur was initiated in August 2015 and was concluded on 15th December 2015, the last date of proposal submission as stipulated by the MoUD. In all 97 cities from across the India submitted their SCPs and these were evaluated by MoUD engaging Personnel. The evaluation process was concluded and the final list of the top 20 winning proposals was announced on 28th January 2016 by the Union Minister for Urban Development. Proposal of Solapur was one of the top 20 winning proposals from the country and is selected to receive the funding from MoUD during first year.

One of the first projects to be implemented in Solapur under the Smart Cities Missions is the development of a 1.1km stretch of road in Solapur as a Smart Road. Under the same, the current project to be implemented is the ‘Redevelopment of Ranga Bhavan Chowk’ as Phase 1 of Smart Road Stretch.

4.2 Request for Proposal

A Contractor is to be appointed as per the provisions of the Agreements for the Project. In pursuance of the above, the SCDCL has decided to carry out the process for selection of a Contractor who shall work in accordance with this Tender Document.

SCDCL invites Proposals (the "Proposals") for selection of a Contractor (the "Contractor" or the “Bidder”) who shall be responsible for execution of the scope mentioned in the Tender Document and ensuring the progress of the Project during the term of the Agreement in conformity with the Tender Document.

The SCDCL intends to select the Contractor through an open competitive bidding in accordance with the procedure set out herein.

5. INSTRUCTIONS TO BIDDERS (ITB)

5.1 Due diligence by Bidders

Bidders are encouraged to inform themselves fully about the assignment and the local conditions before submitting the Proposal by paying a visit to the Corporation and the Project site, sending written queries to the SCDCL.

The bidder is expected to examine carefully all instructions, conditions, terms, specifications and drawings contained in various volumes / addendums / common set of deviations which is a part of contract document. Failure to comply with the requirements of bid submissions or with any other bidding requirements will be at the bidder's risk. Pursuant to Clause 5.4 of ITB, the bids, which are not substantially responsive to the requirements, will be rejected.

5.2 Sale of RFP document

The document can be downloaded from the www.mahatenders.gov.in. The Bidder shall pay the Tender Fee of Rs. 10,000 (Ten Thousand only) online on the above mentioned e-tendering website and copy of the payment proof shall be submitted along with the Proposal.

5.3 Validity of the Proposal

The Proposal shall be valid for a period of not less than 90 (Ninety) days from the Proposal Due Date (the "PDD").

5.4 Eligibility of Bidders:

5.4.1 Registration:

a) The Contractor/s shall be an entity incorporated under the Indian Companies Act 1956/2013 or incorporated under equivalent law abroad or the Contractor should be a firm/LLP and should submit registration /incorporation under the governing legislation.

OR

Contractor/s shall have valid, current registration certificate of Class-1 with PWD, or GOM, or CPWD or such Government organizations. The Contractor shall be required to submit a true copy of its Registration Certificate along with the Proposal.

b) Contractor/s shall have a valid VAT registration in India.

c) The Contractor shall be required to submit a true copy of its Incorporation Certificate along with the Proposal.

d) Contractor/s shall have valid Provident Fund Certificate. The Contractor shall be required to submit a true copy of its Provident Fund Certificate along with the Proposal.

5.4.2 Technical Eligibility :

a) The Single Bidder shall have experience of implementing Civil Works, Road works, complex Fabrication works, Solar panel installations and outdoor LED Video Wall Installations.

b) In case of Consortium, the Lead Member shall have extensive experience of implementing similar Civil Works / Road works / Complex Fabrication works / Electrical works. The Lead member shall demonstrate his/her experience with detailed project information and completed site images in format as per TECH-4 in Technical proposal.

c) The Single Bidder may form a team of four members, including the Bidder himself :
   i. Civil Works member
   ii. Fabrication works member
   iii. LED Display Panel works member
   iv. Solar PV project member

d) The Bidder may be any one of the four specified members.

e) Each Team Member shall be a Company registered under the Indian Companies Act 1956 / 2013 or incorporated under equivalent law abroad or a firm/LLP and should submit registration /incorporation under the governing legislation, or a Proprietorship firm.

f) In case the Bidder can fulfill more than one role on the Team, he/she shall demonstrate adequate technical experience for these roles.

g) All members of the team shall have combined experience of implementing Civil Works, Road works, complex Fabrication works, Solar panel installations and outdoor LED Video Wall Installations.

h) The Bidder / Member of Consortium should have completed Similar Works of at least 50% of the Project Component Cost. (For Example – Electric Work Contractor Bidding for Electric Works in this project shall have completed Similar works of at least 50% of Electric Work Component Cost in this project)

i) The Bidder/member in Consortium should have completed in his own name, at least one fabrication work under single contract of 50 MT or above completed in last 3 years.

j) The Bidder / Member in the consortium shall have installed and commissioned at least one Grid connected Solar PV Power Project having a capacity of not less than 30 kW which should have been commissioned at least six months prior to Techno-Commercial Bid Opening date. The list of project commissioned at least 6 months prior to Techno-Commercial Bid Opening date, indicating whether the project is grid connected, along with

a copy of the Commissioning certificate and Work order / Contract / Agreement/ from the Client/Owner shall be submitted in support.

5.4.3 Financial Eligibility :

a) Minimum Average Annual Turnover of the Single Bidder shall be Indian Rupees (INR) **03 (Three)** Crores in the last three financial years (ending on 31st March 2017) preceding the Proposal Submission Date.

b) If the bid is submitted in Consortium, the Lead member of the Consortium shall have Minimum Average Annual Turnover of Indian Rupees (INR) 03 (Three) Crores in the last three Financial Years (ending on 31st March 2017) preceding the Proposal Submission Date.

c) The Bidder (or all the members in case of Consortium) shall have Net Profit in all the three Financial Years for which the Turnover Certificate is submitted.

d) The bidder should have bid capacity more than the estimated cost put to tender as per bid capacity formula indicated as below.

Available Bid Capacity = (A x N x 2) – B
where A = Maximum value of Civil Engineering works executed in any one year during the last 3 years (updated to the current year by a factor of escalation of 10% per year) which will take into account the completed and ongoing works.
B = Value of existing commitments and works (Ongoing) to be completed in the period stipulated for completion of work in present tender.
N = Number of years prescribed for completion of present tendered work, for which bids are invited.

5.5 One Bid Per Bidder:

One Bid submission allowed per Bidder. Multiple submissions will lead to disqualification and the EMD shall be seized.

5.6 Conditional Bids shall be rejected.

5.7 Cost Of Bidding:

The Bidder shall bear all the costs incurred in the preparation and submission of the Bid, including site visits and other actions mentioned or implied in these instructions. The Employer will not be responsible or liable for such costs regardless of the conduct or outcome of the Bidding process.

5.8 Site Visit:

The bidder is advised to visit and examine the site of work and its surrounding and obtain himself at his own responsibility all information such as Site conditions, topography, hydrological and climatic conditions, extent and nature of work, laws, procedures and

labor practices, availability of labor, material, machineries, fuel, water, electricity etc. and such similar information that may be necessary for preparation of the bid and entering in to the contract. The site visit(s) and collection of information/data shall be at the Bidder's own expense. A declaration to this effect will have to be signed by the bidder in the format given in Pre-qualification forms.

5.9 Clarification Of Bidding Documents:

In case any clarification is required by the bidder, he may obtain it personally or in writing well in advance from the Employer. The clarification for which request has been received prior to pre-bid meeting will be answered.

a) A pre-bid conference open to all prospective bidders will be held at the time and place as per **Tender Schedule** wherein the prospective bidders will have an opportunity to obtain clarifications regarding the bid conditions and the work.

b) The prospective bidders are free to ask any additional information or clarification, either in writing and orally, and reply to the same will be given by Employer and answer will be uploaded on the web site within 05 (Five) working days. Any modifications of bid documents, which may become necessary as a result of pre-bid Conference, shall be through issuance of an addendum on the website.

c) All the government resolutions and circulars mentioned in bidding documents shall be procured by the bidders themselves and they are applicable wherever mentioned.

5.10 Amendments To Bidding Documents:

a) At any time prior to the deadline for submission of bid, the Employer may for any reason or without any reason specified, whether at his own initiative or in response to a clarification requested by a prospective bidder, modify the bid document by issuance of an addendum. The addendum will be uploaded online on the e-tendering portal for incorporation and Bidders are requested to visit the portal time to time and read carefully these amendments before quoting. These amendments shall form part of the Bid Document.

b) **Amendments to Bid submission date:** At any time, the Employer may similarly issue an Addendum to the Bid Documents which amends the Bid submission date. In that event, all rights and obligations of the Employer and the Bidders previously related to the original date shall thereafter be subject to the amended date.

5.11 Preparation Of Bids

5.11.1 Language of bid:

The Bid and all communications between the Bidder and the Employer or his

representative(s) shall be typed or written in indelible ink. The language of the Bid and all related correspondence shall be **English.**

5.11.2 Documents comprising the bid:

The Proposal shall comprise the following:

1st Inner Envelope (Envelope-A): Pre-Qualification Documents

(1) Tender/ Processing Fee - Online payment Receipt

(2) Demand Draft or RTGS receipt of EMD Payment

(3) APPENDIX 1 - Proposal Submission Form

(4) APPENDIX 2 – Memorandum of Understanding (MoU) for Consortium

(5) APPENDIX 3 - Statement of Team Formation (to be submitted by each team member in case of Team Formation)

(6) APPENDIX 4 – Power of Attorney for Lead Member of Consortium

(7) APPENDIX 5 - Power of Attorney for Signing of Application

(8) APPENDIX 6 - Financial Qualification of the Bidder

(9) APPENDIX 7 - Technical Qualification Experience

(10) APPENDIX 8 - Affidavit Certifying that Bidder is not Blacklisted (to be submitted by each team member in case of Consortium)

(11) APPENDIX 9 - Disclosure of Ongoing Litigations (to be submitted by each team member in case of Consortium)

(12) APPENDIX 10 – Declaration of Bidder

(13) APPENDIX 11 – Quality Assurance Requirements

(14) APPENDIX 12 – Declaration of compliance

(15) Certificate of Registration as a Contractor in original (or a true copy duly attested by Gazette officer of Govt. / Semi Government organization) valid on the date fixed for receipt of bids.

(16) The documents for qualifying criteria including liquid assets, Annual Financial Turnover and Bid Capacity as mentioned in ITB.

(17) Details of Income Tax Circle or ward of the district in which the tenderer is assessed to Income Tax, Tenderer's PAN and complete postal address with Pin Code and telephone Numbers. Attested copy of Income Tax Return for the immediate previous financial year.

(18) Professional Tax Registration Certificate in form PTR.

(19)Sales Tax Registration Certificate: Under Maharashtra Value added Tax Act 2007(VAT) Rule 8 & 9 as provided by Maharashtra State Sales Tax Act or undertaking thereof.

(20)Copy of Audited Balance Sheet and Profit & Loss Account for the immediate three previous years along with tax audit report.

(21)Provident Fund Registration Certificate.

(22)Signed and stamped Tender Document. **Please note that no forms included in the Tender Document shall be filled in with information**. They shall be submitted separately as specified in these instructions.

(23)VAT Certificate.

(24)Deed of Partnership or Articles of Association and Memorandum of Association for limited company. For proprietorship business a copy of Shop Act registration certificate with up to date fees paid shall be attached.

Indexing and numbering of Pages in the Bid Submission is COMPULSORY.

The above sequence should be followed strictly. Not following the sequence may lead to disqualification. Images of completed projects with relevance to this Tender Document must be submitted along with the Bid Submission. Preference will be given to projects with good level of finishing. Failure to provide images complying with this Tender Document may lead to disqualification.

AND

2nd Inner Envelope (Envelope-B): Technical Qualification Documents:

(1) TECH-1 : Technical Proposal Submission Form

(2) TECH-2 : Bidders' Organization and Experience

(3) TECH-3 : Assignment Details of Bidder

(4) TECH-4 : List of machinery available

(5) TECH-5 : Work Plan

(6) TECH-6 : Statement of Legal Capacity

AND

3rd Inner Envelope: Financial Proposal -

(1) Form F

5.11.3 Bid Submission :

Hard Copy Submission- Envelope A and B – Technical Bid
Hard copies of the same shall be addressed to :
CEO, Solapur City Development Corporation Limited,
New Planning Office, Near Milk Dairy, Saat Rasta, Solapur-413003

Soft Copy Submission – Envelope A, B and C - Technical and Financial bid
All Bids shall be submitted online to www.mahatenders.gov.in

5.11.4 Bid offer:

a) The Offer quoted by the bidder shall include all the costs towards executing and completing the works including carrying out remedy for any defects therein, maintenance and repairs of the work during and till the end of Defect Liability period. The offer shall provide for all superintendence, labor, material, plant, equipment and all other items required for work including all Taxes, Duties, Royalties, Octroi/ LBT, WCT, outgoings and such charges except for the exemption if any provided in the Bid documents. No taxes whatsoever in any increase shall be reimbursed.

b) The offer quoted by bidder shall be valid for the original contract period as well as during extensions if any duly granted and shall not be subject to any further adjustment by way of claim.

c) The bid price shall be inclusive of Royalty under Mining mineral Act 1968 payable directly to Revenue Department as per rates in force. The Royalty to be paid shall not be reimbursed by SCDCL.

d) The agreement is to be registered with the competent authority, the expenses towards registration, stamp duty etc. will have to be borne by the contractor / bidder.

5.11.5 Currencies of bid and payment:

All the prices and rates mentioned in the bid document are entirely in Indian Rupees only. All the payments shall be made in Indian Rupees only. (INR)

5.11.6 Bid validity:

5.11.6.1 Validity of the bid will be 90 days and shall be reckoned from the last date of submission of bids and thereafter until it is withdrawn by notice in writing duly addressed to the authority opening the bid. Such withdrawal by bidder after 90 days shall be effective from the date of receipt of notice by the employer.

5.11.6.2 During this period, the Bidder shall maintain its original Proposal without any change, including the availability of the Key Personnel, the proposed rates and the total price.

5.11.6.3 If it is established that any Key Personnel nominated in the Bidder's Proposal

was not available at the time of Proposal submission or was included in the Proposal without his/her confirmation, such Proposal shall be disqualified and rejected for further evaluation, and the Bidder's EMD may be seized.

5.11.7 Bid security (earnest money deposit):

The bidder shall furnish as a part of his bid, a bid security of Rs. 4,80,000.00 (Rupees Four Lakhs and Eighty Thousand Only) as per contract data in Volume II**. (The Exemption Certificate for Bid Security is not allowed.)**

a) The Bid Security to be furnished shall be in the form of RTGS as per details provided in Detailed Tender Notice.

b) Any bid not accompanied by the Bid Security shall be rejected by the employer as non-responsive.

c) In the event of Bidder's bid being accepted, the Bid Security Amount can be appropriated/ adjusted towards the amount of Performance security payable by successful Bidder under the conditions of contract.

d) If after submitting the bid, the bidder withdraws his offer or modifies the same or if after acceptance of his bid fails or neglects to furnish the performance security, without prejudice to any rights and power of the Employer here under or in law, the Employer shall be entitled to forfeit the full amount of Bid Security deposited by the bidder.

e) If the bidder does not accept the correction of the bid price, pursuant to, the bid security shall be forfeited.

f) In the event of bid being not accepted, the amount of Bid Security deposited by the bidder shall, unless it is forfeited as proposed above, be refunded to Bidder in Sixty (60) Days on passing of receipt thereto, without any interest.

5.12 Format and Signing of Bid:

a. The bid shall be signed, sealed and submitted as per the Guidelines given hereunder in Section 5.12 [Submission of Bids]. All pages of Bid documents (in original) shall be signed by a person duly authorized to sign on behalf of the Bidder. All pages of the bid where entries or amendments have been made shall be initialed by the person or persons signing the bid.

b. Proof of authorization, in the form of written power attorney, shall be annexed to the letter of bid. All pages of the appendix to the bid and schedules where entries or

amendments have been made shall be initialed by the person(s) signing the letter of bid.

c. The Bid shall contain no alterations or additions, except those to comply with instructions issued by the Employer, or as necessary to correct errors made by the bidder in which case such corrections shall be initialed by the person or persons signing the bid.

d. The Bidder shall digitally sign all pages of volume I, II, III and V with the firm‘s seal and shall enclose with the bid document as content of **Technical Bid.** Also, the bidder shall sign all pages of hard copies of Volume I, II, III and V [**Technical Bid**] as stipulated.

e. The Bidder shall digitally sign all pages of Volume IV with the firm‘s seal and shall upload with the bid document as content of **Financial Bid.**

5.13 Online Bid Submission Procedure

Guidelines to Contractors/Bidders on the operations of Electronic Tendering System of SCDCL

E-Tendering Portal - https://mahatenders.gov.in

Steps for participating in e-Tendering of SCDCL

Purchase Tender Document, drawings and any other supporting document from the website i.e. https://mahatenders.gov.in by making online payment using Debit Card, Credit Card, Net Banking.

↓

Register on the e-Tendering portal of Maharashtra i.e. https://mahatenders.gov.in

↓

Bidders should have valid class 2 and 3 Digital Signature Certificate (DSC). If bidders do not have they should purchase DSC from any valid Certifying Authority. DSC forms are also available on the e-Tendering website of Maharashtra i.e. https://mahatenders.gov.in

↓

Bidders should Prepare and Submit their Technical and Financial Bids online on the e-Tendering portal. Hard copy of the Technical Bid is to be submitted at SCDCL Solapur office. The procedure for Bid Preparation is mentioned below.

5.14 Pre-requisites to participate in the Tenders processed by SCDCL:

a) Registration of Contractors on Electronic Tendering System of SCDCL:
The Contractors interested in participating in the e-Tendering process of SCDCL shall be required to enroll on the Electronic Tendering System to obtain User ID and Password.

After submission of application for enrolment on the System, the application information shall be verified by the Authorized Representative of the Service Provider. If the information is found to be complete, the enrolment submitted by the Vendor shall be approved.

The Contractors may obtain the necessary information on the process of enrolment either from Helpdesk Support Team or may visit the information published under the link ***Enroll*** under the section ***E-Tendering Toolkit for Bidders*** on the Home Page of the Electronic Tendering System.

b) Obtaining a Digital Certificate:
The Bid Data that is prepared online is required to be encrypted and the hash value of the Bid Data is required to be signed electronically using a Digital Certificate (Class – II or Class – III). This is required to maintain the security of the Bid Data and also to establish the identity of the Contractor transacting on the System.

Bid data / information for a particular Tender may be submitted only using the Digital Certificate which is used to encrypt the data / information and sign the hash value during the ***Bid Preparation and Hash Submission*** stage. In case, during the process of preparing and submitting a Bid for a particular Tender, the Contractor loses his / her Digital Signature Certificate (i.e. due to virus attack, hardware problem, operating system problem); he / she may not be able to submit the Bid online. Hence, the Users are advised to store his / her Digital Certificate securely and if possible, keep a backup at safe place under adequate security to be used in case of need.

In case of online tendering, if the Digital Certificate issued to an Authorized User of a Partnership Firm is used for signing and submitting a bid, it will be considered equivalent to a no objection certificate / power of attorney to that User to submit the bid on behalf of the Partnership Firm. The Partnership Firm has to authorize a specific individual via an authorization certificate signed by a partner of the firm (and in case the applicant is a partner, another partner in the same form is required to authorize) to use the digital certificate as per ***Indian Information Technology Act, 2000***.

Unless the Digital Certificate is revoked, it will be assumed to represent adequate authority of the Authority User to bid on behalf of the Firm for the Tenders processed on the Electronic Tender Management System of SCDCL of Maharashtra as per ***Indian***

Information Technology Act, 2000. The Digital Signature of this Authorized User will be binding on the Firm. It shall be the responsibility of Partners of the Firm to inform the Certifying Authority or Sub Certifying Authority, if the Authorized User changes, and apply for a fresh Digital Signature Certificate. The procedure for application of a Digital Signature Certificate will remain the same for the new Authorized User.

The same procedure holds true for the Authorized Users in a Private / Public Limited Company. In this case, the Authorization Certificate will have to be signed by the Director of the Company or the Reporting Authority of the Applicant.

For information on the process of application for obtaining Digital Certificate, the Contractors may visit the section ***Digital Certificate*** on the Home Page of the Electronic Tendering System.

c) Recommended Hardware and Internet Connectivity:
To operate on the Electronic Tendering System, the Contractors are recommended to use Computer System with at least 1 GB of RAM and broadband connectivity with minimum 512 kbps bandwidth. However, Computer Systems with latest i3 / i5 Intel Processors and 3G connection is recommended for better performance.

d) Set up of Computer System for executing the operations on the Electronic Tendering System:
To operate on the Electronic Tendering System of SCDCL of Maharashtra, the Computer System of the Contractors is required be set up. The Contractors are required to install Utilities available under the section ***Mandatory Installation Components*** on the Home Page of the System.

The Utilities are available for download freely from the above mentioned section. The Contractors are requested to refer to the ***E-Tendering Toolkit for Bidders*** available online on the Home Page to understand the process of setting up the System, or alternatively, contact the Helpdesk Support Team on information / guidance on the process of setting up the System.

e) Payment for Service Provider Fees:
In addition to the Pre-bid / Pre-qualification / Main Bidding process fees payable to SCDCL, the Contractors will have to pay Service Providers Fees of Rs. 1038/-through online payments gateway service available on Electronic Tendering System. For the list of options for making online payments, the Contractors are advised to visit the link ***E-Payment Options*** under the section ***E-Tendering Toolkit for Bidders*** on the Home Page of the Electronic Tendering System.

5.15 Steps to be followed by Contractors to participate in the E-Tenders processed by SCDCL

a) Preparation of online Briefcase:

All Contractors enrolled on the Electronic Tendering System of Maharashtra are provided with dedicated briefcase facility to store documents / files in digital format. The Contractors can use the online briefcase to store their scanned copies of frequently used documents / files to be submitted as a part of their bid response. The Contractors are advised to store the relevant documents such as Registration Certificate, PAN Card, VAT Registration Certificate, Services Tax Registration Certificate, Professional Tax Registration Certificate, EPF Registration Certificate, Certificates of Works completed, ownership of Plant and Equipment in the briefcase, etc. so as to avoid scanning / uploading process for each Tender.

In case, the Contractors have multiple documents under the same type (e.g. multiple Work Completion Certificates) as mentioned above, the Contractors advised to either create a single .pdf file of all the documents of same type or compress the documents in a single compressed file in .zip or .rar formats and upload the same.

It is mandatory to upload the documents using the briefcase facility. Therefore, the Contractors are advised to keep the documents ready in the briefcase to ensure timely bid preparation.

Note: Uploading of documents in the briefcase does not mean that the documents are available to SCDCL at the time of ***Tender Opening*** stage unless the documents are specifically attached to the bid during the online ***Bid Preparation and Hash Submission*** stage as well as during ***Decryption and Re-encryption*** stage.

b) Online viewing of Detailed Notice Inviting Tenders:
The Contractors can view the Detailed Tender Notice along with the Time Schedule (Key Dates) for all the ***Live Tenders*** released by SCDCL on e-Tendering Portal on https://mahatenders.gov.in under the section ***Recent Online Tender***.

c) Download of Tender Documents:
The Tender Documents are available for purchase and downloading by Contractors from the website i.e. https://mahatenders.gov.in

d) Online Bid Preparation and Submission of Bid Hash (Seal) of Bids:
Submission of Bids will be preceded by online bid preparation and submission of the digitally signed Bid Hashes (Seals) within the Tender Time Schedule (Key Dates) published in the Detailed Notice Inviting Tender. The Bid Data is to be prepared in the templates provided by SCDCL. The templates may be either form based, extensible tables and / or up-loadable documents. In the form based type of templates and extensible table type of templates, the Contractors are required to enter the data and encrypt the data using the Digital Certificate.

In the up-loadable document type of templates, the Contractors are required to

select the relevant document / compressed file (containing multiple documents) already uploaded in the briefcase.

Notes:

i The Contractors upload a single document or a compressed file containing multiple documents against each up loadable option.

ii The Hashes are the thumbprint of electronic data and are based on one – way algorithm. The Hashes establish the unique identity of Bid Data.

iii The bid hash values are digitally signed using valid Class – II or Class – III Digital Certificate issued by any Certifying Authority. The Contractors are required to obtain Digital Certificate in advance.

iv After the hash value of bid data is generated, the Contractors cannot make any change / addition in its bid data.

v This stage will be applicable during Technical and Financial Bidding Processes.

e) Close for Bidding (Generation of Super Hash Values):
After the expiry of the cut – off time of ***Bid Preparation and Hash Submission*** stage to be completed by the Contractors has lapsed, the Tender will be closed by the Tender Authority.

The Tender Authority from SCDCL shall generate and digitally sign the Super Hash values (Seals).

This stage will be applicable during both Technical and Financial Bidding Processes.

f) Decryption and Re-encryption of Bids (submitting the Bids online):

i In case of Online Bid Submission (Technical and Financial)
After the time instant for Generation of Super Hash values by the Tender Authority from SCDCL has lapsed, the Contractors have to make the online payment of Rs.1038/- towards the fees of the Service Provider.

After making online payment towards Fees of Service Provider, the Contractors are required to submit the hard copy of the Technical Bid (only) with SCDCL at the below mentioned address:
Solapur City Development Corporation Limited New Planning Office, Near Milk Dairy, Saat Rasta, Solapur-413003.

The Contractors are required to decrypt their bid data using their Digital Certificate

and immediately re-encrypt their bid data using the Public Key of the Tendering Authority of the SCDCL. The Public Key of the Tendering Authority is attached to the Tender during the ***Close for bidding*** stage.

The details of the Earnest Money Deposit and Processing Fees shall be verified and matched during the Main Tender Opening event.

Note: At this time, the Contractors are also required to upload the files for which they generated the Hash values during the ***Bid Preparation and Hash Submission*** stage.

The Bid Data and Documents of only those Contractors who have submitted their Bid Hashes (Seals) within the stipulated time (as per the Tender Time Schedule), will be available for decryption and re-encryption and to upload the relevant documents from Briefcase. A Contractor who has not submitted his ***Bid Preparation and Hash Submission*** stage within the stipulated time will not bellowed to decrypt / re-encrypt the Bid data / submit documents. This stage will be applicable during both, Pre-bid / Pre-qualification and Financial Bidding Processes.

ii Short listing of Contractors for Financial Bid Opening:
The Tendering Authority will first open the Qualification Bid, Qualification document/ Technical Documents etc. on the prescribed date and time as mentioned in bidding data Volume-II and after scrutinizing these documents will shortlist the Contractors who are eligible for Financial Bid opening. The shortlisted Contractors will be intimated by email.

iii Opening of the Financial Bids:
The qualified Contractors may remain present in the Office of the Tender Opening Authority at the time of opening of Financial Bids as intimated.

iv Tender Schedule (Key Dates):
The Contractors are strictly advised to follow the Dates and Times allocated to each stage under the column Vendor Stage as indicated in the Tender Schedule. All the online activities are time tracked and the Electronic Tendering System enforces time-locks that ensure that no activity or transaction can take place outside the Start and End Dates and Time of the stage as defined in the Tender Schedule.

At the sole discretion of the Tender Authority, the Tender schedule of the Tender stages may be extended.

5.16 Deadline of submission of Bid:

The bid shall be received by SCDCL at the address mentioned and not later than the Date and Time specified in the Detailed Tender Notice. SCDCL may at their discretion extend the deadline for submission of bid issuing an addendum, in which case, all rights and obligations of the employer and bidders previously subjected to the original dead line shall therefore be subjected to new deadline as extended.

5.17 Late Bids:

Bid submitted after the deadline for submission will either not be received or if received inadvertently, will not be opened and shall be handed over unopened to the bidder on receipt of written request of the bidder.

5.18 Modification and Withdrawal of Bid:

If after submission of the bid the bidder withdraws his offer or modifies the same, without prejudice to any other rights and power of the Employer hereunder or in law, the Employer shall be entitled to forfeit the full amount of the Bid Security deposited by bidder.

5.19 Bid Opening and Evaluation

5.19.1 Bid Opening:

5.20 Brief description of the Selection Process

SCDCL has adopted a single stage selection process (collectively the "Selection Process") in evaluating the Proposals comprising qualification, technical and financial bids to be submitted in three separate sealed envelopes. In the first stage, the Bidders shall be evaluated for their compliance with the qualification. Based on the evaluation of prequalification, qualified Bidders shall be short-listed for further evaluation. In the second stage, a technical evaluation will be carried out. In the third stage, a financial evaluation will be carried out. After the Financial evaluation, the lowest bidder shall be selected for negotiation (the "Selected Bidder") while the second ranked Bidder will be kept in reserve.

a) Technical Bid of each bidder will be opened serially. Documents in the envelope will be verified by the bid opening authority to check their validity as per requirements. If any particular document of any bid is either missing or does not meet the requirements specified then a note to that effect will be made by the bid opening authority. After opening of Technical Bid, the Employer will carry out evaluation of various documents / data submitted in the Technical Bid.

b) After the analysis and scrutiny of the documents with respect to requirements of technical bidding is over, the employer shall declare the outcome of scrutiny and shall intimate the date and time of opening of financial bid to the qualified bidders.

c) The Financial bids will be opened in the presence of bidders / their authorized representatives who choose to remain present at the date, time and place will be intimated later.

d) The procedure for opening of the Bids, as mentioned hereinbefore, in the guidelines to Bidders on the operation of Electronic Tendering System of SCDCL shall be followed.

5.20.1 Process to be Confidential**:**

The information relating to the examination, clarification, evaluation, comparison of bids and recommendations for the award of a contract shall not be disclosed to bidders or any other persons not officially concerned with such process until the award of the contract to successful bidder has been announced.

Any effort by a bidder to influence the Employer in the process of examination, clarification, evaluation, comparison of bids and in decision concerning the award of contract may result in rejection of bid.

5.20.2 Clarification of Bid:

To assist in examination, evaluation of bid, the employer may ask bidders individually for clarification of their offer including break up of costs, reasons in case of very high / very low offer. Such request shall be in writing and the response shall also be in writing. But no change in the price or substance of the bid shall be sought, offered or permitted except as required to confirm the correction of the arithmetic errors discovered by the Employer in the evaluation of the bids in accordance with Clause 5.20.4 of ITB.

5.20.3 Bid Liable for Rejection:

The bid is likely to be rejected if on opening, it is found that

a. The bidder has not strictly followed the procedure laid down for submission of bid.
b. Additions, corrections or alterations are made by the bidder on any page of the bid document, without affixing signature / initials.
c. Any page or pasted slips are missing.
d. The bidder has not signed each page of the bid.
e. The bidder has specified any additional condition.
f. The bidder has not attached the addendum, Common Set of Deviations and documents to the main bid volume as stated in ITB.
g. In case the bidder does not satisfy the bid capacity as specified in the Bid Document, the bid shall be treated as non- responsive and rejected.
h. The Bidder shall submit detailed information about all completed (works done) and on-going works (work in hand and work in progress).
All information shall be furnished duly signed by the officer not below the rank of

Executive Engineer. The Employer reserves the right to inspect the sites of the completed/on-going works to ascertain the correctness of the information submitted by the bidder at the Bidders cost. If false information is found to have been submitted, the bidders bid shall be liable for rejection.

i. Information not submitted (i) in the prescribed format of Sample Forms
(ii) Calculation of bid capacity as per formula (Bidding Data Volume II), declaration of turnover & liquid assets on separate sheets duly Certified by Chartered Accountant and (iii) other information related to Qualification criteria as per Bidding Data Volume-II.

j. Information not submitted regarding Litigation and Arbitration cases.

5.20.4 Correction of Errors:

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

i. In case of lump-sum bid, if there is any discrepancy between the offer quoted in figures and in words, the lower of the two will be treated as the offer.

ii. In case of percentage rate bid, if there is any discrepancy between the percentage quoted in figures and in words, the lower of the two will be treated as the offer.

iii. In case of item rate bid, if there is any discrepancy between the rates in figures and in words, the lower of the two will govern and where there is discrepancy between the unit rate and the item total resulting from multiplying unit rate by the quantity, the unit rate as quoted will govern.

iv. If there is any arithmetical error in totaling of items, the correct total shall be computed by the Employer and the same shall govern.

v. The amount stated in the bid will be adjusted by the employer in accordance with the above procedure for the correction of errors and it shall be considered as binding upon the bidder.

vi. If the bidder does not accept the corrected bid price, the bid will be rejected and the bid security shall be forfeited.

5.20.5 Evaluation and Comparison of Bids

a) The Employer will evaluate and compare only the bids determined to be eligible in accordance with Clause 5.4 of ITB.

b) The estimated effect for the price adjustment provisions of the Conditions of Contract, applied over the period of execution of the Contract shall not be taken

into account in bid evaluation.

c) The decision of the Employer regarding post qualification and opening of bids shall be final and binding on all the bidders.

Award of Contract

5.20.6 Award Criteria:

a) The Employer will award the contract to a bidder whose bid has been found to satisfy all the requirements of bid document and who has offered the lowest price.

b) Price Bid (Form F in Volume II) of only such bidders who qualify as per Clause 5.4 of ITB shall be opened. Provided however that bidders who otherwise qualify as aforesaid, shall be liable to be disqualified if they have –

- Made misleading or false representations in any of the forms, statements and attachments submitted in proof of the qualification requirements;
- A record of poor performance in respect of the works e.g. not properly completing contracts, inordinate delays in completion, bad quality of work, litigation history or financial failures etc.

5.20.7 Deciding Award of Contract:

The process of decision and award of the contract shall be as under:

a. Only bids that qualify pursuant to Clause 5.21.1 above shall be considered for further evaluation. The Financial Bid of non-qualifying bids shall not be opened. The decision of the Employer regarding the post qualification and opening of bids shall be final and binding on all bidders.

b. The bidder with the lowest correct bid price, determined as per Clause 5.20.4 of ITB will be invited for further negotiations as may be necessary. If the negotiations with the firm are successful, the award will be made to that bidder. If, however, it is seen that a contract with reasonable terms cannot be concluded with the bidder with the lowest corrected bid price, the bidder with the second lowest corrected bid price, will be invited for negotiations. The process will be repeated until an agreed contract is concluded.

c. The Employer reserves the right to reject any or all offers received from the bidders without assigning any reasons.

5.20.8 Employers Right To Reject:

The Employer reserves the right to accept or reject any bid, to cancel or suspend the bid process at any stage and reject all the bids at any time prior to award of contract without there by incurring any liability to the affected bidders or any obligation to inform affected bidders of the ground for Employer‘s action.

5.20.9 Notification Of Award:

Prior to the expiration of bids validity period or any such extended period, the Employer will notify the successful bidder in writing by a registered letter that his bid

has been accepted. This letter (herein after and in conditions of contract called letter of acceptance) shall mention the rate (percentage above/below the estimated rates), which the employer will pay to the Contractor as prescribed in the contract. After receiving the letter of Acceptance, the successful bidder shall submit the performance security in accordance with clause 5.21 of ITB. Upon furnishing the performance security by the successful bidder, the bidder shall enter into agreement with the employer in the prescribed format. This agreement shall be made by the bidder as per the guidelines of SCDCL. The order to start work will then be issued. The work order shall be accompanied by a true copy of the agreement bearing the number under which it is registered in the office of the Employer.

After or before signing the Agreement/Award of Contract if the Contractor is found ineligible for any reason or default at any stage of any terms and conditions as provided in the document is committed by the Contractor the Performance Security deposited by the Contractor shall stand forfeited without reference to the contractor and the work would be awarded at his risk and cost to another Contractor as provided in clause 5.21 (Award of Contract). The Agreement shall be signed not later than 15 days from the date of issuance of LOA.

5.20.10 Expected Date of Commencement of Services: Within 15 (fifteen) days from signing of Agreement.

5.21 Performance Security:

The successful bidder whose bid has been accepted will have to pay 5% Performance Security (SD) (As per **Bid Data in Volume-II)** as performance security. It shall carry no interest.

5.21.1 The successful tenderer shall have to pay Rs. 9,60,000.00 (Rupees Nine Lakhs Sixty Thousand Only) initial security deposit in the form of DD from a nationalized bank payable to CEO, Solapur City Development Corporation Limited, **Solapur City Development Corporation Limited** and complete the contract documents failing which his earnest money will be forfeited to Solapur City Development Corporation Limited. The EMD of successful tenderer shall be converted in to the Security Deposit. The balance security deposit will be recovered from the R.A. bill at 2**%** of the bill amount. Amount of total Security Deposit to be paid shall be 5% of the cost of accepted tender or estimated cost put to tender whichever is higher.

5.21.2 All compensation or other sums payable by the Contractor under the terms of this contract or any other contract or on any account may be deducted from his performance security or from any sums which may be due to him or may become due to him by SCDCL on any account and in the event of the security being reduced by reason of any such above noted deductions, the Contractor shall within 10 days of receipt of notice of demand from the SCDCL make good the deficit.

5.21.3 There shall be no liability on SCDCL to pay any interest on the performance security deposited by or recovered from the Contractor.

5.21.4 The performance security shall be refunded after completion of defect liability period prescribed for this contract in accordance with the provisions in the conditions of contract.

5.21.5 The successful bidder quoting below 1 to 10% or more than 10% has to submit additional Performance Security with reference to Government resolution no: **BDG 2016-PWD Dept. Dated 12/02/2016 and BDG 2016-PWD Dept. Dated 01/04/2017.**

5.21.6 Bidders shall take cognizance of Government resolution no. शासन परिपत्रक क्रमांक-संकिर्ण-२०१७/प्र.क्र.९/नियोजन-३ dated 27 April 2017, and sign a Declaration (Volume 2, APPENDIX 11) to this effect.

5.22 Substitution of Key Personnel

5.22.1 If any of the Key Personnel become unavailable during the course of the work, the Contractor shall provide a written adequate justification and evidence satisfactory to the Client together with the substitution request. In such case, a replacement Key Expert shall have equal or better qualifications and experience than those of the originally proposed Key Expert. The technical evaluation score, however, will remain to be based on the evaluation of the CV of the original Key Expert.

5.22.2 If the Contractor fails to provide a replacement Key Expert with equal or better qualifications, or if the provided reasons for the replacement or justification are unacceptable to the Client, such Proposal will be rejected by the Client, and the Performance Security of the Contractor may be seized.

5.23 Corrupt or Fraudulent Practices

5.23.1 The Employer requires that the Bidders /Suppliers/Contractors shall observe the highest standard of ethics during the execution of contracts. In pursuance of this policy, SCDCL defines, for the purposes of this provision, the terms set forth below as follows:

a) 'Corrupt practice' means the offering, giving, receiving or soliciting of anything of value to influence the action of a public official in the procurement process or in contract execution; and

b) 'Fraudulent practice' means a misrepresentation of facts in order to influence a procurement process or the execution of a contract to the detriment of the

Employer,

5.23.2 Will reject a proposal for award if it determines that the Bidder recommended for award has engaged in corrupt or fraudulent practices in competing for the contract in question;

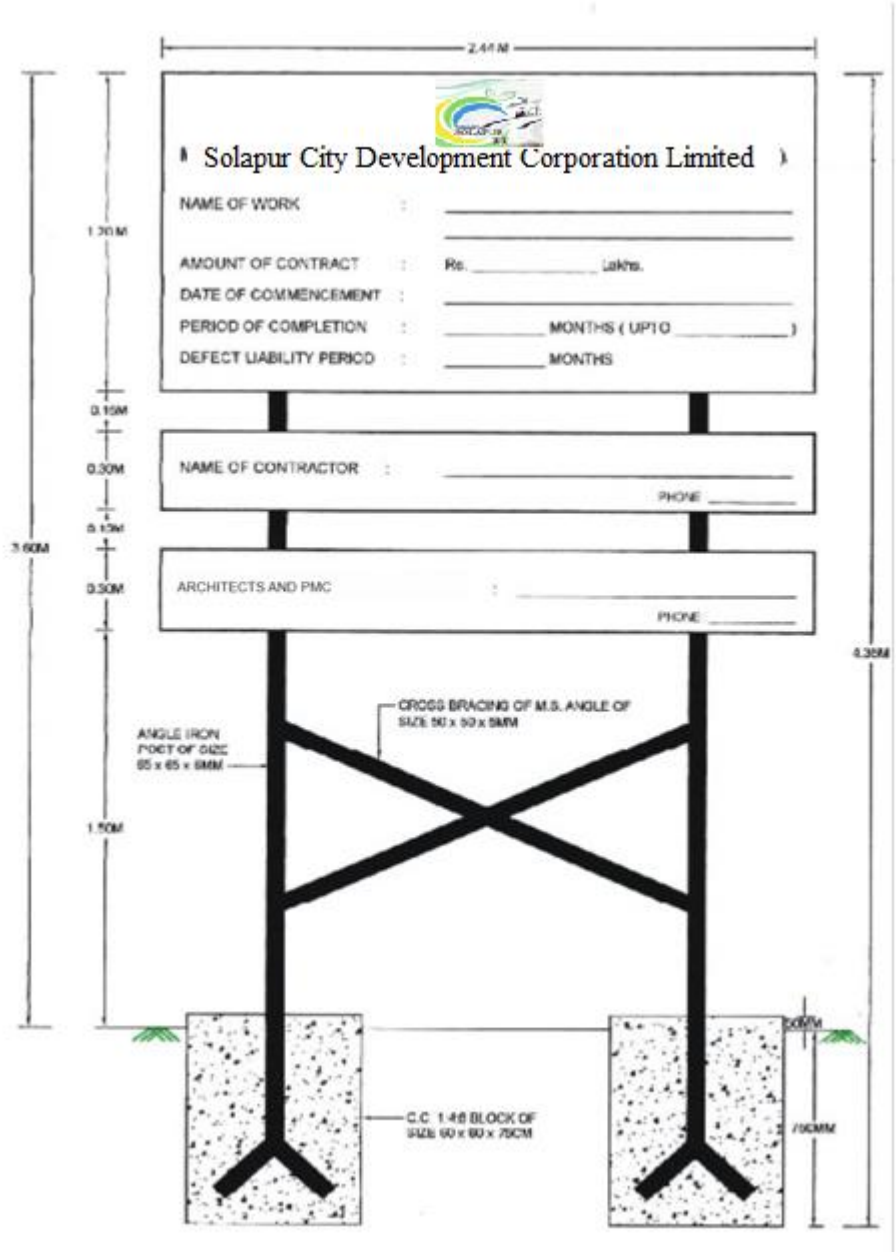
5.23.3 Will declare a firm ineligible, either indefinitely or for a stated period of time, to be awarded any SCDCL contract, if it at any time determines that the firm has engaged in corrupt or fraudulent practices in competing for, or in executing SCDCL contracts.

5.23.4 Bidder shall not be affiliated with firms and entity

I. That has provided consulting services related to the works to the employer (SCDCL), during the preparatory stages of the works or of the projects of which the works form a part

II. That has been hired by employer (SCDCL) as an Urban Designer for the contract.

6. NOTICE BOARD TO BE INSTALLED ON SITE



VOLUME II

CONTENTS

SECTION (I) SCOPE OF WORK

DETAILED DESCRIPTION OF WORK

1. INTRODUCTION

The stretch of road is to be converted into a Smart Road at Solapur is 1.1 kilometers totally. This starts from Ambedkar Chowk, heading South till Duffrin Chowk, then East, passing Home Maidan and ends at Ranga Bhavan Chowk.

This project involves the redevelopment of Ranga Bhavan Chowk, which is a part of the 1.1km long Smart Road Pilot Project (Phase 1)

Figure 1 Location of Ranga Bhavan Chowk

2. EXISTING SITUATION

Ranga Bhavan Chowk is one of the major traffic junctions of Solapur, with 4 roads entering it. It has, in its centre, a triangular island which is approximately 50m x 16m (actually size may vary on site).

Figure 2 Ranga Bhavan Chowk approached from CS Udyan

Figure 3 Central island at Ranga Bhavan Chowk

However, in the absence of adequate footpaths along the chowk and the island, it is very difficult for pedestrians, elderly and cyclists to cross the Chowk. Additionally, the central island is without any urban use.

Figure 4 No Pedestrian crossings in Chowk

Figure 5 The central island

3. RANGA BHAVAN CHOWK REDESIGN

It is proposed to redevelop the entire Ranga Bhavan Chowk into a semi-shaded urban plaza, enveloped by a semi-covered fabricated structure with a covering which is a combination of 100 Solar Panels and 36 LED Display Panels. The LED Panels will be activated during the evening. Along the upper edge of the structure, will run another 600mm high LED ticker panel which will display information during the entire day and some time at night as well. Appropriate pedestrian crossings and parking for visitors shall also be developed around the chowk, and the executed work should look like the following conceptual views at the least.

Figure 6 Conceptual view of Ranga Bhavan Chowk Redevelopment

Figure 7 Conceptual Day View

Figure 8 Conceptual Night View

I) Submission of Detailed work plan:
The contractor has to prepare detailed work plan and submit along with the bid which shall take into account, the traffic position, milestones specified in the tender, and availability of man power, material, machinery and shuttering material etc. with him. Intended Traffic management plan during construction shall be prepared by the bidder and submitted along with the bid.

II) Documentation: Providing Documentation Report of the project at every stage in such as video and photographic formats. As built drawings etc. as specified in the tender. All drawings shall be on Auto CAD of latest version.

4. DETAILED WORK DESCRIPTION

The Redevelopment of Ranga Bhavan Chowk entails the development of 4 main islands within the existing boundaries of Ranga Bhavan chowk – Island 1, Island 2, Island 3 and Island 4. Of these, Island 1 and Island 2 are traffic islands which enable access to Island 3. Each access island has landscape elements – shrubs, trees as well as benches for people to rest.

Island 3 forms a public plaza with a fabricated structure, which comprises of three main parts – A MS Column frame rising from the ground level till a height of 7m, a secondary MS frame to support the structure covering, and thirdly, the covering, which is a combination of 36 LED Display Panels, 100 Solar Panels and plain zinc Sheets. The main column frame consists of 20 clusters of columns, placed at distances of 7m centre-to-centre, with edge clusters varying in their placement. Each cluster comprises 5 (five) columns –MS pipes of 200mm dia., 6.3mm thk, with anti-rust treatment and finished with paint. The central column rises up and bulbs out at the top. The remaining four columns along the edge of each cluster rise, turn and become part of an adjoining cluster. This results in the formation of a grid at 7m level. This grid is the primary structural grid, upon which a secondary grid of 92mm x 172mm MS Box Sections, 5.4mm thick, is fixed. All Solar panels and LED Display Panels are fixed on this grid. Each Solar Panel is 2m x 1m in size and each LED Display Panel is 2.05m x 1.28m. An additional LED display panel, 0.6m in height and 112m in length runs along the perimeter of the roof structure. The zinc sheeting varies in size depending on the location of each panel. This entire structure is based on an RCC foundation (please refer provided drawings).

An existing column / *Stambha* finished with white marble, in the centre of Ranga Bhavan Chowk, is to be retained and protected. No damage shall be caused to it and the grid surrounding this column shall be left open at the top level.

Any and all electrical cabling or cabling related to the LED panels and/or Solar panels shall be routed from top level to ground level through the 200mm dia. MS pipes, and shall be suitably insulated to prevent any electrical accidents. The pipes shall be punctured with entry and exit holes for the cabling

as per approval by Urban Designer. All cables/pipes shall be routed under the flooring of the plaza and shall not be left exposed to be seen by the public.

A three-tiered seating for the public, finished with polished granite runs along the Eastern, Southern and Western sides of the island, which is abutted by a 2.4m wide landscape mound on it's outer side, which is further outlined by a walking track. A service box of 1.5m x 1.5m x 1.2m punctures the landscape mound on the western side. This accommodates all electrical junction boxes, media processors and CPU for media management of the LED display panels.

For details on the project, please refer the following attached drawings (ATTACHMENT 1-DRAWINGS):

Sr. No.	Drawing Details	Drawing No.	Drawing Type
1	Ranga Bhavan Chowk Intersection Layout	1701_UD_PL_ RBC_1	Architectural Drawing
2	Ranga Bhavan Chowk Island 3 Ground Floor Plan	1701_UD_PL_ RBC_ID3_1	Architectural Drawing
3	Ranga Bhavan Chowk Island 3 Roof Plan_1	1701_UD_PL_ RBC_ID3_2	Architectural Drawing
4	Ranga Bhavan Chowk Island 3 Roof Plan_2	1701_UD_PL_ RBC_ID3_3	Architectural Drawing
5	Ranga Bhavan Chowk Island 3 Sections & Details	1701_UD_ RBC_ID3_4	Architectural Drawing
6	Ranga Bhavan Chowk Island 3 Details	1701_UD_ RBC_ID3_5	Architectural Drawing
7	Ranga Bhavan Chowk Island 1 and 2_Plan	1701_UD_PL_ RBC_ID1&2_1	Architectural Drawing
8	Ranga Bhavan Chowk Island 4_Plan	1701_UD_PL_ RBC_ID4_1	Architectural Drawing
9	Ranga Bhavan Chowk Landscape Layout	1701_UD_PL_ RBC_LS_1	Architectural Drawing
10	Ranga Bhavan Chowk Surface Finishes	1701_UD_PL_ RBC_SF_1	Architectural Drawing
11	Ranga Bhavan Chowk Panel SLD		Electrical Drawing
12	Ranga Bhavan Chowk Plinth Level and Details		Structural Drawing
13	Ranga Bhavan Chowk Foundation Levels and Details		Structural Drawing
14	Ranga Bhavan Chowk Fabrication Details		Structural Drawing

5. SPECIFIC CONDITIONS OF WORK PROCESS

- The contractor shall mark outlines of all proposed islands as well as proposed arterial footpaths (not included in these works) on site and get approved by Urban Designer.
- The centerlines and positions of each column cluster shall be clearly marked on site and approved by Urban Designer.
- Finished levels of all islands shall be marked on site and approved by Urban Designer / SCDCL / Principal Consultant.
- The Contractor shall ensure that any and all RCC / metal plates that form a structural base for the primary structural grid (200 mm dia. MS pipes) shall be concealed under the final flooring level and

shall not remain protruding above finished floor level and shall not be exposed to be seen by the public.

- All welding shall be of the highest finishing standards and shall be smooth so that joints between different pipes are not visible.
- All heights and levels shall be approved by Urban Designer.

6. LANDSCAPING WORK

The project involves landscape development of 4 Islands including the main island. The scope of work includes demarcation of the public plaza on the ground, dismantling of existing compound wall, removal of Hi Mast Street Light, Removal of existing signage, Cleaning and preparing of the site for construction. After completion of Civil and Fabrication work, the plantation work shall commence. The work has to be executed as per the drawings attached. The cost of the work is mentioned in the BOQ.

7. LED SYSTEM WORK

The project involves two components of LED Display Panels. The first components comprise of 36 nos. LED Display Panels of 2m x 1m size. The second component is a 0.6m high, 112m long LED Display Panel running along the periphery of the roof structure. The make of the LEDs shall be Cree, Nationstar or Nichia. The 36 LED panels shall be able to display parallel, unique graphics / animations independent of each other. Similarly, the peripheral, 0.6m high LED Display Panel shall also display independent graphics / animations. All the LED Display Panels shall be controlled by Media Processors of Kramer, RGB Link or Extron make. The LED Display Panels / Video Walls shall be of Samsung, Barco, Planner or Xtreme Media make.

8. SOLAR PV SYSTEM WORK

Obtaining No Objection Certificate (NOC)" from Distribution Company (DISCOM) for grid connectivity, complete design, engineering, supply, storage, civil work, erection, testing & commissioning of the grid connected solar PV project including operation and maintenance (O&M) of the project for a period of Five years after commissioning.

Bidder shall quote for the entire facilities on a "single responsibility" basis such that the total Bid Price covers all the obligations mentioned in the Bidding Documents in respect of Design, Supply, Erection, Testing and Commissioning including Warranty, Operation & Maintenance for a period of 5 years (under CAPEX Model), goods and services including spares required if any during O&M period. The Bidder has to take all permits, approvals and licenses, Insurance, power purchase agreement between relevant authorities etc., provide training and such other items and services required to complete the scope of work mentioned above.

The project cost shall be inclusive of all duties and taxes, insurance etc .The prices quoted by the firm shall be complete in all respect and no price variation /adjustment shall be payable.

The project cost shall be in accordance with all terms, conditions, specifications and other conditions of the Contract as accepted by the Solapur City Development Corporation Limited and incorporated into the sanction letter.

9. OPERATION AND MAINTENANCE

The Contractor shall carry out Operation and Maintenance of Ranga Bhavan Chowk for a total period of Five (05) years (from issue of Completion Certificate), of which One (01) year will be Defect Liability Period and Four (04) years are years during which the Contractor shall carry out Operation and

Maintenance. During this period, the Contractor shall maintain the same standards of Ranga Bhavan Chowk as have been specified in the design of the same.

10. MILESTONE SCHEDULE FOR WORK EXECUTION

Sr. No.	Milestone	Duration
		Month
1	Mobilization + Marking-out of all islands	T + 10 Days
2	Completion of Excavation for all islands	T + 1 Months
3	Completion of Foundation up to plinth for all islands	T + 2 Months
4	Erection of complete fabrication structure, including columns and secondary framework	T + 4 Months
5	Completion of landscaping across all islands, including benches, plantation, etc.	T + 5 Months
6	Completion of Installation of LED and Solar panels	T + 5.5 Months
7	Completion and Commissioning of Plaza	T + 6 Months

T - Letter of Award

11. Facilities to be given to SCDCL

- **Site Office** :
    - Providing and maintaining temporary site office i.e. Porta Cabin for the SCDCL Executive Engineer and his staff as well as for Consultants staff. It shall have sufficient area Four (04) persons capacity Tables, Chairs, white board, display boards etc., shall include electric supply, all electrical items, lights, fan and complete wiring, drinking water supply and toilet facilities etc. shall be provided by the contractor and maintained properly during the contract period and also in extended contract period if any.
    - Site office/ field laboratory shall have following minimum specifications:
        - Porta Cabin with all Facility :
          Minimum furniture for site office shall be Three (03) tables of size 3' x 5', Six (6) chairs and 2 cupboards of 6' height, One (1) Executive Chair. Two (2) PC of minimum configuration comprising Core i7 processor, 3.01 GHz Second Generation, 4 GB RAM, 1 GB Graphics, 500 GB HDD, Intel mother Board, Circle Cabinet SMPS, 18.5 inch LCD, Auto Cad 2010, Microsoft Office 2007, Mouse & Keyboard, Color printer, A3 size Scanner make HP 9120 & power backup and broadband (Internet) facility. The site office with all furniture including electrical equipment shall be the property of the contractor & the same shall be removed by contractor on completion of the work. Payment of Water Supply/ Electrical/ Telephone bills for site office shall be made by the contractor. Construction & Maintenance of site office and field laboratory will be carried by the contractor at his own cost during entire construction period. Contractor has to provide all the required licensed software as directed by the

Engineer in Charge at the contractors own cost.

- **Furniture and Equipment details for Site Office and Conference room**

Sr. no.	Description	Make	Nos.
1	Executive Table (For The Engineer)	Make - Godrej model No. T -108 or equivalent	1
2	Executive Chair (For The Engineer)	Make - Godrej model No. PCH -701 or equivalent	1
3	Table (For The Engineer, Accountant & Head Clerk)	Make - Godrej model No. T -104 or equivalent	1
4	Ordinary chair type 1 (For The Engineer, Accountant & Head Clerk)	Make - Godrej model No. CHR -6 or equivalent	2
5	Table (For all other staff).	Make - Godrej model No. T -101 or equivalent	1
6	Ordinary chair type 1 (For all other staff and visitors).	Type II	3
7	Water cooler for drinking purpose		1
8	Steel Cupboard 1980mmX915mmX485mm	Godrej Model No. 1 Storewel Plain or equivalent	1
9	Racks – 5 Tier	1800mm x 900mm x 375mm – made of slotted angles and MS sheets of Godrej make	2
10	Ceiling Fans	1400mm size. Ceiling fans shall be of approved make and colour	2
11	Personal Computer	Core i7 processor, 3.01 GHz Second Generation, 4 GB RAM,1 GB Graphics, 500 GB HDD, Intel mother Board, Circle Cabinet SMPS, 18.5 inch Samsung LCD, Auto Cad 2010, Microsoft Office 2007,Logitech Mouse & Keyboard ,Color printer, A3size Scanner make HP 9120 & power backup, broadband (Internet) facility	2

- The Site Office with all service furniture and fittings shall be the property of the contractor during the period of contract. It shall be removed after the work is over. Payment of Electric / Telephone bills will be made by the contractor. Maintenance will be carried by the contractor. If the contractor fails to make necessary payments for the electric & telephone bills and also to fails to maintain the site office with all services furniture and fittings, SCDCL will levy penalty on the contractor.

11..1.Contractor will have to make his own arrangement at his own cost for minimum 2 telephone connections at work site office – one for Engineer and the other in Contractor's Office.

- **Surveillance Camera:** The Contractor shall install on site, a CCTV camera with HD quality recording capability, for the entire duration of the project to record the progress of work. The CCTV camera must be operational during all working hours, including night, and the direction of it's recording must not be altered during the course of work. The location and height of the CCTV shall be determined in discussion with and approved by the Urban Designer.

- **Laboratory**:

  Laboratory not required on Site. Contractor should test all material, concrete cubes etc. from approved Testing Laboratory as per SCDCL.

  The field laboratory of adequate floor area shall be located on the site as shown or as directed and approved by the Engineer. It shall be provided with all amenities like water supply, electric supply etc.

  EQUIPMENTS FOR FIELD LABORATORY

  The following items of laboratory equipment shall be provided in the field laboratory to be established by the Contractor.

Sr. No.	General	Nos.
1.1	Glass- wares, spatulas, wire gauges, Steel scales, measuring tape, casseroles, Karais, enameled trays of assorted sizes, pestle-mortar, porcelain dishes, gunny bags, plastic bags, chemicals, digging tools like pickaxes, shovels etc.	As Required
1.2	Set of IS sieves with lid and pan: 450 mm diameter: 63 mm, 53 mm, 37.5 mm, 26.5 mm, 13.2 mm, 9.5 mm, 6.7 mm and 4.75 mm size. 200 mm diameter: 2.36 mm, 2.0 mm, 1.18 m, 600 micron, 425 micron, 300 micron, 150 micron and 75 micron.	1 Set
1.3	Water testing kit	1 Set
1.4	First aid box	1
2	**For Soils and Aggregates**	
I	Riffle Box	1 Set
II	Atterberg Limits (liquid and plastic limits), Determination apparatus	1 Set
III	Compaction Test equipment both 2.5 and 4.5 kg. Rammers (light and heavy compaction efforts	1 Set
IV	Dry Bulk Density Test apparatus (sand pouring cylinder, tray, cane etc.) Complete.	1 Set
V	Rapid Moisture Meter complete with chemicals	1 Set
VI	Standard measures of 30, 15 and 3 liters capacity along with standard tamping rod	1 Set

  - Identification of equipments shall be good.
  - Housekeeping in laboratory shall be good.
  - Retrieved samples shall be kept to verify operational status of equipment used for testing.

3	For Cement and Cement Concrete	Nos
I	Slump testing apparatus	01 Set
II	Needle Vibrator	03 Set
III	Cube molds for cement and concrete tests (1 Set= 6 Cube Molds)	06 Set

Note:-

- All equipment in the field laboratory shall be calibrated/ verified before use.
- Frequency of calibrations shall be got approved from Engineer subject to use of equipment at site.
- Identification of equipments shall be good.
- Housekeeping in laboratory shall be good.
- Retrieved samples shall be kept to verify operational status of equipment used for testing.
- Period of retrieved sample shall be got approved subject to quantum of work of each item to be executed.

SECTION (II) SAMPLE FORMS & SCHEDULES

PRE-QUALIFICATION FORMS

APPENDIX 1 – QUALIFICATION DOCUMENTS PROPOSAL SUBMISSION FORM

[On the Letter head of the Applicant]

{Location, Date}

To:

Chief Executive Officer,
Solapur City Development Corporation Limited
New Planning Office, Near Doodh Dairy, Saat Rasta,
Solapur
Maharashtra (INDIA)
Pin 413003

Ref: Request for Selection for Appointment of Contractor/s for carrying out Civil and Fabrication Works for Redevelopment of Ranga Bhavan Chowk

Dear Sirs:

We, the undersigned, offer to provide the Contracting services for Redevelopment of Ranga Bhavan Chowk, Part of Smart Road Project under Smart Cities Mission of Solapur, City of Maharashtra in accordance with your Request for Selection dated [Insert Date] and our Proposal for Percentage Rate Basis Tender method of selection. We are hereby submitting our Proposal, which includes this Technical Proposal and a Financial Proposal sealed in a separate sealed envelope.

We hereby declare that:

(a) All the information and statements made in this Proposal are true and we accept that any misinterpretation or misrepresentation contained in this Proposal may lead to our disqualification by the Client.

(b) Our Proposal shall be valid and remain binding upon us for the period of time specified in the ITB, Clause 5.11.6.

(c) We meet the eligibility requirements as stated in ITB 5.4, and we confirm our understanding of our obligation to abide by the Client's policy in regard to corrupt and fraudulent practices as per ITB 5.23.

(d) We, along with any of our suppliers, or service providers for any part of the contract, are not subject to, and not controlled by any entity or individual that is subject to, a temporary suspension or a debarment imposed by any State Government or Government of India or any multilateral funding agency or any Government of the all the eligible countries.

(e) In competing for (and, if the award is made to us, in executing) the Contract, we undertake to observe the laws against fraud and corruption, including bribery, in force in the country of India.

(f) Except as stated in the ITB 5.11.6, we undertake to negotiate a Contract on the basis of the proposed Key Personnel. We accept that the substitution of Key Personnel for reasons other than those stated in ITB Clause 5.11.6 and ITB Clause 5.23 may lead to the termination of Contract negotiations.

(g) We confirm that our Application is valid for a period of 90 (Ninety) days from XX/XX/XXXX (Application submission online Due Date)

(h) Our Proposal is binding upon us and subject to any modifications resulting from the Contract negotiations.

We undertake, if our Proposal is accepted and the Contract is signed, to initiate the Services related to the assignment no later than the date indicated in Clause 5.21.5 of the ITB.

We understand that the Client is not bound to accept any Proposal that the Client receives.

We remain,

Yours sincerely,

Authorized Signature **{In full and initials}:** _____

Name and Title of Signatory: _____

Name of Bidder (company's name):

In the capacity of: _____

Address: _____

Contact information (phone and e-mail): _____

APPENDIX 2 – FORMAT FOR MEMORANDUM OF UNDERSTANDING (MoU) FOR JOINT BIDDING

(On Non – judicial stamp paper of Rs 100/- or of appropriate value and
Document duly attested by notary public)

This Memorandum of Understanding (MoU) entered into this _____day of 2017 at _____ among _____ and _____ and _____ having its registered office at, _____ (hereinafter referred as"_____", which expression unless repugnant to the context or meaning thereof includes its successors and permitted substitutes) of the First Part and_____ and _____ having its registered office at _____, (hereinafter referred as"_____", which expression unless repugnant to the context or meaning thereof includes its successors and permitted substitutes) of the Second Part _____ and _____

The parties are individually referred to as Party and collectively as Parties.

WHEREAS Assisting Solapur City Development Corporation Limited for carrying out execution of the Project "Redevelopment of Ranga Bhavan Chowk, Part of Smart Road Project under Smart Cities Mission" in Solapur City of Maharashtra ("Project") as per the terms contained in the RFS Document.

AND WHEREAS the Parties have had discussions for formation of a Consortium for bidding for the said Project and have reached an understanding on the following points with respect to the Parties' rights and obligations towards each other and their working relationship.

IT IS HEREBY AS MUTUAL UNDERSTANDING OF THE PARTIES AGREED AND DECLARED AS FOLLOWS:

1. That the roles and the responsibilities of each Party at each stage of the Project shall be as follows:

2. That the Parties shall be jointly and severally liable for the execution of the Projects arising from the States, Union Territories, as the case may be and in accordance with the terms of the Contract Agreement to be executed on award of such Projects.

3. That this MoU shall be governed in accordance with the laws of Land(India) and courts in Solapur shall have exclusive jurisdiction to adjudicate disputes arising from the terms herein.

In witness whereof the Parties affirm that the information provided is accurate and true and have caused this MoU to be duly executed on the date and year above mentioned.

First Party

Party Witness

1. _____
2. _____

Second Party

Party Witness

1. _____
2. _____

Third Party

Party Witness

1. _____
2. _____

APPENDIX 3 – STATEMENT OF TEAM FORMATION

(to be submitted by all Team Members except Bidder on stamp paper of Rs 100/- or such equivalent amount and document duly attested by notary public)

We, M/s. …… (Name of Team Member), located at …… (address of the registered office) do hereby state that we are interested in implementing the Project in accordance with the terms and conditions of the Request for Services Document, and other connected documents in respect of the Project. Towards the same, we state that we are hereby forming a team with M/s. …… (Name of Bidder), in the capacity of …… (role, e.g. Civil works member, Fabrication works member, LED Display Panel works member, Solar PV Project Member). Further, we shall furnish all documentation to demonstrate our technical capability to execute the project as specified by the RfP, and assist M/s. …… (Name of Bidder) in preparation of the bid for the Project, including submission of Application for Qualification/ Application, responding to queries, submission of information/ documents and generally to ease execution of the work.

Yours Sincerely,

(Signature of Authorised Personnel for Team Member)

(Name of Authorised Personnel for Team Member)

(Signature of Bidder)

APPENDIX 4 –FORMAT FOR POWER OF ATTORNEY FOR LEAD MEMBER OF CONSORTIUM

(On Non – Judicial stamp paper of Rs 100/- or such equivalent amount and

Document duly attested by notary public)

Power of Attorney

Whereas Solapur City Development Corporation Limited has invited applications from interested parties for carrying out Execution work of the Project "Redevelopment of Ranga Bhavan Chowk, Part of Smart Road Project under Smart Cities Mission" of Solapur Smart City Proposal **(the "Project")** under Smart City Mission (SCM) in Solapur City of Maharashtra**,**

Whereas, the members of the Consortium are interested in bidding for the Project and implementing the Project in accordance with the terms and conditions of the Request for Services Document, and other connected documents in respect of the Project, and

Whereas, it is necessary under the RFS Document for the members of the Consortium to designate the Lead Member with all necessary power and authority to do for and on behalf of the Consortium, all acts, deeds and things as may be necessary in connection with the Consortium's bid for the Project who, acting jointly, would have all necessary power and authority to do all acts, deeds and things on behalf of the Consortium, as may be necessary in connection the Consortium's bid for the Project.

NOW THIS POWER OF ATTORNEY WITNESS THAT;

We, M/s. …… (Lead Member), and M/s …… (the respective names and addresses of the registered office) do hereby designate M/s. …… being one of the members of the Consortium, as the Lead Member of the Consortium, to do on behalf of the Consortium, all or any of the acts, deeds or things necessary or incidental to the Consortium's bid for the Project, including submission of Application for Qualification/ Application, participating in conferences, responding to queries, submission of information/ documents and generally to represent the Consortium in all its dealings with , any other Government Agency or any person, in connection with the Project until culmination of the process of bidding and thereafter till the execution of the Contract Agreement is entered into with .

We hereby agree to ratify all acts, deeds and things lawfully done by Lead Member, our said attorney pursuant to this Power of Attorney and that all acts deeds and things done by our aforesaid attorney shall and shall always be deemed to have been done by us/Consortium.

Dated this the ……Day of …….2016

…… (Executants)

(To be executed by all the members of the Consortium)

Note: The mode of execution of the Power of Attorney should be in accordance with the procedure, if any, laid down by the applicable law and the charter documents of the executant(s) and when it is so required the same should be under common seal affixed in accordance with the required procedure.

APPENDIX 5 –FORMAT FOR POWER OF ATTORNEY FOR SIGNING OF APPLICATION

(On stamp paper of Rs 100/- or such equivalent amount and document duly attested by notary public)

Power of Attorney

Know all men by these presents, we …… (name and address of the registered office) do hereby constitute, appoint and authorise Mr. / Ms…… …… (name and residential address) who is presently employed with us and holding the position of ……. as our attorney, to do in our name and on our behalf, all such acts, deeds and things necessary in connection with or incidental to our application for Appointment of Contractor/s for carrying out Civil and Fabrication Works for Redevelopment of Ranga Bhavan Chowk **(the "Project")**, including signing and submission of all documents and providing information / responses to SCDCL , representing us in all matters before SCDCL, and generally dealing with SCDCL in all matters in connection with our bid for the said Project.

We hereby agree to ratify all acts, deeds and things lawfully done by our said attorney pursuant to this Power of Attorney and that all acts, deeds and things done by our aforesaid attorney shall and shall always be deemed to have been done by us.

For _____

(Signature)

(Name, Title and Address)

Accepted

…….. (Signature)

(Name, Title and Address of the Attorney)

Note: .

- *The mode of execution of the Power of Attorney should be in accordance with the procedure, if any, laid down by the applicable law and the charter documents of the executant(s) and when it is so required the same should be under common seal affixed in accordance with the required procedure.*
- *In case the Application is signed by an authorized Director of the Applicant, a certified copy of the appropriate resolution/ document conveying such authority may be enclosed in lieu of the Power of Attorney.*

APPENDIX 6 – FINANCIAL QUALIFICATIONS OF THE BIDDER

S. No.	Financial Year	Annual Turnover (Rs.	Net Profit
1	Financial Year 2013-14		
2	Financial Year 2014-15		
3	Financial Year 2015-16		

Note:

- *The audited Financial Statements for the corresponding year has to be attached.*

Name of the auditor issuing the certificate

Name of the auditor's Firm:

Seal of auditor's Firm:

Date:

(Signature, name and designation of the authorized signatory for the Auditor's Firm)

APPENDIX 7 – TECHNICAL QUALIFICATIONS EXPERIENCE

[The following table shall be filled in by all Team Members]

Applicant/ Legal Name: [*insert full name]*

Date: [*Insert day, month, year]*

Tender no and Title: [*Insert Tender number]*

*Page [*Insert Page Number] *of [*Insert *total number of pages]*

[*Identify contracts that demonstrate experience of implementation of projects such as Civil Works, Public Plaza Developments, Road works, Complex Fabrication works, Solar Panel installations and large-scale outdoor LED Video Wall Installations, over the past 10 (ten) years pursuant to Qualification criteria and Requirements. Pictures of completed projects must be attached. List contracts chronologically, according to their commencement (starting date)]*

Duration	**Assignment name/& brief description of main deliverables/outputs**	**Name of Client & Country of Assignment**	**Approx. Contract value (in INR. equivalent)/ Amount paid to your firm**	**Role on the Assignment**	**Certificate from the client provided**
{e.g., Jan.2009–Apr.2010}	{e.g., "Redevelopment of.....": implemented civil works and landscaping of .....; }	{e.g., Ministry of ....., country}	{e.g.,INR 01 Cr.}	{e.g., Lead partner in a Consortium {A&B&C}	Yes/No a. Copy of agreement/if international then apostle; b. Copy of completion certificate; [Issued by Competent Authority]
{e.g., Jan-May 2008}	{e.g., "Fabrication of Skywalk at....." : executed fabrication of.....}	{e.g., municipality of....., country}	{e.g.,INR 2 Cr.}	{e.g., Sole Contractor}	Yes/No a. Copy of agreement/if international then apostle; b. Copy of completion

Duration	Assignment name/& brief description of main deliverables/outputs	Name of Client & Country of Assignment	Approx. Contract value (in INR. equivalent)/ Amount paid to your firm	Role on the Assignment	Certificate from the client provided
					certificate; [Issued by Competent Authority]

(Name and Sign of Authorized Signatory)

Note: Completion certificate from respective Authority covering Scope, Cost and project duration shall be enclosed for all Assignments being submitted for evaluation. Additionally, pictures of completed projects must also be provided.

APPENDIX 8 – FORMAT FOR AFFIDAVIT CERTIFYING THAT BIDDER (CONTRACTING FIRM)/ DIRECTOR(S) OF CONTRACTING FIRM ARE NOT BLACKLISTED

(to be submitted by each member in case of Consortium)

(On a Stamp Paper of relevant value)

Affidavit

I M/s. ……, (the names and addresses of the registered office) hereby certify and confirm that we or any of our promoter/s / director/s are not barred or blacklisted by any state government or central government / department / agency/PSU in India or abroad from participating in Project/s, either individually or as member of a Consortium as on _____.

We further confirm that we are aware our Application for the captioned Project would be liable for rejection in case any material misrepresentation is made or discovered with regard to the requirements of this RfS at any stage of selection and/or thereafter during the Contract period.

Dated this ……..Day of ……., 201….

Name of the Applicant

…….
Signature of the Authorised Person

…….
Name of the Authorised Person

APPENDIX 9 – DISCLOSURE OF ONGOING LITIGATION

(to be submitted by each member in case of Consortium)

Information regarding Litigation / Arbitration during last five years in which the bidder is involved, the parties' concerned and disputed amount.

a) **Pending Litigation**

Pending Litigation				
1) No pending litigation in accordance with Section III, Qualification Criteria and Requirements, Sub-Factor 2.2. 2) Pending litigation in accordance with Section III, Qualification Criteria and Requirements, Sub-Factor 2.2 as indicated below.				
Year of dispute	**Amount in dispute**	**Outcome as Percentage of Net Worth**	**Contract Identification**	**Total Contract Amount (current value, currency, exchange rate and USD equivalent)**
[insert year]	[insert amount]	[insert percentage]	Contract Identification: [indicate complete contract name, number, and any other identification] Name of Employer: [insert full name] Address of Employer: [insert street/city/country] Matter in dispute: [indicate main issues in dispute] Status of dispute: [Indicate if it is being treated by the Adjudicator, under Arbitration or being dealt with by the Judiciary]	[insert amount]

b) **Litigation History**

Litigation History		
1) No court/arbitral award decisions against the Applicant since 1st January [insert year], in accordance with Section III, Qualification Criteria and Requirements, Sub-Factor 2.3. 2) Court/ arbitral award decisions against the Applicant since 1st January [insert year], in accordance with Section III, Qualification Criteria and Requirements, Sub-Factor 2.3 as indicated below.		
Year of award	**Contract Identification**	**Total Contract Amount (current value, currency, exchange rate and USD equivalent)**
[insert year]	Contract Identification: [indicate complete contract name, number, and any other identification]	[insert amount]

	Name of Employer: [insert full name] Address of Employer: [insert street/city/country] Matter in dispute: [indicate main issues in dispute] Party who initiated the dispute: [indicate "Employer" or "Contractor"] Status of dispute: [indicate if it is being treated by the Adjudicator, under Arbitration or being dealt with by the Judiciary]	

Preceding 5 years to be reckoned from the 31st. March of the last financial year.

Signature of the Bidder

APPENDIX 10

DECLARATION OF THE BIDDER

I/ We hereby declare that I / We have made myself / ourselves thoroughly conversant by visiting the site, with the site and the subsoil conditions, topography, geo technical investigation details, hydrological and climatic conditions, extent and nature of work, laws, procedures and labor practices, availability of labor, material, machineries, fuel, water, electricity, the local conditions regarding all materials (such as stone, murum, sand etc.) and labour etc. of which I /We have based on my / our rates for this work. The specification, conditions bore results and lead of materials on this work have been carefully studied and understood by me / us before submitting this tender. I / We undertake to use only the best materials approved by Engineer or his representative or his duly authorized representative during execution of the work and to abide by the decision.

I/We here by further declare that my / our tender is unconditional in every matter of whatsoever in nature.

I / We hereby undertake to pay the laborers engaged on the work as per Minimum Wages Act 1948 applicable to the zone concerned.

I/We have quoted my/our offer in percentage rate in words as well as in figures. I/We further undertake to enter into contract in regular “B-1” form.

SIGNATURE OF BIDDER

APPENDIX 11
QUALITY ASSURANCE REQUIREMENTS

ELEMENT OF QUALITY SYSTEM (ISO – 9001 – 1994)

The applicant(s) are required to provide details of their Quality Assurance Systems for criteria stipulated below, preferably in the form of their Quality Manual to be enclosed separately, in case the system is not finished in total, the extent to which it is completed and documented may be submitted.

1. Management

1.1 Quality Policy Responsibility
1.2 Organization
1.3 Responsibility and Authority
1.4 Resources
1.5 Management Representative
1.6 Management Review

2. Quality System

2.1 General Quality Manual (ISO : 10013)
2.2 Quality System Procedure
2.3 Review

3. Contract Review

3.1 General document procedure
3.2 Review
3.3 Amendment to a contract
3.4 Records

4. Design control

4.1 General Document procedure to DC
4.2 Design & Development planning
4.3 Organization 7 technical Inter Phases
4.4 Design Input
4.5 Design output
4.6 Design Review
4.7 Design Verification
4.8 Design validation
4.9 Design Charges

5. Document & Data control

5.1 General (Documented Procedures to control Documents & Data)
5.2 Document & Data Approval and Issue
5.3 Documents & Data changes

6. Purchasing

6.1 General (Documented Procedures to control product)
6.2 Evaluation of Sub- Contractors.
6.3 Purchasing Data
6.4 Verification of purchased Product
6.4.1 Supplier verification of Sub.
6.4.2 Customer verification of subcontracted product.

7. Control of customer supplied product.

8. product Identification and Traceability

9. Process Control
a) Documented procedures

b) Suitable Equipment

c) Compliance of Quality Plan with respect to relevant codes.

d) Monitoring and control of Indicator properties.

e) Approval of process and Equipment

f) Workmanship

10. Inspection and Testing

10.1 General Documented for procedures equipment for inspection and testing
10.2 Receiving inspection and testing
10.3 In-process inspection and testing
10.4 Final inspection and testing
10.5 Inspection and Test records

11. Control Inspection Measuring and Test
- a) General
- b) Control Procedure

12. Inspection Test Status

13. Control of non-conforming product

- a) General product
- b) Review and disposition of non-conforming product

14. Corrective and Preventive
- a) General Action
- b) Corrective and Preventive
- c) Preventive Action

15. Handling Storage
- a) General packing preservation
- b) Handling and delivering
- c) Storage
- d) Packing
- e) Preservation
- f) Delivery

16. Control of Quality Records

17. Internal Quality Audit

18. Training

19. Servicing

20. Statistical Technique

20.1 Identification of need

20.2 Procedure

SIGNATURE OF BIDDER

APPENDIX 12

DECLARATION OF COMPLIANCE

(on non-judicial Stamp Paper of appropriate value)

I/ We hereby declare that we take cognizance of Government Resolution शासन परिपत्रक क्रमांक-संकिर्ण-२०१७/प्र.क्र.९/नियोजन-३ dated 27 April 2017 and shall maintain the highest standards of quality, safety and workmanship throughout the construction / redevelopment of Ranga Bhavan Chowk. I/We hereby declare that I/We shall alone bear responsibility of the quality, safety and workmanship of said construction, and indemnify SCDCL / Principal Consultant / Urban Designer of any obligation towards the same.

Date : Signature of Bidder

TECHNICAL QUALIFICATION FORMS

TECH-1

TECHNICAL PROPOSAL SUBMISSION FORM

{Location, Date}

To:

Chief Executive Officer,
Solapur City Development Corporation Limited
New Planning Office, Near Doodh Dairy, Saat Rasta,
Solapur
Maharashtra (INDIA)
Pin 413003

Dear Sirs:

We, the undersigned, offer to provide the Contracting services for Redevelopment of Ranga Bhavan Chowk, Part of Smart Road Project under Smart Cities Mission, of Solapur Smart City Proposal of Maharashtra in accordance with your Request for Services dated [Insert Date] and our Proposal for Percentage Rate Basis Tender method of selection. We are hereby submitting our Proposal, which includes this Technical Proposal and a Financial Proposal sealed in a separate sealed envelope.

We hereby declare that:

a) All the information and statements made in this Proposal are true and we accept that any misinterpretation or misrepresentation contained in this Proposal may lead to our disqualification by the Client.
b) Our Proposal shall be valid and remain binding upon us for the period of time specified in the ITB, Clause 5.11.6.
c) We meet the eligibility requirements as stated in ITB 5.4, and we confirm our understanding of our obligation to abide by the Client's policy in regard to corrupt and fraudulent practices as per ITB 5.23.
d) We, along with any of our sub-consultants, suppliers, or service providers for any part of the contract, are not subject to, and not controlled by any entity or individual that is subject to, a temporary suspension or a debarment imposed by a any State Government or Government of India or any multilateral funding agency or any Government of the all the eligible countries.
e) In competing for (and, if the award is made to us, in executing) the Contract, we undertake to observe the laws against fraud and corruption, including bribery, in force in the country of India.
f) Except as stated in ITB, Clause 5.11.6, we undertake to negotiate a Contract on the basis of the proposed Key Personnel. We accept that the substitution of Key Personnel for reasons

other than those stated in ITB Clause 5.11.6 and ITB Clause 5.23 may lead to the termination of Contract negotiations.

g) Our Proposal is binding upon us and subject to any modifications resulting from the Contract negotiations.

We undertake, if our Proposal is accepted and the Contract is signed, to initiate the Services related to the assignment no later than the date indicated in Clause 5.21.5 of the ITB.

We understand that the Client is not bound to accept any Proposal that the Client receives.

We remain,

Yours sincerely,

Authorized Signature {In full and initials}:_____

Name and Title of Signatory: _____

Name of Consultant:

Address: _____

Contact information (phone and e-mail): _____

TECH-2

BIDDER'S ORGANIZATION AND EXPERIENCE

(to be submitted by all Team Members)

Form TECH-2: a brief description of the Bidder's organization and an outline of the recent experience of the Bidder that is most relevant to the assignment. For each assignment, the outline should indicate the names of the Bidder's/Team Member's Key Personnel and Sub-consultants who participated, the duration of the assignment, the contract amount (total and, if it was done in a form of a joint venture or a sub-consultancy, the amount paid to the Contract), and the Contractor's role/involvement. Explanatory pictures of completed projects must also be attached.

A - Member's Organization

1. Provide here a brief description of the background and organization of your company,

2. Include organizational chart, a list of Board of Directors, and beneficial ownership

B - Member's Experience

1. List only previous similar assignments successfully completed[1] in the last10 (ten) years.

2. List only those assignments for which the Bidder / Contractor was legally contracted by the Client as a company or was one of the joint venture partners. Assignments completed by the Bidder / Contractor's individual personnel working privately or through other firms cannot be claimed as the relevant experience of the Bidder / Contractor, or that of the Bidder / Contractor's partners or sub-consultants, but can be claimed by the Personnel themselves in their CVs. The Bidder / Contractor should be prepared to substantiate the claimed experience by presenting copies of relevant documents and references if so requested by the Client.

[1] For similar assignments successfully completed, copy of Contract agreement or Completion Certificate from the competent authority needs to be attached.

Duration	Assignment name/& brief description of main deliverables/outputs	Name of Client & Country of Assignment	Approx. Contract value (in Rs. equivalent)/ Amount paid to your firm	Role on the Assignment	Certificate from the client provided
{e.g., Jan.2009–Apr.2010}	{e.g., "Redevelopment of.....": implemented civil works and landscaping of .....; }	{e.g., Ministry of ....., country}	{e.g.,INR 01 Cr.}	{e.g., Lead partner in a JV A&B&C}	Yes/No c. Copy of agreement/ if internationa l then apostle; d. Copy of completion certificate; [Issued by Competent Authority]
{e.g., Jan-May 2008}	{e.g., "Fabrication of Skywalk at....." : executed fabrication of.....}	{e.g., municipality of....., country}	{e.g.,INR 2 Cr.}	{e.g., Sole Contractor}	Yes/No c. Copy of agreement/if international then apostle; d. Copy of completion certificate; [Issued by Competent Authority]

Note: Completion certificate from respective Authority covering Scope, Cost and project duration shall be enclosed for all Assignments being submitted for evaluation. Explanatory pictures of completed projects must also be attached.

TECH-3

ASSIGNMENT DETAILS OF THE BIDDER / TEAM MEMBER

<table>
<tr><td>Assignment Name :</td><td>Project Cost :</td></tr>
<tr><td>Country :
Location within the Country :</td><td>Duration :</td></tr>
<tr><td>Name of Client :</td><td>Total No. of person-months of the assignment :</td></tr>
<tr><td rowspan="2">Address of Client :</td><td>Approx. value of the services provided by your firm under the contract (in current Rs.) :</td></tr>
<tr><td>No. of person-months provided by your firm :</td></tr>
<tr><td>Start Date (month/year) :
Completion Date (month/year) :</td><td>No. of professional person-months provided by the JV partners of the Sub-Contractors :</td></tr>
<tr><td>Name of associated Contractors, if any :</td><td>Name of senior professional staff of your firm involved and functions performed (indicate most significant profiles such as Lead Engineer / Project Co-ordinator, Team Leader) :
Project Leader :
Project Manager :
Team Members :</td></tr>
<tr><td colspan="2">Narrative description of Project in brief :</td></tr>
<tr><td colspan="2">Description of actual services provided by your firm in the assignment :</td></tr>
<tr><td colspan="2">Name of Firm :</td></tr>
</table>

Note: Completion certificate from respective Authority covering Scope, Cost and project duration shall be enclosed for all Assignments being submitted for evaluation. Explanatory pictures of completed projects must also be attached.

Signature of the Bidder

TECH-4

LIST OF MACHINERY AVAILABLE WITH THE BIDDER WHICH WILL BE USED ON THIS WORK

Sr. No.	Name of Equipment	Nos. of Unit	Kind and Make	Capacity	Age of Machinery	Present condition of Machinery	Present location with name and address of organization where machinery is in use.	Whether the machinery is hypothecated to any bank or institution
1	2	3	4	5	6	7	8	9

Signature of the Bidder

TECH-5

WORK PLAN

Sr. No.	Item of Activity (Work)	Week-wise Program (in the form of a Bar Chart) 1st, 2nd, etc. are weeks from the start of work order							
		1st	2nd	3rd	4th	5th	6th	7th	8th

a) Preliminary Site Organization chart.
b) Narrative description of Site Organization Chart
c) Description of relationship between Head Office and Site Management

Note : Indicate clearly which responsibility and what authority have been delegated to site management

Signature of the Bidder

TECH-6

STATEMENT OF LEGAL CAPACITY

(To be forwarded on the letterhead of the Bidder)

Reference Date:

To

……..

……..

……..

Sub: Appointment of Contractor/s for carrying out Civil and Fabrication Works for Redevelopment of Ranga Bhavan Chowk

Dear Sir,

I/We hereby confirm that we, [Insert Bidder's name] satisfy the terms and conditions laid down in the RFS document.

I/We have agreed that …….. (Insert individual's name) will act as our Authorized Representative/ will act as the Authorized Representative of [Insert Bidder's name] on our behalf and has been duly authorized to submit our Proposal. Further, the authorized signatory is vested with requisite powers to furnish such proposal and all other documents, information or communication and authenticate the same.

Yours faithfully,

(Signature, name, designation of the authorized signatory)

For and on behalf of ……

FINANCIAL PROPOSAL FORM

FORM F

FINANCIAL PROPOSAL (to be submitted online only)

TENDER FOR WORKS	
	1. I / We hereby tender for the execution, for the Solapur City Development Corporation Limited (hereinbefore and hereinafter referred to as "SCDCL") of the work specified in the underwritten memorandum within the time specified in such memorandum at ---------- ---------- percent (%) below / above the estimated rates entered in "Schedule B" (Memorandum showing items of work to be carried out) and in accordance in all respects with the specifications, designs, drawings as specified in ITB

PROJECT COST BREAKUP	
(a) If several sub works are included they should be detailed in a separate list (b) Total estimated cost of the work. .	(a) General Description – Redevelopment of Ranga Bhavan Chowk, Part of Smart Road Project (Phase 1)under Smart Cities Mission, At Solapur. (b) Estimated Cost i) Civil Work: Rs 1,61,06,878.00 ii) Electrical and Other Works: Rs 2,40,46,758.00 iii) Plumbing: Rs. 0,15,99,614.00 iv) AMC: Rs. 50,00,000.00 v)Miscellaneous work Rs. 10,00,270.00 Total for Civil + Electrical +Plumbing and other works. Rs 4,77,53,520.00 Total Estimated Cost of Project Rs 4,77,53,520.00 **Total Time Period - 06 (SIX) Calendar Months**

SECTION (III) CONTRACT DATA

DATA (APPENDIX TO BID)

[Note: with the exception of the items for which the Employer's requirements have been inserted, the following information must be completed before the Tender is submitted].

Sr.No	Item	Data
1	Employer's name and Address	The Chief Executive Officer, Solapur City Development Corporation Limited, New Planning Office, Near Doodh Dairy, Saat Rasta, Solapur, 413003. (INDIA)
2	Contractors Name And Address	
3	Urban Designer- (Architects and PMC) Name and Address	Urban Tree, 1st floor, 'Virashree', 322/9, Shankerseth Road, Pune 411042 India or any other Engineer as employed by SCDCL.
4	Time For Completion For Work	06 Calendar Months including monsoon.
5	Defects Notification Period	1 (ONE) year after date of issuance of Completion Certificate.
6	Electronic transmission Systems	e-mail, soft copies in CD / DVD
7	Governing Law	Laws of India and local law applicable to site of work
8	Ruling language	English
9	Language for Communications	English/ Marathi / Hindi
10	Time for access to the Site	As per the Local conditions to be verified by the contractor
11	Estimated Cost	Rs. 4,77,53,520.00 Cr (Rupees Four Crores Seventy Seven Lakhs Fifty Three Thousand Five Hundred and Twenty Only)
12	Bid Security(EMD)	Rs. 4,80,000.00 (Rupees Four Lakhs Eighty Thousand Only)
13	Performance Security (SD)	Total 5% of the Contract amount
14	Period for submission of the work program	20 Days after the receipt of work order
15	Delay Damages for the Works	As per clause 28 of Volume 3 conditions of contract
16	Maximum amount of delay damages.	As per clause 28 of Volume 3 conditions of contract
17	Payment Certificate	Minimum amount of Interim bill 10% of contract value
18	Currency/currencies of payment	Indian Rupees (INR) payable in India
19	Periods for submission of insurance	Within 7 days of the Commencement of works

VOLUME III

INDEX

General Conditions of Contract

CONTENTS

A) GENERAL CONDITIONS

1. Definitions and Interpretation

1.1 Definitions

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

a. **"Employer"** means the Solapur City Development Corporation Limited (SCDCL) a Company incorporated under the Companies Act, 1956 (The Corporation).

b. "**Contractor**" means the person whose tender has been accepted by the Employer and the legal successors in title to such person, but not any assignee of such person appointed without consent of Employer.

c. "**Subcontractor**" means the person named in the Contract as a Subcontractor for a part of the Works or any person to whom a part of the Works has been subcontracted with the consent of the Engineer and the legal successors in title to such person, but not any assignee of any such person appointed without consent of Employer.

d. "**Engineer**" means the person nominated by the Employer to act as Engineer for the purposes of the Contract and named as such in Annexure "A" of these Conditions.

e. "**Engineer's Representative**" means a person appointed from time to time by the Engineer under Sub-Clause 2.2

f. The '**CEO**' means the Chef Executive Officer of the SCDCL, for the time being holding that office and also his successors and shall include any officer authorized by him.

g. "**Contract**' means these Conditions, the Specifications, the Drawings, the Bill of Quantities, the Tender, the Letter of Acceptance, the Work order, the Contract Agreement (if completed) and such further documents as may be expressly incorporated in the Letter of Acceptance or Contract Agreement (if completed).

h. "**Specification**" means the specification of the Works included in the Contract and any modification thereof or addition thereto or submitted by the Contractor and approved by the Engineer.

i. "**Drawings**" means all drawings, calculations and technical information of a like nature provided by the Engineer to the Contractor under the Contract and all drawings, calculations, samples, patterns, models, operation and maintenance manuals and other technical information of a like nature submitted by the Contractor and approved by the Engineer.

j. "**Bill of Quantities**" means the priced and completed Bill of quantities forming part of the Tender.

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

l. “Letter of Acceptance” means the formal acceptance by the Employer of the Tender.

m. “Contract Agreement” means the contract agreement (if any)

n. “Work Order” means the written communication of the Engineer ordering starting of the Work and specifying Commencement date and date of completion.

o. “Commencement Date” means the date upon which the Contractor receives the notice to commence, issued by the Engineer pursuant to clause 28.

p. “Time for Completion” means the time for completing the execution of and passing the Test on Completion of the Works or any Section or part thereof as stated in the Contract (or as extended under Clause 30) calculated from the Commencement Date.

q. “Tests on Completion” means the tests specified in the contract or otherwise agreed by the Engineer and the Contractor which are to be made by the Contractor before the Works or any section or part thereof are taken over by the Employer.

r. “Taking over Certificate” means a certificate issued pursuant to clause 34.

s. “Contract Price” means the sum stated in the Letter of Acceptance as payable to the Contractor for the execution and completion of the Works and the remedying of any defects therein in accordance with the provisions of the Contract.

t. “Performance Security” means the aggregate of all monies retained by the Employer pursuant to Sub-Clause 5.7.

u. “Interim Payment Certificate” means the certificate of payment issued by the Engineer other than the Final Payment Certificate.

v. “Final Payment Certificate” means the certificate of payment issued by the Engineer pursuant to Sub-Clause 46.8.

w. “Works ” means the Permanent Works and the Temporary Works or either of them as appropriate.

x. “Permanent Works” means the permanent Works to be executed (including Plant) in accordance with the Contract.

y. "Temporary Works" means all temporary Works of every kind (other than Contractor's Equipment) required in or about the execution and completion of the Works and the remedying of any defects therein.

z. "Plant" means machinery, apparatus and the like intended to form or forming part of the Permanent Works.

aa. "Contractor's Equipment" means all appliances and things of whatsoever nature (other than Temporary Works) required for the execution and completion of the Works and the remedying of any defects therein, but does not include Plant, materials or other things intended to form or forming part of the Permanent Works .

bb. "Section" means a part of the Works specifically identified in the Contract as a Section.

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

dd. "Cost" means all expenditure properly incurred or to be incurred, whether on or off the Site, including overhead and other charges properly allocable thereto but does not include any allowance for profit.

ee. "Day" means calendar day.

ff. "Foreign currency" means a currency of a country other than that in which the Works are to be located.

gg. "Writing" means any hand-written, type-written, or printed communication, including telex, cable and facsimile transmission.

1.2 Headings and Marginal Notes

The headings and marginal notes in these Conditions shall not be deemed part thereof or be taken into consideration in the interpretation or construction thereof or of the Contract.

1.3 Interpretation

Words importing persons or parties shall include firms and corporations and any organization having legal capacity.

1.4 Singular and Plural

Words importing the singular only also include the plural and vice versa where the context requires.

1.5 Notices, Consents, Approvals, Certificates & Determinations

Wherever in the Contract provision is made for the giving or issue of any notice, consent, approval, certificate or determination by any person, unless otherwise specified such notice, consent, approval, certificate or determination shall be in writing and the words "notify", "certify" or "determine" shall

be construed accordingly. Any such consent, approval, certificate or determination shall not unreasonably be withheld or delayed.

2. Engineer and Engineer's Representative

2.1 Engineer's Duties and Authority

a. The Engineer shall carry out the duties specified in the Contract.

b. The Engineer may exercise the authority specified in or necessarily to be implied from the Contract, provided, however, that in respect of the items mentioned in following paragraph (d) of this section, the Engineer shall obtain specific approval of the Employer. Provided further that, any requisite approval shall be deemed to have been given by the Employer for any such authority exercised by the Engineer.

c. Except as expressly stated in the Contract, the Engineer shall have no authority to relieve the Contractor of any of his obligations under the Contract.

d. Notwithstanding anything contrary in this document, the Engineer shall obtain specific approval of the Employer in respect of the following:
   i) Approving subletting of the work.
   ii) Granting claims to the Contractor.
   iii) Ordering suspension of the work.
   iv) Determining an extension of time.
   v) Reduction of Compensation for Delay as per Sub-Clause 31.2
   vi) Ordering variations.
   vii) Ordering any work/test beyond the scope of the Contract.
   viii) Determining rates for the varied works.
   ix) Any variations in the Contract condition.
   x) Approval to designs and working drawings.
   xi) payment of bonus for early completion

2.2 Engineer's Representative

The Engineer's Representative may be appointed by and be responsible to the Engineer and shall carry out such duties and exercise such authority as may be delegated to him by the Engineer under Sub-Clause 2.3.

2.3 Engineer's Authority to Delegate

The Engineer may from time to time delegate to the Engineer's Representative any of the duties and authorities vested in the Engineer and he may at any time revoke such delegation. Any such delegation or revocation shall be in writing and shall not take effect until a copy thereof has been delivered to the Employer and the Contractor.

Any communication given by the Engineer's Representative to the Contractor in accordance with such delegation shall have the same effect as though it had been given by the Engineer. Provided that:

a. Any failure of the Engineer's Representative to disapprove any work, materials or Plant shall not prejudice the authority of the Engineer to disapprove such work, materials or Plant and to give instructions for the rectification thereof; and

b. If the Contractor questions any communication of the Engineer's Representative he may refer the matter to the Engineer who shall confirm, reverse or vary the contents of such communication.

2.4 Appointment of Assistants

The Engineer or Engineer's Representative may engage any number of persons to assist the Engineer's Representative in the carrying out of his duties under Sub-Clause 2.2. He shall notify to the Contractor the names, duties and scope of authority of such persons. Such assistants shall have no authority to issue any instructions to the Contractor save in so far as such instructions may be necessary to enable them to carry out their duties and to secure their acceptance of materials, Plant or workmanship as being in accordance with the Contract, and any instructions given by any of them for those purposes shall be deemed to have been given by the Engineer's Representative.

2.5 Instructions in Writing

Instructions given by the Engineer shall be in writing, provided that if for any reason the Engineer considers it necessary to give any such instruction orally, the Contractor shall comply with such instruction. Confirmation in writing of such oral instruction given by the Engineer, whether before or after the carrying out of the instruction, shall be deemed to be an instruction within the meaning of this Sub- Clause. Provided further that if the Contractor, within 7 days, confirms in writing to the Engineer any oral instruction of the Engineer and such confirmation is not contradicted in writing within 7 days by the Engineer, it shall be deemed to be an instruction of the Engineer.

The provision of this Sub-Clause shall equally apply to instructions, given by the Engineer's Representative and any assistants of the Engineer or the Engineer's Representative appointed pursuant to Sub-Clause 2.4.

A site order book shall be maintained on the site and it shall be the property of the Employer and the Contractor shall promptly sign orders given therein by the Engineer or his representative or his assistant and comply with them. The compliance shall be reported by Contractor to the Engineer in good time so that it can be checked.

2.6 Engineer to Act Impartially

Wherever, under the Contract, the Engineer is required to exercise his discretion by:

a. giving his decision, opinion or consent,
b. expressing his satisfaction or approval,
c. determining value, or
d. Otherwise taking action which may affect the right and obligations of the Employer or the Contractor. He shall exercise such discretion impartially with in the terms of the Contract and having regard to all the circumstances. Any such decision, opinion, consent,

expression of satisfaction, or approval, determination of value or action may be opened up, reviewed or revised as provided in Clause 67.

3. Assignment and Subcontracting

3.1 Assignment of Contract

The Contractor shall not, without the prior consent of the Employer (which consent, notwithstanding the provisions of Sub-Clause 1.5, shall be at the sole discretion of the Employer), assign the Contract or any part thereof, or any benefit or interest therein or thereunder, otherwise than by:

a. A charge in favour of the Contractor's bankers of any monies due or to become due under the Contract,

b. assignment to the Contractor's insurers (in cases where the insurers have discharged the Contractor's loss or liability) of the Contractor's right to obtain relief against any other party liable.

3.2 Subcontracting

The Contractor shall not subcontract the whole of the Works. Except where otherwise provided by the Contract, the Contractor shall not subcontract any part of the Works without the prior consent of SCDCL. Any such consent shall not relieve the Contractor from any liability or obligation under the Contract and he shall be responsible for the acts, defaults and neglects of any Subcontractor, his agents, servants or workmen as fully as if they were the acts, defaults or neglects of the Contractor, his agents, servants or workmen. Provided that the Contractor shall not be required to obtain such consent for:

a. The provision of labour,
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 the Subcontractor is named in the Contract.

3.3 Assignment of Subcontractor's Obligations

In the event of a Subcontractor having undertaken towards the Contractor in respect of the Work executed, or the goods, materials, Plant or services supplied by such Subcontractor, any continuing obligation extending for a period exceeding that of the Defects Liability Period under the Contract, the Contractor shall at any time, after the expiration of such Period, assign to the Employer, at the Employer's request and cost, the benefit of such obligation for the unexpired duration thereof.

4. Contract Documents

4.1 Language(s) and Law

a. The languages are English and Marathi, being a Local Language of State of Maharashtra, India. The Ruling Language is English.

b. Law - The Contract shall be governed by and construed in accordance with the law of India and all disputes arising out of or in any way connected to the Contract shall be deemed

to have arisen in Mumbai and only the courts in Mumbai shall have jurisdiction to determine the same.

4.2 Priority of Contract Documents

The several documents forming the Contract are to be taken as mutually explanatory of one another, but in case of ambiguities or discrepancies the same shall be explained and adjusted by the Engineer who shall thereupon issue to the Contractor instructions thereon and such event, unless otherwise provided in the Contract, the priority, in descending order**,** of the documents forming the Contract shall be as follows:

a. Letter of Acceptance
b. Description of items of Work given in bill of quantities.
c. Particular specifications for contract
d. Special conditions of contract.
e. General conditions of contract.
f. Drawing forming part of contract.
g. Any other document forming part of the contract.

In case of Lump-sum contracts/ Turnkey Contracts, the order of preference mentioned above stands altered whereby the drawing forming part of the Contract will have highest priority next to Letter of Acceptance.

4.3 Custody and Supply of Drawings and Documents

The Contract document and Drawings shall remain in the sole custody of the Engineer, but two copies thereof, duly certified by the Engineer, shall be provided to the Contractor free of charge. The Contractor shall make at his own cost any further copies required by him. Unless it is strictly necessary for the purposes of the Contract, the Drawings, Specification and other documents provided by the Employer or the Engineer shall not, without the consent of the Engineer, be used or communicated to a third party by the Contractor. Upon issue of the Defects Liability Certificate, the Contractor shall return to the Engineer all Drawings, Specification and other documents provided under the Contract.

4.4 One Copy of Drawings to be kept on Site

One copy of the Drawing, provided to or supplied by the Contractor as aforesaid, shall be kept by the Contractor on the Site and the same shall at all reasonable times be available for inspection and use by the Engineer and by any other person authorized by the Engineer in writing.

4.5 Disruption of Progress

The Contractor shall give notice to the Engineer, with a copy to the Employer, whenever planning or execution of the Works is likely to be delayed or disrupted unless any further drawing or instruction is issued by the Engineer within a reasonable time. The notice shall include details of the drawing or instruction required and of why and by when it is required and of any delay or disruption likely to be suffered if it is late.

4.6 Delays and Cost of Delay of Drawings

If, by reason of any failure or inability of the Engineer to issue, within a time reasonable in all the circumstances, any drawing or instruction for which notice has been given by the Contractor in

accordance with Sub-Clause 6.3, the Contractor suffers delay and/or incurs costs then the Engineer shall, after due consultations with the Employer & the Contractor, determine:

a. any extension of time to which the Contractor is entitled under Clause 30, and

b. the amount of such costs, which shall be added to the Contract Price, and shall notify the Contractor accordingly, with a copy to the Employer.

4.7 Failure by Contractor to Submit Drawings

If the failure or inability of the Engineer to issue any drawings or instructions is caused in whole or in part by the failure of the Contractor to submit Drawings, Specification or other documents which he is required to submit under the Contract, the Engineer shall take such failure by the Contractor into account when making his determination pursuant to Sub-Clause 4.6

4.8 Supplementary Drawings and Instructions

The Engineer shall have authority to issue to the Contractor, from time to time, such supplementary Drawings and instructions as shall be necessary for the purpose of the proper and adequate execution and completion of the Works and the remedying of any defects therein. The Engineer may also issue further drawings or instructions pursuant to Clause 51. The Contractor shall carry out and be bound by the same.

4.9 Permanent Works Designed by Contractor

Where the Contract expressly provides that part of the Permanent Works shall be designed by the Contractor, he shall submit to the Engineer, for approval :

a. such drawings, specifications, calculations and other information as shall be necessary to satisfy the Engineer as to the suitability and adequacy of that design, and

b. operation and maintenance manuals together with drawings of the Permanent Works as completed, in sufficient detail to enable the Employer to operate, maintain, dismantle, reassemble and adjust the Permanent Works incorporating that design. The Works shall not be considered to be completed for the purposes of taking over in accordance with Clause 48 until such operation and maintenance manuals, together with drawings on completion, have been submitted to and approved by the Engineer.

4.10 Responsibility Unaffected by Approval

Approval by the Engineer, in accordance with Sub-Clause 7.2, shall not relieve the Contractor of any of his responsibilities under the Contract.

5. General Obligations

5.1 Contractor's General Responsibilities

The Contractor shall, with due care and diligence, design (to the extent provided for by the Contract), execute and complete the Works and remedy any defects therein in accordance with the provisions of the Contract. The Contractor shall provide all superintendence, labour, materials, Plant,

Contractor's Equipment and all other things, whether of a temporary or permanent nature, required in and for such design, execution, completion and remedying of any defects, so far as the necessity for providing the same is specified in or is reasonably to be inferred from the Contract. The Contractor shall give prompt notice to the Engineer, with a copy to the Employer, of any error, omission, fault or other defect in the design of or Specification for the Works, which he discovers when reviewing the Contract of executing the Works. The Contractor shall provide all safety equipments to ensure safety and security of all labour working on the project as well as any officials / visitors to the site.

5.2 Site Operations and Methods of Construction

The Contractor shall take full responsibility for the adequacy, stability and safety of all Site operations and methods of construction. Provided that the Contractor shall not be responsible (except as stated hereunder or as may be otherwise agreed) for the design or specification of Permanent Works, or for the design or specification of any Temporary Works not prepared by the Contractor. Where the Contract expressly provides that part of the Permanent Works shall be designed by the Contractor, he shall be fully responsible for that part of such Works, notwithstanding any approval by the Engineer.

5.3 Contractor's Representative

The Contractor shall himself supervise the execution of Works or shall appoint a competent representative approved by the Engineer to act in his stead. If in the opinion of the Engineer the Contractor has himself not sufficient knowledge and experience to be capable of receiving instructions or cannot give his full attention to the Works , the Contractor shall at his own expense, employ as his accredited representative, a suitably qualified and experienced person approved by the Engineer. The name of the representative, so appointed, along with the qualifications, experience and address, shall be communicated to the Engineer. The representative shall be a responsible person adequately authorised by the Contractor to take decision on site and to spend money, if required for procuring material and labour etc., to carry out emergency Work in the interest of the Contract work, if so required by the Engineer. Orders given to Contractor's representative shall be considered to have the same force as if these had been given to the Contractor himself. If the Contractor fails to appoint a suitable representative as directed by the Engineer, the Chief Engineer shall have full powers to suspend the execution of the Works until such date as a suitable representative is appointed and the Contractor shall be held responsible for the delay so caused to the Works.

5.4 Temporary office for the Engineers

The Contractor shall at his own cost and to the satisfaction of the Engineer, Construct an office/ Porta Cabin at the Works site, for Engineer's Supervisory staff which will include adequate furniture and the necessary arrangement for drinking water, toilet, etc. and shall be got approved from the Engineer. The office shall have area not less than the area given below:

a. For the Works above 1.0 crore, the Contractor shall also provide a new Computer of latest configuration with latest software with printer, scanner, back-up facility with UPS including maintenance of the Computer till the end of certified completion period of the contract.

b. The Contractor will bear all the expenses including procurement, installation and maintenance of the Computer. The Contractor shall also provide the Computer Operator and required consumables during the entire Contract period.

c. The Computer, printer, scanner, UPS etc. provided under this clause, shall be the property of the Contractor and shall be taken back after the payment under Final Payment Certificate is made.

5.5 Changes in Constitution

Where the Contractor is a partnership firm, the prior approval in writing of the Managing Director shall be obtained before any change is made in the constitution of the firm. Where the Contractor is an individual or a Hindu Undivided family business concern such approval as aforesaid shall likewise be obtained before the Contractor enters into any partnership agreement where under the partnership firm would have the right to carry out the Work hereby undertaken by the Contractor. If prior approval as aforesaid is not obtained, the Contractor shall be deemed to have been assigned in contravention of the condition 49 hereof and the same action may be taken and the same consequences shall ensure as provided for in the said condition 49.

5.6 Contract Agreement

The Contractor shall, within 30 days from the date of issue of Letter of Acceptance , prepare Contract agreement on stamp paper of required denominations as per the format provided in Contract document and shall attend the office of the Engineer, with intimation to the Engineer, to sign the Contract Agreement.

5.7 Performance Security

The Contractor shall pay a total Performance Security equal to four percent of the Contract Price as a security in form of Contract deposit and Retention money for due fulfilment of the contract, unless otherwise stated in the tender documents.

The mode of making this deposit is as under:

5.7.1 Security deposit

The successful bidder whose bid has been accepted will have to pay 4% Performance Security (SD) (As per Contract Data in Volume-II) as performance security. It shall carry no interest.

(a) The successful tenderer shall have to pay 2% initial security deposit in the form of DD from a nationalized bank payable to CEO, Solapur City Development Corporation Limited, Solapur City Development Corporation Limited. and complete the contract documents failing which his earnest money will be forfeited to Solapur City Development Corporation Limited. The 1% EMD of successful Bidder shall be converted in to the Security Deposit. The balance security deposit will be recovered from the R.A. bill at 2% of the each bill amount. Amount of total Security Deposit to be paid shall be 4% of the cost of accepted tender or estimated cost put to tender whichever is higher.

(b) All compensation or other sums payable by the Contractor under the terms of this contract or any other contract or on any account may be deducted from his performance security or from any sums which may be due to him or may become due to him by SCDCL on any account and in the event of the security being reduced by reason of any such above noted deductions, the Contractor shall within 10 days of receipt of notice of demand from the SCDCL make good the deficit.

(c) There shall be no liability on SCDCL to pay any interest on the performance security deposited by or recovered from the Contractor.

(d) The performance security shall be refunded after completion of defect liability period prescribed for this contract.

5.8 Period of Validity of Performance Security

The performance security shall be valid until the Contractor has executed and completed the Works and remedied any defects therein in accordance with the Contract. No claim shall be made against such security after the issue of the Defects Liability Certificate in accordance with Sub-Clause 48.1 and such security shall be refunded to the Contractor within 14 days of the issue of the said Defects Liability Certificate after deduction for claims, if any.

5.9 removed

5.10 Inspection of Site

The Employer shall have made available to the Contractor, before the submission by the Contractor of the Tender, such data on hydrological and sub-surface conditions as have been obtained by or on behalf of the Employer from investigation undertaken relevant to the Works but the Contractor shall be responsible for his own interpretation thereof.

The Contractor shall be deemed to have inspected and examined the Site and its surroundings and information available in connection therewith and to have satisfied himself (so far as is practicable, having regard to considerations of cost and time) before submitting his Tender, as to:

a. the form and nature thereof, including the sub-surface conditions,
b. the hydrological and climatic conditions,
c. the extent and nature of Work and materials necessary for the execution and completion of the Works and the remedying of any defects therein, and
d. the means of access to the Site and the accommodation he may require and, in general, shall be deemed to have obtained all necessary information, subject as above mentioned, as to risks, contingencies and all other circumstances which may influence or affect his Tender.

If the Contractor shall claim to have been obstructed in the execution of the Contract work by any act of lawlessness on the part of any person other than an agent or servant of SCDCL, the Contractor shall exclusively deal with such act by the due process of law but shall not be entitled to attribute thereby the breach of any obligation under the Contract to SCDCL and to claim from SCDCL compensation for damage or loss, if any thereby suffered, but shall only be entitled

to an appropriate extension of period agreed for the completion of the Contract work. Provided that, the Contractor has reported to the local police authorities and SCDCL, every such act of obstruction with particulars, soon after its occurrence and SCDCL has, after enquiry, found the same to be substantially true and has determined the duration of such obstruction.

The Contractor shall be deemed to have based his Tender confirming details on his own inspection and examination, all as aforementioned.

5.11 Sufficiency of Tender

The Contractor shall be deemed to have satisfied himself as to the correctness and sufficiency of the Tender and of the rates and prices stated in the Bill of Quantities, all of which shall, except insofar as it is otherwise provided in the Contract, cover all his obligations under the Contract (including those in respect of the supply of goods, materials, Plant or services or of contingencies for which there is a Provisional Sum) and all matters and things necessary for the proper execution and completion of the Works and the remedying of any defects therein.

5.12 Not Foreseeable physical obstructions or Conditions

If, however, during the execution of the Works the Contractor encounters physical obstructions or physical conditions, other than climatic conditions on the Site, which obstructions or conditions were, in his opinion, not foreseeable by an experienced contractor, the Contractor shall forthwith give notice thereof to the Engineer, with a copy to the Employer. On receipt of such notice, the Engineer shall, if in his opinion such obstructions or conditions could not have been reasonably foreseen by an experienced contractor, after due consultation with the Employer and the Contractor, determine any extension of time to which the Contractor is entitled under Clause 30, and shall notify the Contractor accordingly, with a copy to the Employer. Such determination shall take account of any instruction which the Engineer may issue to the Contractor in connection therewith, and any proper and reasonable measures acceptable to the Engineer which the Contractor may take in the absence of specific instructions from the Engineer.

5.13 Work to be in Accordance with Contract

Unless it is legally or physically impossible, the Contractor shall execute and complete the Works and remedy any defects therein in strict accordance with the Contract and all provided drawings to the satisfaction of SCDCL, Principal Consultant and Urban Designer. The Contractor shall comply with and adhere strictly to the SCDCL, Principal Consultant and Urban Designer's instructions on any matter, whether mentioned in the Contract or not, touching or concerning the Works. The Contractor shall take instructions only from SCDCL, Principal Consultant and Urban Designer. The Contractor shall execute the project in accordance with the specifications and drawings mentioned in the Tender Documents. In case any work is found to be not compliant with the specifications and drawings provided, the Contractor shall, at his own cost, rectify the said work within 48 hours.

5.14 Program to be submitted

The Contractor shall, within 30 days after the date of issue of Work Order, submit to the Principal Consultant and Urban Designer for their consent a programme, in such form and detail as they shall reasonably prescribe, for the execution of the Works. The Contractor shall, whenever required, by the Principal Consultant and Urban Designer, also provide in writing for his information, a general

description of the arrangements and methods which the Contractor proposes to adopt for the execution of the Works.

5.15 Revised Programme

If at any time it should appear to the Principal Consultant and Urban Designer that the actual progress of the Works does not conform to the programme to which consent has been given under Sub-Clause, 5.14, the Contractor shall produce, at the request of the Principal Consultant and Urban Designer, a revised programme showing the modifications to such programme necessary to ensure completion of the Works within the Time for Completion.

5.16 Cash Flow Estimate to be submitted

The Contractor shall, within 30 days after the date of issue of Work Order, provide to the Principal Consultant and Urban Designer for his information a detailed cash flow estimate, in quarterly periods, of all payments to which the Contractor will be entitled under the Contract and the Contractor shall subsequently supply revised cash flow estimates at quarterly intervals, if required to do so by the Principal Consultant and Urban Designer.

5.17 Contractor not relieved of Duties or Responsibilities

The submission to and consent by the Engineer of such programmes or the provision of such general descriptions or cash flow estimates shall not relieve the Contractor of any of his duties or responsibilities under the Contract.

5.18 Early Warning

The Contractor is expected to warn the Engineer, at the earliest opportunity, of specific likely future events or circumstances that may adversely affect the quality of work, increase the contract price or delay an estimate of the expected effect of the future events or circumstances on the Contract Price and Time for Completion. The estimate shall be provided by the contractor as soon as reasonably possible.

5.19 Contractor's Superintendence

The Contractor shall provide all necessary superintendence during the execution of the Works and as long thereafter as the Engineer may consider necessary for the proper fulfilling of the Contractor's obligations under the Contract. The Contractor, or a competent and authorised representative approved by the Engineer, which approval may at any time be withdrawn, shall give his whole time to the superintendence of the Works. Such authorised representative shall receive, on behalf of the Contractor, instructions from the Engineer.

If approval of the representative is withdrawn by the Engineer, the Contractor shall, as soon as is practicable, having regard to the requirement of replacing him as hereinafter mentioned, after receiving notice of such withdrawal, remove the representative from the Works and shall not thereafter employ him again on the Works in any capacity and shall replace him by another representative approved by the Engineer.

5.20 Use of Corporation's land

The Contractor shall not be permitted to enter (other than for inspection purposes) or take possession of site until instructed to do so by the Engineer in writing. The portion of the site to be occupied by the Contractor shall be defined and/or marked on the site plan, failing which these shall be indicated by the Engineer and the Contractor shall on no account be allowed to extend his operations beyond these areas. The Contractor will be allowed to use such land free of charge for the purpose of sheds, offices thereon for themselves and for the Engineer and his subordinates, and shall remove the same from the ground at the completion of the Works or whenever required to do so by the Engineer after receiving 7 days' notice. He shall make good any damage which may have been done and restore to good condition anything which may have been disturbed during the period of his occupation.

a. The Contractor shall not use or allow to be used any such ground, sheds or offices, or any portion of the site of the Works, for any other purpose than the carrying out of Works under the Contract. In the event of there being no plot or ground or insufficiency of ground belonging to the Corporation, available for the above purposes, the Contractor shall provide other such ground at his own cost. The Contractor shall, in any case, pay all taxes, which have to be paid in respect of all ground sheds or offices used as above, and all the license fees, etc., that may be demanded for the storage or otherwise of the various articles as per rules in force. The Contractor shall provide, if necessary or if required, on the site, all temporary access thereto and shall alter, adopt and maintain the same as required from time to time and shall take up and clear them away as and when no longer required and make good all damage done to the site.

b. In case, the Contractor requires additional land for specialized Works under the Contract, he shall approach to the Chief Engineer with details of his requirements. The decision of Chief Engineer in this respect shall be final and binding on the Contractor.

5.21 Supply of Water and Power

The Contractor shall make, at his own cost, his own arrangement for:

a. supply of water required for the Works including water required for testing purpose and also for drinking purpose.

b. power connection, wherever required.

5.22 Contractor's Employees

The Contractor shall provide on the Site in connection with the execution and completion of the Works and the remedying of any defects therein :

a. only such technical assistants as are skilled and experienced in their respective callings and such foremen and leading hands as are competent to give proper superintendence of the Works , and

b. such skilled, semi-skilled and unskilled labour as is necessary for the proper and timely fulfilling of the Contractor's obligations under the Contract.

5.23 Engineer at Liberty to Object

The Engineer shall be at liberty to object to and require the Contractor to remove forthwith from the Works any person provided by the Contractor who, in the opinion of the Engineer, misconducts himself, or is incompetent or negligent in the proper performance of his duties, or whose presence on Site is otherwise considered by the Engineer to be undesirable, and such person shall not be again allowed upon the Works without the consent of the Engineer. Any person so removed from the Works shall be replaced as soon as possible.

5.24 Setting Out

The Contractor shall be responsible for:

a. The accurate setting out of the Works in relation to original points, line and levels of reference given by the Engineer in writing.

b. The correctness, subject as above mentioned, of the position, levels, dimensions and alignment of all parts of the Works , and

c. The provision of all necessary instruments, appliances and labour in connection with the foregoing responsibilities.

If, at any time during the execution of the Works , any error appears in the position, levels, dimensions or alignment of any part of the Works , the Contractor, on being required so to do by the Engineer, shall at his own cost, rectify such error to the satisfaction of the Engineer, unless such error is based on incorrect data supplied in writing by the Engineer, in which case the Engineer shall determine an addition to the Contract Price in accordance with Clause 52 and shall notify the Contractor accordingly, with a copy to the Employer.

d. All levels referred to in connection with these Works are based on G.T.S. levels The checking of any setting out or of any line or level by the Engineer shall not in any way relieve the Contractor of his responsibility for the accuracy thereof and the Contractor shall carefully protect and preserve all bench-marks, site-rails, pegs and other things used in setting-out the Works.

5.25 Boreholes and Exploratory Excavation

If, at any time during the execution of the Works, the Engineer requires the Contractor to make boreholes or to carry out exploratory excavation, such requirement shall be the subject of an instruction.

6. Safety, Security and Protection of the Environment

6.1 The Contractor shall, throughout the execution and completion of the Works and the remedying of any defects therein :

(a) have full regard for the safety of all persons entitled to be upon the Site and keep the Site (so far as the same is under his control) and the Works (so far as the same are not completed or occupied by the Employer) in an orderly state appropriate to the avoidance of danger to such persons.

The Contractor shall, at his own expense, arrange for the safety provisions indicated in Annexure-'B' or as required by the Engineer, in respect of all labour, directly or indirectly employed for performance of the Works and shall provide all facilities in connection therewith. In case, the Contractor fails to make arrangements and provide necessary facilities as aforesaid, the Engineer may do so and recover the costs thereof from the Contractor.

(b) Provide and maintain at his own cost all lights, guards, fencing, warning signs and watching, when and where necessary or required by the Engineer or by any duly constituted authority, for the protection of the Works or for the safety and convenience of the public or others, and

(c) Take all reasonable steps to protect the environment on and off the Site**,** in accordance with Environment (Protection) Act, 1986, and amendments thereof, and to avoid damage or nuisance to persons or to property of the public or others, resulting from pollution, noise or other causes arising as a consequence of his methods of operation.

(d) Trees designated by the Engineer shall be suitably protected from damage during the course of the Work as directed by the Engineer, cost of which shall be borne by the Contractor.

6.2 Employer's Responsibilities

If under Clause 18 the Employer shall carry out work on the Site with his own workmen he shall, in respect of such work:

(a) have full regard to the safety of all persons entitled to be upon the Site, and

(b) keep the Site in an orderly state appropriate to the avoidance of danger to such persons.

If under Clause 31 the Employer shall employ other contractors on the Site, he shall require them to have the same regard for safety and avoidance of danger.

7. Care of Works

7.1 The Contractor shall take full responsibility for the care of the Works and materials and Plant for incorporation therein from the Commencement Date until the date of issue

of the Taking-Over Certificate for the whole of the Works, when the responsibility for the said care shall pass to the Employer, provided that:

(a) if the Engineer issues a Taking-Over Certificate for any Section or part of the Permanent Works, the Contractor shall cease to be liable for the care of that Section or part from the date of issue of the Taking-Over Certificate, when the responsibility for the care of that Section or part shall pass to the Employer, and

(b) the Contractor shall take full responsibility for the care of any outstanding Works and materials and Plant for incorporation therein which he undertakes to finish during the Defects Liability Period until such outstanding Works have been completed pursuant to Clause 49.

7.2 Responsibility to Rectify Loss or Damage

If any loss or damage happens to the Works, or any part thereof, or materials or Plant for incorporation therein, during the period for which the Contractor is responsible for the care thereof, from any cause whatsoever, other than the risks defined in Sub-Clause 7.3, the Contractor shall, at his own cost, rectify such loss or damage so that the Permanent Works conform in every respect with the provisions of the Contract to the satisfaction of the Engineer. The Contractor shall also be liable for any loss or damage to the Works occasioned by him in the course of any operations carried out by him for the purpose of complying with his obligations under Clause 49 and 50. The rectification to be completed within seven days from the date of notification to the satisfaction of the Engineer.

7.3 Loss or Damage Due to Employer's Risks

In the event of any such loss or damage happening from any of the risks defined in Sub-Clause 7.4, or in combination with other risks, the Contractor shall, if and to the extent required by the Engineer, rectify the loss or damage and the Engineer shall determine an addition to the Contract Price in accordance with Clause 37 and shall notify the Contractor accordingly, with a copy to the Employer.

In the case of a combination of risks causing loss or damage any such determination shall take into account the proportional responsibility of the Contractor and the Employer.

7.4 Force Majeure

7.4.1 In the event of either party being rendered unable by force-majeure to perform any obligation required to be performed by them under the Contract, the relative obligation of the party affected by such force majeure shall upon notification to the other party be suspended for the period during which the effect of the force majeure event lasts. Subject to the Article 7 hereof, the cost and loss sustained by either party shall be borne by the respective parties.

The term 'Force Majeure' as employed herein shall mean an exceptional event or circumstance;

a. which is beyond the control of the party alleging it has been rendered unable,
b. which could not reasonably have been provided against before entering into the Contract by the party alleging so,
c. which, having arisen, could not have reasonably been avoided or overcome, by the said alleging party,
d. which is not attributable to the other party.

Force majeure includes exceptional events or circumstances listed below, so long as conditions (a) to (d) above are satisfied:

i) natural catastrophes such as earthquakes, hurricane, or volcanic activity,
ii) war (declared or undeclared), invasion, or military or usurped power, rebellion, revolt, act of foreign enemies,
iii) riot (other than among the Contractor's/its sub- contractor's employees), civil commotion, civil war,
iv) nuclear fission, ionizing radiation, or contamination by radioactivity from any nuclear fuel, or from any nuclear waste from the combustion of nuclear fuel, radioactive toxic explosive or other hazardous properties of any explosive nuclear assembly or nuclear component thereof,
v) pressure waves caused by aircraft or other aerial devices travelling at sonic or supersonic speeds;

provided these affect the Time of Completion

7.4.2 Upon the occurrence of any such cause, and upon its termination the party alleging that it has been rendered unable, as aforesaid, shall notify the other party in writing immediately but not later than 72 (seventy two) hours of the alleged beginning and ending thereof. Within 14 days after ending of such occurrence a communication shall be given to the other party giving full particulars and satisfactory evidence in support thereof.

7.4.3 Time for performance of the relative obligation suspended by the force majeure shall stand extended pursuant to Article 24 hereof to the extent the effect of such occurrence affects the Time for Completion.

8. Insurance of Works and Contractor's Equipment

8.1 The Contractor shall, without limiting his or the Employer's obligations and responsibilities under Clause 7, insure:

(a) the Works , together with materials and Plant for incorporation therein, to the full replacement cost (the term "cost" in this context shall include profit),

(b) an additional sum of 15 per cent of such replacement cost, to cover any additional costs of and incidental to the rectification of loss or damage including professional fees and the cost of demolishing and removing any part of the Works and of removing debris of whatsoever nature, and

(c) the Contractor's Equipment and other things brought onto the Site by the Contractor, for a sum sufficient to provide for their replacement at the Site.

8.2 Scope of Cover

The insurance in paragraphs (a) and (b) of Clause 8 shall be in the joint names of the Contractor and the Employer and shall cover:

(a) the Employer and the Contractor against all loss and damage from whatsoever cause arising, other than as provided in Sub-Clause 8.4, from the date of start of Work at the Site until the date of issue of the relevant Taking-Over Certificate in respect of the Works or any Section or part thereof as the case may be, and

(b) the Contractor for his liability:

(i) during the Defects Liability Period for loss or damage arising from a cause occurring prior to the commencement of the Defects Liabilities Period, and

(ii) for loss or damage occasioned by the Contractor in the course of any operation carried out by him for the purpose of complying with his obligations under Clauses 35 and 37.

(c) It shall be the responsibility of the Contractor to notify the insurance company of any change in the nature and extent of the Works and to ensure the adequacy of the insurance coverage at all times during the period of the Contract.

8.3 Responsibility for Amounts not recovered

Any amounts not insured or not recovered from the insurers shall be borne by the Employer or the Contractor in accordance with their responsibilities under Clause 7.

8.4 Exclusions

There shall be no obligation for the insurances in Sub-Clause 8.1 to include loss or damage caused by:

(a) war, hostilities (whether war be declared or not), invasion, act of foreign enemies,

(b) rebellion, revolution, insurrection, or military or usurped power, or civil war,

(c) ionising radiations or contamination by radio-activity from any nuclear fuel, or from any nuclear waste from the combustion of nuclear fuel, radio- active toxic explosive or other hazardous properties of any explosive nuclear assembly or nuclear component thereof, or

(d) pressure waves caused by aircraft or other aerial devices travelling at sonic or supersonic speeds.

9. Damage to Persons and Property

9.1 The Contractor shall, except if and so far as the Contract provides otherwise, indemnify the Employer against all losses and claims in respect of:

(a) death of or injury to any person, or

(b) loss of or damage to any property (other than the Works), which, may arise out of or in consequences of the execution and completion of the Works and the remedying of any defects therein, and against all claims, proceedings, damages, costs, charges and expenses whatsoever in respect thereof or in relation thereto, subject to the exceptions defined in Sub-Clause 9.2.

9.2 Exceptions

The "exceptions" referred to in Sub-Clause 9.1 are :

(a) the permanent use or occupation of land by the Works , or any part thereof

(b) the right of the Employer to execute the Works , or any part thereof, on, over, under, in or through any land,

(c) damage to property which is the unavoidable result of the execution and completion of the Works , or the remedying of any defects therein, in accordance with the Contract, and

(d) death of or injury to persons or loss of or damage to property resulting from any act or neglect of the Employer, his agents, servants or other contractors, not being employed by the Contractor, or in respect of any claims, proceedings, damages, costs, charges and expenses in respect thereof or in relation thereto, or where the injury or damage was contributed to by the Contractor, his servants or agents, such part of the said injury or damage as may be just and equitable having regard to the extent of the responsibility of the Employer, his servants or agents or other contractors for the injury or damage.

9.3 Indemnity by Employer

The Employer shall indemnify the Contractor against all claims, proceedings, damages, costs, charges and expenses in respect of the matters referred to in the exceptions defined in Sub-Clause 9.2.

10. Third Party Insurance (including Employer's Property)

10.1 The Contractor shall, without limiting his or the Employer's obligations and responsibilities under Clause 9, insure, in the joint names of the Contractor and the Employer, against liabilities for death of or injury to any person (other than as provided in Clause 24) or loss of or damage to any property (other than the Works) arising out of the performance of the Contract, other than the exceptions defined in paragraphs (a), (b) and (c) of Sub-Clause 9.2.

10.2 Minimum Amount of Insurance

Such insurance shall be for at least the amount equivalent to 1.2 times the Contract Price.

10.3 Cross Liabilities

The insurance policy shall include a cross liability clause such that the insurance shall apply to the Contractor and to the Employer as separately insured.

10.4 Insurance Policy

All insurance to be effected by the Contractor and/or his sub- contractors (if any) shall be taken out only with the Government Insurance Fund, MAHARASHTRA State.

11. Accident or Injury to Workmen

11.1 The Employer shall not be liable for or in respect of any damages or compensation payable to any workman or other person in the employment of the Contractor or any Subcontractor, other than death or injury resulting from any act or default of the Employer, his agents or servants. The Contractor shall indemnify and keep indemnified the Employer against all such damages and compensation, other than those for which the Employer is liable as aforesaid, and against all claims, proceedings, damages, costs, charges and expenses whatsoever in respect thereof or in relation thereto.

11.2 Insurance against Accident to Workmen

The Contractor shall insure against such liability and shall continue such insurance during the whole of the time that any persons are employed by him on the Works. Provided that, in respect of any persons employed by any Subcontractor, the Contractor's obligations to insure as aforesaid under this Sub- Clause shall be satisfied if the Subcontractor shall have insured against the liability in respect of such persons in such manner that the Employer is indemnified under the policy, but the Contractor shall require such Subcontractor to produce to the Employer, when required, such policy of insurance and the receipt for the payment of the current premium.

It is mandatory for the Contractor that all workmen appointed to complete the Contract work, are insured under Workmen's Compensation Insurance Policy.

12. Evidence and Terms of Insurances

12.1 The Contractor shall provide evidence to the Employer as soon as practicable after respective insurances has been taken out but in any case prior to the start of Work at the Site that the insurances required under the Contract have been effected and shall, within 84 days of the Commencement Date, provide the insurance policies to the Employer. When providing such evidence and such policies to the Employer, the Contractor shall notify the Engineer of so doing. Such insurance policies shall be consistent with the general terms agreed prior to the issue of the Letter of Acceptance. The Contractor shall effect all insurances for which he is responsible with insurers and in terms approved by the Employer. The Contractor shall pay full premium prior to start of the Work and take out insurance policies for the entire period of Contract including defects liability period and also pay necessary premium for extended period of Contract if any. The Contractor shall prove to the Engineer from time to time that he has taken out all the insurance policies and has paid the necessary premiums for keeping the policies alive till expiry of the Defects Liability Period.

12.2 Adequacy of Insurances

The Contractor shall notify the insurers of changes in the nature, extent or programme for the execution of the Works and ensure the adequacy of the insurances at all times in accordance with the terms of the Contract and shall, when required, produce to the Employer the insurance policies in force and the receipt for payment of the current premiums.

12.3 Remedy on Contractor's Failure to Insure

If the Contractor fails to effect and keep in force any of the insurances required under the Contract, or fails to provide the policies to the Employer within the period required by Sub-Clause 12.1, then and in any such case the Employer may effect and keep in force any such insurances and pay any premium as may be necessary for that purpose and from time to time deduct the amount so paid from any monies due or to become due to the Contractor, or recover the same as a debt due from the Contractor.

12.4 Compliance with Policy Conditions

In the event that the Contractor or the Employer fails to comply with conditions imposed by the insurance policies effected pursuant to the Contract, each shall indemnify the other against all losses and claims arising from such failure.

13. Compliance with Statutes, Regulations

13.1 The Contractor shall conform in all respects, including by the giving of all notices and the paying of all fees, with the provisions of:

(a) any National or State Statute, Ordinance, or other Law, or any regulation, or bye-law of any local or other duly constituted authority in relating to the execution and completion of the Works and the remedying of any defects therein, and

(b) the rules and regulations of all public bodies and companies whose property or rights are affected or may be affected in any way by the Works,

and the Contractor shall keep the Employer indemnified against all penalties and liability of every kind for breach of any such provisions. Provided always that the Employer shall be responsible for obtaining any planning, zoning or other similar permission required for the Works to proceed and shall indemnify the Contractor in accordance with Sub- Clause 9.3.

14. Fossils

14.1 All fossils, coins, articles of value or antiquity and structures and other remains or things of geological or archaeological interest discovered on the Site shall, as between the Employer and the Contractor, be deemed to be the absolute property of the Employer. The Contractor shall take reasonable precautions to prevent his workmen or any other persons from removing or damaging any such article or thing and shall, immediately upon discovery thereof and before removal, acquaint the Engineer of such discovery and carry out the Engineer's instructions for dealing with the same. If, by reason of such instructions, the Contractor suffers delay and/or incurs costs then the Engineer shall, after due consultation with the Employer and the Contractor determine:

(a) any extension of time to which the Contractor is entitled under Clause 30, and

(b) the amount of such costs, which shall be added to the Contract Price, and shall notify the Contractor accordingly, with a copy to the Employer.

15. Patent Rights

15.1 The Contractor shall save harmless and indemnify the Employer from and against all claims and proceedings for or on account of infringement of any patent rights, design trademark or name or other protected rights in respect of any Contractor's Equipment, materials or Plant used for or in connection with or for incorporation in the Works and from and against all damages, costs, charges and expenses whatsoever in respect thereof or in relation thereto, except where such infringement results from compliance with the design or Specification provided by the Engineer.

15.2 Royalties

Except where otherwise stated, the Contractor shall pay all tonnage and other royalties, rent and other payments or compensation, if any, for getting soil / earth , stone, sand, gravel, murum, clay or other materials required for the Works , imposed by authorities from time to time and submit to the Engineer, proof of such payment, if so required by the Engineer.

16. Interference with Traffic, Utilities, Rain water and Adjoining Properties

16.1 All operations necessary for the execution and completion of the Works and the remedying of any defects therein shall, so far as compliance with the requirements of the Contract permits, be carried on so as not to interfere unnecessarily or improperly with:

a. the convenience of the public, or

b. the access to, use and occupation of public or private roads and footpaths to or of properties whether in the possession of the Employer or of any other person.

c. the underground utilities services such as water pipes, gas pipes, drains, sewers, cables etc., which shall be protected and properly maintained at his own cost.

d. The Contractor shall save harmless and indemnify the Employer in respect of all claims, proceedings, damages, costs, charges and expenses whatsoever arising out of, or in relation to, any such matters insofar as the Contractor is responsible therefore.

e. The Contractor shall prepare a Traffic Management Plan for the area around the site, to be implemented during the period of construction to the satisfaction of SCDCL / Principal Consultant / Urban Designer, and shall get the same approved by Solapur Traffic Police Department.

f. The Contractor shall have to make all necessary arrangements for regulating traffic day and night, during the period of construction and to the entire satisfaction of the SCDCL / Principal Consultant / Urban Designer.

g. Rain water, water through pipelines, sewer lined pumping if required in contractors scope

h. Pumping-out of any water on site in Contractor's scope and at his own cost.

17. Avoidance of damage to Roads

17.1 The Contractor shall use every reasonable means to prevent any of the roads or bridges communicating with or on the routes to the Site from being damaged or injured by any traffic of the Contractor or any of his Subcontractors and, in particular, shall select routes, choose and use vehicles and restrict and distribute loads so that any such extraordinary traffic as will inevitably arise from the moving of materials, Plant, Contractor's Equipment or Temporary Works from and to the Site shall be limited, as far as reasonably possible, and so that no unnecessary damage or injury may be occasioned to such roads and bridges.

17.2 Transport of Contractor's equipment or temporary Works

Save insofar as the Contract otherwise provides, the Contractor shall be responsible for and shall pay the cost of strengthening any bridges or altering or improving any road communicating with or on the routes to the Site to facilitate the movement of Contractor's Equipment or Temporary Works and the Contractor shall indemnify and keep indemnified the Employer against all claims for damage to any such road or bridge caused by such movement, including such claims as may be made directly against the Employer, and shall negotiate and pay all claims arising solely out of such damage.

17.3 Transport of materials or plants

If, notwithstanding Sub-Clause 17.1, any damage occurs to any bridge or road communicating with or on the routes to the Site arising from the transport of materials or Plant, the Contractor shall notify the Engineer with a copy to the Employer, as soon as he becomes aware of such damage or as soon as he receives any claim from the authority entitled to make such claim. Where under any law or regulation the haulier of such materials or Plant is required to indemnify the road authority against damage the Employer shall not be liable for any costs, charges or expenses in respect thereof or in relation thereto. In other cases the Employer shall negotiate the settlement of and pay all sums due in respect of such claim and shall indemnify the Contractor in respect thereof and in respect of all claims, proceedings, damages, costs, charges and expenses in relation thereto. Provided that if an so far as any such claim or part thereof is, in the opinion of the Engineer, due to any failure on the part of the Contractor to observe and perform his obligations under Sub-Clause 17.1, then the amount, determined by the Engineer, after due consultation with the Employer and the Contractor, to be due to such failure shall be recoverable from the Contractor by the Employer and may be deducted by the Employer from any monies due or to become due to the Contractor and the Engineer shall notify the Contractor accordingly, with a copy to the Employer. Provided also that the Employer shall notify the Contractor whenever a settlement is to be negotiated and, where any amount may be due from the Contractor, the Employer shall consult with the Contractor before such settlement is agreed.

17.4 Waterborne Traffic

Where the nature of the Works is such as to require the use by the Contractor of waterborne transport the foregoing provisions of this Clause shall be construed as though "road" included a lock, dock, sea wall or other structure related to a waterway and "vehicle" included craft, and shall have effect accordingly.

18. Opportunities for Other Contractors

18.1 The Contractor shall, in accordance with the requirements of the Engineer, afford all reasonable opportunities for carrying out their work to:

a. any other contractors employed by the Employer and their workmen,
b. the workmen of the Employer, and
c. the workmen of any duly constituted authorities who may be employed in the execution on or near the Site of any work not included in the Contract or of any contract which the Employer may enter into in connection with or ancillary to the Works .

18.2 Facilities for Other Contractors

If, however, pursuant to Sub-Clause 31.1 the Contractor shall, on the written request of the Engineer :

a. make available to any such other contractor, or to the Employer or any such authority, any roads or ways for the maintenance of which the Contractor is responsible,

b. permit the use, by any such, of Temporary Works or Contractor's Equipment on the Site, or

c. provide any other service of whatsoever nature for any such, the Engineer shall determine an addition to the Contract Price in accordance with Clause 52 and shall notify the Contractor accordingly, with a copy to the Employer.

19. Contractor to Keep Site Clear

19.1 During the execution of the Works the Contractor shall keep the Site reasonably free from all unnecessary obstruction and shall store or dispose of any Contractor's Equipment and surplus materials and clear away and remove from the Site any wreckage, rubbish or Temporary Works no longer required.

20. Clearance of Site on Completion

33.1 Upon the issue of any Taking-Over Certificate the Contractor shall clear away and remove from that part of the Site to which such Taking-Over Certificate relates all Contractor's equipment, surplus material, rubbish and Temporary Works of every kind, and leave such part of the Site and Works clean and in a workmanlike condition to the satisfaction of the Engineer. Provided that the Contractor shall be entitled to retain on Site, until the end of the Defects Liability Period, such materials, Contractor's Equipment and Temporary Works as are required by him for the purpose of fulfilling his obligations during the Defects Liability Period.

21. Labour

21.1 Engagement of Staff and Labour

The Contractor shall, unless otherwise provided in the Contract, make his own arrangements for the engagement of all staff and labour, local or other, and for their payment, provident fund, housing, feeding and transport.

The Contractor shall employ the unskilled labour to be employed by him on the Works only from locally available labours and shall give preference to those persons enrolled under Maharashtra Government Employment and Self Employment Departments Scheme. provided, however, that if the required unskilled labours are not available locally, the Contractor shall in the first instant employ such number of persons as is available and thereafter may with previous permission, in writing of the Engineer, obtain the rest of the requirement of unskilled labour from outside

the above scheme. In such case, the Contractor shall obtain requisite license / registration certificate under the Interstate Migrant Workmen Act and/or Contract Labour Act.

21.2 Rates of Wages and conditions of Labor

The Contractor shall pay rates of wages and observe conditions of labour not less favourable than those established for the trade or industry where the work is carried out. The Contractor shall also comply with the provisions of payment of Wages Act, 1936, Minimum Wages Act, 1948, Employees Liability Act 1938, Workmen's Compensation Act, 1923, Industrial Disputes Act, 1947, Indian Factories Act, 1948, Maternity Benefit Act, 1961, Provident F und Act or any modification thereof or any other law relating thereto and rules made thereunder from time to time, he will observe and give effect to the provisions of any law for the time being in force and regulating the rights and privileges of the labourers employed by him directly or indirectly. The Contractor shall indemnify the Corporation against any payments to be made thereunder.

21.3 Housing for Labor

Save insofar as the Contract otherwise provides, the Contractor shall provide and maintain such accommodation and amenities as he may consider necessary for all his staff and labour, employed / engaged for the purpose of or in connection with the Contract, including all fencing, water supply (both for drinking and other purposes), electricity supply, sanitation, cookhouses, fire prevention and firefighting equipment, and other requirements in connection with such accommodation or amenities. On completion of the Contract, unless otherwise agreed with the Employer, the temporary camps or housing provided by the Contractor shall be removed and the site reinstated to its original condition, all to the approval of the SCDCL.

21.4 Health and Safety

Due precautions shall be taken by the Contractor, and at his own cost, to ensure the safety of his staff and labour and in collaboration with and to the requirements of the local health authorities, to ensure that medical staff, first aid equipment and stores sick bay and suitable ambulance services whenever necessary, including an adequate supply of sterilized dressing materials and sterilized cotton wool, as prescribed in the Factory Rules of the Maharashtra State, are available at the camps, housing, and on the Site at all times throughout the period of the Contract and that suitable arrangements are made for the prevention of epidemics and for all necessary welfare and hygiene requirements.

21.5 Measures against Insect and Pest Nuisance

The Contractor shall at all times take the necessary precautions to protect all staff and labour employed on the Site from insect nuisance, rats, and other pests and reduce the dangers to health and the general nuisance caused by the same. The Contractor shall provide his staff and labour with suitable prophylactics for the prevention of malaria, and shall take steps to prevent the formation of stagnant pools of water. He shall comply with all the regulations of the local health authorities in these respects and shall in particular arrange to spray thoroughly with approved insecticide all buildings erected on the Site. Such treatment shall be carried out at least once a year or as instructed by the Engineer. The Contractor shall warn his staff and labour of the dangers of bilharzia and wild animals.

21.6 Disorderly Conduct

The Contractor shall at all times take all reasonable precautions to prevent any unlawful, riotous, or disorderly conduct by or among his staff and labour and take all reasonable precautions for the preservation of peace and protection of persons and property in the neighborhood of the Works against the same. He shall also pay the necessary charges for Police protection, required if any, as the Chief Engineer may deem necessary.

22. Returns of Labour and Contractor's Equipment

22.1 The Contractor shall, if required by the Engineer, deliver to the Engineer a return in detail, in such form and such intervals as the Engineer may prescribe, showing the staff and the number of the several classes of labour from time to time employed by the Contractor on the Site and such information respecting Contractor's Equipment as the Engineer may require.

22.2 Records of Safety and Health

The Contractor shall maintain such records and make such reports concerning safety, health and welfare of persons and damage to property as the Engineer may from time to time prescribe.

22.3 Reporting of Accidents

The Contractor shall report to the Engineer details of any accident as soon as possible after its concurrence. In the case of any fatality or serious accident, the Contractor shall, in addition, notify the Engineer immediately by the quickest available means.

22.4 The Apprentices Act 1961

The Contractor shall duly comply with the provision of the Apprentices Act 1961 (III of 1961) the rules made there under and the order that may be issued from time to time under the said Act and the said Rules and on his failure or neglect to do so he shall be subject to all the liabilities and penalties provided by the said Act and said Rules.

23. Materials, Plant and Workmanship

23.1 Quality of Materials, Plant and Workmanship

All materials, Plant and workmanship shall be:

(a) of the respective kinds described in the Contract and in accordance with the Engineer's instructions, and

(b) subjected from time to time to such tests as the Engineer may require at the place of manufacture, fabrication or preparation, or on the Site or at such other place or places as may be specified in the Contract, or at all or any of such places.

The Contractor shall provide such assistance, transport, labour, electricity, fuels, stores, apparatus and instruments as are normally required for examining, measuring and testing any materials or Plant and shall supply samples of materials, before incorporation in the Works , for testing as may be selected and required by the Engineer.

23.2 Cost of Samples

All samples shall be supplied by the Contractor at his own cost if the supply thereof is clearly intended by or provided for in the Contract.

23.3 Cost of Tests

The cost of making any test shall be borne by the Contractor if such test is:

(a) clearly intended by or provided for in the Contract, or

(b) particularized in the Contract (in case only of a test under load or of a test to ascertain whether the design of any finished or partially finished Work is appropriate for the purpose which it was intended to fulfill) in sufficient detail to enable the Contractor to price or allow for the same in his tender.

23.4 Cost of Test not provided for

If any test required by the Engineer which is:

(a) not so intended by or provided for,

(b) (in the cases above mentioned) not so particularized, or

(c) (though so intended or provided for) required by the Engineer to be carried out at any place other than the Site or the place of manufacture, fabrication or preparation of the materials of Plant tested,

shows the materials, Plant or workmanship not to be in accordance with the provisions of the Contract to the satisfaction of the Engineer, then the cost of such test shall be borne by the Contractor, but in any other case Sub-Clause 24.5 shall apply.

24.5 Engineer's Determination where Tests not provided for

Where, pursuant to Sub-Clause 36.4, this Sub-Clause applies, the Engineer shall, after due consultation with the Employer and the Contractor, determine:

(a) any extension of time to which the Contractor is entitled under Clause 30, and

(b) the amount of such costs, which shall be added to the Contract Price, and shall notify the Contractor accordingly with a copy to the Employer.

24.6 Use of B.I.S. specifications

In cases where no particular specifications are given for any articles to be used under the contract, the relevant specification where one exists of the latest version of Bureau of Indian Standards shall apply.

24. Inspection of Operations

24.1 The Engineer, and any person authorised by him, shall at all reasonable times have access to the Site and to all Works hops and places where materials or Plant are being manufactured, fabricated or prepared for the Works and the Contractor shall afford every facility for and every assistance in obtaining the right to such access.

24.2 Inspection and Testing

The Engineer shall be entitled, during manufacture, fabrication or preparation to inspect and test the materials and Plant to be supplied under the Contract. If materials or Plant are being manufactured, fabricated or prepared in Works hops or places other than those of the Contractor, the Contractor shall obtain permission for the Engineer to carry out such inspection and testing in those Works hops or places. Such inspection or testing shall not release the Contractor from any obligation under the Contract.

24.3 Dates for Inspection and Testing

The Engineer / Official may carry out inspection of site at any time.

24.4 Rejection

If, at the time and place agreed in accordance with Sub-Clause 37.3, the materials or Plant are not ready for inspection or testing or if, as a result of the inspection or testing referred to in this Clause, the Engineer determines that the materials or Plant are defective or otherwise not in accordance with the Contract, he may reject the materials or Plant and shall notify the Contractor thereof immediately. The notice shall state the Engineer's objections with reasons. The Contractor shall then promptly make good the defect or ensure that rejected materials or Plant comply with the Contract. If the Engineer so requests, the tests of rejected materials or Plant shall be made or repeated under the same terms and conditions. All costs incurred for the tests shall be borne by the Contractor.

24.5 Independent Inspection

The Engineer may delegate inspection and testing of materials or Plant to an independent inspector. Any such delegation shall be effected in accordance with Sub-Clause 2.4 and for this purpose such independent inspector shall be considered as an assistant of the Engineer. Notice of such appointment (not being less than 14 days) shall be given by the Engineer to the Contractor.

25. Examination of Work before Covering up

25.1 No part of the Works shall be covered up or put out of view without the approval of the Engineer and the Contractor shall afford full opportunity for the Engineer to examine and measure any such part of the Works which is about to the covered up or put out of view and to examine foundations before any part of the Works is placed thereon. The Contractor shall give notice to the Engineer whenever any such part of the Works or foundations is or are ready or about to be ready for examination and the Engineer shall, without unreasonable delay, unless he considers it necessary and advises the Contractor accordingly, attend for the purpose of examining and measuring such part of the Works or of examining such foundations.

25.2 Uncovering and Making Openings

The Contractor shall uncover any part of the Works or make openings in or through the same as the Engineer may from time to time instruct and shall reinstate and make good such part. If any such part has been covered up or put out of view after compliance with the requirement of Sub-Clause 38.1 and is found to be executed in accordance with the Contract, the Engineer shall, after due consultation with the Employer and the Contractor, determine the amount of the Contractor's costs in respect of such of uncovering, making openings in or through, reinstating and making good the same, which shall be added to the Contractor Price, and shall notify the Contractor accordingly, with a copy to the Employer. In any other case all costs shall be borne by the Contractor.

25.3 Materials brought to site

All materials brought to the site shall become and remains the property of the Corporation and shall not be removed off the site without the prior written approval of the Engineer. But whenever the Works are finally completed and advance paid, if any, in respect of any such material is fully recovered, the Contractor shall at his own expense forthwith remove from the site all surplus materials originally supplied by him and upon such removal, the same shall revest in and become the property of the Contractor.

25.4 Materials obtained from excavation

Materials of any kind obtained from excavation of the site shall remain the property of the Corporation and shall be disposed off as per the Contract and as directed by the Engineer.

25.5 Use of Explosives

The Contractor shall comply with all laws and security regulations in force from time to time, relating to the procurement, importation, movement, storage and use of explosives including the provision of magazines at locations approved by the appropriate authorities. The magazines shall conform in all respects to all laws in force regarding the erection, maintenance and guarding of magazines.

The Contractor shall obtain all necessary licenses as may be required for the procurement, importation, movement, storage and use of explosives and do all things necessary to ensure compliance with the laws in force relating to dangerous goods.

26. Removal of Improper Work, Materials or Plant

26.1 The Engineer shall have authority to issue instructions from time to time, for:

a. the removal from the Site, within such time or times as may be specified in the instruction, of any materials or Plant which, in the opinion of the Engineer, are not in accordance with the Contract,

b. the substitution of proper and suitable materials or Plant, and

c. the removal and proper re-execution, notwithstanding any previous test thereof or interim payment therefore, of any Work which, in respect of

(i) materials, Plant or workmanship, or

(ii) design by the Contractor or for which he is responsible, is not, in the opinion of the Engineer, in accordance with the Contract.

26.2 Default of Contractor in Compliance

In case of default on the part of the Contractor in carrying out such instruction within the time specified therein or, if none, within a reasonable time, the Employer shall be entitled to employ and pay other persons to carry out the same and all costs consequent thereon or incidental thereto shall, after due consultation with the Employer and the Contractor, be determined by the Engineer and' shall be recoverable from the Contractor by the Employer, and may be deducted by the Employer from any monies due or to become due to the Contractor and the Engineer shall notify the Contractor accordingly, with a copy to the Employer.

27. Suspension and foreclosure

27.1 Suspension of work

If at any time after acceptance of the Tender, SCDCL / Principal Consultant / Urban Designer, shall for any reason whatsoever (other than default on the part of the Contractor for which the Corporation is entitled to rescind the contract) desire that the whole or any part of the Work specified in the tender should be suspended for any period or that the whole or part of the Work should not be carried out at all, he shall give the Contractor a notice in writing of such desire and upon the receipt of such notice the Contractor shall forthwith suspend or stop the Work wholly or in part as required, after having due regard to the appropriate stage at which the Work should be stopped or suspended so as not to cause any damage or injury to the Work already done or endanger the safety thereof provided that the decision of the engineer as to the stage at which the Work or any part of it could be or could have been safely stopped or suspended shall be final and conclusive against the Contractor. The Contractor shall have no claim to any payment or compensation whatsoever by reason of in pursuance of any notice as aforesaid on account of any suspension, stoppage or curtailment except to the extent specified in 27.2 & 27.3.

27.2 Where the total suspension of the Work ordered as aforesaid continued for a continuous period exceeding 90 days the Contractor shall be at liberty to withdraw from the contractual obligations under the Contract so far as it pertains to the unexecuted part of the Work by giving 10 days prior notice in writing to the engineer, within 30 days of the expiry of the said period of 90 days, of such intention and requiring the engineer to record the final measurements of the Work already done and to pay final payment. Upon giving such notice the Contractor shall be deemed to have been discharged from his obligation to complete the remaining unexecuted Work under the Contract. On receipt of such notice the engineer shall proceed to complete the measurement and make such payment as may be finally due to the Contractor within a period of 90 days from the receipt of such notice in respect of the Work already done by

the Contractor. Such payment shall not in any manner prejudice the right of the Contractor to any further compensation under the remaining provisions of this clause.

27.3 Where the Engineer required the Contractor to suspend the Work for a period of excess of 30 days at any time or 60 days in the aggregate, the Contractor shall be entitled to apply to the engineer within 30 days of the suspension of Work after such suspension for payment of compensation to the extent of pecuniary loss suffered by him in respect of working machinery remained idle on the site or on the account of his having had to pay the salary or wages of labour engaged by him during the said period of suspension, provided always that the Contractor shall not be entitled to pay any claim in respect of any such working machinery salary or wages for the first 30 days whether consecutive or in the aggregate of such suspension or in respect of any suspension whatsoever occasioned by unsatisfactory work or any other default on his part. The decision of the engineer in this regard shall be final and conclusive against the Contractor.

27.3.1 If the suspension is ordered for the reasons other than default of the Contractor then the Contractor shall be entitled to an extension of time equal to period of such suspension plus a reasonable time as decided by the Engineer.

27.3.2 In the event of -

(i) Any stoppage of Work on notice from the Engineer under Sub Clause 27.1

AND / OR

(ii) Withdrawal by the Contractor from the contractual obligation to complete the remaining unexecuted Work under Sub-Clause 40.2 on account of continued suspension of Work for a period exceeding 90 days.

It shall be open to the Contractor, within 90 days from the service of (i) the notice of stoppage of Work or (ii) the notice of withdrawal from the contractual obligations under the Contract on account of the continued suspension of Work or (iii) notice under clause 40(1) resulting in such curtailment, to produce to the Engineer satisfactory documentary evidence that he had purchased or agreed to purchase material for use in the contracted work, before receipt by him of the notice of stoppage, suspension or curtailment and require the Corporation to take over on payment such material at the rates determined by the Engineer, provided, however, that such rates shall in no case exceed the rates at which the same was acquired by the Contractor. The Corporation shall thereafter take over the material so offered, provided the quantities offered, are not in excess of the requirement of the unexecuted work as specified in the accepted tender and are of quality and specifications approved by the Engineer.

27.4 Foreclosure of Contract in full or in part

If at any time after acceptance of the tender the Managing Director shall decide to abandon or reduce the scope of the Works for any reasons whatsoever and hence not require the whole or any part of the Works to be carried out, he shall inform the Contractor in writing to that effect and the Contractor shall have no claim to any payment or compensation or otherwise whatsoever, on account of any profit or advantage which he might have derived from the execution of the Works in full but which he did not derive in consequence of the foreclosure of the whole or part of the Works .

The Contractor shall be paid at the Contract rates full amount for Works executed at site, and in addition, reasonable amount as certified by the Engineer for the value of such material (which material thereupon become the property of the Corporation) and also such further allowances as the Chief Engineer may think reasonable and fair in respect of (a) any expenditure incurred by the Contractor towards preliminary Works etc., and (b) other reasonable and proper engagement the Contractor may have entered into for carrying out the work.

28. Commencement and Delays

28.1 Commencement of Works

The Contractor shall commence the Works within 15 days of receiving the Work Order from SCDCL. Thereafter, the Contractor shall proceed with the Works with due expedition and without delay.

28.2 Possession of Site

Save insofar as the Contract may prescribe:

(a) the extent of portions of the Site of which the Contractor is to be given possession from time to time.

(b) the order in which such portions shall be made available to the Contractor,

and, subject to any requirement in the Contract as to the order in which the Works shall be executed, the Employer will, with the Engineer's notice to commence the Works , give to the Contractor possession of

(c) so much of the Site, and

(d) such access as, in accordance with the Contract, is to be provided by the Employer as may be required to enable the Contractor to commence and proceed with the execution of the Works in accordance with the programme referred to in Clause 14, if any, and otherwise in accordance with such reasonable proposals as the Contractor shall, by notice to the Engineer with a copy to the Employer, make. The Employer will, from time to time as the Works proceed, give to the Contractor possession of such further portions of the Site as may be required to

enable the Contractor to proceed with the execution of the Works with due dispatch in accordance with such programme or proposals, as the case may be.

28.3 Failure to Give Possession

If the Contractor suffers delay and/or incurs costs from failure on the part of the Employer to give possession in accordance with the terms of the Sub-Clause 28.2, the Engineer shall, after due consultation with the Employer and the Contractor, determine:

(a) any extension of time to which the Contractor is entitled under Clause 30, and

(b) the amount of such costs, subject to maximum of 5% of Contract Price, which shall be added to the Contract Price, and shall, notify the Contractor accordingly, with a copy to the Employer

28.4 Rights of Way and Facilities

The Contractor shall bear all costs and charges for special or temporary rights of way, required by him in connection with access to the Site. The Contractor shall also provide at his own cost any additional facilities outside the Site required by him for the purpose of the Works.

29. Time for Completion

43.1 The whole of the Works and, if applicable, any Section required to be completed within a particular time as stated in the Annexure- A, shall be completed, in accordance with the provisions, within the time stated in the Annexure- A, for the whole of the Works or the Section (as the case may be), calculated from the Commencement Date, or such extended time as may be allowed under Clause 30.

30. Extension of Time for Completion

30.1 In the event of:

a. the amount of nature of extra or additional work,

b. any cause of delay referred to in these Conditions,

c. exceptionally adverse climatic conditions,

d. any delay, impediment or prevention by the Employer, or

e. other special circumstances which may occur, other than through a default of or breach of Contract by the Contractor or for which he is responsible, being such as fairly to entitle the Contractor to an extension of Time for Completion of the Works , or any Section or part thereof, the Engineer shall, after due consultation with the Employer and the Contractor, determine the amount of such extension and shall notify the Contractor accordingly, with a copy to the Employer

30.2 Contractor to Provide Notification and Detailed Particulars

Provided that the Engineer is not bound to make any determination unless the Contractor has

(a) within 28 days after such event has first arisen notified the Engineer, with a copy to the Employer and

(b) within 28 days, or such other reasonable time as may be agreed by the Engineer, after such notification submitted to the Engineer detailed particulars of any extension of time to which he may consider himself entitled in order that such submission may be investigated at the time.

30.3 Interim Determination of Extension

Provided also that where an event has a continuing effect such that it is not practicable for the Contractor to submit detailed particulars within the period of 28 days referred to in Sub-Clause 30.2(b), he shall nevertheless be entitled to an extension of time provided that he has submitted to the Engineer interim particulars at intervals of not more than 28 days and final particulars within 28 days of the end of the effects resulting from the event. On receipt of such interim particulars, the Engineer shall, without undue delay, make an interim determination of extension of time and, on receipt of the final particulars, the Engineer shall review all the circumstances and shall determine an overall extension of time in regard to the event. In both such cases the Engineer shall make his determination after due consultation with the Employer and the Contractor and shall notify the Contractor of the determination, with a copy to the Employer. No final review shall results in a decrease of any extension of time already determined by the Engineer.

31. Restriction on Working Hours

31.1 Subject to any provision to the contrary contained in the Contract, none of the Works shall, save as hereinafter provided, be carried on during the night or on locally recognized days of rest without the consent of the Engineer, except when Work is unavoidable or absolutely necessary for the saving of life or property or for the safety of the Works, in which case the Contractor shall immediately advise the Engineer. Provided that the provisions of this Clause shall not be applicable in the case of any Work which it is customary to carry out by multiple shifts.

32. Rate of Progress

32.1 If for any reason, which does not entitle the Contractor to an extension of time, the rate of progress of the Works or any Section is at any time, in the opinion of the Engineer, too slow to comply with the Time for Completion, the Engineer shall so notify the Contractor who shall thereupon take such steps as are necessary, subject to the consent of the Engineer, to expedite progress so as to comply with the Time for Completion. The Contractor shall not be entitled to any additional payment for taking such steps. If, as a result of any notice given by the Engineer under this Clause, the Contractor considers that it is necessary to do any Work at night or on locally recognized days of rest, he shall be entitled to seek the consent of the Engineer so to do. Provided that if any steps, taken by the Contractor in meeting his obligations under this clause, involve the Employer in additional supervision costs, such costs shall, after due consultation with the

Employer and Contractor, be determined by the Engineer and shall be recoverable from the Contractor by the Employer, and may be deducted by the Employer from any monies due or to become due to the Contractor and the Engineer shall notify the Contractor accordingly, with a copy to the employer.

33. Compensation for Delay

33.1 If the Contractor fails to comply with the Time for Completion in accordance with Clause 48, for the whole of the Works or, if applicable, any Section within the relevant time prescribed by Clause 43, then the Contractor shall pay to the Employer, as agreed compensation, amount calculated at ¼ percent per week of Contract price of the whole Work or of the Section for which separate period of Completion are given in the contract and of which completion is delayed, as Compensation for such default and not as a penalty (which sum shall be the only monies due from the Contractor for such default) for every week or part of a week which shall elapse between the relevant Time for Completion and the date stated in a Taking-Over Certificate of the whole of the Works or the relevant Section, subject to the applicable limit stated. The employer may, without prejudice to any other method of recovery, deduct the amount of such damages from any monies due or to become due to the Contractor. The payment or deduction of such damages shall not relieve the Contractor from his obligation to complete the Works, or from any other of his obligations and liabilities under the Contract.

33.1.1 When the delay is not a full week or in multiple of a week but involves a fraction of a week the compensation payable for that fraction shall be proportional to the number of days involved.

33.1.2 Provided always that the total amount of compensation for delay to be paid under this condition shall not exceed 10 (Ten) percent of the contract price of the whole work or group of items of Work for which a separate period of completion is given.

33.1.3 The amount of compensation may be adjusted or set off against any sum payable to the Contractor under this or any other Contract with the Corporation.

33.1.4 Notwithstanding to any provision of this clause, during the progress of the work till Taking-Over Certificate is issued , Engineer shall be entitled to recover amount towards Compensation for Delay in terms of following provisions, if Contractor fails to proceed as per Works programme i.e. physical and financial programme approved by Engineer

a. Contractor shall analyze or break down the Contract Work to be executed by him into several parts or items and specify the time for the completion of each part of item, in the form of a works programme, and

b. Contractor shall complete each part or item on or before such specified time, being intended to be of the essence of the contract, and

c. If Contractor fails to so complete each part or item of the Work before such specified time, the Contract becomes voidable at the option of the Corporation, and

d. Contractor shall be liable to pay to the Corporation the compensation under clause 47.1 at the rates provided therein on the Contract price of whole Work or of section for which, the separate period of completion is specified and which has not been completed accordingly, and

e. If Contractor fails to so complete one part or item of Work within specified time and pays the compensation to the Corporation but completes the delayed part or item of Work and also the next succeeding part or item of Work on or before the time specified for such next succeeding part or item of work, the compensation so paid by the Contractor, shall be refunded to him by the Corporation free of interest.

31.1.5 The original Works programme submitted by the Contractor and approved by Superintending Engineer and subsequent revisions, if any, approved by the Chief Engineer shall be considered for levy of compensation for delay.

31.1.6 This clause shall become operative after completion of 25 percent of Work in financial terms or after elapse of 25 percent of stipulated time period of contract, whichever is earlier.

31.2 Reduction of Compensation for Delay

If, before the Time for completion of the whole of the Works or, if applicable, any Section, a Taking-Over Certificate has been issued for any part of the Works or of a Section, the Compensation for delay in completion of the remainder of the Works or of that Section shall, for any period of delay after the date stated in such Taking-Over Certificate, and in the absence of alternative provisions in the Contract, be reduced in the proportion with the value of the part so certified bears to the value of the whole of the Works or Section, as applicable. The provisions of this Sub-Clause shall only apply to the rate of Compensation and shall not affect the limit thereof.

34. Taking-Over Certificate

34.1 When the whole of the Works have been substantially completed and have satisfactorily passed all Tests on Completion prescribed by the Contract, 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 Liability Period. Such notice and undertaking shall be deemed to be a request by the Contractor for the Engineer to issue a Taking-Over Certificate in respect

of the Works. The Engineer shall, within one month of the date of delivery of such notice, either issue to the Contractor, with a copy to the Employer, a Taking-Over Certificate, stating the date on which, in his opinion, the Works were substantially completed in accordance with the Contract, or give instructions in writing to the Contractor specifying all the Work which, in the Engineer's opinion, is required to be done by the Contractor before the issue of such Certificate. The Engineer shall also notify the Contractor of any defects in the Works affecting substantial completion that may appear after such instructions and before completion of the Works specified therein. The Contractor shall be entitled to receive such Taking-Over Certificate within one month of completion, to the satisfaction of the Engineer, of the Works so specified and remedying any defects so notified.

34.2 Taking Over of Sections or Parts

Similarly, in accordance with the procedure set out in Sub-Clause 34.1, the Contractor may request and the Engineer shall issue a Taking-Over Certificate in respect of :

a) any Section in respect of which a separate Time for Completion is provided in the Appendix to Tender.

b) any substantial part of the Permanent Works which has been both completed to the satisfaction of the Engineer and, otherwise than as provided or in the Contract, occupied or used by the Employer, or

c) 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 Contractor or has not been agreed by the Contractor as a temporary measure).

34.3 Substantial Completion of Parts

If any part of the Permanent Works has been substantially completed and has satisfactorily passed any Tests on Completion prescribed by the Contract, the Engineer may issue a Taking-Over Certificate in respect of that part of the Permanent Works 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 the expedition any outstanding Work in that part of the Permanent Works during the Defects Liability Period.

34.4 Surface Requiring Reinstatement

Provided that a Taking-Over Certificate given in respect of any Section or part of the Permanent Works before completion of the whole of the Works shall not be deemed to certify completion of any ground or surfaces requiring reinstatement, unless such Taking-Over Certificate shall expressly so state.

35. Defects Liability

35.1 Defects Liability Period

The Defects Liability Period for the works shall be One (01) Years from the issue of Taking-over Certificate.

35.2 Completion of Outstanding Work and Remedying Defects

To the intent that the Works , shall, at or as soon as practicable after the expiration of the Defects Liability Period, be delivered to the Employer in the condition required by the Contract, fair wear and tear excepted, to the satisfaction of the Engineer, the Contractor shall:

a) complete the work, if any, outstanding on the date stated in the Taking- Over Certificate as soon as practicable after such date, and

b) execute all such work of amendment, reconstruction, and remedying defects, shrinkage or other faults as the Engineer may, during the Defects Liability Period or within 14 days after its expiration, as a result of an inspection made by or on behalf of the Engineer prior to its expiration, instruct the Contractor to execute.

35.3 Cost of Remedying Defects

All Work referred to in Sub-Clause 49.2(b) shall be executed by the Contractor at his own cost if the necessity thereof is, in opinion of the Engineer, due to:

a) the use of materials, Plant or workmanship not in accordance with the Contract,

b) where the Contractor is responsible for the design of part of the Permanent Works , any fault in such design, or

c) the neglect or failure on the part of the Contractor to comply with any obligation, expressed or implied, on the Contractor's part under the Contract.

If, in the opinion of the Engineer, such necessity is due to any other cause, he shall determine an addition to the Contract Price in accordance with Clause 52 and shall notify the Contractor accordingly, with copy to the Employer.

35.4 Contractor's Failure to Carry Out Instructions

In case of default on the part of the Contractor in carrying out such instruction within a reasonable time, the Employer shall be entitled to employ and pay other persons to carry out the same and if such work is work which, in the opinion of the Engineer, the Contractor was liable to do at his own under the Contract, then all costs consequent thereon or incidental thereto shall, after due consultation with the Employer, be determined by the Engineer and shall be recoverable from the Contractor, including supervision charges thereupon as per Annexure 'A', by the Employer, and may be deducted by the Employer from any monies due or to become due to the Contractor and the Engineer shall notify the Contractor accordingly, with a copy to the Employer.

36. Contractor to Search

36.1 If any defect, shrinkage or other fault in the Works appears at any time prior to the end of the Defects Liability Period, the Engineer may instruct the Contractor, with copy to the Employer, to search under the directions of the Engineer for the cause thereof. Unless such defect, shrinkage or other fault is one for which the Contractor is liable under the Contract, the Engineer shall, after due consultation with the Employer and the Contractor, determine the amount in respect of the costs of such search incurred by the Contractor, which shall be added to the Contract Price and shall notify the Contractor accordingly, with a copy to the Employer. If such defect, shrinkage or other fault is one for which the Contractor is liable, the cost of the work carried out in searching as aforesaid shall be borne by the Contractor and he shall in such case remedy such defect, shrinkage or other fault at his own cost in accordance with the provisions of Clause 35.

37. Alterations, Additions and Omissions

37.1 Variations

The Engineer shall make any variation of the form, quality or quantity of the Works or any part thereof that may, in his opinion, be necessary and for that purpose, or if for any other reason it shall, in his opinion, be appropriate, he shall have the authority to instruct the Contractor to do and the Contractor shall do any of the following:

a) increase or decrease the quantity of any Work included in the Contract,

b) Omit any such Work (but not if the omitted Work is to be carried out by the Employer or by another contractor),

c) Change the character or quality or kind of any such work,

d) Change the levels, lines, position and dimensions of any part of the work,

e) Execute additional Work of any kind necessary for the completion of the Works, or

f) Change any specified sequence or timing of construction of any part of the Works. No such variation shall in any way vitiate or invalidate the Contractor, but the effect, if any, of all such variations shall be valued in accordance with Clause 52. Provided that where the issue of an instruction to vary the Works is necessitated by some default of or breach of Contract by the Contractor or for which he is responsible, any additional cost attributable to such default shall be borne by the Contractor.

37.2 Instructions of Variations

The Contractor shall not make any such variation without an instruction of the Engineer. Provided that no instruction shall be required for increase or decrease in the quantity of any Work where such increase or decrease is not the result of an instruction given under this Clause, but is the result of the quantities exceeding or being less than those stated in the Bill of Quantities.

38. Valuation of Variations

38.1 All variations referred to in Clause 3 7 and any additions to the Contract Price which are required to be determined in accordance with Clause 3 8 (for the purposes of this Clause referred to as "varied work"), shall be valued as detailed below :

i) If rate for varied item of Work is specified in the Bill of Quantities, the Contractor shall carry out the varied item at the same rate.

ii) If the rate for any varied item of Work is not specified in the schedule of work/items quantities, the rate for the such item shall be derived from the rate for the nearest similar item specified therein. In case of Bills of Quantities forming part of the contract, the rate shall be derived from the nearest similar item in the Bill of Quantities of Works in which the variation is involved, failing that from the lowest of the nearest similar items in other Bills of Quantities of the same Contract.

iii) If the rates of any varied item of Work is not included in the Bill of Quantities, such item of Work shall be carried out as per the latest Schedule of rates of particular department, based on which the estimate is framed, prevailing at the time of execution of such quantities of the item including mark up quoted by the Contractor.

iv) If the rate for any varied item of Work cannot be determined in the manner specified in (i) to (iii) above, then the Contractor will be paid at such fair and reasonable rates as worked out by the Engineer on the basis of material and labour required to execute the item and allowing 12 percent (twelve percent) towards overhead charges and Contractor's profit.

38.1.1. On receipt of letter of award of work, the Contractor shall carefully study the tender specifications, the architectural drawings, the detailed description of item as well as the site conditions and bring to the notice of the Engineer the inadequacies in the above, within a period of two months for consideration of varied items. The Contractor shall communicate the approximate quantities of varied item. The decision in this regard shall be communicated to the Contractor within 3 months from the date of submission of his letter.

38.1.2 In case of Lump-sum contract, the rates for varied item shall be derived in accordance with paragraphs (iii) or (iv) of Sub-Clause 52.1 as applicable. For this purpose, the quoted amount vis-à-vis estimated cost put to tender would be considered for deciding the quoted mark up of the Contractor.

38.1.3 Price variation, as per Clause No. 70, for varied items becomes operative when the rate for varied item is derived only in accordance with paragraphs (i) or (ii) of Sub-Clause 52.1.

38.2 Variations Exceeding 25 percent

If, on the issue of the Final payment Certificate for the whole of the Works , it is found that as a result of:

i) all varied work valued under Sub-Clauses 38.1 and

ii) all adjustments upon measurement of the estimated quantities set out in the Bill of Quantities, excluding Provisional Sums and adjustments of price made under Clause 70, but not from any other clause, there have been additions to or deductions from the Contract Price which taken together are in excess of 15 percent of the "Effective Contract Price" (which for the purposes of this Sub- Clause shall mean the Contract Price, excluding Provisional Sums if any) then in such event the rates for variations beyond 25% shall be derived in accordance with paragraphs (iii) or (iv) of Sub-Clause 38.1.

39. Procedure for Claims

39.1 Notice of Claims

Notwithstanding any other provision of the Contract, if the Contractor intends to claim any additional payment pursuant to any Clause of these Conditions or otherwise, he shall give notice of his intention to the Engineer, with a copy to the Employer, within 28 days after the event giving rise to the claim has first arisen.

39.2 Contemporary Records

Upon the happening of the event referred to in Sub-Clause 53.1, the Contractor shall keep such contemporary records as may reasonably be necessary to support any claim he may subsequently wish to make. Without necessarily admitting the Employer's liability, the Engineer shall, on receipt of a notice under Sub-Clause 53.1, inspect such contemporary records and may instruct the Contractor to keep any further contemporary records as are reasonable and may be material to the claim of which notice has been given. The Contractor shall permit the Engineer to inspect all records kept pursuant to this Sub-Clause and shall supply him with copies thereof as and when the Engineer so instructs.

39.3 Substantiation of Claims

Within 28 days, or such other reasonable time as may be agreed by the Engineer, of giving notice under Sub-Clause 53.1, the Contractor shall send to the Engineer an account giving detailed particulars of the amount claimed and the grounds upon which the claim is based. Where the

event giving rise to the claim has a continuing effect, such account shall be considered to be an interim account and the Contractor shall, at such intervals as the Engineer may reasonably require, send further interim accounts giving the accumulated amount of the claim and any further grounds upon which it is based. In cases where interim accounts are sent to the Engineer, the Contractor shall send a final account within 28 days of the end of the effects resulting from the event. The Contractor shall, if required by the Engineer so to do, copy to the Employer all accounts sent to the Engineer pursuant to this Sub-Clause.

39.4 Failure to Comply

If the Contractor fails to comply with any of the provisions of this Clause in respect of any claim which he seeks to make, his entitlement to payment in respect thereof shall not exceed such amount, as the Engineer with the approval of Employer, assessing the claim considers to be verified by contemporary records (whether or not such records were brought to the Engineer's notice as required under Sub-Clauses 53.2 and 53.3).

39.5 Payment of Claims

The Contractor shall be entitled to have included in any interim payment certified by the Engineer pursuant to Clause 60 such amount in respect of any claim as the Engineer, after due consultation with the Employer and the Contractor, may consider due to the Contractor provided that the Contractor has supplied sufficient particulars to enable the Engineer to determine the amount due. If such particulars are insufficient to substantiate the whole of the claim, the Contractor shall be entitled to payment in respect of such part of the claim as such particulars may substantiate to the satisfaction of the Engineer. The Engineer shall notify the Contractor of any determination made under this Sub-Clause, with a copy to the Employer.

40. Contractor's Equipment, Temporary Works and Materials; Exclusive use for the work

40.1 Works

All Contractors Equipment, Temporary Works and materials provided by the Contractor shall, when brought on to the Site, be deemed to be exclusively intended for the execution of the Works and the Contractor shall not remove the same or any part thereof, except for the purpose of moving it from one part of the Site to another, without the consent of the Engineer. Provided that consent shall not be required for vehicles engaged in transporting any staff, labour, Contractor's Equipment. Temporary Works, Plant or materials to or from the Site.

40.2 Employer not liable for Damage

The Employer shall not at any time be liable, save as mentioned in Clauses 20 and 65, for this loss of or damage to any of the said Contractor's Equipment, Temporary Works or materials.

40.3 Customs Clearance

The Employer will use his best endeavours in assisting the Contractor, where required, in obtaining clearance through the Customs of Contractor's Equipment, materials and other things required for the Works.

40.4 Condition of Hire of Contractor's Equipment

With a view to securing, in the event of termination under Clause 49, the continued availability, for the purpose of executing the Works , of any hired Contractor's Equipment, the Contractor shall not bring on to the Site any hired Contractor's Equipment unless there is an agreement for the hire thereof (which agreement shall be deemed not to include an agreement for hire purchase) which contains a provision that the owner thereof will, on request in writing made by the Employer within 7 days after the date on which any termination has become effective, and on the Employer undertaking to pay all hire charges in respect thereof from such date, hire such Contractor's Equipment to the Employer on the same terms in all respects as the same was hired to the Contractor save that the Employer shall be entitled to permit the use thereof by any other contractor employed by him for the purpose of executing and completing the Works and remedying any defects therein.

In the event of the Employer entering into any agreement for the hire of Contractor's Equipment pursuant to Sub-Clause 54.4, all sums properly paid by the Employer under the provisions of any such agreement and all costs incurred by him (including stamp duties) in entering into such agreement shall be deemed, for the purpose of clause 49, to be part of the cost of executing and completing the Works and the remedying of any defects therein.

40.5 Incorporation of Clause in Subcontracts

The Contractor shall, where entering into any subcontract for the execution of any part of the Works, incorporate in such subcontract (by reference or otherwise) the provisions of this Clause in relation to Contractor's Equipment, Temporary Works or materials brought on to the Site by the Subcontractor.

40.6 Approval of Materials not implied

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

41. Measurements

41.1 Quantities

The quantities set out in the Bill of Quantities are the estimated quantities for the Works, and they are not to be taken as the actual and correct quantities of the Works to be executed by the Contractor in fulfilment of his obligations under the Contract.

42. Works to be measured

The Engineer shall, except as otherwise stated, ascertain and determine by measurement the value of the Works in accordance with the Bill of Quantities and the Contractor shall be paid that value in accordance with Clause 60. The Engineer shall, when he requires any part of the Works to be measured, give reasonable notice to the Contractor's authorised representative, who shall:

(a) forthwith attend or send a qualified representative to assist the Engineer in making such measurement, and

(b) supply all particulars required by the Engineer.

Should the Contractor not attend, or neglect or omit to send such representative, then the measurement made by the Engineer or approved by him shall be taken to be the correct measurement of such part of the Works. For the purpose of measuring such Permanent Works as are to be measured by records and drawings, the Engineer shall prepare records and drawings as the work proceeds and the Contractor, as and when called upon to do so in writing, shall, within 14 days, attend to examine and agree such records and drawings with the Engineer and shall sign the same when so agreed. If the Contractor does not attend to examine and agree such records and drawings, they shall be taken to be correct. If, after examination of such records and drawings, the Contractor does not agree the same or does not sign the same as agreed, they shall nevertheless be taken to be correct, unless the Contractor, within 14 days of such examination, lodges with the Engineer notice of the respects in which such records and drawings are claimed by him to be incorrect. On receipt of such notice, the Engineer shall review the records and drawings and either confirm or vary them.

43. Method of Measurement

The Works shall be measured net, notwithstanding any general or local custom, except where otherwise provided for in the Contract.

Measurement shall be taken in accordance with the procedure set forth in the schedule of rates/ specifications, notwithstanding any provisions in the relevant standard method of measurement or any general or local custom. In the case of items which are not covered by the schedule of rates/specifications, measurement shall be taken in accordance with relevant Standard Method of Measurement of Bureau of Indian Standards.

44. Provisional Sums

44.1 Definition of "Provisional Sum"

"Provisional Sum" means a sum included in the Contract and so designated in the Bill of Quantities for the execution of any part of the Works or for the supply of goods, materials, Plant or services, or for contingencies, which sum may be used, in whole or in part, or not at all, on the instructions of the Engineer. The Contractor shall be entitled to only such amounts in respect of the work, supply or contingencies to which such Provisional Sums relate as the Engineer shall determine as accordance with this Clause. The Engineer shall notify the Contractor of any determination made under this Sub-Clause, with a copy to the Employer.

44.2 Use of Provisional Sums

In respect of every Provisional Sums the Engineer shall have authority to issue instructions for the execution of work or for the supply of goods, materials, Plant or services by:

a. the Contractor, in which case the Contractor shall be entitled to an amount equal to the value thereof determined in accordance with Clause 38, and

b. a nominated Sub-contractor, as hereinafter defined, in which case the sum to be paid to the Contractor thereof shall be determined and paid in accordance with Sub-Clause 45.4.

44.3 Production of Vouchers

The Contractor shall produce to the Engineer all quotations, invoices, vouchers and accounts or receipts in connection with expenditure in respect of Provisional Sums, except where work is valued in accordance with rates or prices set out in the Tender.

45. *Nominated Subcontractors*

45.1 Definition of "Nominated Subcontractor"

All specialists, merchants, tradesmen and others executing any work or supplying any goods, materials, Plant or services for which Provisional Sums are included in the Contract, who may have been or be nominated or selected or approved by the Employer or the Engineer, and all persons to whom by virtue of the provisions of the Contractor the Contractor is required to sub-contract shall, in the execution of such work or the supply of such goods, materials, Plant or services, be deemed to be sub-contractors to the Contractor and are referred to in this Contract as "nominated Sub-contractors".

45.2 Nominated Subcontractors; Objection to Nomination

The Contractor shall not be required by the Employer or the Engineer, or be deemed to be under any obligation, to employ any nominated Sub-contractor against whom the Contractor may raise reasonable objection or who declines to enter into a sub-contract with the Contractor containing provisions:

(a) that in respect of the work, goods, materials, Plant or services the subject of the sub-contract, the nominated Sub-contractor will undertake towards the Contractor such obligations and liabilities as will enable the Contractor to discharge his own obligations and liabilities towards the Employer under the terms of the Contract and will save harmless and indemnify the Contractor from and against the same and from all claims proceedings, damages, costs, charges and expenses whatsoever arising out of or in connection therewith, or arising out or in connection with any failure to perform such obligations or to fulfil such liabilities, and

(b) that the nominated Sub-contractor will save harmless and indemnify the Contractor from and against any negligence by the nominated Sub- contractor, his agents, workmen and servants and from and against any misuse by him or them of any Temporary Works provided by the Contractor for the purposes of the Contract and from all claims as aforesaid.

45.3 Design Requirements to be Expressly Stated

If in connection with any Provisional Sum the services to be provided include any matter of design or specification of any part of the Permanent Works or of any Plant to be incorporated therein, such requirement shall be expressly stated in the Contract and shall be included in any nominated Subcontractor. The nominated Sub-contractor shall specify that the nominated Sub-contractor providing such services will save harmless and indemnify the Contractor from and against the same and from all claims, proceedings, damages, costs, charges and expenses whatsoever arising out of or in connection with any failure to perform such obligations or to fulfil such liabilities.

45.4 Payments to Nominated Subcontractors

For all work executed or goods, materials, Plant or services supplied by any nominated Sub-contractor, the Contractor shall be entitled to:

(a) the actual price paid or due to be paid by the Contractor, or the instructions of the Engineer, and in accordance with the Sub-contractor;

(b) in respect of labour supplied by the Contractor, the sum, if any, entered in the Bill of Quantities or, if instructed by the Engineer pursuant to paragraph (a) of Sub-Clause 58.2, as may be determined in accordance with Clause 52; and

(c) in respect of all other charges and profit, a sum being a percentage rate of the actual price paid or due to be paid calculated, where provision has been made in the Bill of Quantities for a rate to be set against the relevant Provisional Sum, at the rate inserted by the Contractor against that item or, where no such provision has been made, at the rate inserted by the Contractor and repeated where provision for such is made in special item provided in the Bill of Quantities for such purpose.

45.5 Certification of Payments to Nominated Subcontractors

Before issuing, under Clause 60, any certificate, which includes any payment in respect of work done or goods, materials, Plant or services supplied by any nominated Sub-contractor, the Engineer shall be entitled to demand from the Contractor reasonable proof that all payments, less retentions, included in previous certificates in respect of the work or goods, materials, Plant or services of such nominated Sub-contractor have been paid or discharged by the Contractor. If the Contractor fails to supply such proof then, unless the Contractor:

(a) satisfies the Engineer in writing that he has reasonable cause for with holding or refusing to make such payments, and

(b) produces to the Engineer reasonable proof that he has so informed such nominated Sub-contractor in writing,

the Employer shall be entitled to pay to such nominated Sub-contractor direct, upon the certificate of the Engineer, all payments, less retentions, provided for in

the nominated Sub-Contract, which the Contractor has failed to make to such nominated Sub-contractor and to deduct by way of set-off the amount so paid by the Employer from any sums due or to becomes due from the Employer to the Contractor.

Provided that, where the Engineer has certified and the Employer has paid direct as aforesaid, the Engineer shall, in issuing any further certificate in favour of the Contractor, deduct from the amount thereof the amount so paid, direct as aforesaid, but shall not with hold or delay the issue of the certificate itself when due to be issued under the terms of the Contract.

46. *Certificates and Payments*

46.1 Monthly Statements

The Contractor shall submit to the Engineer after the end of each month two copies, each signed by the Contractor's representative, a statement, in such form as the Engineer may from time to time prescribe, showing the amounts to which the Contractor considers himself entitled up to the end of the respective month in relation to:

(a) the value of the Works executed along with detailed measurements of various items in Bill Of Quantities,

(b) adjustments under Clause 70 (to be submitted quarterly), and

(c) any other sum to which the Contractor consider himself to be entitled under the Contract or otherwise.

46.2 Monthly Payment

The Engineer shall within 28 days of receiving such statement, deliver to the Employer an Interim payment Certificate stating the amount of payment to the Contractor which the Engineer considers due and payable in respect of such statement, subject:

(a) firstly, to the retention of the amount calculated by applying the Percentage of Retention stated in Clause 10.1 to the amount to which the Contractor is entitled and

(b) secondly, to the deduction, other than pursuant to Clause 47, of any sums which may have become due and payable by the Contractor to the Employer.

Notwithstanding the terms of this Clause or any other Clause of the Contract no amount will be certified by the Engineer for payment until the performance security, if required under the Contract, has been provided by the Contractor and approved by the Employer.

46.3 Refund of Performance Security

a. Upon the issue of Taking-Over Certificate with respect to the whole of the Works, the Contract Deposit, or upon the issue of Taking-Over certificate with respect of a Section or part of Permanent Works only such proportion thereof as the Engineer determines having regard to the relative value of such Section or part of the Permanent Works, shall be certified by the Engineer for payment to the Contractor.

b. Upon the expiration of the Defects Liability Period for the Works, the Retention Money shall be certified by the Engineer for payment to the Contractor. Provided that, in the event of different Defects Liability Period having become applicable to different Sections or parts of the Permanent Works pursuant to Clause 48, the expression "expiration of the Defects Liability Period" shall, for the purpose of this Sub-Clause, be deemed to mean the expiration of the latest of such period. Provided also that if at such time there shall remain to be executed by the Contractor any work instructed, pursuant to Clauses 49 and 50, in respect of the Works, the Engineer shall be entitled to withhold certification until completion of such work of so much of the balance of the Retention money as shall, in the opinion of the Engineer, represent the cost of the work remaining to be executed.

46.4 Correction of Certificates

The Engineer may by any Interim Payment Certificate make any correction or modification in any previous Interim Payment Certificate which shall have been issued by him and shall have authority, if any work is not being carried out to his satisfaction, to omit or reduce the value of such work in any Interim Payment Certificate.

46.5 Advance against material

Advance may, from time to time, if the Engineer thinks fit, be made to the Contractor to the extent of 90 percent of the value of such material, worked out on the basis of Schedule of Rates prevailing at the time of estimation as indicated in tender or procurement value, whichever is lower, against indenture bond, provided such material is brought to the works and Engineer is satisfied that they are the bona fide property of the contractor, suitable in quantity for use in the permanent work and properly housed and protected. The Engineer shall however have the right to reject any such material of which he may thereafter disapprove and order the removal, and in case of such rejection, disapproval or order for removal, all loss resulting therefrom shall be borne by the contractor, it being the intention of this clause that any such materials shall continue to be subject to all the provisions of the contract.

The advance payment so made shall be recovered from the subsequent interim payment towards monthly statement of the contractor. However, a fresh advance will be recommended once in a month through the interim payment depending upon the physical stock of material, lying at site.

46.6 Final Statement

Not later than 84 days after the issue of the Taking-Over Certificate in respect of the whole of the Works , the Contractor shall submit to the Engineer two copies of a Statement at Completion with supporting documents showing in detail, in the form approved by the Engineer:

a. the final value of all work done in accordance with the Contract up to the date stated in such Taking-Over Certificate,

b. any further sums which the Contractor considers to be due, and

c. an estimate of amounts which the Contractor considers will become due to him under the Contract.

If the Engineer disagrees with or cannot verify any part of the Statement at Completion, the Contractor shall submit such further information as the Engineer may reasonably require and shall make such changes in the Statement as may be agreed between them. The Contractor shall then prepare and submit to the Engineer the final statement as agreed (for the purpose of these Conditions referred to as the "Final Statement").

If, following discussions between the Engineer and the Contractor and any changes to the final statement which may be agreed between them, it becomes evident that a dispute exists, the Engineer shall deliver to the Employer a Final Payment Certificate for those parts of the draft final statement, if any, which are not in dispute. The dispute may then be settled in accordance with Clause 67.

46.7 Discharge

Upon submission of the Final Statement, the Contractor shall give to the Engineer, a written discharge confirming that the total of the Final Statement represents full and final settlement of all monies due to the Contractor arising out of or in respect of the Contract Provided that such discharge shall become effective only after payment due under the Final Payment Certificate issued pursuant to Sub-Clause 60.8 has been made. Provided further that Contractor's liability does not cease till issue of Defect Liability Certificate.

46.8 Final Payment Certificate

Within 60 days after receipt of the Final Statement, and the written discharge, the Engineer shall issue to the Contractor, a Final Payment Certificate stating :

(a) the amount which, in the opinion of the Engineer, is finally due under the Contract or otherwise, and

(b) after giving credit to the Employer for all amounts previously paid by the Employer and for all sums to which the Employer is entitled, the balance, if any, due from the Employer to the Contractor or from the Contractor to the Employer as the case may be.

46.9 Cessation of Employer's Liability

The Employer shall not be liable to the Contractor for any matter or thing arising out of or in connection with the Contract or execution of the Works, unless the Contractor shall have included a claim in respect thereof in his Final Statement and (except in respect of matters or things arising after the issue of the Taking- Over Certificate in respect of the whole of the Works) in the Statement at Completion referred to in Sub-Clause 60.5.

46.10 Time for Payment

Up to 75% of the amount due to the Contractor under any Interim Payment Certificate issued by the Engineer pursuant to this Clause, or to any other term of the Contract, shall, subject to Clause 47, be paid by the Employer to the Contractor within 15 working days and the balance amount within 21 working days of receipt of Interim Payment Certificate. In the case of the Final Payment Certificate referred to in Sub-Clause 60.8, within 60 days, of receipt of such Final Payment Certificate. In the event of the failure of the Employer to make payment within the times stated, the Employer shall pay to the Contractor interest at the rate stated in the Annexure - A upon all sums unpaid but payable from the date by which the same should have been paid. The provisions of this Sub-Clause are without prejudice to the Contractor's entitlement under Clause 69 or otherwise.

46.11 No interest for delayed payments due to disputes etc.

No claim for interest or damage will be entertained by the Employer with respect to any money, or balances which may be in his hands owing to any dispute or difference.

46.12 Recovery of dues from the Contractor

All amounts whatsoever which the Contractor is liable to pay to the Corporation in connection with the Works shall be recovered from any other contract or account of the Contractor or as arrears of Land Revenue under Paragraph 6 of 1st Schedule of the Maharashtra Regional Town Planning Act, 1966.

46.13 Crèche Facility for the Children of Construction Labour

SCDCL has undertaken to provide crèche facilities for children of construction labour through one of the volunteer agency. The facility is open to children of construction labourers employed by the Contractor. In order to meet the expenses of providing crèche facility, the following charges shall be levied on the Contractor.

A	For Contract Price up to Rs.20,000/- to Rs.50,000/-	NIL
B	For Contract Price from Rs.50,001/- to Rs.75,000/-	0.5% of Contract Price with a minimum of Rs. 500.00
C	For Contract Price ranging from Rs.75,001/- to Rs.2,00,000/-	1% of Contract Price with a minimum of Rs.750/-
D	For Contract Price ranging from Rs.2,00,001/- to Rs.5,00,000/-	1.5% of Contract Price with a minimum of Rs.3,000/-
E	For Contract Price above Rs.5,00,000/-	1.5% of Contract Price OR Rs. 100000/- Whichever is Less

i) The aforesaid amount shall be recoverable even if such facility is not made available by the Corporation in the particular node.

ii) The amount shall be recovered, from first three Interim Payment Certificates, in full.

47. Approval only by Defects Liability Certificate

Only the Defects Liability Certificate, referred to in Clause 62, shall be deemed to constitute approval of the Works.

48. *Defects Liability Certificate*

48.1 The Contract shall not be considered as completed until a Defects Liability Certificate shall have been signed by the Engineer and delivered to the Contractor, stating the date on which the Contractor shall have completed his obligations to execute and complete the Works and remedy any defects therein to the Engineer's satisfaction. The Defects Liability Certificate shall only be given by the Engineer after the inspection of work, made prior to expiry of defects liability period & shall be issued within 28 days after the expiration of the Defects Liability Period, or, if different defects liability periods shall become applicable to different Sections or parts of the Permanent Works , the expiration of the latest such period, or as soon thereafter as any Works instructed, pursuant to Clause 49 and 50, have been completed to the satisfaction of the Engineer.

Unfulfilled Obligations

48.2 Notwithstanding the issue of the Defects Liability Certificate the Contractor and Employer shall remain liable for the fulfilment of any obligation incurred under the provisions of the Contract prior to the issue of the Defects Liability Certificate which remains unperformed at the time such Defects Liability Certificate is issued and, for the purpose of determining the nature and extent of any such obligation, the Contract shall be deemed to remain in force between the parties to the Contract.

49. Remedies

49.1 Default of Contractor

If the Contractor is deemed by law unable to pay his debts as they fall due, or enters into voluntary or involuntary bankruptcy, liquidation or dissolution (other than a voluntary liquidation for the purposes of amalgamation or reconstruction), or becomes insolvent, or makes an arrangement with, or assignment in favour of, his creditors, or agree to carry out the Contractor under a committee of inspection of his creditors, or if a receiver, administrator, trustee or liquidator is appointed over any substantial part of his assets, or if, under any law or regulation relating to reorganisation, arrangement or readjustment of debts, proceeding are commenced against the Contractor or resolutions passed in connection with dissolution or liquidation or if any steps are taken to enforce any security or interest over a substantial part of the assets of the Contractor, or if any act is done or event occurs with respect to the Contractor or his assets which, under any applicable law has a substantially similar effect to any of the foregoing acts or events, or if the Contractor has contravened Sub-Clause 3.1, or has an execution levied on his goods,

or if the Engineer certifies to the Employer, with a copy to the Contractor, that, in his opinion, the Contractor:

(a) has repudiated the Contract,

(b) without reasonable excuse has failed,

(i) to commence the Works in accordance with Sub-Clause 41.1, or

(ii) to proceed with the Works , or any Section thereof, within 28 days after receiving notice pursuant to Sub-Clause 46.1,

(c) has failed to comply with a notice issued pursuant to Sub-Clause 37.4 or an instruction issued pursuant to Sub-Clause 39.1 within 28 days after having received it,

(d) despite previous warning from the Engineer, in writing, is otherwise persistently or flagrantly neglecting to comply with any of his obligations under the Contract,

(e) has contravened Sub-Clause 4.1

(f) is an individual or a proprietary concern and the individual or the proprietor died or the Contractor is a partnership concern and one of the partners has died and the legal representative of the deceased contractor or surviving partners of the partnership concern, in opinion of the Employer, cannot carry out and complete the Contract.

then the Employer may, after giving 14 days notice to the Contractor, enter upon the Site and the Works and terminate the employment of the Contractor without thereby releasing the Contractor from any of his obligations or liabilities under the Contract, or affecting the rights and authorities conferred on the Employer or the Engineer by the Contract, and may himself complete the Works or may employ any other contractor to complete the Works. The Employer or such other contractor may use for such completion so much of the Contractor's Equipment, Temporary Works and materials as he or they may think proper.

49.2 Valuation at Date of Termination

The Engineer shall, as soon as may be practicable after any such entry and terminations by the Employer, fix and determine ex parte, or by or after reference to the parties or after such investigation or enquiries as may think fit to make or institute, and shall certify:

a. what amount (if any) had, at the time of such entry and termination, been reasonably earned by or would reasonably accrue to the Contractor in respect of work then actually done by him under the Contract, and

b. the value of any of the said unused or partially used materials, any Contractor's Equipment and any Temporary Works .

49.3 Payment after Termination

If the Employer terminates the Contractor's employment under this Clause, he shall not be liable to pay to the Contractor any further amount (including damages) in respect of the Contract until the expiration of the Defects Liability Period and there after until the costs of execution, completion and remedying of any defects, damages for delay in completion (if any) and all other expenses incurred by the Employer have been ascertained and the amount thereof certified by the Engineer. The Contractor shall then be entitled to receive only such sum (if any) as the Engineer may certify would have been payable to him upon due completion by him after deducting the said amount. If such amount exceeds the sum which would have been payable to the Contractor on due completion by him, then the Contractor shall, upon demand, pay to the Employer the amount of such excess and it shall be deemed a debt due by the Contractor to the Employer and shall be recoverable accordingly.

49.4 Assignment of Benefit of Agreement

Unless prohibited by law, the Contractor shall, if so instructed by the Engineer within 14 days of such entry and termination referred to in Sub-Clause 63.1, assign to the Employer the benefit of any agreement for the supply of any goods or materials or services and/or for the execution of any work for the purposes of the Contract, which the Contractor may have entered into.

50. *Urgent Remedial Work*

50.1 If, by reason of any accident, or failure, or other event occurring to, in, or in connection with the Works or any part thereof, either during the execution of the Works , or during the Defects Liability period, any remedial or other work is, in the opinion of the Engineer, urgently necessary for the safety of the Works and the Contractor is unable or unwilling at once to do such work, the Employer shall be entitled to employ and pay other persons to carry out such work as the Engineer may consider necessary. If the work of repair so done by the Employer is work which, in the opinion of the Engineer, the Contractor was liable to do at his own cost under the Contract, then all costs consequent thereon or incidental thereto shall, after due consultation with the Employer and the Contractor, be determined by the Engineer and shall be recoverable from the Contractor by the Employer, and may be deducted by the Employer from any monies due or to become due to the Contractor and the Engineer shall notify the Contractor accordingly, with a copy to the Employer. Provided that the Engineer shall, as soon after the occurrence of any such emergency as may be reasonably practicable, notify the Contractor thereof.

51. *Special Risks*

51.1 No Liability for Special Risks

The Contractor shall be under no liability whatsoever in consequence of any of the special risks referred to in Sub-Clause 65.2, whether by way of indemnity or otherwise, for or in respect of:

(a) Destruction of or damage to the Works, save to work condemned under the provisions of Clause 39 prior to the occurrence of any of the said special risks.

(b) Destruction of or damage to property, whether of the Employer or third parties, or

(c) Injuries or loss of life.

51.2 Special Risks

The special risks are:

(a) the risks defined under paragraphs (a), (c) (d) and (e) of Sub-Clause 20.4, and

(b) the risks defined under paragraphs (b) of Sub-Clause 20.4 insofar as these relate to the country in which the Works are to be executed.

51.3 Damage to Works by Special Risks

If the Works or any materials or Plant on or near or in transit to the Site, or any of the Contractor's Equipment, sustain destruction or damage by reason of any of the said special risks, the Contractor shall be entitled to payment in accordance with the Contract for any permanent Works duly executed and for any materials or Plant so destroyed or damaged and, so far as may be required by the Engineer or as may be necessary for the completion of the Works , to payment for:

(a) rectifying and such destruction or damage to the Works , and

(b) replacing or rectifying such materials or Contractor's Equipment and the Engineer shall determine an addition to the Contract Price in accordance with Clause 52 (which shall in the case of the cost of replacement of Contractor's Equipment include the fair market value thereof as determined b the Engineer) and shall notify the Contractor accordingly, with a copy to the Employer.

51.4 Projectile, Missile

Destruction, damage, injury or loss of life caused by the explosion or impact, whenever and wherever occurring, of any mine, bomb, shell, grenade, or other projectile, missile, munitions, or explosive of war, shall be deemed to be a consequence of the said special risks.

51.5 Increased Costs arising from Special Risks

Save to the extent that the Contractor is entitled to payment under any other provision of the Contract, the Employer shall repay to the Contractor any costs of the execution of the Works (other than such as may be attributable to the cost or reconstructing work condemned under the provisions of Clause 39 prior to the occurrence of any special risk) which are howsoever attributable to or consequent on or the result of or in any was whatsoever connected with the said special risks, subject however to the provisions in this Clause hereinafter contained in regard to outbreak of war,

but the Contractor shall, as soon as any such cost comes to his knowledge, forthwith notify the Engineer thereof. The Engineer shall, after due consultation with the Employer and the Contractor, determine the amount of the Contractor's cost in respect thereof which shall be added to the Contractor Price and shall notify the Contractor accordingly, with a copy to the Employer.

51.6 Outbreak of War

If, during the currency of the Contract, there is an outbreak of war, whether war is declared or not, in any part of the world which, whether financially or otherwise, materially affects the execution of the Works, the Contractor shall, unless and until the Contract is terminated under the provision of this Clause, continue to use his best endeavours to complete the execution of the Works. Provided that the Employer shall be entitled, at any time after such outbreak of war, to terminate the Contract by giving notice to the Contractor and, upon such notice being given, the Contract shall, except as to the rights of the parties under this Clause and Clause 67, terminate, but without prejudice to the rights of either party in respect of any antecedent breach thereof.

51.7 Removal of Contractor's Equipment on Termination

If the Contract is terminated under the provisions of Sub-Clause 65.6, the Contractor shall, with all reasonable dispatch, remove from the Site, all Contractor's Equipment and shall give similar facilities to his Subcontractors to do so.

51.8 Payment if Contract Terminated

If the Contract is terminated as aforesaid, the Contractor shall be paid by the Employer, insofar as such amounts or items have not already been covered by payments on account made to the Contractor, for all work executed prior to the date of termination at the rates and prices provided in the Contract and in addition:

(a) the amounts payable in respect of any preliminary items referred to in the Bill of Quantities, so far as the work or service comprised therein has been carried out or performed, and a proper proportion of any such items which have been partially carried out or performed;

(b) the cost of materials, Plant or goods reasonably ordered for the Works which have been delivered to the Contractor or of which the Contractor is legally liable to accept delivery, such materials, Plant or goods becoming the property of the Employer upon such payments being made by him;

(c) a sum being the amount of any expenditure reasonably incurred by the Contractor in the expectation of completing the whole of the Works insofar as such expenditure has not been covered by any other payment referred to in this Sub-Clause;

(d) any additional sum payable under the provisions of Sub-clause 51.3 and 51.5;

(e) such proportion of the cost as may be reasonable, taking into account payment made or to be made for work executed, of removal of Contractor's Equipment under Sub-Clause 65.7 and, if required by the Contractor, return thereof to the Contractor's main plant yard in this country of registration or to other destination, at no greater cost; and

(f) the reasonable cost of repatriation of all the Contractor's staff and workmen employed on or in connection with the Works at the time of such termination.

Provided that against any payment due from the Employer under this Sub- Clause, the Employer shall be entitled to be credited with any outstanding balance due from the Contractor for advances in respect of Contractor's Equipment, materials and Plant and any other sums which, at the date of termination, were recoverable by the Employer from the Contractor under the terms of the Contract. Any sums payable under this Sub-Clause shall, after due consultation with the Employer and the Contractor, be determined by the Engineer who shall notify the Contractor accordingly, with a copy to the Employer.

52. *Release from Performance*

52.1 Payment in Event of Release from Performance

If any circumstance outside the control of both parties arises after the issue of the Letter of Acceptance which renders it impossible or unlawful for either or both parties to fulfil his or their contractual obligations, or under the law governing the Contract the parties are released from further performance, then the parties shall be discharged from the Contract, except as to their rights under this Clause and Clause 67 and without prejudice to the rights of either party in respect of any antecedent breach of the Contract, and the sum payable by the Employer to the Contractor in respect of the work executed shall be the same as that which would have been payable under Clause 65 if the Contract had been terminated under the provisions of Clause 51.

53. *Settlement of Disputes*

53.1 If a 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 the Works or after their completion and whether before or after repudiation or Foreclosure or termination of the Contract, including any dispute as to any opinion, instruction, determination, certificate or valuation of the Engineer, the matter in dispute shall, in the first place, be referred in writing to the Engineer, with a copy to the other party. Such reference shall state that it is made pursuant to this Clause. Not later than the Ninetieth day after the day on which he received such reference the engineer shall give notice of his decision to the Employer and the Contractor. Such decision shall state that it is made pursuant to this Clause.

Unless the Contract has already been repudiated or foreclosed 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 unless and until the same shall be revised, as hereinafter provided.

53.2 In case, the Contractor or Employer is dissatisfied with any decision of the Engineer or Appellate authority or as the case may be, he may appeal within 30 days of such decision, in accordance with the provisions in Sub-Clause 67.3, to the appellate authorities, and on payment of a Claim deposit equivalent to 5 percent of total Claim amount. The appeal shall also lie if no decision is given within time specified in clause 67.1 and 67.3

In case of failure of such an appeal, the decision of the Engineer or the appellate authority shall become final and binding upon the Employer and the Contractor without further appeal to any authority.

53.3 The appeal pursuant to sub-clause 67.2 shall be dealt with in accordance with the provisions given hereunder.

Order of Appeal	**Appellate authority**	**Period allowed for the decision**
i) for the Contracts up to 10 Crores		
1st appeal	Superintending Engineer	30 days
2nd & Final appeal	Chief Engineer	60 days
ii) for the Contracts above 10 Crores and up to 25 Crores		
1st appeal	Chief Engineer	45 days
2nd & Final appeal	Managing Director	60 days
iii) for the Contracts above 25 Crores		
1st appeal	Managing Director	60 days
2nd & Final appeal	Dispute Review Board	90 days

a) On receipt of the appeal, the appellate authority shall give a hearing to the Contractor, the Employer and the Engineer, before delivering his decision.

b) The decision of appellate authority on final appeal shall be final, conclusive and biding on both the parties and without further appeal to any authority.

c) No professional lawyer shall be allowed to appear at any level of hearing including in the proceedings before the Dispute Review Board.

d) Out of Claim deposit made under sub-clause 67.2, the amount in proportion to the claims granted shall be refunded to the Contractor.

53.4 <u>Procedure for Settlement of Dispute through Dispute Review Board</u>

53.4.1 If the contractor is dissatisfied with any decision of the Managing director or if the Managing director fails to give decision within a period allowed for decision as per sub-clause 67.3, the Contractor shall communicate his dissatisfaction to the Managing Director, within 30 days from receipt of the notice of such decision or the expiry of such period, as the case may be, with a request to start the process of Settlement of Dispute through Dispute Review Board or to start the process of constitution of Dispute Review Board, if the Dispute Review Board is not constituted.

53.4.2 The Dispute Review Board ("the Board") shall comprise of three members experienced with the type of construction involved in the works and with the interpretation of contractual documents. One member each shall be selected by Employer and Contractor and approved by the other. If either of these members is not so selected and approved within 180 days of the letter of acceptance or such other reasonable time as may be mutually agreed by the contractor and the Engineer, then upon the request of either or both the parties such members shall be selected as soon as practicable by the President of the Institute of Engineers (I). The 3rd member shall be selected by the other two and approved by the parties. If the two members selected by or on behalf of the parties fail to select the

3rd member within 30 days after the letter of their selections, or if within 30

days, on selection of the 3 rd Member, the parties fail to approve that member, then upon the request of either or both parties such 3 rd member shall be selected promptly by the President of the Institute of Engineer (I), who shall seek the approval of the proposed 3 rd Member by the parties before selection but failing such approval, nevertheless select the 3 rd member. The 3rd member shall serve as Chairman of the Board.

In the event of death, disability or resignation of any Member, such Member shall be replaced in the same manner as the Member being replaced was selected. If

for whatever other reason, a Member shall fail or be unable to serve, the Chairman (or failing the action of Chairman then either of the other Member) shall inform the parties and such non serving member shall be replaced in the same manner as the Member being replaced was selected. Any replacement made by the parties shall be completed within 28 days after the event giving rise to the vacancy on the Board, failing which the replacement shall be made by the above appointing authority in the same manner as described above. Replacement shall be considered completed when the new Member signs the Board members declaration of acceptance. Throughout the replacement process, the Members not being replaced shall continue to serve and the Board shall continue to function except, however, that the Board shall not conduct a hearing in order to issue a recommendation until the replacement is completed.

53.4.3 Either the Employer or the Contractor may refer the dispute to the Board in accordance with the provisions of Appendix-I to Sub-Clause 67.4.

Payment to the Board members shall be shared equally by the Employer and the Contractor as prescribed in Paragraph 7 of Appendix-I to Sub- Clause 67.4.

The decision of the Board will be final, conclusive and binding on both the parties and is not appealable. If either the Employer or the Contractor is dissatisfied with any recommendation of the Board, then in that case either of the party can proceed in the matter as per the legal remedy available to that party.

If the Board fails to issue its recommendation within 90 days after receipt by the Chairman of the Board of the written request for recommendation then in that case also either of the party can proceed with legal action for getting resolved the matter. If the Board has issued recommendations to the Engineer and the Contractor within the said 90 days and no notice of intention to proceed with the legal action to resolve the dispute has been given by the Employer as well as the Contractor within 14 days after the parties received such recommendation from the Board, the recommendation shall be become final, conclusive and binding on both the parties. All the recommendation which have become final, conclusive and binding shall be implemented by the parties forthwith, such implementation to include any relevant action of the Engineer.

Unless the contract has already been repudiated or terminated, the contractor shall, in every case continue to proceed with the work with all due diligence and the contractor and Employer shall give effect forthwith to every decision of the engineer unless and until the same shall be revised as a result of operation of this sub clause.

53.4.4 If during the contract period, the Employer and Contractor are of the opinion that the Board is not performing its function properly; the Employer and Contractor may together disband the Board. In such an event, the dispute will

have to be resolved by taking legal recourse. The Employer and the contractor shall jointly sign a notice specifying that the Board shall stands dissolved with effect from the date specified in the notice. The notice shall be posted by Register letter or delivered personally to each member of the Board.

54. *Notices*

54.1 Notice to Contractor

All certificates, notices or instructions to be given to the Contractor by the Employer or the Engineer under the terms of the Contract shall be sent by post, cable, telex or facsimile transmission to or left at the Contractor's principal place of business or at the works Site office or such other address as the Contractor shall nominate for that purpose.

54.2 Notice to Employer and Engineer

Any notice to be given to the Employer or to the Engineer under the terms of the Contract shall be sent by post, cable, telex or facsimile transmission to or left at the respective addresses nominated for that purpose in Annexure 'A' of these conditions.

54.3 Change of Address

Either party, may change a nominated address to another address in the country where the Works are being executed by prior notice to the other party, with a copy to the Engineer, and the Engineer may do so by prior notice to both parties.

55. *Default of Employer*

55.1 Default of Employer

In the event of the Employer :

(a) failing to pay to the Contractor the amount due under any certificate of the Engineer within 28 days after the expiry of the time stated in the Sub- Clause 60.10 within which payment is to be made, subject to any deduction that the Employer is entitled to make under the Contract,

(b) interfering with or obstructing or refusing any required approval to the issue of any such certificate.

(c) becoming bankrupt or, being a company, going into liquidation, other than for the purpose of a scheme of reconstruction or amalgamation, or

(d) giving notice to the Contractor that or unforeseen economic reasons it is impossible for him to continue to meet his contractual obligations, the Contractor shall be entitled to terminate his employment under the Contract by giving notice to the Employer, with a copy to the Engineer. Such termination shall take effect 28 days after the giving of the notice.

55.2 Removal of Contractor's Equipment

Upon the expiry of the 28 days notice referred to in Sub-Clause 69.1, the Contractor shall, notwithstanding the provisions of Sub-Clause 54.1, with all reasonable dispatch, remove from the Site all Contractor's Equipment brought by him thereon.

55.3 Payment on Termination

In the event of such termination, the Employer shall be under the same obligations to the Contractor in regard to payment as if the Contract had been terminated under the provision of Clause 65, but, in addition to the payments specified in Sub-Clause 65.8, the Employer shall pay to the Contractor the amount of any loss or damage to the Contractor arising out of or in connection with or by consequence of such termination.

55.4 Contractor's Entitlement to Suspend Work

Without prejudice to the Contractor's entitlement to interest and to terminate under Sub-Clause 54.1, the Contractor may, if the Employer fails to pay the Contractor the amount due under any certificate of the Engineer within 28 days after the expiry of the time stated in Sub-Clause 60.10 within which payment is to be made, subject to any deduction that the Employer is entitled to make under the Contract, after giving 28 days prior notice to the Employer, with a copy to the Engineer, suspend work or reduce the rate of work.

If the Contractor suspends work or reduce the rate of work in accordance with the provisions of this Sub-Clause and thereby suffers delay or incurs costs the Engineer shall, after due consultation with the Employer and the Contractor, determine any extension of time to which the Contractor is entitled, and shall notify the Contractor accordingly, with a copy to the Employer.

55.5 Resumption of work

Where the Contractor suspends work or reduces the rate of work, having given notice in accordance with Sub-Clause 69.4, and the Employer subsequently pays the amount due, including interest pursuant to Sub-Clause 60.10, the Contractor's entitlement under Sub-Clause 69.1 shall, if notice of termination has not been given, lapse and the Contractor shall resume normal working as soon as is reasonably possible.

56. *Changes in cost and Legislation*

The Contractor shall be bound to complete the work in the approved cost. No price variation or escalation shall be claimed by the Contractor during or after completion of the project.

57. ANNEXURE 'A'

Deleted

58. *ANNEXURE 'B'* ***(See Clause 6)*** *SAFETY PROVISIONS*

1. Suitable scaffolds shall be provided for workmen for all works that cannot safely be done from the ground or from solid construction except such short period work as can be done safely from ladders. When a ladder is used an extra mazdoor shall be engaged for holding the ladder and if the ladder is used for carrying materials as well, suitable footholds and holds shall be provided on the ladder and the ladder shall be given an inclination not steeper than 1/4 to 1 (1/4 horizontal and 1 vertical).

2. Scaffolding or staging more than 3.25 metres above the ground or floor swung or suspended from an overhead support or erected with stationary support, shall have a guard rail properly attached, bolted, braced and otherwise secured at least 1 metre high above the floor or platform of such scaffolding or staging and extending along the entire length of the outside and ends thereof with only such openings as may be necessary for the delivery of materials. Such scaffolding or staging shall be so fastened as to prevent it from swaying from the building or structure.

3. Working platform, gangways, and stairways shall be so constructed that they do not sag unduly or unequally, and if height of a platform of gangway or stairway is more than 3.25 metres above ground level or floor level, it shall be closely boarded, have adequate width and be suitably fenced, as described in 2 above.

4. Every opening in floor of a building or in a working platform shall be provided with suitable means to prevent fall of persons or materials by providing suitable fencing or railing with a minimum height of 1 metre.

5. Safe means of access shall be provided to all working platforms and other working places. Every ladder shall be securely fixed. No portable single ladder shall be over 9 metres in length. Width between side rails in a rung ladder shall in no ease be less than 30 cm for ladders up to and including three metres in length for longer ladders this width shall be increased by at least 6 mm. for each additional 30 cm. of length. Uniform step spacing shall not exceed 30 cm.

5.1 Adequate precautions shall be taken to prevent danger from electrical equipment.

No materials on any of the sites shall be so stacked or placed as to cause danger or inconvenience to any person or the public. The Contractor shall provide all necessary fencing and lights to protect public from accidents and shall be bound to bear expenses of defence of every suit, action, other proceedings at law that may be brought by any

person for injury sustained owing to neglect of the above precautions and to pay any damages and costs which may be awarded in any such suit, action or proceedings to any such person or which may with the consent of the Contractor be paid to compromise any claim by any such person.

6. Excavation and Trenching : All trenches, 1.5 metres or more in depth, shall at all times be supplied with at least one ladder for each 30 metres in length or fraction thereof. Ladder shall be extended from bottom of trench to at least 1 metre above surface of the ground. Sides of a trench which is 1.5 metres or more in depth shall be stepped back to give suitable slope, or securely held by timber bracing, so as to avoid the danger of sides collapsing. Excavated material shall not be placed within 1.5 metres of edge of trench or half of depth of trench, whichever is more. Cutting shall be done from top to bottom. Under no circumstances shall undermining or undercutting be done.

7. Demolition : Before any demolition work is commenced and also during the process of the Work :

a) All roads and open areas adjacent to the Work site shall either be closed or suitably protected. Corrugated metal sheet fencing of 2 meter high to be provided on all the sides of the project site.

b) No electric cable or apparatus which is liable to be a source of danger over a cable. or apparatus used by operator shall remain electrically charged.

c) All practical steps shall be taken to prevent danger to persons employed, from risk of fire or explosion, or flooding. No floor, roof, or other part of a building shall be so overloaded with debris or materials as to render it unsafe. Cautionary signs to be provided at various locations as per the requirement of site.

d) Cautionary signs to be provided at various locations as per the requirement of site.

8. All necessary personal safety equipment as considered adequate by the Engineer shall be available for use of persons employed on the site and maintained in a condition suitable for immediate use, and the Contractor shall take adequate steps to ensure proper use of equipment by those concerned.

(a) Protective head wear shall be provided to workers on the site or in quarries etc. to protect them against accidental fall of materials from above. Additionally, 10 sets of helmets for inspection of personnel from employer and consultant.

(b) The workmen shall be supported with proper belts, ropes etc. where working on any mast, cranes crib, hoist etc.

(c) Necessary steps towards training the workers concerned on the use of machinery shall be taken before they are allowed to handle it independently and taking all necessary precautions in and around the area where machines, hoists and similar units are working.

(d) Life belts, protective railings and /or Jali shall be provided for safety of all workers, working at such situations from where they may accidentally fall.

(e) Sufficient first aid trained staff and equipments shall be quickly available at the work site to render immediate first aid treatment in case of accidents due to scaffolding, drowning and other injuries.

(f) Workers employed in mixing asphaltic material, cement and lime mortars/concrete shall be provided with protective footwear, hand-gloves and goggles.

(g) Those engaged in handling materials, which is injurious to eyes shall be provided with protective goggles.

(h) Those engaged in welding Works shall be provided with welder's protective eye shields.

(i) Stonebreakers shall be provided with protective goggles and protective clothing and seated at sufficiently safe intervals.

(j) When workers are employed in sewers and manholes, which are in use, the Contractor shall ensure that manhole covers are opened and manholes are ventilated at least for an hour before workers are allowed to get into them. Manholes so opened shall be cordoned off with suitable railing and provided with warning signals or boards to prevent accident to public.

(k) The Contractor shall not employ men below the age of eighteen and women on the work of painting with products containing lead in any form.

Whenever men above the age of eighteen are employed on the work of lead painting the following precautions shall be taken;

i) No paint containing lead products shall be used except in the form of paste or ready made paint.

ii) Suitable face masks shall be supplied for use by workers when paint is applied in the form of spray or a surface having lead paint dry rubbed and scrapped.

iii) Overalls shall be supplied by the Contractor to workmen and adequate facilities shall be provided to enable working painters to wash during and on cessation of work.

9. When Work is done near any place where there is risk of drowning, all necessary equipment shall be provided and kept ready for use and all necessary steps taken for prompt rescue of any person in danger and adequate provision made for prompt first aid, treatment of all injuries likely to be sustained during the course of the work.

10. Use of hoisting machines and tackle including their attachments, anchorage and supports shall conform to the following:

a) (i) These shall be good mechanical construction, sound material and adequate strength and free from patent defects and shall be kept in good repair and in good working order.

(ii) Every rope used in hoisting or lowering materials or as a means of suspension shall be of durable quality and adequate strength, and free from patent defects.

b) Every crane driver or hoisting appliance operator shall be properly qualified and no person under the age of 21 years shall be in-charge of any hoisting machine including any scaffold winch or give signals to operator.

c) In case of every hoisting machine and of every chain ring hook, shackle, swivel and pulley block used in hoisting or lowering or as means of suspension, safe working load shall be ascertained by adequate means. Every hoisting machine and all gear referred to above shall be plainly marked with safe working load. In case of a hoisting machine having a variable safe working load, each safe working load and the conditions under which it is applicable shall be clearly indicated. No part of any machine or of any gear referred to above in this paragraph shall be loaded beyond safe working load except for the purpose of testing.

d) In case of a departmental machine, safe working load shall be notified by the Engineer. As regards Contractor's machine the Contractor shall notify safe working load of each machine to the Engineer whenever he brings it to site of Work and get it verified by the Engineer.

11. Motors, gearing, transmission, electric wiring and other dangerous parts of hoisting appliances shall be provided with efficient safe guards, hoisting appliances shall be provided with such means as will reduce to the minimum risk of accidental descent of

load, adequate precautions shall be taken to reduce to the minimum risk of any part of suspended load becoming accidentally displaced. When workers are employed on electrical installations which are already energised, insulating mats, wearing apparel such as gloves, sleeves and boots, as may be necessary, shall be provided. Workers shall not wear any rings, watches and carry keys or other materials which are good conductors of electricity.

12. All scaffolds, ladders and other safety devices mentioned or described herein shall be maintained in a safe condition and no scaffold, ladder or equipment shall be altered or removed, while it is in use. Adequate washing facilities shall be provided at or near places of work.

13. These safety provisions shall be brought to the notice of all concerned by display on a notice board at a prominent place at the Work spot. Persons responsible for ensuring compliance with the safety provisions shall be named therein by the Contractor.

14. To ensure effective enforcement of the rules and regulations relating to safety precautions, arrangements made by the Contractor shall be open to inspection by the Engineer or his representative and the Inspecting Officers.

15. Notwithstanding the above provision 1 to 14, the Contractor is not exempted from the operation of any other Act or Rule in force.

59. *ANNEXURE 'C'*

FORMAT FOR TAKING OVER CERTIFICATE

SCDCL/EE (_____)/ Date :_____

_____

To,

M/s. _____

_____

Subject : _____

C.A.NO. _____

TAKING OVER CERTIFICATE

Dear Sir,

In pursuance of Clause 48 of General Conditions of Contract, I here by certify that, the

Work under C.A. No. for

_____

"_____" completed by

M/s. on

_____ _____

and taken over by SCDCL subject to completion of outstanding Works, rectification of defects as per statement attached at Appendix-"A" and rectification of defects noticed during defects liability period and communicated to the agency by Engineer.

The Contract shall be considered as completed only after issue of Defects liability

Certificate by the Corporation. Encl: As above.

Yours faithfully

CEO (SCDCL) (_____)

60. APPENDIX-"A" to Annexure 'C'

1. Name of work : _____

2. C.A.NO. : _____

3. Agency : M/s. _____

4. Contract Price of Work : Rs. _____

5. Value of Work as per execution : Rs. _____

6. Date of start : _____

7. Date of completion : _____

8. Outstanding Works

   (if any) : 1. _____

   2. _____

9. Defects (If any) : 1. _____

   2. _____

10. Defects Liability Period : _____

11. Certified that, Work is completed satisfactorily except the defects listed above and subject to satisfactory completion of Defects Liability Period and attending the defects noticed during Defect Liability Period.

AE (_____) AEE (_____) EE (_____)

61. Appendix I to Sub Clause 67.4

DISPUTES REVIEW BOARDS RULES & PROCEDURE

1. Except for providing the services required hereunder, the Board members shall not give any advice to either party or to the Engineer concerning conduct of the works. The board members,

   (a) Shall have no financial interest in any party to the contract or the engineer, or a financial interest in the contract except for payment for services on the Board.

   (b) Shall have no financial ties to any party to the contract or the Engineer except for fee based consultancy services on other projects, all of which must be disclosed in writing to both the parties prior to appointment to the Board.

   (c) Shall have no prior involvement in the project to which the contract relates.

   (d) Shall not, while a Board member, be employed whether as a Consultant otherwise for either party to the Contract, or the Engineer except as a Board Member without the prior consent of the parties and the other Board members.

   (e) shall be and remain impartial and independent of the parties and shall disclose in wiring to the employer, the Contractor, the engineer and one another any fact or circumstance which might be such as to cause either the employer or the contractor to question the continued existence of the impartially and independence required of Board members and

   (f) shall be fluent in English i.e. the language of the contract.

2. Except for its participation in the boards activities as provided in the contract and in the agreement none of the employer the contractor and or the engineer shall solicit advice or consultation from the board or Board member on matters dealing with the conduct of the works

3. The Contractor Shall:

   a) Furnish to each Board member one copy of all documents which the Board may request, including one copy of contract documents, progress reports, variation orders and other documents pertinent to the performance of the contract.

b) In co-operation with the employer coordinate the site visits of the board, including conference facilities and secretarial and copying services.

4. The Board shall begin its activities following the signing of board members declaration of acceptance by all three board members, and it shall terminate these activities as set forth below:

a) The board shall terminate its regular activities after finalization of their recommendations for the various disputes, if any, referred to the Board in accordance with the clause No. 67 or after the expiry of the Defects Liability Period or the employer have expelled the contractor from the site pursuant and to sub clause 63.1 and when in either case the board has communicated to the parties ,to the Engineer its recommendations on all disputes previously referred to it.

b) Once the board has terminated its regular activities as provided by the previous paragraph, the Board shall remain available to process any dispute referred to it either party incase of such a referral, board members shall receive payments as provided in paragraph 7.

5. Board members shall not assign or subcontract any of their work under these rules and procedures.

6. The board members are independent contractors and not employees or agents of either the employer or the contractor.

7. Payments to the Board members for the services shall be governed by the following provisions.

a Each Board member shall receive the fess for their site visits and meetings required from time to time from the date of establishment of Board on day basis at L.S. fees (Rs.6,000 to 10,000) or as finalized by the employer or and agreed by the contractor in writing. The fees shall include the charges of transportation required for attending meetings and site visits.

b) The Board members shall be available on 7 days notice for all hearings site visits and other meetings of the board.

c) The Board members shall be conversant with all the project development and maintaining relevant files.

d) The board members shall be provided the secretarial services during site visits, meeting & during hearings.

e) The board member shall be preferably selected from Mumbai / Navi Mumbai or nearby areas. Incase any member of the board is selected out of these areas then the necessary arrangement for their transportation and stay shall be made by the concern party selecting the member.

f) The remuneration payable shall include the reimbursements of any taxes that maybe levied from time to time as an act of State Govt. / Central Govt. legislature.

g) Payment to the board member shall be shared equally by the employer and the contractor and the payments shall be released to the board members by the employer and shall be subsequently recovered from the contractor through any interim payment certificate or from the performance security paid by the contractor of the contract.

8. **Board site visits**

a) The board shall visit the site and meet with representatives of the employer and the contractor and the engineer at regular intervals or at the times of critical construction event, at the written request of either party, but in any case not less than 3 times in any period of 12 months. Thetiming of site visit shall be agreed among the employer, the contractor and the board; failing agreement, shall be fixed by the board.

b) Site visits shall include an informal discussion of the status of the construction of the works an inspection of the works and the review of any requests of recommendation made in accordance with paragraph 10 below Site visits as shall be attended by personnel from the employer the contractor and the engineer.

c) At the conclusion of each site visit, the Board shall prepare a report covering its activities during the visit and shall send copies to the parties and to the engineer.

9. **Procedure for Dispute Referral to the Board**

a) If either party objects to any action or inaction of the other party or the Engineer the objecting party may file a written Notice of Dispute to the other party with a copy to the Engineer stating that it is given pursuant to Clause 67 and stating clearly and in detail the basis of the dispute.

b) The party receiving the Notice of Dispute will consider it and respond in writing within 14 days after receipt.

c) The response shall be final and conclusive on the subject unless a written appeal to the response is filed with responding party within 7 days after receiving the response. Both parties are encouraged to pursue the matter further to attempt to settle the dispute. When it appears that the dispute can not be resolved without assistance of the Board, or if the party receiving the Notice of Dispute fails to provide a written response within

14 days after receipt of such Notice, either party may refer the dispute to the Board by written request for recommendation to the board. The request shall be addressed to the Chairman of the Board, with copies to the other Board Members, the other party ,& the Engineer and it shall state that it is made pursuant to Clause 67.

d) The request for Recommendation shall state clearly and in full detail the specific issues of the dispute to be considered by the Board.

e) When a dispute is referred to the Board, and the Board is satisfied that the dispute requires the Board's assistance, the Board shall decide when to conduct a hearing on the dispute. The Board may request that written documentation and arguments from both the parties be submitted to each Board Member before the hearing begins. The parties shall submit insofar as possible agreed statements of the relevant facts.

f) During the hearing, the Contractor, the Employer, and the Engineer shall each have ample opportunity to be heard and to offer evidence. The Board's Recommendations for resolution of the dispute will be given in writing to the Employer, the Contractor and Engineer as soon as possible and in any event not latter than 90 days after receipt by the Chairman of the Board of the written Request for Recommendation.

10. **Conduct of hearings**

a) Normally hearings will be conducted at the Site, employer's office but any location that would be more convenient and still provide all required facilities and access to necessary documentation may be utilized by the Board Private Sessions of the Board may be held at any cost effective location convenient to the Board.

b) The Employer, the Engineer and the Contractor shall be given the opportunity to have representatives at all hearings.

c) During the hearings, no Board Member shall express any opinion concerning the merit of the respective arguments of the parties.

d) After the hearings are concluded, the Board shall meet privately to formulate its Recommendations. All Board deliberation shall be conducted in private,

with all Members individual views kept strictly confidential. The Board's Recommendations together with an explanation of its reasoning shall be submitted in writing to both parties and to the

Engineer. The recommendations shall be based on the pertinent Contract provisions, applicable laws and regulations, and the facts and circumstances involved in the dispute.

e) The Board shall make every effort to reach a unanimous Recommendation, if this proves impossible, the majority shall decide and the dissenting Member may prepare a written minority report for submission to both parties and to the Engineer.

11. In all procedural matters, including the furnishing of written documents and arguments relating to disputes, Site visits and conduct of hearings, the Board shall have full and final authority.

12. After having been selected and where necessary, approved, each Board Member shall sign three copies of the enclosed declaration and make one copy available each to the Employer, to the Contractor and to the Engineer.

62. Appendix II to Sub Clause 67.4

BOARD MEMBER'S DECLARATION OF ACCEPTANCE

WHEREAS:

a) A Construction Contract (the Contract) for the _____ (fill in name of project) has been signed on (fill in date) _____

between _____ (name of Employer)
and
_____ (name of Contractor)
(the Contractor).

b) Sub-clause 67.4 of the Conditions of the Contract and Appendix- I to Sub-clause 67.4 provide for the establishment and operation of a Dispute Review Board (the Board).

c) The undersigned has been selected (and where required, approved) to serve as a Board Member on said Board;

NOW THEREFORE, the undersigned Board Member hereby declares as follows:

1. I accept the selection as Board Member and agree to serve on the Board and be bound by the provisions of Sub-clause 67.4 of Conditions of the Contract and Appendix- I to Sub-clause 67.4.

2. With respect to paragraph 1 of said Appendix- I, I declare;

   a) that I have no financial interest of the kind referred to in sub-paragraph (a);

   b) that I have no employment nor financial ties of the kind referred to in sub-paragraph (b); and

   c) I am not serving as an employee of either party.

   d) that I have made to both parties any disclosures that may be required by sub-paragraphs (b) and (c).

BOARD MEMBER

_____

_____ (insert name of Board Member)

Date: _____

B- SPECIAL CONDITIONS OF THE CONTRACT

1. **Contractor to inform himself fully:**
   The contractor shall be deemed to have carefully examined the work and site conditions, the special conditions, schedules and drawings and shall be deemed to have visited the work site, his own quarries for rubble and sand and to have fully informed himself regarding the availability of construction materials, local conditions, ancillary works required to be done etc before quoting the tender.

2. **Errors, Omissions, Discrepancies:**
   In case of errors, omissions and/or disagreement between written and scaled dimensions on the drawings or between the drawings and specifications, the same shall be referred to the engineer-in-charge, whose elaboration or decision shall be considered authentic and final. The contractor shall be held responsible for any errors that may occur in the work through lack of reference and precaution.

3. **Use of the site :**
   All land required other than actual work site shall be arranged by the contractor from private land owner / revenue department at his own cost and no claim on this account shall be entertained. All gold, silver, coins, treasure, relics, antiquities and other similar things which shall be found in or upon the site shall be property of Govt and the contractor shall duly deliver the same to the persons as the C.T.O. SCDCL may order.

4. **Line out**, **work book etc:**
   The contractor shall do the provisional and final line out of the work at his own cost including labors, tape, strings etc and under the supervision of the representative of the Corporation. A work order book shall be provided by the contractor. He or his agent authorized by him shall sign and acknowledge the orders given by the engineer in charge and carry out the instructions accordingly. The work order book shall remain in the custody of the engineer in charge.

5. **Underground utilities:** Any utilities/ Wires/ Cable Lines/ Water Supply Lines/ Drainage Lines/ Storm Water Lines found running underground during excavation shall be moved by the Contractor at his own cost.

6. **Damage to existing structures:**
   The contractor shall ensure that existing structures on the Site to be retained, especially the existing Stambha at the central island at Ranga Bhavan Chowk, are not caused any damage either before, during or at completion of work. Any untoward damage shall be rectified to the highest standards as specified by SCDCL / Principal Consultant / Urban Designer, by the Contractor at his/her own cost. Unless otherwise specified, the contractor shall keep all the portions of the Stambha free from under water seepage, dirt etc. by his own cost.

7. **Accidents / injuries / fatalities :**
   The contractor shall be responsible and solely liable for any accidents, injuries or fatalities that occur due to this ongoing work during the entire duration of construction of the project. In any condition, SCDCL / Principal Consultant / Urban Designer shall not bear responsibility of any loss to life or property.

8. **Specification**:
   The contractor shall carry out the work as per correct grade levels and dimensions as per drawings, specifications and as per the instructions given. The work shall be carried in best workmanship manner and in accordance with the specification from PWD handbook Vol. 1 and Vol. 2 (1960) edition as amended and revised up to date and as per standard specifications (red book of B & C.)

9. Workman's Compensation Act, Minimum Wages Act, and all such acts and rules and regulations for the labor shall be binding ion the contractor. The contractor shall be responsible for complying with all bye laws and other regulation for the provisions and maintenance of night fencing and protection that may be necessary and will be liable for all claims that may arise from death accidents or injuries to the persons involved.

10. The Contractor shall erect safety barricading along all excavated areas to prevent any untoward incidents. Additionally, hazard signs and night lighting shall be erected along the Smart Road stretch, along with watchmen stationed along the project stretch.

11. **Excavated materials**:
    The contractor shall not sell the excavated material which shall be property of the Corporation. The excavated stuff shall be disposed as per items in schedule B of the respective sub work. The contractor may with the permission of the engineer in charge in writing and when directed by him use any of the excavated materials for the purpose of this work free of cost.

12. Inspection:
    The engineer in charge if considers it necessary in order to satisfy himself as to the quality of the work, the contractor shall at any time during the continuance of contract pull down or cut any part of the work or make such opening in and such and extend through the same as the engineer in charge may direct, the contractor shall make good the same at his own cost to the satisfaction of the engineer in charge.

13. Third Party Technical Audit (TPTA) to be carried out of all works as per QAP by contractor own cost. Failure to submit the reports of any third party audits shall result in non-payment of raised bills. If the results of any third party audit are found negative, the Contractor shall remedy the affected work at his own cost as per instructions by Engineer without affecting the project timeline. Further, the Contractor shall repeat the TPTA until a positive result is achieved. The cost of any such TPTA and remedial work shall not be reimbursed.

14. All materials used for electrical and plumbing purposes shall be Class A and as per approval by SCDCL / Principal Consultant / Urban Designer.

15. **Monthly progress**:
    The contractor shall furnish within one month from the date of the order to start the work the progress schedule in duplicate showing monthly progress expected to as achieved. The schedule should be such as practicable for achievement for progress. If SCDCL / Principal Consultant / Urban Designer requires modification in such schedule the same shall be revised after incorporating the modification.

16. Co-ordination Meetings :

The Contractor shall be obligated to attend Co-ordination meetings involving the Contractor of Smart Road Project. Authorized personnel from SCDCL / Principal Consultant / Urban Designer shall preside over the meetings and decisions taken during the meeting shall be binding on the Contractor. The schedule of the Co-ordination meetings shall be as decided by SCDCL / Principal Consultant / Urban Designer.

17. Death, bankruptcy etc:

If the contractor shall die or commit any act of bankruptcy or being a company commences winding up except reconstruction purposed or carry on its business under a receiver, the executors, successors or other representatives in law of the estate of the contractor or any such receiver. Liquidator or any person whom the contract may become vested shall forthwith give notice thereof in writing to the Corporation and shall for one month, during which he shall take all reasonable steps to prevent a stoppage of work, have the option of carrying out this contract subject to his or their providing such guarantee as may be required by the Corporation, but not exceeding value of the work for the time being remaining unexecuted. In the event of stoppage of work, the period of the option under this clause shall be fourteen days only. Should the above option be not exercised, the contract may be terminated by the Corporation, by a notice in writing to the contractor or his successor. The power and provisions reserved to Corporation in this contract of raking of the work out of the contractor's hand shall be immediately become operative. Copy of such notice shall be pasted on the work site and advertised in newspaper.

18. Quantities of the work:

The quantities of the work under the various items in the schedule B are estimated by the Corporation, and have been provided as could be reasonable anticipated and should be taken as indicative only. The amount of work will depend upon the actual conditions that will be encountered in the construction and the result of detailed designs which will continue to be refined as more field data and information comes to hand. No claims on account of reduction/increase in quantity will be entertained. Specifically the quantities of excavation may change as per the actual execution policies to be decided by the Commissioner during the course of work. No claim for reduction in quantities shall be entertained by the Corporation on this account.

19. The Contractor shall submit the entire billing in Metric system only. Any other systems will not be accepted.

20. **Corporation Taxes:**

The contractor will have to pay all Corporation taxes. Contractor will have to abide by all labor laws and acts for breach of the same he will be held responsible.

21. Insurance of LED Display Panels and Solar Panels :

The Contractor shall insure all LED Display Panels and Solar Panels, including the 600mm high LED Display Panel running along the upper edge of the structure against theft and any damage due to any reasons. Additionally, the insurance shall also cover death of or injury to any persons or loss of or damage to property.

22. Completion of work:

After completion of the work in all respect and to the entire satisfaction of the engineer in charge the contractor shall hand over the work in whole to the engineer in charge in clean and good condition. The date of taking over the whole work shall be considered as the date of completion of the work as long as possession at the work is not taken the work shall not be considered as completed and the contractor shall take every precaution of preserve and watch the same till the time limit is taken over by the engineer in charge failing which any damage or less accounting to the work during this period shall be made by the contractor at his own cost. The final bill will be prepared after the work is handed over to the Corporation or duly authorized representative in thoroughly complete, clean, sound and workman like manner.

23. **Authority**:

The decision of Chief Executive Officer on all the disputes, rules and regulations under this contract shall be final and binding on the contractor.

24. Maintenance :

a. The Contractor shall maintain the entire work in the same standard as it has been specified in this document for a period of 5 (Five) years after completion of work.
b. Landscape :
    i. The Contractor shall ensure that all landscape elements – trees, lawn/grass, shrubbery, are watered as required to maintain their good health at all times. The bidder shall take care of mortality of plants used in landscaping. In case of damage or death of the plants, the plants have to be replaced and replanted at no additional cost.
    ii. The Contractor shall arrange for supply of water for the aforesaid watering of plants, by any means required, including water tankers (in required)
    iii. Proper irrigations systems have to be developed and maintained to ensure appropriate watering of plants.
c. Solar Panels: The Contractor shall ensure cleaning of Solar Panels by using Oxalic acid or equivalent so as not to damage any parts of the panels from time to time.
d. LED Display Panels: All LED Display panels as well as video wall along the upper edge of the fabricated structure shall be maintained regularly to ensure smooth functioning. Any malfunctioning LEDs / Panels shall be replaced / repaired within 24 hours of such defect coming to notice.

25. Annual Maintenance Contract (For 5 Years)

A. Landscape Maintenance Contract

Effective Date ____/____/_____

Client: Solapur City Development Corporation Limited New Planning Office, Near Doodh Dairy, Saat Rasta, Solapur-413003.
Located at- Ranga Bhavan Chowk, Solapur
&
The Contractor-
Address-

The Client and Contractor hereby agree and promise to the following terms:

The Contractor will provide the services as detailed below. A maintenance worksheet will be supplied to the Client every time work is completed at the worksite. The Client will pay all charges as specified below.

This contract is for landscape maintenance for the property that is located at Ranga Bhavan Chowk, Solapur.
Contract start date: ____/ ____/ _____
Contract end date: ____/ ____/ _____

Either the Client or Contractor may cancel this contract at any time with a thirty day written notice.
The amount due for the below listed services is Rs. _____ per Three months (Quarterly) for the term listed above of this contract and is payable the last day of each month for the service that was provided. The Client will receive a landscaping invoice at the end of each month and receipt of payment shall be due within ten business days from the date of the landscape invoice. All additional charges that are unscheduled will be billed separately and will be due ten days from receipt of the additional invoice.
All spraying for pest control will be done before 10:30am and with temperatures below 80 degrees Fahrenheit. The Contractor will practice pest management to control insects, diseases and weeds that live on and around the Client's ground cover, shrubs, perennials, trees and vines using insecticidal soaps, horticulture oils and biological controls. Any weeds that are in beds or mulched areas will be removed on a weekly basis either by machine or manually. If the Client gives approval for treating heavy pest infestations herbicides may be used. Any weeds in paved areas will be brought under control with trimming machines.

Any shrubs and trees that are less than five years old will be fertilized three times per year during the months of February, May and September. Any shrubs and trees that are more than five years old will be fertilized twice a year in the months March and September. Shrubs and trees that receive lawn fertilizations will not be additionally fertilized. The rate of fertilization will be one pound of nitrogen per 1,000 square feet or the equivalent.

For any palm trees that are less than eight feet in height will receive 2 – 5 pounds of granular fertilizer for palms two to five times per year. While any mature palms will receive a granular fertilizer treatment four times per year of six pounds per application.

Queen palms will receive a supplement of five pounds manganese sulfate for mature palms and this will occur in March. Date palms showing chlorosis of the lower leaves will receive applications of magnesium sulfate twice per year.

All mulched areas will be replenished once per year and during the winter months of November through April. Mulch will consist of either cypress or pine bark and at a depth of three inches. All bed line edges and curbs will be trenched to help contain the new mulch application. Additional mulch applications are available at the rate of Rs. _____ per yard. Mulch will not be placed against any trunks of the plants.

Shrubs will be pruned by hand on an as needed basis to help ensure proper shape, fullness, and a natural bloom. Tree and palm pruning will be done once per year and will be limited to only those branches that are below twenty feet in height and no palm fronds will be pruned. No trees that are located under utility wires will be pruned. After pruning the Contractor will remove all litter that is created. There will be no pruning paint applied and any sucker growth will be removed by hand from the base of the trees. There will be no herbicide treatment for pruning purposes.

Applicable Law

This contract shall be governed by the laws of the State of _____ in _____ County and any applicable Federal Law.

B. ANNUAL MAINTENANCE CONTRACT FOR LED LIGHTS AND SOLAR PV INSTALLATION.

This agreement is made on _____ (Date / Year) between SCDCL, Solapur, for annual maintenance of _____. / LED LIGHTS and Solar PV System installed at Rang Bhavan Chowk, Solapur.

General Terms & Conditions:

1. **Period of Contract:** The contract is valid for Four year from the date of One year after completion date of the project signing of MOU on AMC. This may be renewed after completion of AMC period subject to rendering of satisfactory service & fulfilling the term & conditions.
2. **Payment Term:** For all AMC, payment will be made on quarterly basis (25% of order value of AMC) after completion of the said quarter subject to their satisfactory performance to be certified by customer / user. The servicing agency will give a performance Bank Guarantee of 10% of order value of AMC exceeding Rs. 1 Lakh at the time of accepting the contract.
3. **Replacement of Parts:** Maintenance of the LED Light & Solar Panel includes supply & replacement of parts free of cost except some consumable items. Annexure is enclosed for components not covered under AMC. However, the servicing agency may provide such components and the price may be fixed at the time of signing of AMC.
4. **Prevent Maintenance:** Periodical preventive maintenance will be made once every month.
5. **Quality of Spares:** The equipment parts replaced must be new and equivalent in performance of existing parts.
6. **Additional Charges:** The AMC cost includes the traveling cost for rendering service throughout the year for one or all locations & for one or all systems.
7. **Statutory Levies:** The AMC cost includes all statutory levies if any, charged by State or central Govt. for rendering this type of service.
8. **Working Hours:** The maintenance work shall normally be done during working hours of the customer. However, in case of emergency maintenance may have to be done beyond office hours and even on holidays prior arrangement through proper communication should be worked out in all cases by the servicing agencies.
9. **Reporting Authority:** The Service Engineer will be allowed to handle the respective equipments only with permission of the officer in-charge of SCDCL.
10. **Response Time:** Normal response time for repair is 24-hours from the actual time of reporting the problem to the Second party.
11. **Warrantees and Guarantees** The Bidder shall warrant that the goods supplied under this contract are new, unused, of the most recent or latest technology and incorporate all recent improvements in design and materials. The bidder shall provide system warrantee covering the rectification of any and all defects in the design of equipment, materials and workmanship including spare parts for a period of 5 years from the date

of commissioning. The successful bidder has to transfer all the Guarantees /Warrantees of the different components to the Owner of the project. The responsibility of operation of Warrantee and Guarantee clauses and Claims/ Settlement of issues arising out of said clauses shall be joint responsibility of the Successful bidder and the owner of the project and Solapur City Development Corporation Limited will not be responsible in any way for any claims whatsoever on account of the above.

12. **Operation & Maintenance (O&M)** During this period, the bidder shall be responsible for supply of all spare parts as required from time to time for scheduled and preventive maintenance, major overhauling of the plant, replacement of defective modules, inverters, PCU's etc and maintaining log sheets for operation detail, deployment of staff for continuous operations and qualified engineer for supervision of O&M work, complaint logging & its attending.

13. **Plant Performance Evaluation** The successful bidder shall be required to meet minimum guaranteed generation with Performance Ratio (PR) at the time of commissioning and related Capacity Utilization Factor (CUF) as per the GHI levels of the location during the O&M period. PR should be shown minimum of 75% at the time of inspection for initial commissioning acceptance to qualify for release of Bill. Minimum CUF of 15% should be maintained for a period of 5 years. The bidder should send the periodic plant output details to Solapur City Development Corporation Limited for ensuring the CUF. The PR will be measured at Inverter output level during peak radiation conditions.

14. **Progress Report** The bidder shall submit the progress report monthly to Solapur City Development Corporation Limited in Prescribed Proforma. Solapur City Development Corporation Limited will have the right to depute his/their representatives to ascertain the progress of contract at the premises of works of the bidder.

15. **Project Inspection** The project progress will be monitored by Solapur City Development Corporation Limited and the project will be inspected for quality at any time during commissioning or after the completion of the project either by officer(s) from Solapur City Development Corporation Limited or any authorized agency/ experts. Solapur City Development Corporation Limited reserves the right to do sample inspection checks for the projects commissioned by the Bidder. Solapur City Development Corporation Limited may also depute a technical person(s) from its list of empanelled experts for inspection, Third party verification, monitoring of system installed to oversee, the implementation as per required standards and also to visit the manufactures facilities to check the quality of products as well as to visit the system integrators to assess their technical capabilities as and when required. The bidder shall be responsible for supply of all spare parts as required from time to time for scheduled and preventive maintenance, major overhauling of the plant, replacement of defective modules, inverters, PCU's etc and maintaining log sheets for operation detail, deployment of staff for continuous operations and qualified engineer for supervision of O&M work, complaint logging & its attending.

16. **Type And Quality of Materials and Workmanship the** Design, engineering, manufacture, supply, installation, testing and performance of the equipment shall be in accordance with latest appropriate IEC/Indian Standards as detailed in the Section- III (Technical specifications) of the bid document. Where appropriate Indian Standards and Codes are not available, other suitable standards and codes as approved by the MNRE shall be used.

The specifications of the components should meet the technical specifications mentioned in the RFS. Any supplies which have not been specifically mentioned in this Contract but which are necessary for the design, engineering, manufacture, supply & performance or completeness of the project shall be provided by the Bidder without any extra cost and within the time schedule for efficient and smooth operation and maintenance of the SPV plant.

	Period	Penalty
Response Time	Above 24 Hours & below 48 hours	Warning but no penalty
	Above 48 Hours & below 96 hours	A penalty of 1% of the contract amount per system
	Above 96 hours	A penalty of 2% of the contract amount per system

Signature of the Bidder

2. DECLARATION

I hereby declare that I/We have carefully studied the site conditions and the contract specifications including the drawings and the scope of contract and they are understood by me/us before signing the tender and executing the agreement. The meaning of the tender provision if not understood correctly due to errors, spelling mistakes, omissions in the tender, will got clarified in writing from Chief Technical Officer and his decision will be final and binding on me/us.

I have quoted the rates considering the time limit given in the tender. I/We are abided to complete the work as per specifications.

Date: _____

Contractor

VOLUME IV

CONTENTS

SCHEDULE-B

Sr no	Item code	Description of items	Unit	Qty	Rate	Amount
		CIVIL WORK				
1	47 / 23 MORTH 3.15	Scarifying the existing bituminous roadsurface to a depth of 50 mm by manual means and disposal of scarified materialwith in all lifts and lead upto 1000 metres. Spec : M.O.R.T & H - 305.4.3	Sqm	803.34	7.88	6,330.30
2	13 b / 21 BDW 8	Dismantling brick masonry in lime or cement mortar and stacking the materials as directed with all leads, lifts, com-plete. Spec : As directed by Engineer In Charge. **Item No - 13 b / 21 BDW 8**	Cum	52.50	146.40	7,686.00
3	15 h / 21 BDW 8	Removing cement tiles, or marble or polished shahabad floor or dado without bed concrete including stacking the materials as directed with all leads, lifts, complete. Spec : As directed by Engineer In Charge	Sqm	40.00	23.10	924.00
4	Non DSR Item	Dismantling of structural steel and stacking the materials as directed with all leads, lifts, com-plete. Spec : As directed by Engineer In Charge.	MT	10.00	7,501.20	75,012.00
5	1 i a / 1 BDA 1..	Excavation for foundation in earth, soil of all types, sand, gravel and soft murum, including removing the excavated material upto a distance of 50 m. beyond the building area & stacking and spreading as directed, dewatering, preparing the bed for the foundation and necessary back filling, ramming, watering including shoring and strutting etc. complete. (Lift upto 1.5 m.)By Manual Means Spec. No.: Bd.A.1 Page No. 259.	Cum	546.52	183.75	100,422.16

Sr no	Item code	Description of items	Unit	Qty	Rate	Amount
6	2 i a / 4 BDE 2	Providing and casting in situ cement concrete M-15 of trap / granite / quartzite / gneiss metal for steps including centering, formwork, compacting, roughening them if special finish is to be provided and curing and finishing if required complete,with fully automatic micro processor based PLC with SCADA enabled reversible Drum Type mixer ... With natural sand. Spec. No.: Bd.E.2 Page No. 288 and B.7 Page No 38 **Item No :-2 i a / 4 BDE 2**	Cum	233.78	6,139.14	1,435,233.63
7	10 / 1 BDA 11	Filling in plinth and floors with contractors soil sand or murum in 15 cm to 20cm, layers including watering and compaction complete. Spec. No.: Bd.A.11 Page No. 263	Cum	2.40	827.45	1,985.88
8	Item No ;- 12 a / 23 MORTH 305	Conveying materials obtained from road cutting including all lifts, laying in layers of 20cm. to 30cm. (about 8 inch to 12 inch) breaking clods, dressing to the required lines, curves, grades and section, watering and compaction to 95% of standard proctor density for a lead of 50 to 300 m. inclusive from the site of excavation to the site of deposition as directed. Spec : MORTH 305. **Item No ;- 12 a / 23 MORTH 305**	Cum	676.79	220.50	149,232.89
9	11 / 1 BDA 12	Providing dry/ trap/ granite/ quartzite/ gneiss rubble stone soling 15 cm to 20 cm thick including hand packing and compacting complete. Spec. No.: Bd.A. 12 Page No. 264	Cum	168.69	876.75	147,894.75
10	12 / 1 BDA 13	Providing and filling in the foundation with sand of approved quality including watering, compaction complete. Spec. No.: Bd.A.13 Page No. 264	Cum	89.97	1,627.50	146,418.75

Sr no	Item code	Description of items	Unit	Qty	Rate	Amount
11	Item No :- 6 B b i / 5 BDF 11	Providing and casting in situ cement concrete in M-25 of trap/ granite/ quartzite/ gneiss metal for R.C.C. pardi 75mm thick fins including centering, formwork, cover blocks compacting and roughening them if special finish is to be provided and curing complete.(Excluding reinforcement).with fully automatic micro processor based PLC with SCADA enabled concrete batch mix plant (pan mixer).... With natural sand. Spec. No.: Bd.F.11 Page No. 304 and B.7, Page No. 38 **Item No :- 6 B b i / 5 BDF 11**	Cum	3.78	10,913.42	41,252.73
12	Item No :- 15 i a / 5 BDF 8	Providing and laying in situ cement concrete M - 25 Ready mix of trap /granite /quartzite /gneiss metal, Natural Sand for R.C.C. Slabs and Landings as per detailed designs & drawing or as directed including centering, formwork, cover blocks, compaction, curing and roughening the surface if special finish is to be provided (Excluding reinforcement & structural steel) complete With Natural Sand ---(Item to be used with prior permission of Superintending Engineer) Spec. No.:No.: Bd. F 8 page No. 302 and B-7, Page No. 38 **Item No :- 15 i a / 5 BDF 8**	Cum	2.21	10,285.52	22,728.32
13	1 A b i / 5 BDF 3	Providing and laying in situ cement concrete M-25 of trap / granite /quartzite/ gneiss metal for R.C.C. work in foundations like raft, strip foundations, grillage and footings of R.C.C. columns and steel stanchions etc. including bailing out water, formwork ,cover blocks compaction and curing roughening the surface if special finish is to be provided (Excluding reinforcement and structural steel) complete, With fully automatic micro processor based PLC with SCADA enabled reversible drum type concrete mixer. With natural sand. Spec. No.: Bd.F.3 Page No. 298 and B.7, Page No.38	Cum	36.51	6,480.91	236,640.71

Sr no	Item code	Description of items	Unit	Qty	Rate	Amount
14	2 A b i / 5 BDF 5	Providing and casting in situ cement concrete M-25 of trap / granite /quartzite/ gneiss metal for R.C.C. columns as per detailed designs and drawings or as directed including centering, formwork, cover blocks compacting and roughening if special finish is to be provided and curing complete. (Excluding reinforcement). With fully automatic micro processor based PLC with SCADA enabled reversible drum type concrete mixer.With natural sand. Spec. No.: Bd.F.5 Page No. 300 and B-7,Page No 38.	Cum	61.71	6,011.50	370,969.67
15	3 A b i / 5 BDF 6	Providing and casting in situcement concrete M-25 of trap/ granite/ quartzite/ gneiss metal for R.C.C. beams and lintels as per detailed designs and drawings or as directed including centering, formwork, cover blocks compaction and roughening the surface if special finish is to be provided and curing complete. (Excluding reinforcement).With fully automatic micro processor based PLC with SCADA enabled reversible drum type concrete mixer.With natural sand. Spec. No.: Bd.F.6 Page No. 300 and B.7, Page No.38	Cum	28.61	9,420.91	269,541.66
16	Item No -8 / 5 BDF 17	Providing and fixing in position TMT - FE - 500 bar reinforcement of various diameters for R.C.C. pile caps, footings, foundations, slabs, beams columns, canopies, staircase, newels, chajjas, lintels pardis, copings, fins, arches etc. as per detailed designs, drawings and schedules, including cutting, bending, hooking the bars, binding with wires or tack welding, with anti-corrosive treatment and supporting as required complete. **Item No -8 / 5 BDF 17**	MT	40.00	53,411.34	2,136,453.60

Sr no	Item code	Description of items	Unit	Qty	Rate	Amount
17	27 / 18 BDT	Providing and fixing M.S. grill door 24 kg/sqm of various size as per detailed drawings without hot dip coating, Steel fixtures and fastenings, with anti-corrosive treatment and 3 coats of oil painting etc. Spec : As directed by Engineer In Charge	Sqm	5.25	2,226.00	11,686.50
18	25 / 18 BDT 53	Providing and fixing steel ventilator fully glazed partly fixed as per detailed drawing without hot dip zinc coating including fabricating glazing with plain / obscured glass panes and approved type and quality and Steel fixtures, with anti-corrosive treatment and fastening oil paint 2 coats etc. complete. Spec. No.: Bd. T. 53, Page No. 509 & As directed by Engineer in charge.	Sqm	2.25	2,210.25	4,973.06
19	1 a / 19 BDU 1	Providing and fixing mild steel grill / Grating work 20 kg./sq.m. as per drawing including fixtures, necessary welding & painting with one coats of anticorrosive paint & two coats of oil painting complete. Spec. No.: Bd.U.1 Page No. 537	Sqm	70.00	1,380.75	96,652.50
20	Item No - 6 / 3 BDC	Providing and erecting structural steel for sakav with all bracing gusset plates etc. as per detailed design and drawing or as directed including cutting, fabrication, hoisting, erecting, fixing in position, making riveted/ bolted/ welded connection, with anti-corrosive treatment and oil painting with two coats complete. Spec. No.: As directed by Engineer in charge. Item No - 6 / 3 BDC	MT	85.00	82,643.34	7,024,683.90
21	4 a / 17 BDR 5	Providing and fixing plain zinc sheeting of 0.80 mm thick (22 B.W.G.) over the ridge hip or valley to galvanized iron sheet roofing including all fastening and bolt galvanised iror screws and bolts and lead and bitumen washers complete. (Weight of 6.8 kg/sq.m.). Spec : Bd.R.5, Page No. 453	Sqm	39.00	846.30	33,005.70

Sr no	Item code	Description of items	Unit	Qty	Rate	Amount
22	4 / 6 BDG 5	Providing second class Burnt Brick masonry with conventional/ I.S. type bricks in cement mortar 1:6 in superstructure including striking joints, racking out joints, watering and scaffolding Complete. Spec.No.:Bd.G.5PageNo.315	Cum	171.72	5,640.03	968,501.44
23	2 b / 11 BDL 2A	Providing internal cement plaster 12mm thick in single coat in cement mortar 1:4 without neeru finish to concrete or brick surfaces, in all positions including scaffolding and curing complete. Spec. No.: Bd. L.2 Page No. 368	Sqm	249.00	177.05	44,085.45
24	13 / 11 BDL	Providing fine cement finish 1.5 mm thick over green plaster surface including scaffolding curing etc. complete. Spec. No.: As directed by Engineer in charge.	Sqm	240.00	56.71	13,610.40
25	15 / 12 BDM 22	Providing and fixing machine cut machine polished 18 mm to 20 mm thick Polished Steel Grey Granite/ telephone black / Amba White / Cat bary brown / RBI red / Ocean Brown granite stone for treads and risers of steps and staircases of approved colour and shade with rounded moulding and three grooved line for the treads on bed of 1;4 Cement mortar including float filling joints with neat cement slurry curing polishing and cleaning etc. complete. Spec. No.: Bd. M.22 B/Page No. 390	Sqm	184.40	4,090.14	754,221.82
26	27 / 12 BDM	Providing and laying chequered tiles of approved quality of company VYARA or equivalent make of size 30 cm x 30 cm for flooring in required position laid on a bed of 1:4 cement mortar including cement float, filling joint with cement slurry cleaning curing complete. Spec. No.: Bd. M-12				-
27		Vyara make Mattee tile in Brown colour	Sqm	612.88	679.80	416,635.82
28		Vyara make Pebblino Tiles :	Sqm	70.30	679.80	47,789.94

Sr no	Item code	Description of items	Unit	Qty	Rate	Amount
29	Item No:- 21 B ii / 12 BDM	Providing and fixing heavy duty inter locking concrete Coloured paving blocks (Coble Stone Patern) of 80 mm thickness of having a strength of 300 kg/Sq.cm. of approved quality and shape on a bed of crushed sand of 25 to 30 mm thick including skirting joints and cleaning etc. complete ** Spec. No.: As directed by Engineer in charge Item No:- 21 B ii / 12 BDM	Sqm	223.08	711.90	158,810.65
30	78 / 23 MORTH 2703	Providing and fixing Guard Railing of 900mm height in 50mm M.S. Round Tube for Hand Rail & Vertical post 900mm C/C & 10mm round MS bar 2 Nos in horizontal as per Type drawing No. 1701 and fixed in 50mm x 50mm x 6mm iron angle embedded in 1:2:4 C.C. bedding 55 x 45 cm and 50 x 6 iron patti as per detailed drawing, with anti-corrosive treatment and 3 coats of approved yellow and Brown Synthatic Enamal paint. Spec : MORTH 2703	Rmt	290.62	129.75	37,707.95
31	73 B / 23MORTH409	Providing and casting in situ or precast tapering R.C.C. 1:2:4 Kerbs type-III as per Drg. No. 13 dt. 20-4-79, tapering (9 inch x 6 inch) both side embedded 6 inch below ground level finished neatly with C.M. 1:2 with 4 Nos. 6mm dia. bars and 6mm dia. strips at 18 inch C/c setting the same in C.M. 1:2, painting the exposed surface of the kerbs with 2 coats of road marking paint of approved quality and colour including the required excavated stuff any where in city and redoing the surface as specified and directed for single line dividers. Spec : MORTH 409	Rmt	290.62	782.25	227,337.50

Sr no	Item code	Description of items	Unit	Qty	Rate	Amount
32	33 a / 23 MORTH 4.3	Laying and spreading available soil inthe sub-grade on a prepared surfacepulverizing, mixing the spread soil in placewith rotavator with 3 per cent slaked limhaving minimum content of 70 per cent oCaO, grading with motor grader ancompacting with the road roller at OMC tthe desired density to form a layer ofimproved sub grade -- By Mechanical Means Spec : MORTH - 401	Cum	35.45	1,147.70	40,683.67
33	34 a ii / 23MORTH 4.1	Construction of granular sub-base by providing close graded material, spreading in uniform layers with motor grader on prepared surface, mixing by mix in place method with rotavator at OMC, and compacting with vibratory roller to achieve the desired density, complete as per clause 401 -- By Mix in Place Method and Grade II Material. Spec : M.O.R.T & H - 401	Cum	14.18	1,459.41	20,693.27
34	45 / 23 MORTH 4.12	Wet Mix Macadam -- Providing, laying, spreading and compacting graded stone aggregate to wet mix macadam specification including premixing the Material with water at OMC in mechanical mix plant carriage of mixed Material by tipper to site, laying in uniform layers with paver in sub- base / base course on well prepared surface and compacting with vibratory roller to achieve the desired density. Spec : MORTH - 406	Cum	26.59	1,720.53	45,742.01
35	49 / 23 MORTH 5.1	Prime coat (Providing and applying primecoat with bitumen emulsion on preparedsurface of granular Base including clearingof road surface and spraying, primer athe rate of 0.60 kg/sqm usingmechanical means.)Spec : M.O.R.T & H – 502	Sq.M	177.24	72.24	12,803.82

Sr no	Item code	Description of items	Unit	Qty	Rate	Amount
36	50 b / 23 MORTH 5.2	Providing and applying tack coat on the prepared surface heating by flames in Boiler and spraying bitumen with sprayer on / Granular surface with primer @ 3.0 kg/10 sqm with VG-30 bulk Bitumen Spec : M.O.R.T & H - 503	Sq.M	177.24	68.57	12,153.35
37	61 / 23 MORTH5.6	Dense Bituminous macadam: Providing and laying dense bituminous macadam using crushed aggregates of specifiedgrading premixed with bituminous binder@ 4.50 per cent by weight of total mix and filler, transported to site with VTS, laid over a previously prepared surface, finished to the required grade, level, alignment, and rolling to achieve thedesired compaction VG-30 Bitumen. --USING 80 TPH Batch mix type hot mix plant with SCADA, Sensor Paver, Intelligent Compactor with mcompactionanalyzer and V-Sat attachment with Stone Dust filler. Spec : As per MORTH specification FifthEdition Clause No.507 and IRC-SP-972013	Cum	8.86	8,073.09	71,543.72
38	65 / 23 MORTH	Providing and laying bituminous concrete using B77 crushed aggregate of specified grading premixed with bituminous binder @5.5%'by weight of total mix and filler,transportedat site with VTS, laid over a previouslyprepared surface , finished to the requiredgrade ,level, alignment,and rolling toachieve the desired density for 50/75mm compacted thickness with drum mix typehot mix plant without SCADA, WithSensor paver, and Vibratory rollerexcluding prime/ Tack coat etc. complete - Bitumen VG-30 grade with stonedust filler Spec: As per MORTH specification FifthEdition Clause No.507 and IRC-SP-972013	Cum	8.86	8,729.47	77,360.56

Sr no	Item code	Description of items	Unit	Qty	Rate	Amount
39	2.2 (Horticultural DSR)	Garden Soil:- Supplying and stacking of good earth at site including royalty and carriage upto 5 km complete (earth measured in stacks will be reduced by 20% for payment).	Cum	177.47	553.65	98,258.48
40	2.3 (Horticultural DSR)	Farm Yard Manure:- Supplying and stacking sludge at site including royalty and carriage upto 5km complete (sludge measured in stacks will be reduced by 8% for payment).	Sqm	591.58	451.80	267,275.84
41	2.33 (Horticultural DSR)	Preparation of beds for hedging and shrubbery by excavating 60 cm deep and trenching the excavated base to a further depth of 30 cm, refilling the excavated earth after breaking clods and mixing with sludge or manure in the ratio of 8:1 (8 parts of stacked volume of earth after reduction by 20% : one part of stacked volume of sludge or manure after reduction by 8%), flooding with water, filling with earth if necessary, watering and finally fine dressing, leveling etc. including stacking and disposal of materials declared unserviceable and surplus earth by spreading and leveling as directed, within a lead of 50 m, lift up to 1.5 m complete (cost of sludge, manure or extra earth to be paid for separately)	Sqm	591.58	136.87	80,969.55
42	2.33 (Horticultural DSR)	Preparing instant Lawn:- Providing and laying Neelgiri/Mexican grass turf with earth 50mm to 60mm thickness of existing ground prepared with proper level and ramming with tools wooden (Dhurmos) and than rolling the surface with light roller make the surface smoothen and light waterning with sprinkler and maintenance for 30 days or more till the grass estofficer-in-charge.	Sqm	591.58	214.10	126,657.28
43	As per CPWD Item no 7.16	Supply and stacking of Cassia fistula (Amaltash) plant of height 120-135 cm. in big poly bags of size 25 cm as per direction of the officer-in-charge.	Each	12.00	63.00	756.00

Sr no	Item code	Description of items	Unit	Qty	Rate	Amount
44	As per CPWD Item no 7.7	Supply and stacking of Bauhinia blakeana (Kachnar) plant of height 120150 cm. in big poly bags of size 25 cm as per direction of theofficer-in-charge.	Each	3.00	84.00	252.00
45	As per CPWD Item no 9.4	Supply and stacking of Bougainvillea (Variety Butiana, Lady Mary Baring, Mahara, Mohan,Scarlet Queen, Varigata, Glabra Formosa, Peruviana Odissi, Partha, Subhra,Thimma, Spectabilis L.N Birla, Refulgens) plant of height 30 cm. to 45 cm. with 2-3 branches in 20 cm size of Earthen pots / Plastic pots & as per direction of the Engineer-in-charge.	Each	20.00	35.76	715.20
46	As per CPWD Item no 8.44	Supply and stacking of plant Murraya Paniculata/ exotica of height 45-60 cm. in poly bags of size 15 cm.	Each	80.00	15.75	1,260.00
47	Non DSR Item	Providing & Fixing Benches of with Synthetic Wood –in Size: 1500 MM L x 525 MM D x 850 MM H & in Colour : Seat & Backrest – Teak Wood, M.S. Structure – Grey as per Drawing/ Image including M.S. Angle frame with Synthetic Wood slats Seat & Backrest. All Metal Parts are galvanized & Polyester Powder Coated. All fitting are in S.S. (Synthetic Wood : 100% engineered polymer contains no organic fillers such as wood, bamboo, or rice husk flour so it does not absorb moisture causing swelling, staining and rot, in addition, termites are not an issue with synthetic wood) etc. complete. as directed by Engineer-In-Charge.	Each	13.00	20,101.84	261,323.96
		Total Amount of Civil Work				**16,106,878.38**

Sr no	Item code	Description of items	Unit	Qty	Rate	Amount
		ELECTRICAL WORK				
A		**STREET LIGHTS**				
1	WG-MA/BW 1-3-15	Supplying & erecting mains with 3x4 Sq.mm F.R copper PVC insulated wire laid in provided conduit/trunking/inside pole/Bus bars or any other places as per specification No: WG-MA/BW 1-3-15	Mtr	280	108.00	30,240.00
2	WG-MA/BW 1-3-13	Supplying & erecting mains with 3x2.5 Sq.mm F.R copper PVC insulated wire laid in provided conduit/trunking/inside pole/Bus bars or any other places as per specification No: WG-MA/BW 1-3-13	Mtr	520	76.00	39,520.00
3	CB-LT/AL 7-1-17	Supplying, erecting & terminating PVC armoured cable 3½ core 25 sq mm aluminium conductor with continuous 5.48 sq mm (12 SWG) G.I. earth wire complete erected with glands & lugs, on wall/ trusses/pole or laid in provided trench/ pipe as per specification no. CB-LT/AL 7-1-17	Mtr	743	230.00	1,70,775.00
4	CB-LT/AL 7-1-21	Supplying, erecting & terminating PVC armoured cable 3½ core 95 sq mm aluminium conductor with continuous 8.35 sq mm (10 SWG) G.I. earth wire complete erected with glands & lugs, on wall/ trusses/pole or laid in provided trench/ pipe as per specification no. CB-LT/AL 7-1-21	Mtr	0	589.00	-
5	CB-LT/AL 7-1-16	Supplying, erecting & terminating PVC armoured cable 4 core 16 sq mm aluminium conductor with continuous 5.48 sq mm (12 SWG) G.I. earth wire complete erected with glands & lugs, on wall/ trusses/pole or laid in provided trench/ pipe as per specification no. CB-LT/AL 7-1-16	Mtr	63	195.00	12,187.50
6	CB-LT/AL 2-1-30	Supplying and erecting CFL 18 to 20 W with ceramic adopter p.f. more than 0.9. 2-1-30	Nos.	82	205.00	16,810.00

Sr no	Item code	Description of items	Unit	Qty	Rate	Amount
7	NON-DSR ITEM	LED Ground Mounted Bollard with a system lumen output of 500 lumens and a minimum system efficacy of 56lm/W. The luminaire shall have a rated system lifetime of 50,000 burning hours at L70 @ 35 Deg C. The luminaire should have a color temperature of 6500K and CRI>70. The luminaire shall meet IP65 & IK10 rating with PF > 0.9. The luminaire housing should made of pressure die cast aluminium with polycarbonate diffuser. The total power consumption should not exceed 8.5W. (NON-DSR ITEM)	Nos.	82	9,900.00	811,800.00
8	CB-LT/AL 2-1-14	Supplying and erecting T5 28 W energy efficient fluroscent tube. 2-1-14	Nos.	5	138.00	690.00
9	NON-DSR ITEM	Dismantling of existing street lights alongwith foundation & accessories. Using the existing poles for refitting, complete wiring with new street fittings & accessories. NON-DSR ITEM	Job	1	60,000.00	60,000.00
10	CB-LT/AL 7-8-10	Supplying & erecting FRP box of size 150mm x 125mm x 100 mm, 2.7 mm thick complete on pole as per specification No. CB-SB For Plaza LED lighting. 7-8-10	Nos.	38	469.00	17,822.00
11	NON-DSR ITEM	LED Post Top with a system lumen output of 3000 lumens and a minimum system efficacy of 75 lm/W. The luminaire shall have a rated system lifetime of 50,000 burning hours at L70. The luminaire should have a color temperature of 4000K and CRI 80. The luminaire shall meet IP66 & IK10 with PF > 0.9. The total power consumption should not exceed 40W (including driver). LED POST TOP with 2.5 / 3 m Pole. (NON-DSR ITEM)	Nos.	25	46,650.00	1,166,250.00

Sr no	Item code	Description of items	Unit	Qty	Rate	Amount
12	CB-LT/AL 16-3-7	Providing & casting of M- 20 grade reinforced cement concrete (RCC) foundation suitable for 3m to 5m high octagonal / conical G.I. pole considering the safe soil bearing apacity at site as 10 T/sq m at 1.5 m depth including supply of steel, concrete, excavation and fixing provided nut bolts with the help of template as per design in an approved manner. 16-3-7	Nos.	25	3,668.00	91,700.00
13	NON-DSR ITEM	Supply & Installation of LED Lighting panel for Ranga Bhavan Plaza(IP 65). MS fabricated panel in 14/16 SWG with duly powder coated.The panel shall be compartmental type with Aluminium busbar and separate cable and busbar chambers. The cable chambers shall be free from any live open connections. (NON-DSR ITEM)	Nos.	1	70,000.00	70,000.00
		Fabricated DB.				
		Incomer- 160 A 36kA TP MCCB				
		Outgoing-				
		10 A SP MCB 10 kA- 12 Nos,				
		16 A TP MCB 10 kA- 09 Nos,				
		16 A SP MCB 10 kA- 09 Nos,				
		20 A SP MCB 10 kA- 04 Nos,				
		32 A TP MCB 10 kA- 01 Nos,				
		100 A TP MCCB 16 kA- 01 Nos,				
		100 A TP MCCB 16 kA- 01 Nos Spare				
		32 A TP MCB 10 kA- 02 Nos Spare				
		10 A TP MCB 10 kA- 02 Nos Spare				
		16 A TP MCB 10 kA- 02 Nos Spare				
		20 A SP MCB 10 kA- 03 Nos Spare				

Sr no	Item code	Description of items	Unit	Qty	Rate	Amount
14	1.1.1 1-2-8	Supplying and erecting rigid PVC conduit 25 mm dia. with PVC accessories on wall/ ceiling as per specification No: WG-MA/CON, para no. 1.1.1 1-2-8	Mtrs.	430	76.00	32,680.00
15	CB-LT/AL 16-2-6	Supplying and erecting RCC chamber cover of size 750 mm x 750 mm x 50mm thick with lifting arrangment including laying of angle iron frame of angle size as 50 x 50 x6 mm to be fixed/embeded on top of chamber. 16-2-6	Nos.	5	3,395.00	16,975.00
16	CB-LT/AL 2-3-14	Supplying and erecting fresh air cum Exhaust fan of light duty 250 V A.C. 50 cycles 300mm. 1400 RPM rust proof body & blades, wire mesh, duly erected in an approved manner and marking Sr. No. and date of erection. 2-3-14	Nos.	6	1,343.00	8,058.00
17	NON-DSR ITEM	Dismantling of existing High Mast Pole consisting of 8 nos. of Light Fittings(more than 20m). (NON-DSR ITEM)	Job	1	86,250.00	86,250.00
B		**SOLAR ROOFTOP SYSTEM**				
1		Turnkey setting up of 31.5 kWp rooftop Solar PV {100 nos. panels, 1000mm(ht) x 2000mm(length} at Ranga Bhavan chowk consisting of following items:	Job	1	2,205,000.00	2,205,000.00
a		DC ELECTRICAL SYSTEM				
		Solar PV Module				
		Solar Cable for string connection and String to Inverter connection				
		String inverter				
b		AC ELECTRICAL SYSTEM				
		ACDB				
		AC Cables from Inverter to ACDB				
		AC Cables from ACDB to LT Panel				
		Switchgear at main Evacuation Point				
		Testing & Commisioning				

Sr no	Item code	Description of items	Unit	Qty	Rate	Amount
2		Supply & Installation of NET METER for the Solar Rooftop system including Liaisoning with MSEDCL. LT AC Three Phase, Four wire, 10 - 40 Amps fully Static AMR compatible TOD Tri – vector Energy Meters with Net Metering arrangement consumer as per Category – C of IS: 15959 / 2011 of class 1.0 accuracy confirming to IS: 13779 / 1999 amended upto date suitable for measurement of different electrical parameters listed elsewhere in the document including Active Energy (kWh), Reactive Energy (kVArh), Apparent Energy (kVAh) Import / Export mode etc. in three phase, four wire balanced / unbalanced loads of LT Consumers. The meter shall also be capable to record measurement of various cumulative energies Import & Export mode separately, so as to calculate the Net Energy.	Job	1	75,000.00	75,000.00
C		**LED VIDEO WALL SYSTEM**				
1		Supply & Installation of LED Wall Video system for Ranga Bhavan Chowk Plaza comprising of following items & 1 Computer with Media player/mini CPU to control the screen with Wi-fi & 4G connectivity. Computer should have a PCI slot, one DVI port and 1 GB Graphics. One CAT 6 cable would need to be laid to connect this computer with the LED Screen.				
1		Outdoor LED Video Wall. Pitch- 8 mm, Pixel density- 10240 pixels/tile. LED life 100000 hrs. White balance 5600° K(adjustable upto 9000° K).Frame frequency 50-60 Hz.Horizontal & Vertical viewing angle 120°. Tile casing made of Mild steel(IP 65). Dimensions- 1000mm(H) X 2000mm(W).	Nos.	36	316,000.00	11,376,000.00

Sr no	Item code	Description of items	Unit	Qty	Rate	Amount
2		Outdoor LED Wall video. Pixel density- 14500 pixels/tile. LED life 100000 hrs. White balance 5600° K(adjustable upto 9000° K).Horizontal & Vertical viewing angle 120°. Tile casing made of Mild steel(IP 65). Dimensions- 650mm(H) X 111568mm(W).	Nos.	1	6,759,000.00	6,759,000.00
3		Media Processer- HDMI 1.3a with HDCP, HD 1080P input,10-bit Processing, 4 custom PIP/POP display modes,2048 x1152 full high-definition input and output,Seamless Switching, Fade-in / Fade-out switching & Blend switching in random input signals.	Nos.	10	100,000.00	1,000,000.00
		TOTAL OF ELECTRICAL WORK				**2,40,46,757.50**
		PLUMBING WORK				
1	Item No:-'2 i b / 1 BDA 2	Excavation for foundation in hard murum including removing the excavated materials upto distance of 50 metres beyond the building area and stacking and spreading as directed, dewatering, preparing the bed for the foundation and necessary back filling, ramming, watering including shoring and strutting etc. complete. (Lift upto 1.50 m) By Mechanical Means Spec. No.: Bd.A.2 Page No. 259, Item No:-'2 i b / 1BDA 2	Cum	552.78	129.15	71,391.54
2	Item No :-'2 ii b / 1 BDA 2	Excavation for foundation in Hard murum including removing the excavated material upto a distance of 50 metres beyond the building area and stacking and spreading as directed, dewatering, preparing the bed for the foundation and necessary back filling, ramming, watering including shoring and strutting etc. complete. (Lift from 1.5 to 3.0m.) By Mechanical Means Spec. No.: Bd.A.2 Page No. 259	Cum	276.39	204.75	56,590.85

Sr no	Item code	Description of items	Unit	Qty	Rate	Amount
3	Section E (17) Excavation page no 39 MJP	Murum bedding - 'Filling in plinth and floors / trenches with contractor's murum for bedding in 15 cm to 20 cm layers including watering and compaction, etc. complete. (Bd-A-11/263)	Cum	71.00	660.45	46,891.95
4	Section E (15)Excavation page no 38 MJP	Refilling - 'Refilling the trenches with available excavated stuff with soft material firstover pipeline and then hard material in15 cm layers with all leads and lifts including consolidation, surcharging,etc. complete.	Cum	727.75	63.00	45,848.25
5	Section I(VI) (1.D)R.C.C pipes page no 86 MJP	Providing ISI standard R.C.C. pipes in standard lengths of following class and diameter suitable for either collar joints or rubber ring joints, including all taxes (Central and local), inspection charges, transport to departmental stores / site, unloading and stacking, etc. complete. (IS-458/1988)				
		One collar should be supplied with each full length plain ended RCC pipe, cost included in rates below. 'One rubber ring should be supplied witheach full length of socketed pipe, costincluded in rates below.				
		NP-II class				
		150 mm dia	Rmt	0	371.70	-
		200 mm dia	Rmt	10	435.75	4,357.50
		250 mm dia	Rmt	5	522.90	2,614.50
		300 mm dia	Rmt	0	698.25	
		450 mm dia	Rmt	110	994.35	109,378.50
		NP-III class (Road Crossing)				
		300 mm dia R.C.C. Pipe	Rmt	10	929.25	9,292.50
		450 mm dia R.C.C. Pipe	Rmt	245	2,192.40	537,138.00

Sr no	Item code	Description of items	Unit	Qty	Rate	Amount
6	Section I(VI) (2)R.C.C pipes page no 88 MJP	Lowering, laying and jointing in proper grade and alignment R.C.C. pipes withcollar joints in CM 1:1 proportion or socketed R.C.C. pipes with rubber joints excluding cost of rubber ring or R.C.C.collar), including cost of conveyancefrom stores to site of works, cost ofjointing material, labour, giving hydraulic testing, etc. complete as directed by Engineer-in-charge. (IS-783/1985)				
		NP-II class				
		450 mm dia	Rmt	110	279.30	30,723.00
		NP-III class (Road Crossing)				
		450 mm dia R.C.C. Pipe	Rmt	245	279.30	68,428.50
7		Providing and constructing B.B. masonry circular manhole without conical shape excluding excavation, RCC 1:2:4 proportion, 20 cm bedding brick masonry in CM 1:4 proportion, 23 cm thick for 2 M depth from top 35 cm thick for 2 M below it and 45 cm thick for balance depth, RCC slab at top and at 2 M depth from top for supporting brick masonry above it, plastering with smooth finish in CM 1:2 proportion, C.C. 1:2:4 finishing channels in smooth rendering, providing C.I. dapuri type steps each weighing 5.5 kg., providing and fixing S.F.R.C. frame and cover of 56 cm dia. at top including cost of all materials and labour, etc. complete.				
		1.00 M dia. x 2 M depth	Nos	6	27,342.00	164,052.00
		Rebate for every decrease in depth of 50 cm	50 cm	0	4,604.25	-
		1.00 M dia. x 3 M depth	Nos	2	36,086.40	72,172.80
		Rebate for every decrease in depth of 50 cm	50 cm	0	6,363.00	-

Sr no	Item code	Description of items	Unit	Qty	Rate	Amount
8		Providing and fixing in position steel fibre reinforced concrete (S.F.R.C.) frame and covers of approved make including loading, unloading, transportation, all taxes, etc. complete as directed by Engineer-in-charge (20 tonnes capacity).				
		560 mm dia	Nos	8	3,435.60	27,484.80
9	Pune PWD DSR 15-16, item no-20/20 BDV 38, Pg no-150	Providing and fixing 15cm x 10cm salt glazed stoneware gully trap in cement concrete 1:4:8 outside the building including cast iron grating in the sink, connecting glazed stoneware pipe, brick masonry chamber with cast iron lid and cast iron grating for the gully trap. Spec. No.: Bd.V.38, Page No. 572	Nos	1.00	1,207.50	1,207.50
10	Pune PWD DSR 15-16, item no-21b/20 BDV 39, Pg no-158	Providing and laying 150 mm dia salt glazed stoneware pipe including fittings such as bends, tees, single junction, double junctions laying, jointing (including excavation and refilling the trenches) complete. Spec. No.: Bd.V.39, Page No. 573	Rmt	2.00	309.75	619.50
11	Pune PWD DSR 15-16, item no-26/20 BDV 44, Pg no-152	Providing and constructing Brick Masonry inspection trap Chamber 90cm x 45cm including 1:4:8 C.C foundation, 1:2:4 C.C.channels/half round glazed stoneware pipe channel, salt glazed stoneware intercepting trap with rodding pipe set in 1:4:8 cement concrete block, brick masonry plastering inside and Outside, fixed in cement concrete with R.C.C. Cover. Spec. No.: Bd.V.44, Page No. 575	Nos	2.00	5,460.00	10,920.00
12	69 / 20 BDV 5	Providing and laying in trenches 25 mm dia. heavy grade having embossed as ISI Mark galvanised iron pipes of 3.01 kg/metre necessary fitting remaking good the demolished portion with filling trenches and with primer of anti-corrosive oil paint , 2 coats complete. Spec. No.: Bd.V.5 Page No. 551 Pune PWD DSR 15-16, item no- 69 / 20 BDV5, Pg no-165	RMT	50	365.40	18,270.00

Sr no	Item code	Description of items	Unit	Qty	Rate	Amount
13	30 c / 20 BDV 60	Providing, laying & fixing P.V.C. pipe of 25mm dia. with fittings such as bends, tees, reducers, clamps, etc. including necessary excavation, trench filling etc. complete. Spec : As directed by Engineer In Charge	RMT	125	77.70	9,712.50
14	6 c / 20 BDV 7	Providing and fixing 25mm diameter water meter with non-returnvalve including strainer, sockets/ union nut and including water meter box making locking arrangement and lock. [Without chamber]. Spec. No.: Bd.V.7 Page No. 554 Pune PWD DSR 15-16, item no- 6c/20 BDV 7, Pg no-145	Nos	2	4,620.00	9,240.00
15	8 c / 20 BDV 9	Providing and fixing screw down for 25 mm dia. wheeled stop tap of brass including necessary sockets/union nut complete Spec. No.: Bd.V.9 Page No. 555 Pune PWD DSR 15-16, item no-8c/20 BDV 9, Pg no-147	Nos	6	425.25	2,551.50
16		Valve chamber with precast steel fibre reinforced concrete frame and covers (S.F.R.C. frame and covers) Providing and constructing B.B. masonry valve chamber with 15 cm thick 1:3:6 proportion PCC bedding, excluding excavation, B.B. masonry in CM 1:5 proportion precast S.F.R.C. frame and cover, etc. complete as directed by Engineer-in-charge. Note : Wall thickness : 0.23 M for depth of 1.2 M and 0.35 M for balance depth exceeding 1.2 M.				
	257-3 - C	As above of 90 x 60 cm internal size and depth upto 1.2 M with S.F.R.C. frame and cover.	Nos	2	11,270.70	22,541.40
	258-3 - F	As above of 90 x 60 cm internal size and depth upto 1.2 M with S.F.R.C. frame and cover.	Nos	10	21,474.60	214,746.00

Sr no	Item code	Description of items	Unit	Qty	Rate	Amount
17	38 a / 20 BDV	Providing and fixing 25 mm. dia Ball cock medium type with PVC float including sockets & necessary fittings and tested as per municipal requirements etc. complete. Spec : As directed by Engineer In Charge	Nos	2	640.50	1,281.00
18	262 - 17 e	Providing and fixing in position steel fibre reinforced concrete (S.F.R.C.) frame and covers of approved make including loading, unloading, transportation, all taxes, etc. complete as directed by Engineer-in-charge (20 tonnes capacity). 60 x 60 cm size	Nos	2	2,736.30	5,472.60
19	47 c / 20 BDV 4	Providing and making ISI Mark ferrule connection of 25mm dia. To water main including ferrule coupling cast iron bell mouth cover, built in non return valve and fixing including excavation and reinstatement complete. Spec. No.: Bd.V. 4 page 551 Pune PWD DSR 15-16, item no- 47c/20 BDV 4, Pg no-161	Nos	2	1,874.25	3,748.50
20	57 - 13	Providing and constructing two taps standpost as per type design with excavation 30 cm thick boulder filling 15 cm thick PCC in 1:3:6, 20 mm thick RCC, 1:2:4 platform of 1.75 M dia. with side curb and bucket rest, 80 mm dia, heavy duty GI pipe central post duly filled therein with C.C. 1:2:4, 5 M long, 20 mm dia. medium G.I. pipe from point of tapping to standpost, additional 20 mm dia G.I. pipe fixed horizontally and providing and fixing two 15 mm dia GI self closing water taps, one brass ferrule, etc. complete together with all labour and material charges as per drawing and as directed by Engineer-incharge when B.C. soil is available. ate includes draining arrangement by excavating open gutters. (MJP-Section H, Item no-13, Pg no-57)	No	1	8,856.75	8,856.75

Sr no	Item code	Description of items	Unit	Qty	Rate	Amount
21	Mah. PWD Electrical DSR 15-16, item no- 12-4-6	Supplying and erecting 1 phase, 230 V, 50 Hz, submersible pump set suitable for erection on open well, pump having discharge 130 / 475 L.P.M., head 21 / 9 m & delivery pipe of necessary diameter erected with necessary H type clamps as per specification No. WP-OSP	Nos	2	16,999.50	33,999.00
22	Mah.PWD Electrical DSR 15-16, item no- 12-5-20	Supplying & erecting automatic control panel for 1 Ph, 230 volt, A.c. Submersible/centrifugal pump set upto 2 HP consisting of DOL starter Of suitable relay range S.P.P., Combined ammeter/ voltmeter, phase indicating lamp enclosed in CRCA powder coated Vibration proof encloser with IP 54 protection. Control Panel should offer single phasing, phase reversal, phase inbalence etc (Similar to LT model no.MR G2)	Nos	1	4,954.95	4,954.95
23	Mah.PWD Electrical DSR 15-16, item no- 12-5-14	Supplying & erecting Water lavel controller 230/415 V AC., Two way for under ground tank operation only.	Nos	1	1,493.10	1,493.10
24	Mah.PWD Electrical DSR 15-16, item no- 12-5-16	Supplying & erecting PVC coated 5 mm dia Brass Sensor/electrode duly wired with nut & bolts complete	Nos	2	242.55	485.10
25	Mah.PWD Electrical DSR 15-16, item no- 12-5-16	Supplying and erecting flat flexible 3 core 4 sq mm PVC sheathed submersible type copper cable suitably clamped at fixed intervals with column pipe assembly complete.	RMT	20	157.50	3,150.00
		TOTAL FOR PLUMBING WORK				**1,599,614.09**

Sr no	Item code	Description of items	Unit	Qty	Rate	Amount
		Annual Maintanance Contract- As per special condition of contract				
1		Annual Maintanance Contract for all elements of Ranga Bhavan Chowk, including Garden with supply of Water, Gardener, cleaning, cutting of Grass, maintaining of all trees & shrubs, watering to all with good arrangement; maintaining all physical elements such as Benches, Tiles, Granite platforms and replacing any broken tiles, granite platforms, benches; metal elements such as columns, railings, framework; LED Display Panels, Solar PV system, efficiency and cleaning of Solar PV system; all electrical and plumbing systems, as directed by Engineer In Charge etc. complete	-	04 (FOUR) Years	-	50,00,000.00
		Total Amount for AMC				**50,00,000.00**
		MISSCELLENEOUS WORK				
1	N/A	Any items including light fittings, street furniture, etc., as per site conditions, as specified by Urban Designer				10,00,270.00
		Total Amount for Misscelleneous Work				**10,00,270.00**

SCHEDULE C

DETAILED SPECIFICATIONS

Sr no	Description of items	Standard Specifications / Item Code as per DSR (2016-2017) Specifications	Additional Specifications
A	**CIVIL WORK**		
1	Scarifying the existing bituminous roadsurface to a depth of 50 mm by manual means and disposal of scarified materialwith in all lifts and lead upto 1000 metres. Spec : M.O.R.T & H - 305.4.3	47 / 23 MORTH 3.15	
2	Dismantling brick masonry in lime or cement mortar and stacking the materials as directed with all leads, lifts, com-plete. Spec : As directed by Engineer In Charge. **Item No - 13 b / 21 BDW 8**	13 b / 21 BDW 8	
3	Removing cement tiles, or marble or polished shahabad floor or dado without bed concrete including stacking the materials as directed with all leads, lifts, complete. Spec : As directed by Engineer In Charge	15 h / 21 BDW 8	
4	Dismantling of structural steel and stacking the materials as directed with all leads, lifts, com-plete. Spec : As directed by Engineer In Charge.	Non DSR Item	Specification as instructed by Engineer in charge
5	Excavation for foundation in earth, soil of all types, sand, gravel and soft murum, including removing the excavated material upto a distance of 50 m. beyond the building area & stacking and spreading as directed, dewatering, preparing the bed for the foundation and necessary back filling, ramming, watering including shoring and strutting etc. complete. (Lift upto 1.5 m.)By Manual Means Spec. No.: Bd.A.1 Page No. 259.	1 i a / 1 BDA 1..	

Sr no	Description of items	Standard Specifications / Item Code as per DSR (2016-2017) Specifications	Additional Specifications
6	Providing and casting in situ cement concrete M-15 of trap / granite / quartzite / gneiss metal for steps including centering, formwork, compacting, roughening them if special finish is to be provided and curing and finishing if required complete,with fully automatic micro processor based PLC with SCADA enabled reversible Drum Type mixer ... With natural sand. Spec. No.: Bd.E.2 Page No. 288 and B.7 Page No 38 **Item No :-2 i a / 4 BDE 2**	2 i a / 4 BDE 2	
7	Filling in plinth and floors with contractors soil sand or murum in 15 cm to 20cm, layers including watering and compaction complete. Spec. No.: Bd.A.11 Page No. 263	10 / 1 BDA 11	
8	Conveying materials obtained from road cutting including all lifts, laying in layers of 20cm. to 30cm. (about 8 inch to 12 inch) breaking clods, dressing to the required lines, curves, grades and section, watering and compaction to 95% of standard proctor density for a lead of 50 to 300 m. inclusive from the site of excavation to the site of deposition as directed. Spec : MORTH 305. **Item No ;- 12 a / 23 MORTH 305**	Item No ;- 12 a / 23 MORTH 305	
9	Providing dry/ trap/ granite/ quartzite/ gneiss rubble stone soling 15 cm to 20 cm thick including hand packing and compacting complete. Spec. No.: Bd.A. 12 Page No. 264	11 / 1 BDA 12	
10	Providing and filling in the foundation with sand of approved quality including watering, compaction complete. Spec. No.: Bd.A.13 Page No. 264	12 / 1 BDA 13	

Sr no	Description of items	Standard Specifications / Item Code as per DSR (2016-2017) Specifications	Additional Specifications
11	Providing and casting in situ cement concrete in M-25 of trap/ granite/ quartzite/ gneiss metal for R.C.C. pardi 75mm thick fins including centering, formwork, cover blocks compacting and roughening them if special finish is to be provided and curing complete.(Excluding reinforcement).with fully automatic micro processor based PLC with SCADA enabled concrete batch mix plant (pan mixer).... With natural sand. Spec. No.: Bd.F.11 Page No. 304 and B.7, Page No. 38 **Item No :- 6 B b i / 5 BDF 11**	Item No :- 6 B b i / 5 BDF 11	
12	Providing and laying in situ cement concrete M - 25 Ready mix of trap /granite /quartzite /gneiss metal, Natural Sand for R.C.C. Slabs and Landings as per detailed designs & drawing or as directed including centering, formwork, cover blocks, compaction, curing and roughening the surface if special finish is to be provided (Excluding reinforcement & structural steel) complete With Natural Sand ---(Item to be used with prior permission of Superintending Engineer) Spec. No.:No.: Bd. F 8 page No. 302 and B-7, Page No. 38 **Item No :- 15 i a / 5 BDF 8**	Item No :- 15 i a / 5 BDF 8	
13	Providing and laying in situ cement concrete M-25 of trap / granite /quartzite/ gneiss metal for R.C.C. work in foundations like raft, strip foundations, grillage and footings of R.C.C. columns and steel stanchions etc. including bailing out water, formwork ,cover blocks compaction and curing roughening the surface if special finish is to be provided (Excluding reinforcement and structural steel) complete, With fully automatic micro processor based PLC with SCADA enabled reversible drum type concrete mixer. With natural sand. Spec. No.: Bd.F.3 Page No. 298 and B.7, Page No.38	1 A b i / 5 BDF 3	

Sr no	Description of items	Standard Specifications / Item Code as per DSR (2016-2017) Specifications	Additional Specifications
14	Providing and casting in situ cement concrete M-25 of trap / granite /quartzite/ gneiss metal for R.C.C. columns as per detailed designs and drawings or as directed including centering, formwork, cover blocks compacting and roughening if special finish is to be provided and curing complete. (Excluding reinforcement). With fully automatic micro processor based PLC with SCADA enabled reversible drum type concrete mixer.With natural sand. Spec. No.: Bd.F.5 Page No. 300 and B-7,Page No 38.	2 A b i / 5 BDF 5	
15	Providing and casting in situcement concrete M-25 of trap/ granite/ quartzite/ gneiss metal for R.C.C. beams and lintels as per detailed designs and drawings or as directed including centering, formwork, cover blocks compaction and roughening the surface if special finish is to be provided and curing complete. (Excluding reinforcement).With fully automatic micro processor based PLC with SCADA enabled reversible drum type concrete mixer.With natural sand. Spec. No.: Bd.F.6 Page No. 300 and B.7, Page No.38	3 A b i / 5 BDF 6	
16	Providing and fixing in position TMT - FE - 500 bar reinforcement of various diameters for R.C.C. pile caps, footings, foundations, slabs, beams columns, canopies, staircase, newels, chajjas, lintels pardis, copings, fins, arches etc. as per detailed designs, drawings and schedules. including cutting, bending, hooking the bars, binding with wires or tack welding, with anti-corrosive treatment and supporting as required complete. **Item No -8 / 5 BDF 17**	Item No -8 / 5 BDF 17	

Sr no	Description of items	Standard Specifications / Item Code as per DSR (2016-2017) Specifications	Additional Specifications
17	Providing and fixing M.S. grill door 24 kg/sqm of various size as per detailed drawings without hot dip coating, Steel fixtures and fastenings and 3 coats of oil painting etc. Spec : As directed by Engineer In Charge	27 / 18 BDT	
18	Providing and fixing steel ventilator fully glazed partly fixed as per detailed drawing without hot dip zinc coating including fabricating glazing with plain / obscured glass panes and approved type and quality and Steel fixtures, with anti-corrosive treatment and fastening oil paint 2 coats etc. complete. Spec. No.: Bd. T. 53, Page No. 509 & As directed by Engineer in charge.	25 / 18 BDT 53	
19	Providing and fixing mild steel grill / Grating work 20 kg./sq.m. as per drawing including fixtures, necessary welding & painting with one coats of anticorrosive paint & two coats of oil painting complete. Spec. No.: Bd.U.1 Page No. 537	1 a / 19 BDU 1	
20	Providing and erecting structural steel for sakav with all bracing gusset plates etc. as per detailed design and drawing or as directed including cutting, fabrication, hoisting, erecting, fixing in position, making riveted/ bolted/ welded connection, with anti-corrosive treatment and oil painting with two coats complete. Spec. No.: As directed by Engineer in charge. Item No - 6 / 3 BDC	Item No - 6 / 3 BDC	
21	Providing and fixing plain zinc sheeting of 0.80 mm thick (22 B.W.G.) over the ridge hip or valley to galvanized iron sheet roofing including all fastening and bolt galvanised iror screws and bolts and lead and bitumen washers complete. (Weight of 6.8 kg/sq.m.). Spec : Bd.R.5, Page No. 453	4 a / 17 BDR 5	

Sr no	Description of items	Standard Specifications / Item Code as per DSR (2016-2017) Specifications	Additional Specifications
22	Providing second class Burnt Brick masonry with conventional/ I.S. type bricks in cement mortar 1:6 in superstructure including striking joints, racking out joints, watering and scaffolding Complete. Spec.No.:Bd.G.5PageNo.315	4 / 6 BDG 5	
23	Providing internal cement plaster 12mm thick in single coat in cement mortar 1:4 without neeru finish to concrete or brick surfaces, in all positions including scaffolding and curing complete. Spec. No.: Bd. L.2 Page No. 368	2 b / 11 BDL 2A	
24	Providing fine cement finish 1.5 mm thick over green plaster surface including scaffolding curing etc. complete. Spec. No.: As directed by Engineer in charge.	13 / 11 BDL	
25	Providing and fixing machine cut machine polished 18 mm to 20 mm thick Polished Steel Grey Granite/ telephone black / Amba White / Cat bary brown / RBI red / Ocean Brown granite stone for treads and risers of steps and staircases of approved colour and shade with rounded moulding and three grooved line for the treads on bed of 1;4 Cement mortar including float filling joints with neat cement slurry curing polishing and cleaning etc. complete. Spec. No.: Bd. M.22 B/Page No. 390	15 / 12 BDM 22	
26	Providing and laying chequered tiles of approved quality of company VYARA or equivalent make of size 30 cm x 30 cm for flooring in required position laid on a bed of 1:4 cement mortar including cement float, filling joint with cement slurry cleaning curing complete. Spec. No.: Bd. M-12	27 / 12 BDM	1) Vyara make Mattee tile in Brown colour 2) Vyara make Pebblino Tiles

Sr no	Description of items	Standard Specifications / Item Code as per DSR (2016-2017) Specifications	Additional Specifications
27	Providing and fixing heavy duty inter locking concrete Coloured paving blocks (Coble Stone Patern) of 80 mm thickness of having a strength of 300 kg/Sq.cm. of approved quality and shape on a bed of crushed sand of 25 to 30 mm thick including skirting joints and cleaning etc. complete ** Spec. No.: As directed by Engineer in charge Item No:- 21 B ii / 12 BDM	Item No:- 21 B ii / 12 BDM	
28	Providing and fixing Guard Railing of 900mm height in 50mm M.S. Round Tube for Hand Rail & Vertical post 900mm C/C & 10mm round MS bar 2 Nos in horizontal as per Type drawing No. 1701 and fixed in 50mm x 50mm x 6mm iron angle embedded in 1:2:4 C.C. bedding 55 x 45 cm and 50 x 6 iron patti as per detailed drawing with 3 coats of approved yellow and Brown Synthatic Enamal paint. Spec : MORTH 2703	78 / 23 MORTH 2703	
29	Providing and casting in situ or precast tapering R.C.C. 1:2:4 Kerbs type-III as per Drg. No. 13 dt. 20-4-79, tapering (9 inch x 6 inch) both side embedded 6 inch below ground level finished neatly with C.M. 1:2 with 4 Nos. 6mm dia. bars and 6mm dia. strips at 18 inch C/c setting the same in C.M. 1:2, painting the exposed surface of the kerbs with 2 coats of road marking paint of approved quality and colour including the required excavated stuff any where in city and redoing the surface as specified and directed for single line dividers. Spec : MORTH 409	73 B / 23MORTH409	

Sr no	Description of items	Standard Specifications / Item Code as per DSR (2016-2017) Specifications	Additional Specifications
30	Laying and spreading available soil inthe sub-grade on a prepared surfacepulverizing, mixing the spread soil in placewith rotavator with 3 per cent slaked limhaving minimum content of 70 per cent oCaO, grading with motor grader ancompacting with the road roller at OMC tthe desired density to form a layer ofimproved sub grade -- By Mechanical Means Spec : MORTH - 401	33 a / 23 MORTH 4.3	
31	Construction of granular sub-base by providing close graded material, spreading in uniform layers with motor grader on prepared surface, mixing by mix in place method with rotavator at OMC, and compacting with vibratory roller to achieve the desired density, complete as per clause 401 -- By Mix in Place Method and Grade II Material. Spec : M.O.R.T & H - 401	34 a ii / 23MORTH 4.1	
32	Wet Mix Macadam -- Providing, laying, spreading and compacting graded stone aggregate to wet mix macadam specification including premixing the Material with water at OMC in mechanical mix plant carriage of mixed Material by tipper to site, laying in uniform layers with paver in sub- base / base course on well prepared surface and compacting with vibratory roller to achieve the desired density. Spec : MORTH - 406	45 / 23 MORTH 4.12	
33	Prime coat (Providing and applying primecoat with bitumen emulsion on preparedsurface of granular Base including clearingof road surface and spraying, primer athe rate of 0.60 kg/sqm usingmechanical means.)Spec : M.O.R.T & H – 502	49 / 23 MORTH 5.1	

Sr no	Description of items	Standard Specifications / Item Code as per DSR (2016-2017) Specifications	Additional Specifications
34	Providing and applying tack coat on the prepared surface heating by flames in Boiler and spraying bitumen with sprayer on / Granular surface with primer @ 3.0 kg/10 sqm with VG-30 bulk Bitumen Spec : M.O.R.T & H - 503	50 b / 23 MORTH 5.2	
35	Dense Bituminous macadam: Providing and laying dense bituminous macadam using crushed aggregates of specifiedgrading premixed with bituminous binder@ 4.50 per cent by weight of total mix and filler, transported to site with VTS , laid over a previously prepared surface,finished to the required grade, level,alignment, and rolling to achieve thedesired compaction VG-30 Bitumen. --USING 80 TPH Batch mix type hot mix plant with SCADA, Sensor Paver,Intelligent Compactor with mcompactionanalyzer and V-Sat attachment with Stone Dust filler. Spec : As per MORTH specification FifthEdition Clause No.507 and IRC-SP-972013	61 / 23 MORTH5.6	
36	Providing and laying bituminous concrete using B77 crushed aggregate of specified grading premixed with bituminous binder @5.5%'by weight of total mix and filler,transportedat site with VTS, laid over a previouslyprepared surface , finished to the requiredgrade ,level, alignment,and rolling toachieve the desired density for 50/75mm compacted thickness with drum mix typehot mix plant without SCADA, WithSensor paver, and Vibratory rollerexcluding prime/ Tack coat etc. complete - Bitumen VG-30 grade with stonedust filler Spec: As per MORTH specification FifthEdition Clause No.507 and IRC-SP-972013	65 / 23 MORTH	

Sr no	Description of items	Standard Specifications / Item Code as per DSR (2016-2017) Specifications	Additional Specifications
37	Garden Soil:- Supplying and stacking of good earth at site including royalty and carriage upto 5 km complete (earth measured in stacks will be reduced by 20% for payment).	2.2 (Horticultural DSR)	
38	Farm Yard Manure:- Supplying and stacking sludge at site including royalty and carriage upto 5km complete (sludge measured in stacks will be reduced by 8% for payment).	2.3 (Horticultural DSR)	
39	Preparation of beds for hedging and shrubbery by excavating 60 cm deep and trenching the excavated base to a further depth of 30 cm, refilling the excavated earth after breaking clods and mixing with sludge or manure in the ratio of 8:1 (8 parts of stacked volume of earth after reduction by 20% : one part of stacked volume of sludge or manure after reduction by 8%), flooding with water, filling with earth if necessary, watering and finally fine dressing, leveling etc. including stacking and disposal of materials declared unserviceable and surplus earth by spreading and leveling as directed, within a lead of 50 m, lift up to 1.5 m complete (cost of sludge, manure or extra earth to be paid for separately)	2.33 (Horticultural DSR)	
40	Preparing instant Lawn:- Providing and laying Neelgiri/Mexican grass turf with earth 50mm to 60mm thickness of existing ground prepared with proper level and ramming with tools wooden (Dhurmos) and than rolling the surface with light roller make the surface smoothen and light waterning with sprinkler and maintenance for 30 days or more till the grass estofficer-in-charge.	2.33 (Horticultural DSR)	

Sr no	Description of items	Standard Specifications / Item Code as per DSR (2016-2017) Specifications	Additional Specifications
41	Supply and stacking of Cassia fistula (Amaltash) plant of height 120-135 cm. in big poly bags of size 25 cm as per direction of the officer-in-charge.	As per CPWD Item no 7.16	
42	Supply and stacking of Bauhinia blakeana (Kachnar) plant of height 120150 cm. in big poly bags of size 25 cm as per direction of theofficer-in-charge.	As per CPWD Item no 7.7	
43	Supply and stacking of Bougainvillea (Variety Butiana, Lady Mary Baring, Mahara,Mohan,Scarlet Queen, Varigata, Glabra Formosa, Peruviana Odissi, Partha, Subhra,Thimma, Spectabilis L.N Birla, Refulgens) plant of height 30 cm. to 45 cm. with 2-3 branches in 20 cm size of Earthen pots / Plastic pots & as per direction of the Engineer-in-charge.	As per CPWD Item no 9.4	
44	Supply and stacking of plant Murraya Paniculata/ exotica of height 45-60 cm. in poly bags of size 15 cm.	As per CPWD Item no 8.44	
45	Providing & Fixing Benches of with Synthetic Wood –BSW-8 in Size: 1500 MM L x 525 MM D x 850 MM H & in Colour : Seat & Backrest – Teak Wood M.S. Structure – Grey as per Drawing/ Image including M.S. Angle frame with Synthetic Wood slats Seat & Backrest. All Metal Parts are galvanized & Polyester Powder Coated. All fitting are in S.S. (Synthetic Wood : 100% engineered polymer contains no organic fillers such as wood, bamboo, or rice husk flour so it does not absorb moisture causing swelling, staining and rot, in addition, termites are not an issue with synthetic wood) etc. complete. as directed by Engineer-In-Charge.	Non DSR Item	Specification as instructed by Engineer in charge

Sr no	Description of items	Standard Specifications / Item Code as per DSR (2016-2017) Specifications	Additional Specifications
B	**ELECTRICAL WORK**		
B1	**STREET LIGHTS**		
1	Supplying & erecting mains with 3x4 Sq.mm F.R copper PVC insulated wire laid in provided conduit/trunking/inside pole/Bus bars or any other places as per specification No: WG-MA/BW 1-3-15	WG-MA/BW 1-3-15	
2	Supplying & erecting mains with 3x2.5 Sq.mm F.R copper PVC insulated wire laid in provided conduit/trunking/inside pole/Bus bars or any other places as per specification No: WG-MA/BW 1-3-13	WG-MA/BW 1-3-13	
3	Supplying, erecting & terminating PVC armoured cable 3½ core 25 sq mm aluminium conductor with continuous 5.48 sq mm (12 SWG) G.I. earth wire complete erected with glands & lugs, on wall/ trusses/pole or laid in provided trench/ pipe as per specification no. CB-LT/AL 7-1-17	CB-LT/AL 7-1-17	
4	Supplying, erecting & terminating PVC armoured cable 3½ core 95 sq mm aluminium conductor with continuous 8.35 sq mm (10 SWG) G.I. earth wire complete erected with glands & lugs, on wall/ trusses/pole or laid in provided trench/ pipe as per specification no. CB-LT/AL 7-1-21	CB-LT/AL 7-1-21	
5	Supplying, erecting & terminating PVC armoured cable 4 core 16 sq mm aluminium conductor with continuous 5.48 sq mm (12 SWG) G.I. earth wire complete erected with glands & lugs, on wall/ trusses/pole or laid in provided trench/ pipe as per specification no. CB-LT/AL 7-1-16	CB-LT/AL 7-1-16	
6	Supplying and erecting CFL 18 to 20 W with ceramic adopter p.f. more than 0.9. 2-1-30	CB-LT/AL 2-1-30	

Sr no	Description of items	Standard Specifications / Item Code as per DSR (2016-2017) Specifications	Additional Specifications
7	LED Ground Mounted Bollard with a system lumen output of 500 lumens and a minimum system efficacy of 56lm/W. The luminaire shall have a rated system lifetime of 50,000 burning hours at L70 @ 35 Deg C. The luminaire should have a color temperature of 6500K and CRI>70. The luminaire shall meet IP65 & IK10 rating with PF > 0.9. The luminaire housing should made of pressure die cast aluminium with polycarbonate diffuser. The total power consumption should not exceed 8.5W. (NON-DSR ITEM)	NON-DSR ITEM	Specification as instructed by Engineer in charge
8	Supplying and erecting T5 28 W energy efficient fluroscent tube. 2-1-14	CB-LT/AL 2-1-14	
9	Dismantling of existing street lights alongwith foundation & accessories. Using the existing poles for refitting,complete wiring with new street fittings & accessories. NON-DSR ITEM	NON-DSR ITEM	Specification as instructed by Engineer in charge
10	Supplying & erecting FRP box of size 150mm x 125mm x 100 mm, 2.7 mm thick complete on pole as per specification No. CB-SB For Plaza LED lighting. 7-8-10	CB-LT/AL 7-8-10	
11	LED Post Top with a system lumen output of 3000 lumens and a minimum system efficacy of 75 lm/W. The luminaire shall have a rated system lifetime of 50,000 burning hours at L70. The luminaire should have a color temperature of 4000K and CRI 80. The luminaire shall meet IP66 & IK10 with PF > 0.9. The total power consumption should not exceed 40W (including driver). LED POST TOP with 2.5 / 3 m Pole. (NON-DSR ITEM)	NON-DSR ITEM	Specification as instructed by Engineer in charge

Sr no	Description of items	Standard Specifications / Item Code as per DSR (2016-2017) Specifications	Additional Specifications
12	Providing & casting of M- 20 grade reinforced cement concrete (RCC) foundation suitable for 3m to 5m high octagonal / conical G.I. pole considering the safe soil bearing apacity at site as 10 T/sq m at 1.5 m depth including supply of steel, concrete, excavation and fixing provided nut bolts with the help of template as per design in an approved manner. 16-3-7	CB-LT/AL 16-3-7	
13	Supply & Installation of LED Lighting panel for Ranga Bhavan Plaza(IP 65). MS fabricated panel in 14/16 SWG with duly powder coated.The panel shall be compartmental type with Aluminium busbar and separate cable and busbar chambers. The cable chambers shall be free from any live open connections. (NON-DSR ITEM)	NON-DSR ITEM	Specification as instructed by Engineer in charge
	Fabricated DB.		
	Incomer- 160 A 36kA TP MCCB		
	Outgoing-		
	10 A SP MCB 10 kA- 04 Nos,		Make- Siemens, L&T, Legrand, Schneider
	16 A TP MCB 10 kA- 10 Nos,		Make- Siemens, L&T, Legrand, Schneider
	16 A SP MCB 10 kA- 10 Nos,		Make- Siemens, L&T, Legrand, Schneider
	20 A SP MCB 10 kA- 05 Nos,		Make- Siemens, L&T, Legrand, Schneider
	32 A TP MCB 10 kA- 01 Nos,		Make- Siemens, L&T, Legrand, Schneider
	100 A TP MCCB 16 kA- 01 Nos,		Make- Siemens, L&T, Legrand, Schneider

Sr no	Description of items	Standard Specifications / Item Code as per DSR (2016-2017) Specifications	Additional Specifications
	100 A TP MCCB 16 kA- 01 Nos Spare		Make- Siemens, L&T, Legrand, Schneider
	32 A TP MCB 10 kA- 02 Nos Spare		Make- Siemens, L&T, Legrand, Schneider
	10 A TP MCB 10 kA- 02 Nos Spare		Make- Siemens, L&T, Legrand, Schneider
	16 A TP MCB 10 kA- 02 Nos Spare		Make- Siemens, L&T, Legrand, Schneider
	20 A SP MCB 10 kA- 03 Nos Spare		Make- Siemens, L&T, Legrand, Schneider
14	Supplying and erecting rigid PVC conduit 25 mm dia. with PVC accessories on wall/ ceiling as per specification No: WG-MA/CON, para no. 1.1.1 1-2-8	1.1.1 1-2-8	
15	Supplying and erecting RCC chamber cover of size 750 mm x 750 mm x 50mm thick with lifting arrangment including laying of angle iron frame of angle size as 50 x 50 x6 mm to be fixed/embeded on top of chamber. 16-2-6	CB-LT/AL 16-2-6	Specification as instructed by Engineer in charge
16	Supplying and erecting fresh air cum Exhaust fan of light duty 250 V A.C. 50 cycles 300mm. 1400 RPM rust proof body & blades, wire mesh, duly erected in an approved manner and marking Sr. No. and date of erection. 2-3-14	CB-LT/AL 2-3-14	
17	Dismantling of existing High Mast Pole consisting of 8 nos. of Light Fittings(more than 20m). (NON-DSR ITEM)	NON-DSR ITEM	Specification as instructed by Engineer in charge
B2	**SOLAR ROOFTOP SYSTEM**		
1	Turnkey setting up of 31.5 kWp rooftop Solar PV at Ranga Bhavan chowk consisting of following items:		Specification as instructed by Engineer in charge
a	DC ELECTRICAL SYSTEM		

Sr no	Description of items	Standard Specifications / Item Code as per DSR (2016-2017) Specifications	Additional Specifications
	Solar PV Module		
	Solar Cable for string connection and String to Inverter connection		
	String inverter		
b	AC ELECTRICAL SYSTEM		
	ACDB		
	AC Cables from Inverter to ACDB		
	AC Cables from ACDB to LT Panel		
	Switchgear at main Evacuation Point		
	Testing & Commisioning		
2	Supply & Installation of NET METER for the Solar Rooftop system including Liaisoning with MSEDCL. LT AC Three Phase, Four wire, 10 - 40 Amps fully Static AMR compatible TOD Tri – vector Energy Meters with Net Metering arrangement consumer as per Category – C of IS: 15959 / 2011 of class 1.0 accuracy confirming to IS: 13779 / 1999 amended upto date suitable for measurement of different electrical parameters listed elsewhere in the document including Active Energy (kWh), Reactive Energy (kVArh), Apparent Energy (kVAh) Import / Export mode etc. in three phase, four wire balanced / unbalanced loads of LT Consumers. The meter shall also be capable to record measurement of various cumulative energies Import & Export mode separately, so as to calculate the Net Energy.		Specification as instructed by Engineer in charge

Sr no	Description of items	Standard Specifications / Item Code as per DSR (2016-2017) Specifications	Additional Specifications
B3	**LED VIDEO WALL SYSTEM**		
1	Supply & Installation of LED Wall Video system for Ranga Bhavan Chowk Plaza comprising of following items & 1 Computer with Media player/mini CPU to control the screen with Wi-fi & 4G connectivity. Computer should have a PCI slot, one DVI port and 1 GB Graphics. One CAT 6 cable would need to be laid to connect this computer with the LED Screen.	NON-DSR ITEM	Specification as instructed by Engineer in charge
1.1	Outdoor LED Video Wall. Pitch- 8 mm, Pixel density- 10240 pixels/tile. LED life 100000 hrs. White balance 5600° K(adjustable upto 9000° K).Frame frequency 50-60 Hz.Horizontal & Vertical viewing angle 120°. Tile casing made of Mild steel(IP 65). Dimensions- 650mm(H) X 1000mm(W).		
1.2	Outdoor LED Wall video. Pixel density- 14500 pixels/tile. LED life 100000 hrs. White balance 5600° K(adjustable upto 9000° K).Horizontal & Vertical viewing angle 120°. Tile casing made of Mild steel(IP 65). Dimensions- 650mm(H) X 111568mm(W).		
1.3	Media Processer- HDMI 1.3a with HDCP, HD 1080P input,10-bit Processing, 4 custom PIP/POP display modes,2048 x1152 full high-definition input and output,Seamless Switching, Fade-in / Fade-out switching & Blend switching in random input signals.		

Sr no	Description of items	Standard Specifications / Item Code as per DSR (2016-2017) Specifications	Additional Specifications
C	**PLUMBING WORK**		
1	Excavation for foundation in hard murum including removing the excavated materials upto distance of 50 metres beyond the building area and stacking and spreading as directed, dewatering, preparing the bed for the foundation and necessary back filling, ramming, watering including shoring and strutting etc. complete. (Lift upto 1.50 m) By Mechanical Means Spec. No.: Bd.A.2 Page No. 259, Item No:-'2 i b / 1BDA 2	DSR ITEM NO Item No:-'2 i b / 1 BDA 2	
2	Excavation for foundation in Hard murum including removing the excavated material upto a distance of 50 metres beyond the building area and stacking and spreading as directed, dewatering, preparing the bed for the foundation and necessary back filling, ramming, watering including shoring and strutting etc. complete. (Lift from 1.5 to 3.0m.) By Mechanical Means Spec. No.: Bd.A.2 Page No. 259	DSR ITEM NO Item No :-'2 ii b / 1 BDA 2	
3	Murum bedding - 'Filling in plinth and floors / trenches with contractor's murum for bedding in 15 cm to 20 cm layers including watering and compaction, etc. complete. (Bd-A-11/263)	DSR ITEM NO Section E (17) Excavation page no 39 MJP	
4	Refilling - 'Refilling the trenches with available excavated stuff with soft material firstover pipeline and then hard material in15 cm layers with all leads and lifts including consolidation, surcharging,etc. complete.	DSR ITEM NO Section E (15)Excavation page no 38 MJP	

Sr no	Description of items	Standard Specifications / Item Code as per DSR (2016-2017) Specifications	Additional Specifications
5	Providing ISI standard R.C.C. pipes in standard lengths of following class and diameter suitable for either collar joints or rubber ring joints, including all taxes (Central and local), inspection charges, transport to departmental stores / site, unloading and stacking, etc. complete. (IS-458/1988)	DSR ITEM NO Section I(VI) (1.D)R.C.C pipes page no 86 MJP	
6	Lowering, laying and jointing in proper grade and alignment R.C.C. pipes withcollar joints in CM 1:1 proportion or socketed R.C.C. pipes with rubber joints excluding cost of rubber ring or R.C.C.collar), including cost of conveyancefrom stores to site of works, cost ofjointing material, labour, giving hydraulic testing, etc. complete as directed by Engineer-in-charge. (IS-783/1985)	Section I(VI) (2)R.C.C pipes page no 88 MJP	
7	Providing and constructing B.B. masonry circular manhole without conical shape excluding excavation, RCC 1:2:4 proportion, 20 cm bedding brick masonry in CM 1:4 proportion, 23 cm thick for 2 M depth from top 35 cm thick for 2 M below it and 45 cm thick for balance depth, RCC slab at top and at 2 M depth from top for supporting brick masonry above it, plastering with smooth finish in CM 1:2 proportion, C.C. 1:2:4 finishing channels in smooth rendering, providing C.I. dapuri type steps each weighing 5.5 kg., providing and fixing S.F.R.C. frame and cover of 56 cm dia. at top including cost of all materials and labour, etc. complete.		
8	Providing and fixing in position steel fibre reinforced concrete (S.F.R.C.) frame and covers of approved make including loading, unloading, transportation, all taxes, etc. complete as directed by Engineer-in-charge (20 tonnes capacity).		

Sr no	Description of items	Standard Specifications / Item Code as per DSR (2016-2017) Specifications	Additional Specifications
9	Providing and fixing 15cm x 10cm salt glazed stoneware gully trap in cement concrete 1:4:8 outside the building including cast iron grating in the sink, connecting glazed stoneware pipe, brick masonry chamber with cast iron lid and cast iron grating for the gully trap. Spec. No.: Bd.V.38, Page No. 572	Pune PWD DSR 15-16, item no-20/20 BDV 38, Pg no-150	
10	Providing and laying 150 mm dia salt glazed stoneware pipe including fittings such as bends, tees, single junction, double junctions laying, jointing (including excavation and refilling the trenches) complete. Spec. No.: Bd.V.39, Page No. 573	Pune PWD DSR 15-16, item no-21b/20 BDV 39, Pg no-158	
11	Providing and constructing Brick Masonry inspection trap Chamber 90cm x 45cm including 1:4:8 C.C foundation, 1:2:4 C.C.channels/half round glazed stoneware pipe channel, salt glazed stoneware intercepting trap with rodding pipe set in 1:4:8 cement concrete block, brick masonry plastering inside and Outside, fixed in cement concrete with R.C.C. Cover. Spec. No.: Bd.V.44, Page No. 575	Pune PWD DSR 15-16, item no-26/20 BDV 44, Pg no-152	
12	Providing and laying in trenches 25 mm dia. heavy grade having embossed as ISI Mark galvanised iron pipes of 3.01 kg/metre necessary fitting remaking good the demolished portion with filling trenches and with primer of anti-corrosive oil paint , 2 coats complete. Spec. No.: Bd.V.5 Page No. 551 Pune PWD DSR 15-16, item no- 69 / 20 BDV5, Pg no-165	DSR ITEM NO 69 / 20 BDV 5	
13	Providing, laying & fixing P.V.C. pipe of 25mm dia. with fittings such as bends, tees, reducers, clamps, etc. including necessary excavation, trench filling etc. complete. Spec : As directed by Engineer In Charge	DSR ITEM NO 30 c / 20 BDV 60	

Sr no	Description of items	Standard Specifications / Item Code as per DSR (2016-2017) Specifications	Additional Specifications
14	Providing and fixing 25mm diameter water meter with non-returnvalve including strainer, sockets/ union nut and including water meter box making locking arrangement and lock. [Without chamber]. Spec. No.: Bd.V.7 Page No. 554 Pune PWD DSR 15-16, item no- 6c/20 BDV 7, Pg no-145	DSR ITEM NO 6 c / 20 BDV 7	
15	Providing and fixing screw down for 25 mm dia. wheeled stop tap of brass including necessary sockets/union nut complete Spec. No.: Bd.V.9 Page No. 555 Pune PWD DSR 15-16, item no-8c/20 BDV 9, Pg no-147	DSR ITEM NO 8 c / 20 BDV 9	
16	Valve chamber with precast steel fibre reinforced concrete frame and covers (S.F.R.C. frame and covers) Providing and constructing B.B. masonry valve chamber with 15 cm thick 1:3:6 proportion PCC bedding, excluding excavation, B.B. masonry in CM 1:5 proportion precast S.F.R.C. frame and cover, etc. complete as directed by Engineer-in-charge. Note : Wall thickness : 0.23 M for depth of 1.2 M and 0.35 M for balance depth exceeding 1.2 M.		
	As above of 90 x 60 cm internal size and depth upto 1.2 M with S.F.R.C. frame and cover.	DSR ITEM NO 257-3 - C	
	As above of 90 x 60 cm internal size and depth upto 1.2 M with S.F.R.C. frame and cover.	DSR ITEM NO 258-3 - F	
17	Providing and fixing 25 mm. dia Ball cock medium type with PVC float including sockets & necessary fittings and tested as per municipal requirements etc. complete. Spec : As directed by Engineer In Charge	DSR ITEM NO 38 a / 20 BDV	

Sr no	Description of items	Standard Specifications / Item Code as per DSR (2016-2017) Specifications	Additional Specifications
18	Providing and fixing in position steel fibre reinforced concrete (S.F.R.C.) frame and covers of approved make including loading, unloading, transportation, all taxes, etc. complete as directed by Engineer-in-charge (20 tonnes capacity). 60 x 60 cm size	DSR ITEM NO 262 - 17 e	
19	Providing and making ISI Mark ferrule connection of 25mm dia. To water main including ferrule coupling cast iron bell mouth cover, built in non return valve and fixing including excavation and reinstatement complete. Spec. No.: Bd.V. 4 page 551 Pune PWD DSR 15-16, item no- 47c/20 BDV 4, Pg no-161	DSR ITEM NO 47 c / 20 BDV 4	
20	Providing and constructing two taps standpost as per type design with excavation 30 cm thick boulder filling 15 cm thick PCC in 1:3:6, 20 mm thick RCC, 1:2:4 platform of 1.75 M dia. with side curb and bucket rest, 80 mm dia, heavy duty GI pipe central post duly filled therein with C.C. 1:2:4, 5 M long, 20 mm dia. medium G.I. pipe from point of tapping to standpost, additional 20 mm dia G.I. pipe fixed horizontally and providing and fixing two 15 mm dia GI self closing water taps, one brass ferrule, etc. complete together with all labour and material charges as per drawing and as directed by Engineer-incharge when B.C. soil is available. ate includes draining arrangement by excavating open gutters. (MJP-Section H, Item no-13, Pg no-57)	DSR ITEM NO 57 - 13	
21	Supplying and erecting 1 phase, 230 V, 50 Hz, submersible pump set suitable for erection on open well, pump having discharge 130 / 475 L.P.M., head 21 / 9 m & delivery pipe of necessary diameter erected with necessary H type clamps as per specification No. WP-OSP	Mah. PWD Electrical DSR 15-16, item no- 12-4-6	

Sr no	Description of items	Standard Specifications / Item Code as per DSR (2016-2017) Specifications	Additional Specifications
22	Supplying & erecting automatic control panel for 1 Ph, 230 volt, A.c. Submersible/centrifugal pump set upto 2 HP consisting of DOL starter Of suitable relay range S.P.P., Combined ammeter/ voltmeter, phase indicating lamp enclosed in CRCA powder coated Vibration proof encloser with IP 54 protection. Control Panel should offer single phasing, phase reversal, phase inbalence etc (Similar to LT model no.MR G2)	Mah.PWD Electrical DSR 15-16, item no- 12-5-20	
23	Supplying & erecting Water lavel controller 230/415 V AC., Two way for under ground tank operation only.	Mah.PWD Electrical DSR 15-16, item no- 12-5-14	
24	Supplying & erecting PVC coated 5 mm dia Brass Sensor/electrode duly wired with nut & bolts complete	Mah.PWD Electrical DSR 15-16, item no- 12-5-16	
25	Supplying and erecting flat flexible 3 core 4 sq mm PVC sheathed submersible type copper cable suitably clamped at fixed intervals with column pipe assembly complete.	Mah.PWD Electrical DSR 15-16, item no- 12-5-16	

VOLUME V

CONTENTS

A) CIVIL & STRUCTURAL

1 PREAMBLE

These Specifications cover the items of work in structural and non- structural parts of the works coming under Preview of this document. All work shall be carried out in conformation with this. In general, provisions of Indian Standards, Indian Roads Congress Codes and other national standards have been followed. These specifications are not intended to cover the minute details. The work shall be executed in accordance with best modern practices. All codes and standards referred to in these specifications shall be the latest thereof.

2 INCLUSIVE DOCUMENTS:

The provision of Special Conditions of Contract, General Conditions of Contract, those specified on the tender as well as execution drawings and notes or other specifications issued in writing by the PMC / Engineer shall from part of these specifications.

3 ORDER OF PRECEDENCE, CLARIFICATION AND INTERPRETATION

When the various specifications and codes referred to in preceding portion are at variance with these specifications and each other the following order of precedence will generally be accepted.

- Special conditions of contract, item wise technical specifications if provided and execution drawings.
- Provisions of general specifications.
- I. S. Codes.
- IRC Codes, M. O. S. T., Specifications etc.
- All works shall be carried out as per Maharashtra Govt. P.W. Dept. Handbook and other specifications of the Solapur City Development Corporation Limited or as directed.

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 previous approval of the Engineer before taking up the supply/ construction.

4 MEASUREMENT AND PAYMENTS

The methods of measurement and payment shall be as described under various items and in the bill of quantity. Where specific definitions are not given, the methods described in IS 1200 will be followed? Should there be any detail of construction or materials which has not been referred to in specification or in the bill of quantities and drawings but the necessity for which may be implied or inferred wherefrom, or which are usual or essential

to the completion of the work in the trades, the same shall be deemed to be included in the rates and prices quoted by the contractor in the bill of quantities.

5 UNACCEPTABLE WORK

Work deemed to be defective shall be demolished and rebuilt. Defective materials shall be replaced and installed 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. 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.

a) INSTRUMENTATION AND MONITORING

- **Stability and Settlement of Adjacent Properties**

  The Contractor shall be solely responsible for the stability of all-adjoining structures and facilities. The Contractor shall execute his work such that public roadways, private access road, underground utilities; principal building and permanent facilities in adjoining properties are adequately protected from the detrimental effects of instability and ground subsidence.

  The Contractor shall be required to assess the settlements and ground movements that he anticipates will occur around the site boundaries due to his work. His calculations and assumptions on which these assessments will be made shall form a part of his submission to the local authority for the purpose of obtaining statutory clearance and securing the permit to commence work. A copy of such calculations and assumptions shall be made available to the Engineer for his record.

- **Limits on Ground Movement.**

  The Contractor shall be responsible for restricting the maximum settlement and lateral movement of the ground adjacent to the site to lesser of either the statutory limit imposed by the Local Authority or 50 mm, measured from the initial pre-construction reference level or line. The Contractors' compliance to these limits shall not relieve him of his sole responsibility to make good at his own cost and in the manner prescribed by the Engineer and / or the local authority, all consequential damages to adjoining structures, roads and other properties arising from ground movements caused by excavation work.

b) DILAPIDATION SURVEY

Immediately after taking possession of the site and BEFORE commencing any work on Site. The Contractor shall conduct an adequate dilapidation survey of all principal buildings and permanent facilities around the site boundaries to establish their general pre-construction

condition. The survey report shall be lodged with the Employer, the Engineer, the local Authority, the adjacent Owners, and with any other party that the employer may direct.

For each adjacent building or facility, the Contractor shall prepare a set of photographic records and a schedule listing the size of the superstructure, extent of underground structure, visible defects and any other relevant details pertaining to the general condition of that building or facility.

c) INSTRUMENTATION AND MONITORING

The Contractor shall allow in his tender for the cost of implementing an adequate ground movement monitoring system complying with the minimum requirements set out in this section. He shall be responsible for installing, measuring, recording and maintaining all necessary surface settlement points, peizometers and inclinometers, including securing the required permits and written consents from the local Authority and / or the adjacent Owners to have instrumentation installed.

d) GROUP MOVEMENT INSTRUMENTATION AND MONITIORING

- **Settlement of Adjacent Ground Surface**

  The Contractor shall undertake an initial level survey along the site boundaries and maintain level checks of surface settlement points at daily intervals, or at such intervals as the Engineer may decide, for the duration of this Contract. Surface settlement points as the Engineer may decide, for the duration of this Contract. Surface settlement points shall be laid out at not more than 3m apart, or at such distances as the Engineer may decide, in two orthogonal directions to form a horizontal survey grid next to the boundaries.

- **Ground Water Level and Lateral Movement**

  Piezometers and inclinometers shall be installed around the Site to monitor the level of the water table and lateral ground movement in the vicinity of principal buildings, utilities and public roadways during construction. The contractor shall provide a minimum of one set of piezometer and inclinometer at every 30 m length of boundary with an adjoining building and roadway, or at such distances as the Engineer may decide.

- **Measurement of Tilt Existing Building**

  In order to protect the adjacent buildings, at least 2 sets of tilt meters shall be installed on its walls or columns to measure any tilt during execution of piling works.

  The Contractor shall make careful and regular checks on the rate and magnitude of any settlements or ground movements of adjoining buildings, permanent facilities and roadways for the currency of the Contract. Records of all checks on ground movements shall be maintained by the Contractor and submitted to the Engineer

and / or the Local Authority not later than two (2) days after measurement, and immediately should settlement or ground movement be such as to endanger the stability of adjoining properties.

6 EARTH WORK IN EXCAVATION AND BACK FILLING

CONTENTS

EARTH WORK IN EXCAVATION and BACK FILLING

1. SCOPE

This part of the specification deals with general requirement for earth in excavation in different materials, site grading, filling in areas shown in drawings, filling back around foundations, plinths and approach ramps, conveyance and disposal of excess excavated soil or stacking them properly as shown on the drawings or as directed by the Engineer - in-charge and all operations covered within the intent and purpose of the specifications. The excavation in rock by blasting etc. shall be as per relevant specifications.

2. APPLICABLE CODES

The provisions of the latest Indian Standards listed below, but not restricted to from part of these specifications:

IS:783	Code of practice for lying concrete pipes.
IS:1200	Method of measurement of building and (Part I) Civil Engineering Works - Part I Earth Work.
IS:1498	Classification and identification of soils for general engineering purposes.
IS:2720	(All Parts) Methods of test for soils.
IS:2809	Glossary of terms and symbols relating to soil engineering.
IS:3764	Safety Code for excavation work
IS:4081	Safety Code for blasting and related drilling operations.
IS:4988	(All Parts) Glossary of terms and classifications of earth moving machinery.

3. DRAWINGS

The Engineer-in-charge will furnish drawings wherever in his opinion such drawings are required to show the areas to be excavated/filled, sequence of priorities etc. The contractor shall follow such drawings strictly.

4. CLASSIFICATION OF EARTH

For purpose of earth work soil shall be classified as under:

Loose/ Soft Soil:

Any soil which generally yields to the application of picks and shovels, phawras, rakes or any such ordinary excavating implements or organic soil, gravel, silt, sand, turf loam, clay, peat etc. fall under this category.

Dense/ Hard Soil:

Any soil, which generally requires the close application of picks, or jumpers or scarifies to loosen it. Stiff clay gravel and cobble stone etc. fall under this category.

(Note: Cobble stones are the rock fragments usually rounded or semi-rounded having maximum diameter in any one direction between 80 and 300mm)

Mud:

Mud is a mixture of ordinary soft soil and water in fluid or weak solid state.

Soft/ Decomposed Rock:

This shall include rock, boulders, slag, chalk, slate, hard mica schist laterite and all other materials which in the opinion of Engineer is rock, but does not need blasting and could be removed with picks, hammer, crowbars, wedges and bucket of Pocklain, Hydraulic & Mechanical Breakers. The mere fact that contractor resorts to blasting for reasons of his own, shall not qualify for classification under 'Hard Rock'.

This shall also include excavation in macadam and tarred roads and pavements. This shall also include rock boulders not longer than 1 meter in any direction and not more than 500mm in any one of the other two directions. Masonry to be dismantled will also be measured under this item.

Hard Rock:

This shall include all rock occurring in large continuous masses which cannot be removed except by controlled blasting and / or Pneumatic breaker. Hardened varieties of the rock with or without veins and secondary minerals which, in the opinion of the Engineer requires blasting shall be considered as hard rock. Boulders of rock occurring in such sizes and not classified under (a) and (b) above shall also be classified as hard rock. Concrete work, both reinforced and unreinforced, to be dismantled will be measured under this item, unless a separate provision is made in the Schedule of Quantities.

Hard Rock: (Requiring Blasting where blasting is prohibited)

Under this category shall fall hard rocks, which though normally requires blasting for their removal but blasting is prohibited and excavation has to be done by chiselling, wedging or other suitable method.

5. GENERAL

5.1 The contractor shall furnish all tools, plant, instruments, qualified supervisory staff, labour, materials, any temporary works, consumable and everything necessary, whether or not such items are specifically stated herein, for completion of the job in accordance with the specification requirements.

5.2 The contractor shall carry out the surveys of the site before excavation and set out properly all lines and establish levels for various works such as earth work in excavation for grading, foundations, plinth filling, road drains, cable trenches, pipe lines, culverts, retaining walls etc. Such surveys shall be carried out taking accurate cross sections of the area perpendicular to the grid lines at intervals determined by the Engineer-in-Charge, depending on the ground profiles. These will be checked by the Engineer-in-Charge or his representative and thereafter properly recorded.

5.3 The excavation shall be done to correct lines and levels. This shall include where required, proper shoring to maintain excavation and also the furnishing, erection and maintaining of substantial barricades around excavations and warning lamps at night for safety purposes.

5.4 The rates quoted shall include for dumping of excavated material in regular heaps, bunds, and rip rap with regular slopes as directed by the Engineer-in-charge within the lead specified and levelling the same so as to provide natural drainage. Rock/ soil excavation shall be properly stacked as directed by the Engineer-in-charge. As a rule all softer materials shall be laid along the centre of the heaps, the harder and more resistant materials, forming the casting on the sides and the top. Rock shall be stacked separately.

6. CLEARING

The area to be excavated / filled shall be cleared of all fences, trees, plant logs, stumps, bush, vegetation, rubbish, slush etc. and other objectionable matter. If any roots or stumps of trees are met during excavation, they shall be removed. The material so removed shall be disposed off as directed by the Engineer-in-charge. Where earth fill is intended, the area shall be cleared of all loose or soft patches, top soil containing objectionable matter/ materials before filling commences. No separate payment shall be made for such clearing works.

7. PRECIOUS OBJECTS, RELICS, OBJECTS OF ANTIQUITIES ETC.

All gold, silver, oil, minerals, archaeological and other findings of importance or other materials of any description and all precious stones, coins, treasures trove, relics, antiquities and similar things which may be found in or upon the site shall be property of the Employer and the contractor shall duly preserve the same to the satisfaction of the Engineer-in-charge and from time to time deliver the same to him.

8. EXCAVATION FOR STRUCTURES

8.1 **Description**

Excavation for structures shall consist of removal of materials for the construction of the foundations, retaining walls, pipe trenches, tunnels and other similar structures in accordance with the requirements of this specification and the lines and dimensions shown on the drawings or as indicated by the Engineer-in-charge. The work shall include construction of shoring, bracing, draining and pumping; the removal of all logs, stumps, grubs and other deleterious matter and obstruction necessary for placing the foundations, trimming bottoms of excavation; backfilling, cleaning up the site and disposal of all surplus materials.

8.2 **Setting Out**

After the site has been cleared as per clause 5 above, the limits of excavation shall be set out true to lines, curves, slopes, grades and sections as shown on the drawings or as directed by the Engineer-in-charge. The contractor shall provide all labour, survey instruments and materials such string, pegs, nails, bamboo, stones, lime, mortar, concrete etc. required in connection with the setting out of works and establishment of bench marks. The contractor shall be responsible for the maintenance of bench marks and other marks and stakes as long as they are required for the work in the opinion of the Engineer-in-charge.

8.3 **Excavation**

Excavation shall be taken to the width of the lowest step of footing or the pile caps and the sides shall be left plumb where the nature of the soil allows it. Where the nature of the soil or the depth excavated trench/ pit does not permit vertical sides, the contractor at his own expense shall put up the necessary shoring, strutting and planking or cut slopes to a safe angle or both with due regard to the safety of personnel and the works and to the satisfaction of the Engineer-in-Charge. 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-in-Charge.

8.4 **Dewatering and Protection**

Where water is met within excavation due to stream flow, seepage, springs, rain or other reasons, the contractor shall take adequate measures such as bailing, pumping, construction of diversion channels, drainage channels, bunds and other necessary works to keep the foundation trenches/ pits dry when so required and to keep the green concrete/ masonry against damage by erosion or sudden rise of water level. The method to be adopted in this regard and other details thereof shall be left to choice of the contractor but subject to the approval of the Engineer-in-charge. Approval of the Engineer-in-charge shall, however, not relieve the contractor of his responsibility for the adequacy of dewatering and protection arrangements and the safety of the works. Pumping from inside of any foundation enclosure shall be done in such a manner as to preclude the possibility for the movement of water through any freshly placed concrete. No pumping shall be permitted during the placing of concrete or 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 similar means. At the discretion of the contractor and at his cost, cement grouting or other approved methods may be used to prevent or reduce seepage and to protect the excavation area. The contractor shall take all precautions in diverting channels and in discharging the drained water so as not to cause damage to the works or to adjoining property.

8.5 **Preparation of Foundation**

The bottom of the foundation shall be levelled both longitudinally and transversally or stepped as directed by the Engineer-in-charge. Before the footing is laid, the surface shall be slightly watered and rammed. In the event of the excavation having been made deeper than that shown on the drawing or as otherwise ordered by the Engineer-in-charge, the extra depth shall be made up with concrete of the foundation grade at the cost of the contractor. Ordinary filling shall not be used for the purpose to bring the foundation to level.

When rock or other hard strata is encountered, it shall be freed of all loose and soft materials, cleaned and cut to a firm surface either level, stepped, or serrated as directed by the Engineer-in-charge. All seams shall be cleaned out and filled with cement mortar or grout to the satisfaction of the Engineer-in-charge.

8.6 **Slips and Blows**

If there are any slips or blows in the excavation, these shall be removed by the contractor at his own cost.

8.7 **Backfilling**

To the extent available, selected surpluses soil from the excavation shall be used as backfill. Fill material shall be free from clods, salts, sulphates, organic or other foreign materials. All clods of earth shall be broken or removed. Where excavated material is mostly rock, the boulders shall be broken into pieces not larger than 150 mm size mixed with properly graded fine materials consisting of murrum or earth fill up the voids and the mixture used for filling.

If any selected fill is required to be borrowed, the contractor shall make arrangement for bringing the material from outside borrow pits. The material sources shall be subject to the prior approval of the Engineer-in-Charge. The contractor shall make necessary access roads to such borrow areas at his own cost, if such access roads do not exist.

Use of surplus selected soil from excavated stuff for backfilling can be permitted only up to the original ground level. Above this level, only selected borrowed material shall be used.

Backfilling of the foundation/ pits shall be done as soon as the foundation work has been completed to the satisfaction of the Engineer-in-Charge and measured but not earlier than the full setting of the concrete or masonry of the foundation. Backfilling shall be carried out in such manner as to not cause undue thrust on any part of the structure. Backfilling shall be done in space around the foundations after clearing it of all debris and in layers of 150mm loose thickness, watered and compacted to the satisfaction of the Engineer-in-charge and to the original surface.

For embankments, initially the top width is to be increased by 600mm on either side for enabling proper compaction up to the edge. The embankment shall be cut and sectioned for correct profile. This additional earthwork on either side of 600mm width shall not be paid for and shall be included in the respective item of road work quoted by the tenderer.

The slopes of embankment shall be compacted by using earth compactors wherever necessary as directed by the Engineer-in-charge.

8.8 **Disposal of Surplus Excavated Materials:**

All the excavated material shall be the property of the employer. Where the excavated material is directed to be used in the construction of the works for general grading, plinth filling or embankments, the operation shall be arranged in such a manner that the capacity for cutting, haulage and compaction are nearly the same.

All hard materials such as hard murrum, rubble etc. not intended for filling in foundations, plinth or embankments, shall be stacked neatly for future use as directed by the Engineer-in-Charge within the lead specified. Unsuitable or surplus materials not intended for use in part of the works or for reuse shall be disposed off outside the complex as directed by the Engineer-in-Charge.

9. MEASUREMENT AND RATES

The measurement shall be generally confirming to IS: 1200 Part-I unless otherwise specified. Measurement for excavation of foundations and footings shall be as required for the exact width, length and depth as shown or figured on the drawings or as may be directed by the Engineer-in-Charge. If taken out to a greater width, length or depth than shown or required, the extra work occasioned thereby shall be done at the contractor's expenses. The dimensions of the trenches and pits shall be measured correct to the nearest cm. And cubical contents worked out in cubic meters, correct to two places of decimal.

Measurements of filling excavated earth or sand in plinth or under floors:

Depth of consolidated earth filling, shall be measured for the purpose of payment. The dimension of the filling shall be measured corrected to the nearest cm. and cubical contents worked out in cubic meters correct to two places of decimal.

Rate for earthwork shall include the following:

a) Excavation and disposing earth as specified.
b) Setting out works, profiles etc.
c) Site clearance such as cleaning of rank vegetation, shrubs, bush wood.
d) Forming (or leaving) "Deadmen" or "Tell Tales" and their removal after measurement.
e) Bailing/ pumping out water in excavation from rains, sub-soil water etc.

f) Protection, temporarily supporting of existing service, i.e. pipes, water mains, cables etc. met within the course of excavation. Care shall be taken not to disturb electric and communication cables, removal of such cables, if necessary, shall be arranged by the Engineer-in-charge.
g) Forming (or leaving) steps in sides of deep trenches and their removal
h) Removing slips or falls in excavation.
i) Fencing and/or suitable measures for protection against risk of accidents as approved by the Engineer-in-charge.
j) Excavation for insertion of planking and strutting where required and
k) Backfilling the trenches with selected excavated material.

10.RECLAMATION

The working area including area required for the construction of the building will be filled by material suitable for filling work. The material shall be free of clay, roots, vegetable matter or other injurious matter, samples of the material to be used for the filling shall be submitted for approval before use.

The portion of the reclamation on the outer side of the building which is not a part of the permanent reclamation required and is only for providing working area will be protected and maintained by the contractor for the period required for the execution of the building work.

In the area of the reclamation, the filling material will be placed in layers and compacted in the portion above water level using a roller of not less than 8 tons.

11.Additional Specifications

Note: The specifications described herein shall govern in case of any discrepancy.

11.1 **Mode of Measurement**

The measurements shall be generally conforming to IS: 1200 Part I unless and otherwise specified. Measurements for excavation of foundations and footings shall be as per drawing and dimensions of bed concrete net, without any allowance for increase in bulk. Extra excavation for working space on account of slips or fall shall not be measured. Rate to include cost of planking, strutting etc. and filling with soil after removal of planking.

The following shall not be measured separately and allowance for the same shall be deemed to have been made in description of the main item.

a) Setting out works, erecting profiles, etc.
b) Site clearance such as clearing of shrubs, brushwood and small trees not exceeding 300 mm in girth measured at one meter above ground.
c) Unauthorized battering or benching of excavation.
d) Forming (or leaving) DEAD MEN or TELL-TALES in borrow pits and their removal after measurements.

e) Forming or leaving steps in the sides of deep excavation and their removal after measurements.
f) Excavations for insertion of planking and strutting.
g) Removing slips or falls in excavations.
h) Dewatering by bailing or pumping out of water in excavations from rains, sub-soil water, tides undercurrents etc.
i) Slinging or supporting pipes electric, cables etc met during excavation or while carrying out any other item of work.
j) Dressing, trimming of sides, levelling or grading and ramming of bottoms.
k) Soils, soft rocks, hard rocks shall be measured as per SP 27 Part I except for the followings:

Filling shall be in cubic meter for consolidated volume. The lift shall be considered from made up ground level.

Back filling of foundation is part of excavation and not paid separately. Void percentage considered for computing net quantities shall be

Loose Earth 20%

Hard Rock 40%

These deductions shall be made from actual measurements. The EIC may at his discretion conform at start of work other predetermined percentage for deduction for particular project.

12.RUBBLE SOLING

Rubble used for packing under floors, foundations etc. shall be hard, durable rock, free from veins, black trap, flaws and other defects. The size of the rubble shall be 150 mm – 200 mm unless otherwise specified in the item description in the Schedule of Quantities and the EIC shall be approved the quality.

Rubble shall be laid closely in position on the sub-grade. All interstices between the stones shall be wedged in with smaller stones of suitable size well driven to ensure tight packing and complete filling of interstices. Such filling shall be carried out simultaneously with the placing in position of rubble stone and shall not lag behind.

Small interstices shall be filled with murrum, well watered and rammed.

7 PLAIN AND REINFORCED CEMENT CONCRETE

Sr. No.	Description
1.0	General
2.0	Grade of Concrete
3.0	Strength Requirement of Concrete
4.0	Materials
5.0	Proportioning Concrete
6.0	Mixing Concrete
7.0	Transport, Placing and Compaction of Concrete

PLAIN AND REINFORCED CEMENT CONCRETE

1 GENERAL

These specifications cover the requirement of plain, reinforced and pre-stressed concrete for use in various components of structures. For all items of concrete in any portion of the structure or its associated works controlled concrete shall be used unless otherwise specified. When ordinary concrete of the mix is shown on drawings or directed by the Engineer, the same may be used.

The provision of the latest revision of the following IS Codes shall from a part of this specification to the extent they are relevant.

IS – 226 Specification for structural steel (standard quality)

IS – 269 Specification for ordinary and low heat Portland cement

IS – 280 Specification for mild steel wire for general engineering purpose

IS – 303 Plywood for general purposes

IS – 383 Specification for coarse and fine aggregate

IS – 432 (All Parts) - Specifications for mild steel and medium tensile steel bars and hard- drawn steel wire for concrete reinforcement.

Part – I Mild steel and medium tensile bars

Part – II Hard drawn steel wire

IS – 455 Specification for Portland blast furnace slag cement

IS – 456 Code of practice for plain and reinforced concrete for general building construction

IS – 460 Specification for test sieves

IS – 516 Methods of test for strength of concrete

IS – 650 Standard sand for testing of cement

IS – 1139 Hot rolled mild steel, medium tensile steel and HYSD bars for concrete reinforcement

IS – 1199 Sampling and analysis of concrete

IS - 1200 Part II Method of measurement of building works

IS – 1343 Code of practice for pre-stressed concrete

IS – 1489 Specification for Portland pozzolana cement

IS – 1542 Sand for plaster

IS - 1566 Specification for hard - drawn steel wire fabric

IS - 1732 Dimensions for round and square steel bars for structural and general engineering purposes.

IS - 1785 Plain hard drawn steel wire pre-stressed concrete (Part I) Cold drawn stress - relieved wire.

IS - 1786 Specification for high strength deformed steel bars and wires for concrete reinforcement

IS - 1791 Batch type concrete mixers

IS - 2062 Wieldable structural steel

IS - 2386 (8 Parts) Method of test for aggregates for concrete

IS - 2502 Code of practice for bending and fixing of bars for concrete reinforcement.

IS - 2505 Immersion type concrete vibrators

IS – 2506 Screed board concrete vibrators

IS - 2722 Specification for portable swing weigh batcher (Single and double bucket type)

IS - 2751 Code of practice for welding of MS bars

IS - 2911 Code of practice for design and construction of pile foundation

IS - 3366 Pan Vibrators

IS - 3370 (All Parts) Code of practice for concrete structure for the storage of liquids.
IS - 3558 Code of practice for the use of immersion vibrators for consolidating concrete.
IS - 4656 Form vibrators for concrete
IS - 5525 Recommendation for detailing of reinforcement in reinforced concrete works.
IS - 5640 Method of test for determining aggregate impact value of soft, coarse aggregate.
IS - 5816 Methods of test for splitting strength of concrete cylinder
IS - 6006 Uncoated stress relieved strand for pre-stressed concrete.
IS - 6461 Cement concrete: glossary of terms
IS – 6925 Methods of tests for determination of water soluble chlorides in concrete admixtures.
IS - 8041 Specifications for rapid hardening Portland Cement
IS - 8043 Specifications for hydrophobic Portland Cement
IS - 8112 Specification for high strength ordinary Portland cement.
IS - 9103 Admixtures for concrete.
IS – 1893 Criteria for earthquake resistant design of structures.
IS-13920 Ductile detailing of reinforced concrete structures subjected to earthquake forces
IS-4326 Earthquake resistant design of buildings
IS-800 Criteria for design of steel structures
IS-4990 Specifications for plywood for concrete shuttering works
IS-2750 Specifications for steel scaffoldings
IS-4014 Code of practice for steel tubular scaffoldings

Other codes and specifications

Other IS codes pertaining to the items of cement concrete work in structural work and not listed above shall also be deemed to come under the preview of this clause. All Indian Roads Congress Standards, Specifications and codes of practice also come under this purview.

2 GRADE OF CONCRETE

Concrete of minimum grade M-20 design mix shall only be used for all reinforced and plain cement concrete works unless otherwise specified. Nominal mix may be permitted at the discretion of the Engineer-In-Charge only for the lean mix (M10) used for PCC for the bedding concrete, all other concrete shall be done with the approved mix design.

2.1 Controlled Concrete

For controlled concrete, design of the mix shall be arrived at after preliminary tests and in its production all necessary precautions shall be taken to ensure that the required works cube strength is attained and maintained. The controlled concrete shall be in nine grades designated as M10, M15, M20, M25, M30, M35, M40, M45 and M50.

2.2 Ordinary Concrete

In case of ordinary concrete, mix is not required to be designed by preliminary tests and proportions of cement, fine aggregates and coarse aggregates are specified by volume. The ordinary concrete shall be in four grades designated as M10,

M15, M20 and M 25 with the suffix 'Ordinary' added to it. It can also be specified by volume as given in Table 3 of this specification.

In the designation of a concrete mix. Letter 'M' refers to the mix and the number to the specified 28 days works cube compressive strength of that mix on 150 mm cubes, expressed in N/sq.mm.

3 STRENGTH REQUIRMENT OF CONCRETE

Where Ordinary Portland Cement conforming to IS: 269 or Portland Blast Furnace Cement conforming to IS: 456 is used, the compressive strength requirements for various grades of concrete controlled as well as ordinary shall be as given in Table 1. Where rapid hardening Portland cement is used, the 28 days compressive strength requirements specified in Table 1 shall be met at 7 days.

For controlled concrete, the mix shall be so designed as to attain in preliminary tests strength at least 33 percent higher than that required on work tests, for concrete up to and including M25 and 25 % higher for higher strengths. Preliminary tests need not be made in case of 'ordinary concrete'.

Table- 1

Grade of Concrete	**Compressive works test strength in N/sq.mm on 150mm cubes after testing conducted in accordance with IS: 516**	
	Min at 7 days	Min at 28 days
M-10	7	10
M-15	10	15
M-20	13.5	20
M-25	17	25
M-30	20	30
M-35	23.5	35
M-40	27	40
M-45	30	45
M-50	33.5	50

Note: In all cases, the 28 days compressive strength specified in Table 1 shall alone be the criterion for acceptance or rejection of the concrete.

Where the strength of a concrete mix, as indicated by tests, lies between the strength for any two grades specified in table 1, such concrete shall be classified for all purposes as a concrete belonging to the lower of the two grades between which its strength lies.

4 MATERIALS

4.1 Cement

All types and brands of cement shall be subjected to the approval of the Engineer-in-charge.

a) Following types of Cement shall be used.

I. All cement used for the work shall be ordinary Portland cement or such other cement as may be permitted by the Engineer-in-charge. Portland cement shall comply with requirements of the latest issue of IS 269. High alumina cement, rapid hardening cement and Portland Slag cement etc. can be used only when permitted by the Engineer-in-charge. Such cements shall be in accordance with relevant IS codes. Portland Pozzolana cement when permitted by the Engineer-in-charge shall conform to IS 1489.

II. Cement which has remained in bulk storage at the mill for more than 6 months, or which has remained in bags at the dealer's storage for over 3 months, or which has been stored at project site for more than 3 months shall be re-rested before use. Cement shall also be rejected if it fails to conform to any of the requirements of these specifications.

III. The Cement to be used in the work shall be of grade not less than Grade 43 which shall be got approved by the Engineer –in-charge.

IV. The following other types of cement may be used in works if specified or with prior approval of the Engineer in Charge in writing purpose. Specialist literature shall be consulted for guidance regarding use of these types of cement.

a) 43 Grade ordinary Portland cement conforming to IS 8112
b) 53 Grade ordinary Portland cement conforming to IS 12269
c) Portland slag cement conforming to IS 455
d) Portland pozzolana cement (fly ash based) conforming to IS 1489 (Part-I)
e) Portland pozzolana cement (calcined clay based) conforming to IS 1489 (Part–II)
f) Sulphate resisting Portland cement conforming to IS 12330

V. Fly ash when used for partial replacement of cement, shall conform to the requirements of IS: 3812 (part I)-1966.

4.2 Fine Aggregates

Fine aggregates shall consist of natural sand, manufactured sand, or an approved combination thereof and shall conform to IS: 383. The grading zone of sand proposed for use shall be supplied by the contractor and got approved by the Engineer-in-charge. The sand shall be of siliceous material, sharp, hard, strong and durable and shall be free from adherent coatings, clay, dust, alkali, organic material, deleterious matter, lumps, etc.

Either natural or manufactured sand shall be prepared for use by such screening or washing, or both, as necessary, to remove all objectionable foreign matter. Natural sand shall be washed, unless specific written authority is given by the Engineer-in-charge to use sand that meets specifications and standards of cleanliness without washing. The cost of screening and washing must be borne by the contractor. The fine aggregate shall be taken from a source approved by the Engineer-in-charge.

Sometimes Sand is obtained from crushed stone screening but often contains a high percentage of dust and clay. It tends to be flaky and angular. This type produces harsh concrete and should be avoided.

Sea sand should not be used unless approved by the EIC. If approved, the required treatment shall be done at the contractor's cost.

Sand shall be hard, durable, clean and free from adherent coatings and organic matter and shall not contain any appreciable amount of clay, Sand shall not contain harmful impurities such as iron, pyrites, coal particles, lignite, mica shale or similar laminated material, alkali, and organic impurities in such form or quantities as to affect the strength of durability of concrete or mortar. Also it should not contain any material liable to attack the steel reinforcement.

When tested as per IS 2386 Part I and Part II, fine aggregate shall not exceed permissible quantities of deleterious materials as given in table 1 of Annexure.

Fine aggregate shall be thoroughly washed at site with clean fresh water such that the percentage of all deleterious materials is within the permissible limits laid down.

4.3 Coarse Aggregates

Coarse aggregates shall consist of hard, strong, durable particles of crushed stone and shall be free from thin elongated soft pieces, organic or other deleterious matter. It shall not have adherent coatings. It will be from a source approved by the Engineer-in-charge.

Coarse aggregate shall conform to IS: 383

Coarse aggregate shall be washed if necessary to remove all vegetable and other perishable substances and objectionable amounts of other foreign matter, the cost of washing and screening being borne by the contractor.

Size of Coarse Aggregates

Following shall be the maximum nominal size of coarse aggregate for the different items of work:

	Item of Construction	Max. Nominal Size of Coarse Aggregate
I)	RCC works in, retaining walls, columns, footings, Slabs, beams, corbels, brackets, struts, hangers, Chajjas, lofts, lintels, etc.	20mm
II)	All PCC works	20mm

III) For any other item of construction not covered by items (I) to (II) shall be as specified in the drawings or as desired by the Engineer-in-Charge in case it is not specified on the drawing.

For heavily reinforced concrete members as in the case of ribs of main beams, the nominal maximum size of aggregate shall usually be restricted to 5 mm less than the minimum lateral clear distance between the main bars, or 5 mm less than the minimum cover to the reinforcement, whichever is smaller. However, if required under special circumstances, the Engineer-in-Charge may permit nominal maximum aggregate size of 25% more than this critical spacing/ cover, provided that proper vibrating is ensured.

4.4 Reinforcing Steel

Reinforcing steel shall be clean and free from loose mill scales, dust, loose rust and coats of paints, oil, grease or other coating, which may impair or reduce bond.

High strength deformed bars for use as reinforced in concrete shall be of grade Fe 500 (As per the structural Consultant) and conforming to IS 1786.

Chemical composition shall conform to IS 1786 when made as a relevant part of IS 228. Permissible limits shall be as shown in table 12 of the Annexure.

4.5 Water

Water used for mixing and curing shall be free from injurious amounts of deleterious materials. Potable waters are generally considered satisfactory for mixing and curing concrete.

Where water can be shown to contain an excess of acid, alkali sugar or salt, Engineer may refuse to permit its use.

As a guide, the following concentrations represent the maximum permissible values:

1) To neutralize 200 ml sample of water, using phenolphthalein as indicator, it should not require more than 2 ml. or 0-1 normal NaOH. The details of test shall be as given in IS 3025.
2) To neutralize 200 ml sample of water, using methyl orange as an indicator, it should not require more than 10 ml of 0.1 normal HCL. The details of test shall be as given in IS 3025.
3) Percentage of solids, when tested in accordance with the IS 3025, shall not exceed the following:

Particular	**Permissible Limit Solids**
Organic	2000 mg/l
Inorganic	3000 mg/l
Sulphates (as SO4)	500mg/l
Alkali Chlorides(as Cl)	2000 mg/l for plain concrete work and 1000 mg/l for reinforced concrete work.

Suspended matter 2000 mg/l

The P.H. value of water shall generally be not less than 6.0

4.6 a) Admixtures

No materials other than the essential ingredients, i.e., cement, aggregates and water, shall ordinarily be used in the manufacture of concrete or mortar. But the Engineer-in-charge may permit the use of approved mixtures confirming to IS: 6925 for imparting special characteristics to the concrete, on satisfactory evidence that its use does not in any way adversely affect the properties of concrete particularly its strength, volume changes, durability and has no deleterious effect on the reinforcement. Admixtures where allowed will generally be conforming to relevant ASTM standards and IS: 9103.

b) Fly Ash

F1y ash is a finely divided residue resulting from the combustion of pulverised coal in boilers. F1yash used shall be as per IS 3812-1981. It shall be clean and free from any contamination of bottom ash, grit or small pieces of pebbles. Fly ash covered in this part is meant for use as' a part replacement or fine aggregate in mortar with a view to improve grading and to make use of its pozzolanic properties.

F1y ash shall be supplied in the following grades:

Grade- 1: For incorporation in cement mortar and concrete and in lime pozzolana mixtures, and for manufacture of Portland Pozzolana cement

Grade- 2: For incorporation in cement mortar and concrete and lime pozzolana mixture.

4.7 Material for Repair Work

The use of epoxy for bonding fresh concrete used for repairs will be permitted on written approval of the Engineer-in Charge. Epoxies shall be applied in accordance with the instructions of the Manufacturer. The cost of such repair when approved by the Engineer-in-charge shall be borne by the contractor.

4.8 Storage of Materials

i) Cement

The contractor shall make arrangements to the satisfaction of Engineer-in-charge for the storage of cement to prevent deterioration due to moisture and/or intrusion of foreign matter. Bulk cement shall be stored in approved waterproof bin or silo. Bagged cement shall be stored in a suitable weather tight warehouse in a manner to provide easy access for identification and inspection of each consignment. Stored cement shall meet the test requirements as per IS - 269 at any time after storage, when a retest is ordered by Engineer-in-charge. Each consignment shall be stacked separately with the date of receipt of flagged

on it, not more than 12 bags being stacked height, the bags being arranged with header and stretchers.

Normally consignments shall be used in the order of receipt at site unless otherwise directed. In case of large concrete pours the Engineer-in-Charge will decide on the batch of cement to be used taking into consideration the quantity of cement with particular reference to the concerned concrete pours. Any additional work in handling and storage of cement contingent upon this requirement shall be to the contractors' account and no extra claim will be entertained. Cement shall be protected from exposure to moisture in transit, in storage at the works and until; it enters the concrete mixes. The contractor shall keep accurate record of the deliveries of the cement and of its use in the work.

ii) Aggregates

Coarse and fine aggregates shall be stacked separately in such manner as to prevent contamination by foreign materials. All aggregates shall be stored on concrete or masonry platforms. Each size shall be kept separate with wooden, steel, concrete, or masonry bulk heads, or shall be stored in separate stacks, taking care to prevent the materials at the edges of the stock piles from getting intermixed. Stacks of fine and coarse aggregates shall be kept sufficiently apart. The aggregates shall be stored in easily measurable stacks of suitable heights as may be directed by the Engineer-in-Charge.

iii) Reinforcing Steel

Reinforcing steel shall not be stored directly on the ground. These shall be stored under cover and shall be protected from rusting, oil, grease and distortions as directed by the Engineer-in-Charge.

4.9 Batching Plant

Necessary permission may be obtained by you from appropriate authority for operating Batching Plant and payment of taxes, if any, shall be paid by the contractor. RMC from approved batching plants shall be allowed for concreting at site.

5 PROPORTIONING CONCRETE

5.1 Controlled Concrete

Concrete mix shall be designed on the basis of preliminary tests. The proportions for ingredients chosen shall be such that concrete has adequate workability for conditions prevailing on the work in question and can be properly compacted with the means available. Except where it can be shown to the satisfaction of Engineer-in-charge that a supply of properly graded aggregate of uniform quality can be maintained

till the completion of work, grading of aggregate should be controlled by obtaining the coarse aggregate in different sizes and blending them in the right proportions as required. The different sizes shall be stocked in separate stock piles. Required quantity of material shall be stockpiled several hours, preferably a day, before use. Grading of coarse and fine aggregate shall be checked as frequently as possible, frequency for given job being determined by the Engineer-in-Charge to ensure that the suppliers are maintaining the uniform grading as approved for samples used in the preliminary tests.

In proportioning concrete, the quantity of both cement and aggregate shall be determined by weight. Water shall either be measured by volume in calibrated tanks or weighed. All measuring equipment shall be maintained in a clean and serviceable condition. Their accuracy shall be periodically checked.

It is most important to keep the specified water-cement ratio constant and at is correct value. To this end, the moisture content in both fine and coarse aggregates shall be determined by Engineer-in-Charge according to weather conditions. The amount of mixing water shall than be adjusted to compensate for variations in the moisture content. For the determination of moisture content in the aggregates, IS 2386 (Part III) shall be referred to. Suitable adjustments shall also be made in the weights of aggregates to allow for the variation in weights of aggregates due to variation in their moisture content.

The minimum quantity of cement to be used shall not less than 210 Kg/cum for plain concrete and not less than 340 Kg/cum for reinforced concrete structural members subject to a maximum limit of 540 Kg/cum.

5.2 Ordinary Concrete

The ordinary concrete mix shall generally be specified by volume. For cement, which normally comes in bags and used by weight, volume shall be worked out taking 50 kg. of cement as 0.035 cubic meters in volume, shaking, ramming or hammering shall not be done. Proportioning of sand shall be as per its dry volume and in case it is damp, allowance for bulking shall be made as per IS : 2386 (Part III).Ingredients required for ordinary concrete containing one kg. Bag of cement for different proportions of mix shall be as given in Table 3.

Table- 3

Grade of Concrete	**Total qty. of dry aggregates by volume per 50 kg. Cement to be taken as the sum of individual vol. of fine and coarse aggregate (max.)**	**Proportion of fine aggregate to coarse aggregate.**	**Quantity of water per 50 Kg of cement max.**
1	2	3	4
M-10	300 Litres	Generally 1:2 for fine aggregate to coarse aggregate by volume	34 Litres
M-15	220 Litres		32 Litres

M-20	160 Litres	but subject to upper limit of 1:1.5 and lower limit of 1:2.5 *	30 Litres
M-25	100 Litres		27 Litres

- The proportions of the aggregate shall be adjusted from upper limit to lower limit progressively as the grading of the fine aggregates becomes finer and the maximum size of coarse aggregate becomes larger.
- The amount of water should be kept minimum required for proper workability. The quantity given in col. 4 is not to be exceeded.

Example

For an average grading of the fine aggregate (that is Zone II of IS:383-1963) the proportions shall be 1:1.5, 1:2 and 1:3, for maximum size of aggregates 10mm, 20 mm and 40 mm respectively.

Note: A mix leaner than M10 (1:3:6) may be used for non-structural parts if specified on the drawing or provided in the contract. In such case grading of aggregate shall be as specified in the contract or on the drawings. Other requirements for mixing, placing and curing shall be the same as specified in this section.

5.3 Quantity of Water

The quantity of water shall be just sufficient to produce a dense concrete of required workability and strength for the job. An accurate and strict control shall be kept on the quantity of mixing water.

In the case of reinforced concrete work, workability shall be such that the concrete surrounds and properly grips, all reinforcement. The degree of consistency, which shall depend upon the nature of work and the methods of vibration of concrete, shall be determined by regular slump tests. The following slumps shall be adopted for different types of works.

Sr. No.	Type of work	Slump
1	Mass concrete in RCC foundations, footings and retaining walls.	110
2	Beams, slabs and columns simply reinforced	120
3	Thin RCC section or section with congested steel	125

Note: With use of ordinary concrete the slump requirement specified above would not be applicable.

6 MIXING CONCRETE

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 throughout the construction. Mixing shall be continued till materials are uniformly distributed and a uniform colour of the 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 shall the mixing be done for less than 2 minutes after all ingredients have been put into the mixer. In hand mixing quantity of cement shall be increased by 10% above that specified in clause 5.2 above, the cost of increased cement being borne by the Contractor. Hand mixing will be permitted only under exceptional conditions and the contractor must take the permission of the Engineer-in-charge in advance. Mixers, which have been out of use more than 30 minutes, shall be thoroughly cleaned before putting in a new batch. Unless otherwise agreed to by the Engineer-in-charge, 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.

6.1 All structural concrete shall be weigh batched preferably by using a batching plant. All ingredients for concrete shall be batched by weight using a weigh batcher of approved make conforming to IS: 2722. Batching shall be to an accuracy of 0.50kg and the weigh batcher shall be tested for accuracy of calibration before commencement of the works and at least once a week thereafter or more frequently if so required by the Engineer.

6.2 Use of Ready Mixed Concrete (RMC) may be permitted at the discretion of the Engineer-In-Charge without any extra cost.

7 TRANSPORT, PLACING AND COMPACTION OF CONCRETE

The method of transporting and placing concrete shall be approved by the Engineer-in-charge. Concrete shall be transported and placed such that no contamination, segregation or loss of it's constitute materials takes place.

All formwork and reinforcement contained in it shall be cleaned and made free from standing water or dust, immediately before placing of concrete.

No concrete shall be placed in any part of the structure until the approval of the Engineer-in-charge has been obtained in writing.

If concreting is not started within 24 hours of the approval being given, it shall have to be obtained again from the Engineer-in-charge. Concreting shall then proceed continuously over the area between construction joints. Fresh concrete shall not be placed against concrete, which has been in position for more than 30 minutes unless a proper construction joint is formed. Concrete when deposited shall have a temperature of not less than 4.5 deg. C and not more than 38 deg. C unless otherwise specified. It shall be compacted in its final position within 30 minutes of its discharge from the mixer unless carried on properly designed agitators, operating continuously, in which case this time shall be within 2 hours of the addition of cement to the mix and within 30 minutes of its discharge from the agitator.

Except where otherwise agreed to by the Engineer-in-Charge, concrete shall be deposited in horizontal layers to a compacted depth of not more than 0.45 m when internal vibrators are used and not exceeding 0.30m in all other cases.

Unless otherwise agreed to by the Engineer-in-charge, concrete shall not be dropped into place from a height exceeding 2 meters. When trunking or chutes are used, they shall be kept clean and used in such a way as to avoid segregation.

When concrete is conveyed by chute, the plant shall be of such size and design as to ensure practically continuous flow. Slope of the chute shall be so adjusted that the concrete flows without the use of an excessive quantity of water and without any segregation of its ingredients. The delivery end of the chute shall be as close as possible to the point of deposit. The chute shall be thoroughly flushed with water before and after each working period and the water used for this purpose shall be discharged outside the formwork.

When concreting has to be resumed on a surface which has hardened, it shall be roughened, swept clean, thoroughly wetted and covered with 15 mm thick layer of mortar composed of cement and sand in the same ratio as in the concrete mix itself. This 15mm layer of mortar shall be freshly mixed and placed immediately before placing of new concrete.

Where concrete has not fully hardened, all laitance shall be removed by scrubbing the wet surface with wire or bristle brushes, care being taken to avoid dislodgement of any particles of coarse aggregate. The surface shall then be thoroughly wetted, all free water removed, and then coated with neat cement grout. The first layer of concrete to be placed on this surface shall not exceed 150mm in thickness, and shall be well rammed against old work, particular attention being given to corners and close spots.

All concrete shall be compacted to produce a dense homogeneous mass with the assistance of vibrator. For exceptional cases, where vibrators cannot be used an alternate scheme of compaction shall be approved by the Engineer-in-charge. Sufficient vibrators in serviceable condition shall be kept at site so that spare equipment is always available in the event of break down.

The performance requirements of vibrators shall conform to relevant IS codes. Vibration shall not be applied through reinforcement, and where vibrators of the immersion type are used, contact with reinforcement and all inserts shall be avoided as far as practicable.

8 CONCRETING UNDER WATER

When it is necessary to deposit concrete under water, the methods, equipment, materials and proportions of the mix to be used shall be got approved from the Engineer-in-charge before any work is started. Such concrete shall not be considered as 'Controlled Concrete'. Concrete shall not be placed in water having temperature below 4.5 deg. C. The temperature of the concrete, when deposited, shall be not less than 16 deg C., nor more than 38 deg. C.

Concrete shall contain 10 percent more cement than that required for the same mix placed in the dry. The materials shall be so proportioned as to produce a concrete having a

slump of not less than 100 mm. and not more than 180mm. The slump shall be tested as per IS: 516.

Coffer-dams or forms shall be sufficiently tight to ensure still water conditions if practicable, and in any case to reduce the flow of water to less than 3 meters per minute through the space into which concrete is to be deposited. Coffer-dams or forms in still water shall be sufficiently tight to prevent loss of mortar through the joints in the wells. Pumping shall not be done while concrete is being placed, or until 24 hours thereafter.

Concrete shall be deposited continuously until it has been brought to the required height. While depositing, the top surface shall always be kept as nearly level as possible and formation of seams avoided. For depositing concrete any one of the following method may be used:

(a) Tremie - When concrete is to be deposited under water by means of tremie, the top section of the tremie shall be a hopper large enough to hold one full batch of the mix or the entire contents of the transporting bucket if any. The tremie pipe shall not be less than 200 mm in diameter, and shall be large enough to allow a free flow of concrete and strong enough to withstand the external pressure of the water in which it is suspended, even if a partial vacuum develops inside the pipe. Preferably, flanged steel pipe of adequate strength for the job shall be used. A separate lifting device shall be provided for each tremie pipe with its hopper at the upper end. Unless the lower end of the pipe is equipped with an approved automatic check valve, the upper end of the pipe shall be plugged with a wadding of gunny sacking or other approved material before delivering the concrete to the tremie pipe through the hopper, so that when the concrete is forced down from the hopper to the pipe it will force the plug (and along with it any water in the pipe) down the pipe and out of the bottom end, thus establishing a continuous stream of concrete. It will be necessary to raise slowly the tremie in order to allow a uniform flow of concrete, but it shall not be emptied so that water enters above the concrete in the pipe. At all times after the placing of concrete is started and until all the required quantity has been placed, the lower end of the tremie pipe shall be kept below the top surface of the placed concrete. This will cause the concrete to build up from below instead of flowing out over the surface, and thus avoid formation of layers of laitance. If the charge in the tremie is lost while depositing, the tremie shall be raised above the concrete surface, and unless sealed by a check valve it shall be re-plugged at the top end, as at the beginning, before refilling for depositing further concrete.

(b) Drop Bottom Bucket -The top of the bucket shall be closed. The bottom doors shall move freely downward and outward when tripped. The bucket shall be filled completely and lowered slowly to avoid backwash. It shall not be dumped until it rests on the surface upon which the concrete is to be deposited and when discharged shall be withdrawn slowly until above the concrete.

To minimize the formation of laitance, great care shall be exercised not to disturb the concrete as far as possible while it is being deposited.

9 CURING OF CONCRETE

9.1 Protection and Water Curing

Immediately after compaction, concrete shall be protected against harmful effect of weather, including rain, running water, shocks, vibration, traffic, rapid temperature changes and premature dying out. It shall be covered with wet sacking, Hessian or other similar absorbent material approved by the Engineer-in-charge soon after the initial set, and shall be kept continuously wet for a period of not less than 21 days from the date of placement. Masonry work over the foundation concrete may be started after 48 hours of its laying but the curing of concrete shall be continued for a minimum period of 21 days.

9.2 Steam Curing

When steam curing is adopted it shall be ensured that it is done in a suitable enclosure to contain the live steam in order to minimise moisture and heat losses. The initial application of the steam shall be from two to four hours after the final placement of concrete to allow the initial set of the concrete to take place.

Where retarders are used, the waiting period before application of the steam shall be increased from four to six hours. The steam shall be at 100% relative humidity to prevent loss of moisture and to provide excess moisture for proper hydration of the cement. The application of steam shall not be directly on the concrete, and the ambient air temperature shall increase at a rate not exceeding 5 deg. centigrade per hour until a maximum temperature of 60 deg. cent. to 70 deg. cent is reached. The maximum temperature shall be maintained until the concrete has reached the desired strength.

When steam curing is discontinued the ambient air temperature shall not drop at a rate exceeding 5 deg. cent per hour until a temperature of about 10 deg. Cent above the temperature of the air to which the concrete will be exposed, has been reached.

10 WORKING IN EXTREME WEATHER

When depositing concrete in very hot weather, precaution shall be taken so that the temperature of wet concrete does not exceed 38 deg. C. while placing. This shall be achieved by stacking aggregate under sheds and keeping it moist using cold water or crushed or flaked ice if specified and permitted by the Engineer, reducing the time between mixing and placing to the minimum, cooling formwork by sprinkling water on the exterior, starting curing before the concrete dries out and restricting concreting, as far as possible, to mornings and evenings. During hot weather and rains the concrete shall be covered with tarpaulin and transported and placed in the forms and consolidated to final state in as short a time as possible. Commencement of concrete pours shall be avoided during heavy rains, storms and high winds.

11 FINISHING

11.1 General

Immediately after the removal of forms, all exposed bars or bolts passing through the reinforced cement concrete member and used for shuttering or any other purpose shall be cut inside the reinforced cement concrete member to a depth of at least 25 mm below the surface of the concrete and the resulting holes be closed by cement mortar. All fins caused by form joints shall be broken. All cavities produced by the removal of form ties, all holes and depressions, honeycomb spots, broken edges or corners and all other defects shall be thoroughly cleaned, saturated with water and carefully pointed and rendered true with mortar of cement and fine aggregate mixed in the proportions used in the grade of concrete that is being finished and of as dry a consistency as is possible to use. Considerable pressure shall be applied in filling and pointing to ensure thorough filling in all voids. Surfaces which have been filled/ pointed shall be kept moist for period of twenty-four hours. Any repair and rectification of defective work is to be undertaken and carried out as directed by the Engineer-in-charge and the cost is to be borne by the contractor. If rock pockets/ honeycombs, in the opinion of the Engineer-in-charge, are of such an extent or character as to affect the strength of the structure materially or to endanger the life of the steel reinforcement, he may declare the concrete defective and require the removal and replacement of the affected portion of the structure.

All construction and expansion joints in the completed work shall be left carefully tooled and free from any mortar and concrete. Expansion joint filler shall be left exposed for its full length with clean and true edges. Curing of the surface shall be continued for a period of 21 days.

11.2 Classes of Finishing

The surface finish for formed and unformed surfaces are classified and defined as below. Surface irregularities permitted for the various classes of finishes are termed either “abrupt” or “gradual”. Fins or offsets caused by displaced or misplaced from sheeting, lining or form sections, by loose knots in form timber or by otherwise defective form timber are considered abrupt irregularities. All other cases are described as gradual irregularities. Gradual irregularities will be measured with a template consisting of a straight edge for plane surfaces or its equivalent for curved surfaces. The length of template for testing gradual irregularities on formed surfaces shall be 1.5 m in length, the permissible gradual irregularities being measured over this length of the template.

Special surfaces, finishes and treatments falling outside the classes described here but defined elsewhere by the Engineer-in-charge shall also form part of these specifications.

Finish F1, F2 and F3 shall describe formed surfaces.

Finish U1, U2 and U3 shall describe unformed surfaces.

Class F1 Finish

This class of finish shall apply to all formed surfaces for which class F2 or F3 is not specified. It shall generally be formed by sawn timber formwork so constructed that there shall be no loss of material from the concrete during placement and compaction. After hardening, the concrete shall be in the position required and shall have the shape and dimensions called for in the drawings. Any abrupt irregularities shall not exceed 8 mm and gradual irregularities shall not exceed 16mm. All fins and drifts in excess of the above limits shall be made good by chipping and grinding if required by the Engineer-in-charge. Small blemishes caused by entrapped air or water may be expected but the surface shall be free from voids, honeycombing or other large blemishes. Class F1 finish shall be generally specified for all surfaces buried in ground or not visible during service or for surfaces that are to receive further rendering treatment such as plastering etc. Unless otherwise specified in the Bill of Quantities the surface finish shall be understood to be Class F1.

Class F2 Finish

Class F2 finish shall be obtained by the use of properly designed forms, either close jointed wrought timber forms or with forms having plywood or steel sheet lining. The abrupt irregularities shall not exceed 5 mm and gradual irregularities shall be less than 8mm. Small blemishes caused by entrapped air or water may be permitted but the surface shall be generally free from honeycombing, voids and large blemishes. Surface irregularities in excess of those stipulated shall be removed by chipping or rubbing with abrasive stone.

Class F3 Finish

Class F3 finish shall be formed by specially designed close jointed rigid forms having lining of high quality form plywood. The surface irregularities shall be limited to nil for abrupt irregularities and 3 mm for gradual irregularities. Class F3 irregularities including fins and projections by finish may be obtained from class F2 finish by carefully removing all abrupt rubbing/ grinding. If steel forms are used they shall be subjected to Engineer-in-charge's approval.

In addition, finish F3 shall include filling air holes with mortar and treatment of the entire surface with sack rubbed finish. It shall also include clean up of loose and adhering debris. For a sack rubbed finish, the surface shall be prepared within two days after of removal of the forms. The surface shall be wetted and allowed to dry slightly before mortar is applied by sack rubbing. The mortar used shall consist of one part cement to one and one half parts by volume of fine (IS No. 16 mesh) sand. Only sufficient mixing water to give the mortar a workable consistency shall be used. The

mortar shall then be rubbed over the surface with a fine burlap or linen cloth so as to fill the surface voids. The mortar in the voids shall be allowed to stiffen and solidify after which the whole surface shall be wiped clean with clean burlap such that all air holes etc. are filled and the entire surface presents a uniform appearance without air holes, irregularities etc.

Class U1 Finish

This is the screeded finish used on surfaces over which other finishes such as wearing coats etc. are to be placed. It is also the first step in the formation of U2 and U3 finishes. The finishing operation consists of levelling and screeding the concrete to produce an even and uniform surface so that the gradual irregularities are not greater than 6 mm. Surplus concrete should be removed immediately after consolidation by striking it off with a sawing motion of a straight edge or template across a wooden or metal strip that has been set as guide. Unless the drawings specify a horizontal surface or show the slope required, the tops of narrow surfaces, such as stair treads, walls, curbs and parapets shall be sloped approximately 10 mm per 300 mm width. Surfaces to be covered with concrete topping, terrazzo and similar surfaces shall be smooth and levelled to produce even surfaces, irregularities not exceeding 6 mm.

Class U2 Finish

This is a floated finish used on all outdoor unformed surfaces not prominently exposed to view such as tops of piers etc. The floating may be done by hand or power driven equipment. It should not however be started until some stiffening has taken place in the surface concrete and the moisture film or "shine" has disappeared. The floating should work the concrete no more than is necessary to produce a surface that is free from screed marks. All joints and edges should be finished with edging tools. It shall include the repair of gradual irregularities exceeding 6 mm. All abrupt irregularities shall also be repaired unless a roughened texture is specified.

Class U3 Finish

This is a travelled finish used on all surfaces exposed to view at close quarters such as tops of parapets and kerbs etc. Steel travelling should not be started after the moisture film and "shine" have completely disappeared from the floated surface and the concrete has hardened enough to prevent an excess of fine material and water from being worked to the surface. Excessive travelling, especially if started too soon, tends to produce crazing and lack of durability. Too long a delay will result in a surface too hard for proper finishing. Steel travelling should be performed with a firm pressure that will flatten and smooth the sandy surface left by floating. Travelling should produce a dense, uniform surface free of blemishes, ripples and travel marks. It shall include the repair of all abrupt irregularities and the

repair of gradual irregularities exceeding 6 mm. It shall also include finishing the joints and the edges of concrete with edging tools.

Form Finished Concrete

It is desired that certain areas like lift walls, and other areas as per the Bill of Quantity will not have any finishing on it. The Shuttering, in such areas to be of highest quality. No undulations should be seen in the concrete. The finish should be as per the Architect's satisfaction.

12 CONSTRUCTION JOINTS

Concreting shall be carried out continuously up to the construction joints, the position and details of which shall be as shown on approved drawings or as directed by the Engineer-in-Charge. Such joints shall, however, be kept to the minimum.

For a vertical construction joint, a stopping board shall be fixed previously at the pre-determined position and shall be properly stayed for sufficient lateral rigidity to prevent its displacement or bulging when concrete is compacted against it. Concreting shall be continued right up to the board. The board shall not be removed before the expiry of the specified period for removal of vertical forms. Before resuming work at a construction joint where the concrete has not yet fully hardened, all laitance shall be removed thoroughly, care being taken to avoid dislodgement of coarse aggregates. When work has to be resumed on a surface, which has hardened, the surface shall be thoroughly hacked, swept clean, wetted and covered with a layer of neat cement grout. The neat cement grout shall be followed by 15 mm thick layer of mortar mixed in the same proportion as in the concrete and concreting resumed immediately thereafter. The first batch of concrete shall be rammed against the old work to avoid formation of any stone pockets, particular attention being paid to corners and close spots.

In all cases, the position and detailed arrangement of all construction joints shall be predetermined and approved by the Engineer-in-Charge. In cases where concrete finish is to be exposed, the concrete shall be from the same batch, of consistent colour, texture and finish from construction joint to construction joint – lack of adherence to these requirements are grounds for rejection.

13 TESTS AND STANDARDS OF ACCEPTANCE

13.1 Preliminary Tests for Controlled Concrete

For controlled concrete preliminary tests referred to in Para 2.1 and 3.0 shall consist of three sets of separate tests, and in each set tests shall be conducted on six specimens. Not more than one set of six specimens shall be made on any particular day. Of the six specimens in each set, three shall be tested at seven days and the remaining three at 28 days. The preliminary tests of 7 days are intended only to indicate the strength likely to be attained at 28 days.

13.2 Work Strength Tests for Controlled and Ordinary Concrete

Works strength tests shall be made in accordance with IS 516. Each test shall be conducted on ten specimens, five of which shall be tested at seven days and the remaining five at 28 days. The cubes shall be made at the rate of one set for every 50 cubic meter of concrete or a part thereof for each grade. However, if in each grade concreting done in a days less than 15 cubic meter, the number of cubes can be reduced to 6 with the specific permission of the Engineer-in-Charge.

Similar works tests shall be carried out whenever the quality and grading of materials is changed irrespective of the quantity of concrete poured. The number of specimens may be suitably increased as deemed necessary by the Engineer-in-Charge, when procedure of tests given above reveals a poor quality of concrete and in other special cases.

All work shall be carried out under the supervision of a qualified and competent Engineer who will supervise proportioning, placing and compacting of concrete at all stages.

All necessary labour, materials, equipment, etc. for sampling, preparing test cubes, curing, etc., shall be provided by the Contractor. Testing of materials and concrete may be arranged by the Engineer-in-Charge in an approved laboratory at the cost of the contractor.

13.3 Standard of Acceptance

The strength of concrete shall conform to clause 16.0, Acceptance Criteria, as specified in IS: 456 – 2000.

13.4 Manufacture's Certification: Testing Results etc.

For all materials required for concrete construction including cement, aggregate, water, reinforcing and pre-stressing steel the original copies of test certificates, test results etc. either carried out by the manufacturer or any other agency, the mix design recommendations etc. shall be submitted to the Engineer-in-Charge for his approval and record. It shall remain the property of the Employer.

13.5 Chloride Contents

Since the chloride contents of the constituent materials of the concrete would be additive, it is desirable to keep a check on the overall chloride content of the concrete to keep it minimal. Specially, for pre-stressed concrete, the total chloride content of the concrete when manufactured according to the requirements of workability and strength shall not exceed 500 ppm. By weight of cement. The costs of testing for the chloride content of the ingredients of concrete and of undertaking remedial measures if the chloride content is more than the permissible limit shall be borne by the contractor.

14 REPAIR WORK

Concrete, which is unsatisfactory, shall be repaired by cutting out the unsatisfactory material and by replacing it with new concrete. Voids to be so filled shall be provided with anchors, keys or dovetail slots wherever necessary to attach the new material securely in place. Surface of prepared voids shall be wetted for 24 hours immediately before the patching material is placed. Repair of concrete shall be made by skilled workmen. Repairs shall be made as soon as practicable after removal of forms and in a manner to meet the requirements for the finish specified for the particular location.

Repairing leakage in liquid retaining structures, which become apparent during leak testing, will also have to be repaired by the contractor at his own cost following methods and specifications as directed by the Engineer-in-Charge.

For repair of the concrete works, the contractor may use epoxy as a bonding agent prior to placing fresh concrete. The use or otherwise of epoxy for the repair work will be at the discretion of the Engineer-in-charge. Epoxies shall be applied in strict accordance with the instructions of the manufacturer.

Epoxy is a two packed or three packed system containing base and hardener/s. The shelf life of the unmixed cans is about one year or more when stored in a place where ambient temperature does not increase beyond 75 deg. F. The base and hardener/s shall be mixed in the correct proportions recommended by the manufacturer. The blend, after mixing intimately, shall have a pot life of one hour and the material shall be applied over the old concrete to form a thin film. Fresh concrete shall be deposited immediately prior to the film drying up so as to ensure proper bonding between both concrete.

Where the dry pack method is used, holes shall be sharp and square at the surface edges, but corners within holes shall be rounded. The perimeter of the hole shall be under-cut in several places. Holes for dry pack shall have a minimum depth of 25 mm. The holes to be repaired shall be scrupulously clean and slightly wet with no free water on the surface. The surface shall then be dusted lightly with cement by means of dry brush. Under no conditions shall the holes be painted with neat cement grout.

The dry pack mix shall be proportioned by weight: 1 part cement to 2.5 parts of sand that will pass a No. 16 screen. Only enough water shall be used to produce a mortar, which will stick together when moulded into a ball by a slight pressure of the hands and will not extrude water but will leave the hands just damp.

Dry pack material shall be placed and packed in layers having a compacted thickness of about 10 mm. Each layer shall be solidly compacted over its entire surface by use of hardwood stick and hammer. The stick is normally about 300 mm to 460 mm long and not over 30 mm in diameter. Most of the tamping should be directed at a slight angle and towards the side of the hole to assure maximum compaction and bond. Water shall not be used to facilitate finishing.

Filling material used in repair of surfaces which will be exposed after completion of the project shall be made with cement from the same sources as the used in concrete and blended with a sufficient amount of white Portland cement to produce the same colour as in the

adjoining concrete. Parched surfaced shall be given a final treatment as required to make the texture of the parch match that of the surrounding material.

Immediately after patching is completed, the patched area shall be covered with an approved non-staining, water-saturated material, which shall be kept wet and protected against sun and wind for a period of 12 hours. Thereafter, the patched area shall be kept continuously wet by a fine spray or sprinkling of water for not less than 10 days as required under section 9.1 and 11.1 of this specification. The layers of gunite may be reinforced with steel mesh if directed by the Engineer- in –Charge.

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

The extent of repair shall be decided upon by Engineer-in-charge. The cost of repairs of defective areas shall be borne by the contractor. The engineer-in-charge may adopt at his discretion any other method of repairing like grouting with cement grout, epoxy grouts or guniting etc., which will be carried out by the contractor at his cost as per the specifications supplied by the Engineer-in-charge. Repair work is not an accepted remedy for exposed finishes

15 USE OF PLUMS IN ORDINARY CONCRETE

Stone plums shall not be used unless specified on the drawings. When used the size of stone plums may be from 150 to 300 mm. The maximum dimension of these stones or plums shall not exceed 1/3rd the least dimension of the members.

All plums shall be hard, durable, clean and free from soft materials or loose piece or deleterious substance in them and shall not have sharp corners.

During concreting the first layer of concrete of the specified mix shall be laid to a thickness of at least two and a half times the thickness of the maximum size of plums to be used. The plums shall then be laid while the top portion of this concrete is still green but sufficiently stiff to prevent complete submergence of the plums under their own weight. These plums shall be about half embedded in the concrete and the remaining part exposed so as to form a key with the next layer of concrete. No plums shall be used for concrete laid under water.

While placing the plums, care shall be taken to see that the clear distance between any two plums is not less than either the width or thickness of either of the plums. The distance from plums to the outer surface or from any steel reinforcement shall be equal to greatest width of the plum.

If plums of stratified stone are used, they shall be laid on their natural bed. Stones with concave faces shall be laid with the concave upwards.

The thickness of the next and successive layers of concrete shall be at least twice that of the largest plums.

The total **volume of plums shall not exceed 35% OR as per RCC design/ Consultant** of the volume of the finished concrete or as per the Consultant.

16 MEASUREMENT FOR PAYMENT

i) The cement concrete shall be measured in cubic meters. In reinforced concrete the volume occupied by reinforcement shall not be deducted.

ii) Any concrete used in excess of the theoretical dimensions as shown on the drawings will not be paid for.

iii) Unacceptable work: All defective concreting work, including but not limited to defects arising out of honey-combing, under sizing, under strength, etc. are liable to be demolished and rebuilt 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-in-charge, the cost of repair will be borne by the Contractor. In the event of the works being accepted by giving a design concession arising out of but not limited to under sizing, under strength accepting higher than design stresses in members or accepting materials not fully meeting the specifications etc. the contractor will be paid for the work actually carried out by him at the reduced rate of 75% of the tendered rate or as decided by the Engineer-in-Charge for portion of the work thus accepted. The decision of the Engineer-in-Charge shall be final and binding.

iv) All works shall be measured in the decimal system.

v) Dimensions shall be measured to the nearest 0.01 metre except for thickness of slab which shall be measured to the nearest 0.005 metre.

vi) Areas shall be worked out to the nearest 0.01 sq. m.

vii) Cubic contents shall be worked out to the nearest 0.01 cu. m.

viii) All measurements of cutting shall, unless otherwise stated, be held to include the consequent waste.

ix) Cement concrete work shall be classified as under:

a) Concrete cast-in-situ — Plain and reinforced
b) Pre-Cast Concrete — Plain and reinforced
c) Pre- stressed concrete — Cast-in-situ or pre-cast

All concrete, except as hereinafter provided, shall be measured in cubic meters.

x) No reductions shall be made for:

a) Ends of dissimilar materials (for example beams, posts, girders, purlins, corbels and steps) up to 500 sq. cm in section.
b) Opening up to 0.1 sq. m.
c) Volume occupied by reinforcement.
d) Volume occupied by drainage, water pipes, conduits, etc. not exceeding 100 sq. cm in cross sectional area.
e) Small voids each not exceeding 40 sq. m. in section.
f) Small moulds, drip moulds, chamfers, splays, rounded or covered angles, beads, grooves and rebates up to 10 cm in depth and width.

17 DESIGN MIX CONCRETE

- Design Mix Concrete are classified in three categories, viz. "Normal Concrete (M)", "Heavy Concrete (H)", "Super Heavy Concrete (SH)". Each class of concrete shall be identified by a prefix and two numbers. Prefix "M" would denote Normal Concrete, prefix "H" would denote heavy concrete and prefix "SH" would denote super heavy concrete. The two numbers e.g. 25 - 40 would denote the crushing strength of cube at 28 days in N/sq.mm and maximum size of the coarse aggregates in millimetres respectively.
- Normal concrete shall have a net dry unit weight of not less than 25 kN/cum, for the finished structure after curing, Heavy concrete shall have a net dry unit weight of not less than 36.30 kN/cum, for the finished structure after curing and special heavy concrete shall have a net dry unit weight of not less than 41 kN/cum for the finished structure after curing.
- **Mix Design & Testing**

  For Design Mix Concrete, the mix shall be designed as per any of four methods given in SP: 23 to provide the grade of concrete having the required workability and characteristic strength not less than appropriate values given in IS: 456. The design mix shall in addition be such that it is cohesive and does not segregate during placement and should result in a dense and durable concrete capable of giving the specified finish. For liquid retaining structures, the mix shall also result in watertight concrete. The CONTRACTOR shall exercise great care while designing the concrete mix and executing the works to achieve the desired result.
- The minimum grade of concrete shall be as per Table 5 of IS: 456 for various exposure conditions of concrete. For various environmental conditions, refer Table 3 of IS: 456.

- **READY MIXED CONCRETE**
- All specification as per IS: 4926 – "Specification for ready mixed concrete" shall be used.
- The Contractor shall identify at least two sources of ready mix concrete supplier and get it approved by ENGINEER prior to start of the Works. Any change in the source of the RMC, shall be got approved by the ENGINEER.
- The design mix prepared by the RMC supplier shall be the responsibility of the Contractor. The testing of concrete as per Codal provisions and the specifications shall be done by the Contractor same as the normal concreting works.

- **TRANSPORTING, PLACING AND COMPACTING CONCRETE**
- Concrete shall be transported from the mixing plant to the formwork with minimum time lapse by methods that shall maintain the required workability and will prevent segregation, loss of any ingredients or ingress of foreign matter or water.
- In all cases concrete shall be deposited as nearly as practicable directly in its final position. To avoid segregation, concrete shall not be re-handled or caused to flow. For locations

where direct placement is not possible and in narrow forms, CONTRACTOR shall provide suitable drops and "Elephant Trunks". Concrete shall not be dropped from a height of more than 1.5 m as stipulated in clause 9.13.

- Concrete shall not be placed in flowing water. Under water concrete shall be placed in position by tremie or by pipeline from the mixer and shall never be allowed to fall freely through the water.
- While placing concrete the CONTRACTOR shall proceed as specified below and also ensure the following:
  - Continuously between construction joints and predetermined abutments.
  - Without disturbance to forms or reinforcement.
  - Without disturbance to pipes, ducts, fixings and the like to be cast in; ensure that such items are securely fixed. Ensure that concrete cannot enter open ends of pipes and conduits, etc.
  - Without dropping in a manner that could cause segregation or shock.
  - In deep pours only when the concrete and formwork is designed for this purpose and by using suitable chutes or pipes.
  - Do not place if the workability is such that full compaction cannot be achieved.
  - Without disturbing the unsupported sides of excavations; prevent contamination of concrete with earth. Provide sheeting if necessary. In supported excavations, withdraw the linings progressively as concrete is placed.
  - If placed directly onto hardcore or any other porous material, dampen the surface to reduce loss of water from the concrete.
  - Ensure that there is no damage or displacement to sheet membranes.
  - Record the time and location of placing structural concrete.

- Concrete shall normally be compacted in its final position within thirty minutes (Initial setting time) of leaving the mixer. Concrete shall be compacted during placing with approved vibrating equipment without causing segregation until it forms a solid mass free from voids, thoroughly worked around reinforcement and embedded fixtures and into all corners of the formwork. Immersion vibrators shall be inserted vertically at points not more than 450 mm apart and withdrawn slowly till air bubbles cease to come to the surface, leaving no voids. When placing concrete in layers advancing horizontally, care shall be taken to ensure adequate vibration, blending and melding of the concrete between successive layers. Vibrators shall not be allowed to come in contact with reinforcement, formwork and finished surfaces after start of initial set. Over-vibration leads to segregation and shall be avoided.

- Concrete may be conveyed and placed by mechanically operated equipment after getting the complete procedure approved by ENGINEER. The slump shall be held to the minimum necessary for conveying concrete by this method. When concrete is to

be pumped, the concrete mix shall be specially designed to suit pumping. Care shall be taken to avoid stoppages in work once pumping has started.

- CONTRACTOR shall submit a method statement to ENGINEER for approval, furnishing details of pour sequence, thickness of each layer, mixing and conveying equipments proposed etc. preferably with a sketch.

- Except when placing with slip forms, each placement of concrete in multiple lift work shall be allowed to set for at least 24 hours after the final set of concrete before the start of subsequent placement. Placing shall stop when concrete reaches the top of the opening in walls or bottom surface of slab, in slab and beam construction, and it shall be resumed before concrete takes initial set but not until it has had time to settle as determined by ENGINEER. Concrete shall be protected against damage until final acceptance.
- **PLACING OF CONCRETE BY PUMPING METHODS**
  - **General**
  - Placing of concrete by pumping will be as specified or authorized by Engineer to achieve the required speediness of construction and maintain targeted schedules.

  - Pumping of concrete shall be done only after conducting pumpability trials to ascertain the performance of fresh concrete on pumping in presence of the Engineer as per approved procedure. During pumping, concrete shall be conveyed either through rigid pipe or through flexible hose and discharged directly into the desired area. A steady supply of pumpable concrete is necessary for satisfactory pumping. Pumpable concrete requires properly graded aggregates, material uniformity, consistent batching and thorough mixing. Concrete pumps used shall be able to deliver concrete over a horizontal distance of about 400 m or of about 100 m in a vertical direction, (with intermediate figures for a combination of horizontal and vertical movements). They shall be used for concreting densely reinforced structures, internal structural elements of buildings and for large pours of concrete.

  - Placement of normal concrete by pumping will be permitted as specified or authorized by the Engineer. The decision, whether or not to pump any particular mix shall rest entirely with the Engineer and no extra claims for payment on this account will be entertained. The pumping equipment, pipe lines and accessories as well as proportioning of pumpable concrete shall generally confirm to the recommendations of ACI-304.2 (latest revision) – Placing of concrete by pumping method - Proportioning of pumpable mixes gives certain guide lines on concrete mix. However, final selection of mix shall be as instructed by the Engineer.

- **Pumping Equipment**

  Requisite numbers of modern dependable concrete pumps capable of pumping concrete of specified quality at a rate required to meet the construction schedules, together with a balanced complement of pipelines, accessories, spare parts, power controlled placing booms, and experienced pump operators and maintenance staff shall be provided at locations and in a manner approved by the Engineer.

- The pumping plant shall be completely installed on each occasion, with preliminary mock operation for a sufficient length of time prior to scheduled placement of a particular concrete pour, to enable the Engineer to conduct pumpability tests and necessary adjustments for the concrete mix, prior to use of the pumping for placement of concrete.

- **Type of Pump**

  The selection of the concrete pump shall be done as per the project requirement. The Contractor shall submit the concrete pump data sheets proving the suitability for the given project to ENGINEER for approval.

- The concrete pump shall be selected on its best pumping capacity and the speediness to be achieved in the project. The piston pumps of a net horizontal pumping capacity of 30 m3/hr or 20 m3/hr or 15 m3/hr or 10 m3/hr can be utilized. The combination of various pumps to be used shall be decided by Contractor and shall submit the necessary documents and targeted progress to be achieved in line with the Time Period and Milestones.

- These pumps shall have capacity to pump the concrete upto at a horizontal distance of 400 m and capable of generating a minimum pressure of 80 bar. These parameters shall depend upon the building sizes, manoeuvrability and other construction features. These pumps shall consist of a receiving hopper with a bolted grill at top of capacity not less than 600 liters. The hoppers shall be provided with hydraulically driven re-mixing blades or other agitating devices to keep the concrete mixed continuously and maintain consistency and uniformity. The pumps shall be provided with two cylinders with max. diameter not less than 150 mm, stroke of about 1200 mm and the number of strokes not exceeding 25 per minute. The outlet valves shall be located on the discharge lines. Type of inlet and outlet valves may vary depending on the manufacturer, but they shall preferably be of sliding-rod-flat-gate type. The piston shall be hydraulically driven. Primary power shall be supplied by gasoline, diesel or electric motor of requisite power rating. Care shall be taken by the Contractor to ensure uninterrupted operation of the pumps during the entire period of concreting by providing adequate standby arrangements. The

primary power and pump equipment shall be either truck or trailer mounted, and not skid mounted.

- **Pipelines and Accessories**
  - **Rigid pipelines**

    Concrete transported to the placement area by pumping methods shall be pumped thorough rigid pipes or a combination of rigid and heavy-duty flexible hoses. Rigid pipe shall be made available in minimum 125 mm diameter size. Aluminium alloy lines shall not be used for delivery of concrete. Rigid pipes shall be furnished in such lengths as can be manually handled by a single person.
  - **Flexible conduit (hose)**

    Flexible conduit shall be made of rubber, or spirally wound flexible metal, and plastic flexible conduits generally present greater resistance to movement of concrete and their performance is not the same as that of a rigid pipe and also larger sizes (100 mm to 123 mm) have a tendency to leak. Flexible conduits provided, shall be interchangeable with rigid pipes and their use restricted to curves, difficult placement areas, and as connection to moving cranes or to water borne lines.

  - **Couplings**

    The couplings provided to connect both flexible and rigid pipe sections shall be adequate in strength to withstand handling during erection of the pipe system, misalignments, and poor support along the lines. They should be nominally rated for at least 3.45 Mpa and greater for rising over 30 mtr. The strength and tightness of joints shall be guaranteed. Couplings shall be designed to allow replacement of any pipe section without moving other pipe sections, and shall provide a full internal cross-section with no obstructions or crevices to disrupt the smooth flow of concrete.

  - **Accessories**
    - The pump and the distribution system for a particular concreting job shall use the accessories as listed below and they shall be approved by the Engineer.
    - Rigid and flexible pipes in varying lengths, such as 3, 1.5, 0.9, 0.6 and 0.3 m lengths.
    - Curved sections of rigid pipes such as large radius elbows at angles of 90 deg., 45 deg., 22 deg. 30 min. and 11 deg. 15 min.
    - Swivel joints and rotary distributors.
    - Pin and gate valves to prevent back-flow in the pipe line.
    - Switch valve to direct flow into another pipe line.

- Connection devices to fill forms the bottom up.
- Temporary supports, rollers and other devices for protection of conduit over rock, concrete, reinforcement steel and forms. Lifting and leashing points.
- Extra strong coupling for vertical runs in inaccessible areas.
- Transition for connecting different sizes of pipes.
- Air vents for downhill pumping.
- Clean-out equipment

- Adequate numbers of separate placement booms of various radius and reach, either stationary steel column mounted or tower crane mast mounted moving on rail tracks, or truck mounted shall be provided by the Contractor to match within concrete placement schedule and pumps. For maximum flexibility of operation the separate placement boom shall be such that they can be easily lifted by the tower cranes provided. Their mounting arrangements shall be quick connecting type and interchangeable between tower crane masts, steel columns and truck mountings etc. The placement booms shall consist of three hinged parts incorporating a concrete pipe line with articulated inserts at boom joints and ending in a flexible hose. The boom shall be remote controlled.

- The pumping plant and the pipe distribution system

- The concrete pumping plant apart from the receiving hopper and the pump shall also be provided with a water pressure valve, connecting pipes with needle valve, cleaning rods, outlets for drainage water and a high pressure pumps for flushing out the concrete in pipe line.

- The shortest way shall be selected in planning the direction of the concrete pipeline, and the number of bends (elbows) shall be as small as possible. Should a change be made of the direction in plan of the pipe lines or a change of their vertical profile, these shall be arranged with easy transitions.

- Before the pipeline is assembled all pipe flanges shall be tested and carefully cleaned, packing rings cleaned or replaced, and the internal surfaces of all pipe section cleaned. Horizontal lengths of concrete pipe lines shall be laid on supports, wooden trestles, scaffolding, staging etc. Vertical and inclined lengths of pipe shall be fastened by clamp irons or stirrups to masts, or to the frame of the structure being erected. It is recommended to replace vertical sections of the pipeline by inclined sections where possible. Sharp turns and bends at an angle of 90 deg. shall be avoided. Pipes shall be supported in such a manner that they do not disturb the forms during concreting.

- A vertical section of the concrete pipeline shall not be arranged closer than 8 to 9 m from the concrete pump. Before a vertical section a valve shall normally be placed, to prevent back flow of the concrete when the pump stops or when the pipe is cleaned or replaced. When pumping vertically through the placer boom, a thrust block shall be provided at the base of the vertical riser to resist the forces in the pipeline due to the pumping of concrete.

- When pumping downwards, 15 m or more, it is desirable to provide an air release valve at the middle of the top bend.

- Line resistance and lubrication.

- When concrete is pumped through a straight section of a pipe or hose, it moves as a cylinder riding on a thin lubricant film of a grout or mortar. At changes in direction or cross-section some re-mixing occurs. In all cases at the start of pumping operation lubricating mortar is required, and this shall be a properly designed mortar of cement-sand grout (1:1) or a batch of the regular concrete with the coarse aggregate omitted. Except for a small portion of this mortar which may be used for bedding at the construction joint, it shall be wasted and not used in the concrete placement. It can be assumed that about 0.35 cu. m of mortar will lubricate a 125 mm diameter horizontal pipeline of about 300 m length and the lubrication shall be maintained as long as the pumping continues. For vertical or smaller lines less mortar will be required. The mortar shall have the same cement content as that of the concrete. The water cement ratio shall be determined by the placing condition and finally decided by the Engineer. In order to ensure that only minimum quantity of grout mortar is used to lubricate the pipeline, a rubber sponge ball shall be allowed to pass through the pipeline immediately before the first batch of grout mortar is pumped. This rubber ball shall be pushed by the following mortar along the pipeline slowly and allowed to emerge at the open end. The cost of the lubricating mortar to be used, shall be deemed to have been included in the general rate structure for works in the schedule of items and nothing extra shall be payable.

- It shall be taken into account when planning the pipeline that, in straight horizontal and vertical section of pipe and at bends the resistance to the movements of concrete differ. For convenience in calculating the resistance of a concrete pipeline experimental co-efficient of equivalent length shall be used by means of which the equivalent length of a horizontal concrete pipeline is to be obtained. In absence of the pump manufacturer's data, equivalent lengths of concrete pipeline as indicated in Table –8 may be used.

Table- 8		
EQUIVALENT LENGTH OF CONCRETE PIPELINES		
Sr. No.	**Characteristics of a length of concrete pipeline**	**Equivalent length of horizontal concrete pipeline in meter**
1	Bend in pipeline at an angle of 90 deg.	12
2	Bend in pipeline at an angle of 45 deg.	7
3	Bend in pipeline at an angle of 22 deg. 30 min.	4
4	1 m of vertical concrete pipeline	8

- The equivalent length of the concrete pipeline must be less than or equal to the range of feed in horizontal direction as specified by the pump manufacturer for the same rate of pumping. To obtain the least line resistance, the layout of the pipeline system shall contain a minimum number of bends and preferably with no change in pipe size. If two sizes of pipes are required to be used, the smaller diameter shall be used at the pump end and the larger at the discharge end. The contractor shall exercise care in handling of the pipeline, during assembly, cleaning and dismantling so as to lower the line resistance by preventing the formation of rough surfaces, dents in pipe section and crevices in couplings. If any pipe, bend, coupling and other accessories are considered to be defective or damaged by the Engineer, the same shall not be used in the concrete pipeline till such time the defect has been removed and the damage repaired to the entire satisfaction of the Engineer. Qualified chemical admixtures shall be used effectively to get workable concrete.

- Proportioning pumpable concrete

- Basic Consideration

- Although the ingredients of concrete to be placed both by pumping and by othermeans are the same, more emphasis shall be laid on the quality control and proportioning of a dependable pumpable mix. Dependability is effected by the equipment and the operator, with the control of all of the ingredients in the mixture, the batching and mixing operations, and the knowledge and experience of all the personnel from beginning to end.
- Concrete mixes for pumping shall be “plastic” at all times. Stiff mixes shall not be used for pumping as they do not pump well. Particular attention shall be given to the mortar (cement, sand and water) and the amounts and sizes of coarse aggregates.

- Normal Weight Aggregates

- Coarse normal weight aggregates

- The maximum size of angular coarse aggregate shall be limited to one-third of the smallest inside diameter of the hose or pipe based on simple geometry of cubical shape aggregates. For well-rounded aggregates, the maximum size shall be limited to 40% of the pipe or hose diameter. Adequate provisions shall be made to eliminate over size particles in the concrete by screening or by careful selection of aggregate. Gradation of sizes of coarse aggregates shall correspond to Grades A and B of Table–9 and shall meet IS: 2386 requirements. If required certain fractional sizes shall be combined and blended to produce the required gradation. Greater emphasis shall be laid on uniformity of gradation throughout the entire job.

- The maximum size of the coarse aggregate has a significant effect on the volume or amount of coarse aggregate that may be effectively used in a mix. As will be seen from Table –10 the quantity of coarse aggregate must be substantially reduced as the maximum size become smaller. Mixes consisting of too large a portion of coarse aggregate with less cement shall be avoided.

Table- 9

Grading Requirement of Coarse Aggregates for Pumped Concrete

Grade - A (Maximum Size 40 mm)		Grade –B (Maximum Size 20 mm)	
Sieve Size	**Percent Passing By weight**	**Sieve Size**	**Percent Passing By weight**
50 mm	100	25 mm	100
40 mm	95 to 100	20 mm	95 to 100
20 mm	35 to 70	12.5 mm	20 to 55
10 mm	10 to 30	10 mm	0 to 15
4.75 mm	0 to 5	4.75 mm	0 to 5

Table- 10

Volume of coarse Aggregate per unit of volume of concrete.

Max. size aggregates	**Volume of Dry-rodded Coarse Aggregate per Unit volume of concrete for different fineness module of sand**			
FMS =2.40	FMS =2.60	FMS =2.80	FMS =3.00	
10.0	0.50	0.48	0.46	0.44
12.5	0.59	0.57	0.55	0.53
20.0	0.66	0.64	0.62	0.60
25.0	0.71	0.69	0.67	0.65
40.0	0.76	0.74	0.72	0.70
50.0	0.78	0.76	0.74	0.72

- **Note :**

- Volume is based on aggregates in dry-rodded condition.
- These volumes are selected from empirical relationships to produce concrete with a degree of workability suitable for usual reinforced construction. When placement is to by pump, they shall be reduced by about 10 percent.
- FMS = Fineness Modulus of Sand.
- **Fine normal weight aggregate**
- Fine aggregate shall consist of natural sand, manufactured sand or a combination thereof and shall be graded within the following limits.

Sieve Size	Percentage passing by weight
9.5 mm	100
4.75 mm	95 to 100
2.36 mm	80 to 100
1.18 mm	50 to 85
600 microns	25 to 60
300 microns	10 to 30
150 microns	20 to 10

- Fine aggregates shall conform to the requirements of IS: 2386. Particular attention shall be given to those passing through finer screen sizes. For small line system (less than 150 mm) 15 to 30 percent shall pass 300 micron sieve and 5 to 10 percent shall pass 150 micron sieve. Sands which are deficient in either of these two sizes shall be blended with selected finer sands or inert material such as quarry dust to produce these desired percentages.

- The fineness modulus of sand meeting the above grading limits will fall between 2.13 and 3.37 with the median being 2.75. Pumpability of mixes will generally improve with a decrease in the fineness modulus value or in other words with the use of finer sands. Sands having a fineness modulus between 2.40 and 3.00 are generally satisfactory provided that the percentages passing 300 micron and 150 micron sieves meet the previously stated requirements. It shall also be emphasized that for uniformity, the fineness modulus of the sand shall not vary more than 0.20 from the average value used in proportioning.

- Table –10 is suggested as a guide to determine the amounts of coarse aggregate to be combined with sand of different fineness modulus. The foot note of Table –10 require a reduction in the volume of coarse aggregate by 10 percent for pumping. This margin shall be considered as a safety margin for variations in sand gradation to reduce pumping pressure. Under conditions of good materials control and uncomplicated line systems, this reduction may not be required.

- Although in practice it may not be possible to duplicate this recommended sand gradation exactly, sands having a gradation closer to the upper limit (fine sand) are more desirable for pumping than those near the lower limit (coarse sand). The fineness modulus of sand according to the recommended curve is 2.68 and the gradation meets all the requirements stated earlier.

- **Water and Slump**
- Water requirements and slump control for pumpable normal weight concrete are interrelated and extremely important considerations. The mixing water requirements for a particular mix shall be determined by the Engineer and modified to suit the fineness of sands, quality of admixtures, additives, cement replacements or other special materials being used in the concrete.

- The Contractor shall establish the optimum slump jointly with the Engineer for a pumpable mix at the discharge hose end and shall maintain control of that particular slump throughout the course of a job. Excess water shall not be added in the receiving hopper to make the concrete mix pumpable, instead attempt shall be made to obtain 'truly plastic mix' by proper proportioning.

- Slump of concrete may undergo change between initial mixing and final placement. If the slump at the discharge hose end is to be maintained within specified limits, it will be necessary for the concrete to enter the pump at a higher slump to give the required mobility during transport. Slump adjustments by re-proportioning of the constituents as may be required shall be carried out by the Contractor jointly in consultation with the Engineer for every type of mix and for every new placement and set up of pump and pipelines.

- **Cement Content**
- The determination of the cement content for a normal weight pump mix shall follow the same basic principles used for conventionally placed concrete. The water cement ratio shall be established by the Engineer on the basis of exposure conditions, strength requirements or minimum cement consumption, whichever governs. However, because of slightly higher ranges of slump and ratios of fine to coarse aggregates, the pump mix may require an increase in the amount of cement above those pumpable concrete mass. The total quantity of fines passing through the 300 micron sieve including cement, fine sand, stone dust etc. Shall be in the range of 380 to 450 kg/cu. m of concrete.

- Cement content in case of M-50 shall be maximum of 425 kg/m3, and shall be a mix with high range of workability i.e. 175 mm +/- 25 mm. All the contents shall be mixed based on the mix design & trial studies. • While establishing the cement content for normal

weight trial mixes, it will be necessary to take into account the capabilities of the particular pump and its operator for over strength proportioning in the laboratory to provide for field variations.

- In case of pumping difficulties, it is desirable and economical to correct any deficiencies in the aggregates, especially in the sand instead of using extra quantities of sand. With well graded coarse and fine aggregates properly combined, the cement requirement for pumpable mixes shall closely resemble to those used in conventially placed concrete.

- **Admixtures**
- The use of poor aggregate grading or aggregate with continuous change in overall grading of the 'combinations' during concreting operation will make special admixtures quite useful in overcoming the main difficulty like blockage in pumping. These admixtures shall be incorporated in pumpable concrete to aim the following.
    - Increase in the range of mix designs which may be successfully pumped using water reducing admixtures/Super plasticizers with the approval of the Engineer.
    - Reducing the risk of pipeline blockages by preventing segregation of concrete mix.
    - To have satisfactory/specified performance both in fresh and hardened state.
    - Any admixture that increases workability in normal weight concrete may usually improve pumpability. The choice of type of admixture and the advantage gained from its use in concrete to be pumped will depend on the characteristics of the pump mix and will be finally decided by the Engineer in consultation with the admixture manufacturer.
    - For improvement of pumpability the following admixtures are generally recommended. Such admixtures used shall be conforming to ASTM C-494/IS 9103.
    - Water Reducing Admixtures/Super Plasticizers.
    - These cause reduction in water requirements at constant slump or an increase in slump at constant water-cement ratio. They can be designed to have no apparent effect on setting time, or alternately to achieve varying degrees of acceleration or retardation in rate of hardening of the mixture. Most water reducing admixtures increase the pumpabillity of the concrete mix through plasticising action.

- **Air Entraining Admixtures**
- Air entrained concrete is considerably plastic and more workable than non air entrained concrete. It can be pumped with less coarse aggregate segregation and has less tendency for concrete to bleed. Start-up after shut down is also generally easier due to reduced bleeding. For pumped concrete these limits shall be obtained at the point of

placement in the structure. To compensate for air content loss in the air entrained concrete higher entrainment of air may be required at the batching plant. The required adjustment of admixture dose shall be carried out by the Engineer after carrying out necessary air loss tests. An air content in the range of 3 to 5 % shall be preferred as higher ranges reduces the delivery capacity of pump systems due to increased compressibility of the concrete and also reduces strength of concrete.

- If air-entraining plasticizer is used, typically 13 % minimum water reduction is possible. Therefore, strength loss due to air entrainment will be compensated by using such air-entraining plasticizer.

- **Finely Divided Mineral Admixtures**
- Contractor, if specifically approved by the engineer, can use mineral admixture. In concrete mixtures, deficient in fines, the addition of a finely divided inert mineral admixture generally improves workability, pumpability, reduces the amount of bleeding and increases the strength. The effect on strength depends on the type of mineral admixture used, conditions under which the concrete is cured, and the amount of admixture used. Water soluble polymers obtained from cellulose derivations may also be used as an admixture with a small dose of 60 to 150 gms/cu.m. to increase viscosity of the mixing water and reduce the frictional resistance to flow and bleeding in the pipe system.

- **Trial Mixes**
- The trial mixes for pumping shall be prepared and tested in the Site laboratory by contractor in accordance with clause of this specification. The ingredients, particularly the coarse and fine aggregates shall also be checked for the conformance to the desired properties described, by the contractor. Table –10 may be used to select the volume of coarse aggregate per cu. m. of concrete. In using this table it is recommended that the highest probable fineness modulus of sand be used rather than the average fineness modulus to ensure consistent performance during pumping. For additional plasticity, 10 % reduction in coarse aggregate quantities shall be considered. Experience with the use of local aggregate and their uniformity shall also be considered in the proportioning concepts.

- **Mix Design for Pumpable Concrete**
- Taking the above factors into account, the concrete shall first be designed for normal placement conditions and then modified as necessary to suit pumping. The following procedure shall be adopted:
    - Design the mix for specified characteristic strength and workability.

- Check and ensure combined grading of aggregates i.e. as uniform grading as possible. This requirement is vital as gaps or partial gaps are the basic reasons for poor water retention property and segregation under pressure.

- Determine the optimum sand content for the required workability and increase sand content by reducing volume of coarse aggregate per unit volume of concrete by about 10 % as a degree of protection against under sanding due to batch variations.

- Recheck the minimum cement content for durability.

- Examine the total fines content i.e. cement and fine aggregates passing through 300 micron sieve and readjust the mix, if necessary. A very rich mix with fine sand will be as problematic as coarse sand with lean mix.

- Re-appraise the grading if the particle shape of any particular fraction is such as may cause excessive voids. Re-adjust as required, if necessary examining the void ratio of various combinations, using void meter to achieve minimum voids at the expense of 'sufficient fines' content.

- If dissatisfied with (a) to (f) as above, consider what remedial action may be taken to overcome the troublesome factor. For example, the following two situations may occur :
    - If the sand has more coarser fraction it is worth considering the addition of a proportion of finer sand, or alternately if the sand has finer fraction, the addition of coarse fraction may be considered. Addition or reduction of cement may help, but the correct solution is to overcome the gap in overall grading as stated above.

    - In a 20 mm aggregate max. Size, if there is an excess of 10 to 4.75 mm fraction, and this fraction is flaky with unduly large surface area, either increase the sand content to reduce the possibility of segregation and to reduce the inter-practical stresses, or (better) re-grade using single sized aggregates.

- At the trial mix stage small variations can be made preferably in the light of the pressures registered and observed performances through the pump. In certain cases admixtures may be economically and beneficially used to improve or eliminate circumstances that cannot readily be overcome by other means.

- **Testing For Pumpability**
- No mix shall be accepted for use on a pumping job until an actual test under field condition has been completed. Testing a mix for pumpability involves duplication of the anticipated job condition from beginning to end. The batching and conveying by truck mixers shall be the same as will be used; the same pump and operator shall be present. The pipe and hose layouts shall simulate the actual condition as far as practicable. Prior use of a mix on another job may furnish evidence of pumpability but only if conditions are duplicated. Before commencing a new concreting job, the contractor shall carry out pumpability tests in consultation with the Engineer. Concrete used in such tests shall not be used in the actual construction, unless specifically permitted by the Engineer. Following parameter shall be established by pumpability trials:
  - Insitu compressive & split tensile strength of concrete by
  - Curing the sample at Site by sprinkling water.
  - Curing the sample at Laboratory in curing tanks.
  - Wet sieve analysis of concrete to ensure that proportions of ingredients before and after pumping are same.
- **Field Practices.**
- Proper planning of concrete supply, pump location, line layout, placing sequence and the entire pumping operation shall be done by the Contractor and got approved by the Engineer on every occasion before commencement of concreting job. The pump shall be as near the placing area as practicable, and the entire surrounding area must have adequate bearing strength to support the concrete delivery trucks, thus assuring a continuous supply of concrete. For important concrete placements and large jobs, adequate standby power and pumping equipment shall be provided as replacement, should break down occur.

- Direct communications shall be maintained between the pump operator, concrete placing crew and batching plant. The placing rate shall be estimated so that concrete can be operated at an appropriate delivery rate. As a final check, the pump shall be started and operated without concrete to ascertain that, all moving parts are operating properly. As stated previously, the grout mortar shall be pumped into the line to provide initial lubrication for the concrete. As soon as concrete is received, the pump shall be run slowly until the lines are completely full and the concrete is slowly moving. Once the pumping is started, the operator shall ensure that the hopper of the pump is not emptied beyond a certain level, as air may enter the pipeline and cause choking. Continuous pumping should be ensured. If a delay occurs because of concrete delivery, form repairs, or other factors, the pump shall be slowed down to maintain some movement of the concrete till normal supply is resumed. For longer delays, the concrete in the

receiving hopper shall be made to last as long as possible by moving the concrete in the lines occasionally with one stroke of the pump. In confined areas, attempt shall be made by the Contractor to run a return line back to the pump, so that concrete can be re-circulated during delays.

- The Contractor shall ensure that obstructions are not found in the pipe due to interruption in the feed of the concrete by more than 30 to 45 minutes.

- Minor blockages shall be cleared by operating a few strokes of the pump in reverse momentarily and then by returning to normal forward pumping. If this fails, a succession of reverse and forward strokes shall be carried out to remove the blockage. Should this fail also, the blockage may be due to air-lock and the entrapped air has to be removed.

- Attempt to push through the obstructions by repeatedly starting the pump will result in compaction of the concrete and complicate the removal of the concrete in the pipe. Blockages in the pipe are usually discovered by the sound when the pipe is struck. To remove the obstruction, the concrete pipe shall be taken apart at the assured position and cleaned. Then the pumping process shall be started all over again.

- This method of checking the blockage and setting it right shall be done with great speed as excessive delay will cause setting of concrete in the pipeline downstream of the choke and will lead to further blockage. When the blockage is being found out and remedied, the pump shall periodically be given one or two strokes forward to keep the concrete in motion. If blockage occurs in the placer boom, a pipe joint near the base of the placer boom shall be opened and the boom made vertical to drain the pipeline by gravity.

- Cleaning blockages are time consuming and as such major blockages shall best be avoided by ensuring a pumpable mix. Concrete that is either under or over sanded, short of fines, gap graded, has an excess of a particular size, or excessively wet or dry will be rejected by the pump either by blockage or by hard pumping involving excessive pressures.

- The termination of pumping operations shall be carefully planned to utilize the concrete dormant in the pipeline and the hopper when the pump is stopped and to avoid wastage.

- When the form is nearly full, and there is enough concrete in the line to complete the placement, the pump shall be stopped and a go-devil be inserted and forced through the line to clear it out. Water under pressure shall be used to push the go-devil. The go-devil shall be stopped about one meter from the end of the line, so that the water in the

line will not spill over into the placement area. After flushing, water in the pipe shall be removed by drain cock which shall be located for this purpose in the lowest part of the line. After all concrete has been removed from the lines, all lines and equipment shall be immediately cleaned thoroughly.

- **Quality Control**
- Contractor shall ensure that workmanship and plant shall be maintained at peak efficiency. Degree of control on all the concrete operation from selection of the ingredients to the final testing of specimen shall be in line with the assumptions made in mix design with respect to the standard deviation and co-efficient of variation.

- The Contractor shall ensure that any compromise in quality is not done for the pumped concrete. To be pumpable, a high level of quality control for the assurance of uniformity must be maintained. Sampling at both the truck discharges and point of final placement shall be done by the Contractor and the Engineer jointly, as frequently as the Engineer desires to determine, if any change in the slump air content, and other significant mix characteristics occur take necessary corrective actions.

- The Contractor shall engage experienced supervision at all levels. The placing crew shall be experienced and qualified and each operation shall be well planned and properly scheduled.

- All the crew engaged in each of the concrete activities shall demonstrate in the presence of the Engineer, their skills and capabilities to produce the final product as specified.

- **Placing temperature of concrete**
- Placing temperature of concrete should be maintained as specified in Bill of Quantities or as directed by ENGINEER, to avoid shrinkage cracking Mixing water shall be kept cool by storing it under cover. Chilled water or crushed ice as part of the mixing water to achieve the specified placing temperature shall be used. For chilled water, it is recommended that the contractor install and maintain refrigeration facility of required capacity. The contractor shall also build and maintain well insulated adequate capacity storage tank for cold water with insulated connected piping. To supplement this refrigeration facility, the contractor will have to have ice plant or use commercial ice subject to approval of the ENGINEER. The full quantity of crushed ice shall be stored in cold storage 24 hours in advance of the start of concreting. The temperature in cold storage shall not be more than –20ºc. The contractor should study the placing temperature condition and work out plant capacity commensurate

with the construction schedule requirements and submit his scheme along with the tender.

- Ice when used as replacement for a portion or all the mixing water shall be produced from water which meets the requirements of relevant clause. Ice when used shall be in flakes of size 3mm or below or crushed condition and the crushed ice shall be such as to pass completely, 10mm sieve.

18 MORTARS

18.1 Mortars shall be prepared by mixing fine graded aggregate with cement, in the proportion specified for respective items of work as detailed in the BOQ. Mixing of mortars shall be done by mechanical mixers only. Hand mixing may be permitted in specified cases on the written permission of the EIC.

18.2 Mortars shall be specified by proportion only and not by strength, volumetric mixing shall be based on dry volumes of each ingredient. For convenience, measurement shall correspond to volume of one cement bag i.e. 0.035 cu. m. Boxes shall be of size of 40 x 35 x 25 cm. These shall be marked as mortar mixing boxes by red paint and shall be used throughout the contract. Hand mixing or mechanical mixing proportions shall be done with the use of these boxes.

19 RATE

The unit rate for concrete shall include the cost of all materials, labour, tools and plant required for mixing, placing in position, vibrating and compacting, finishing as per directions of the Engineer-in-Charge, curing and all other incidental expenses for producing concrete of specified strength to complete the structure or its components as shown on the drawings and according to these specifications. The rate shall also include the cost of making, fixing and removing of all centres and forms required for the work unless otherwise specified in the contract.

All expenses likely to be incurred by the contractor in transporting materials supplied to him to the site of works, the expenses incurred in improving the quality of materials to acceptable levels (such as screening, washing, etc.) and expenses incurred in proper storage of materials as directed by the Engineer-in-charge etc. are to be including in the unit rate.

20 STEEL REINFORCEMENT

20.1 **<u>Bending of Reinforcement</u>**

Reinforcing steel shall conform accurately to the dimensions shown on relevant drawings and conforming to IS: 2502

The contractor shall make bar bending schedules, based on the drawings furnished to him and submit the same for the Engineer's approval at no extra cost.

Approval by the Engineer does not relieve the contractor of his responsibility to ensure correctness in respect of details / placing.

Bars shall be bent cold to the specified shape and dimensions or as directed by the Engineer-in-Charge using a proper bar bender, operated by hand or power to attain proper radii of bends.

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

Bars bent during transport or handling shall be straightened before being used on work; they shall not be heated to facilitate bending.

Unless otherwise specified, a U type hook at the end of each bar shall invariably be provided. The radius of the bend shall not be less than twice the diameter of the round bar for mild steel plain bars and not less than four times the diameter for high strength deformed bars. In case of bars with diameters greater than 25mm, the minimum radius should be three times the diameter for mild steel bars and six times the diameter for high strength deformed bars the length of the straight part of the bar beyond the end of the curve shall be at least four times the diameter of the bar. In the case of bars, which are not round, and in the case of deformed bars, the diameter shall be taken as the diameter of a circle having an equivalent effective area. The hook shall be suitably encased to prevent any splitting of the concrete.

20.2 <u>Placing of Reinforcement</u>

All reinforcing bars shall be accurately placed in the exact position shown on the drawings, and shall be securely held in position during placing of concrete by annealed binding wire not less than 1 mm in size and conforming to IS: 280, and by using stays, blocks or metal chairs, spacers, metal hangers, supporting wires or other approved devices at sufficiently close intervals. Bars will not be allowed to sag between supports nor displaced during concreting or any other operation over the work. All devices used for positioning shall be of non-corrodible material. Wooden and metal supports will not extend to the surface of concrete, except where shown on the drawings. Placing bars on layers of freshly laid concrete as the work progresses for adjusting bar spacing will not be allowed. Pieces of broken stone, brick or wooden blocks shall not be used. Layers of bars shall be separated by spacer bars, pre-cast mortar blocks or other approved devices.

Reinforcement after being placed in position shall be maintained in a clear condition until completely imbedded in concrete. Special care shall be exercised to prevent any displacement of reinforcement in concrete already placed.

To protect reinforcement from corrosion, concrete cover shall be provided as indicated on the drawings. All bars protruding from concrete to which other bars are to be spliced and which are likely to be exposed for an indefinite period shall be protected by a thick coat of neat cement grout.

In the case of columns and walls, vertical bars shall be kept in normal position with timber templates having slots accurately cut in for bar position. Such

templates shall be removed after the concreting has progressed up to a level just below them. Bars crossing each other, where required, shall be secured by annealed binding wire of size not less than 1 mm and conforming to IS : 280 in such a manner that they do not slip over each other at the time of fixing and concreting

As far as possible, bars of full length shall be used. In case this is not possible, overlapping of bars shall be done as directed by the Engineer-in-Charge. When practicable, overlapping bars shall not touch each other, but be kept apart by 25 mm or 1.25 times the maximum size of the coarse aggregate in the concrete between them, whichever is greater. Where this is not feasible, overlapping bars shall be bound with annealed steel wire, not less than 1 mm thickness twisted tight. The overlaps shall be staggered for different bars and located at points along the span where neither shear nor bending moment is maximum.

Bars of less than 3.0 M length shall not be used as main reinforcement.

20.3 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 percent of the maximum permissible stresses and the welded joints should be staggered such that at any one section, not more than 33 percent of the 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 in 2 or 3 stages, the previous surfaces shall be cleaned properly. Ends of the 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 M. S. 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 the frequency of tests shall be as directed by the Engineer-in-Charge.

20.4 M.S. STEEL

Rolled mild steel and medium tensile steel plain round bars used in concrete shall conform to IS 432 Part I. Steel received shall conform to the following IS with regards to manufacturing and chemical composition.

1. M.S. bar Grade I Steel designation Fe 410-S of IS 226
2. M. S. Bar Grade II Steel designation Fe 410-O of IS 1977
3. Medium Tensile Steel designation Fe 540 W-HT IS 961 Steel bars

National sizes and tolerances shall be as specified in IS 432 Part I. Physical requirements shall be determined in accordance with IS 1608, read in conjunction with IS 226. For ready reference of minimum requirements, properties are tabulated in table 11 of the Annexure.

20.5 TOR STEEL

High strength deformed bars for use as reinforced in concrete shall be of grade Fe 500 conforming to IS 1786.

Chemical composition shall conform to IS 1786 when made as a relevant part of IS 228. Permissible limits shall be as shown in table 12 of the Annexure.

Nominal sizes, cross sectional areas and their mass shall be as specified in IS 1786, allowing due consideration for tolerance specified therein.

Material received at site shall have ISI certification mark. Each bundle or coil containing the bars shall be suitably marked with ISI certification mark. Also bars shall be marked to identify categories. This shall be done as per IS 1387.

In case bars are without ISI certification mark, the manufacturer shall give a certificate stating process of manufacturer, chemical composition and mechanical properties. Each certificate shall indicate the number or identification mark of the batch production / cast to which it applied. Corresponding number or identification mark should be found on the material.

Each batch brought at site shall be tested prior to use for respective specification / Physical properties. Cost of all such tests shall be borne by the contractor. Material acceptable as per IS shall be allowed into the works. The contractor shall remove all rejected material from site within 3 days of rejection. If the same is not done, the EIC shall impose a penalty of Rest. 500/- per metric ton per day. This will be without any appeal and shall not be subjected to arbitration.

Reinforcement bars received at site shall be stored on hard concrete platform and clear of the ground with the use of timber sleeper, concrete sleeper or any other means. Reinforcement material shall be kept covered by tarpaulins or plastic to avoid corrosion and other contamination. It is advised to follow storage methods as described in IS 4082.

20.6 COVER BLOCKS

Cover blocks shall be of non-corrosive material such as plastic but not wooden or broken bricks or stone. Especially PVC made cover spacers shall be used in the Works. Concrete cover spaces may me permitted by the EIC. Such concrete spaces shall be cast from concrete and not cement mortar. Strength of these blocks shall be equal to the strength of concrete in use. These should be fully cured prior to use in works.

20.7 BINDING WIRE

Binding wire shall be 16 or 18 gauge galvanized wire conforming to IS 280. Binding shall be done with double wire. It shall be free from rust, oil, paint, grease, loose mill scale or any other deleterious material undesirable for the reinforcement and concrete or which may prevent adhesion of concrete with reinforcement.

20.8 Deformed bars for concrete reinforcement and rolled mild steel and medium tensile steel conforming to IS 1139 shall be allowed in construction provided they are approved by the EIC.

20.9 Unit weight of reinforcement payable per meter shall be as follows:

1)	6 mm	0.22 Kg/m
2)	8mm	0.40 Kg/m
3)	10mm	0.62 Kg/m
4)	12mm	0.89Kg/m
5)	16mm	1.58 Kg/m
6)	18mm	2.00 Kg/m
7)	20mm	2.47 Kg/m
8)	22mm	2.98 Kg/m
9)	25mm	3.85 Kg/m
10)	28mm	4.83 Kg/m
11)	32mm	6.31 Kg/m
12)	40mm	9.85 Kg/m

20.10 <u>LAPPING OF BAR</u>

Laps shall be strictly as per the drawing or as directed by the EIC. For general guidance, the following principles shall be followed as given in IS 456.

a) Splices shall be provided as far as possible away from sections of maximum stress and be staggered.

b) Not more than half of the total bars shall be spliced at a section.

c) Where more than one half of the bars are spliced at a section or where splices are made at points of maximum stress, special precautions shall be taken, such as increasing the length of lap and / or using spirals or closely spaced stirrups around the length of the splice.

d) Lap splices shall not be used for bars larger than 36 mm diameter, for larger diameters, bars may be welded. In cases where welding is not practical, lapping of bars larger than 36 mm diameter may be permitted and additional spirals should be provided around the lapped bars.

e) Lap length including anchorage value of hooks in flexural tension shall be Ld (as defined in 25.2.1 of IS 456) or 30 dia whichever is greater and for direct tension 2

Ld or 30 dia whichever is greater. The straight length of lap shall not be less than 15 dia or 20 cm. Where Ld is the development as described in 25.2.1 of IS 456.

f) When splicing of welded wire fabric is to be carried out, lap splices or wires shall be made so that the overlap measured between the extreme cross wires shall be not less than the spacing of cross wires plus 10 cm.

g) The lap length in compression shall be equal to the development length in compression, calculated as described in 25.2.1 of IS 456 or as specified in drawing but not less than 24 dia.

20.11 SPACING OF BARS

Bars shall be placed in position as shown in the drawing. Following guidelines as given in IS 456 shall be followed in case of difficulties or shall be carried out as directed by the EIC.

a) Horizontal distance between two parallel main reinforcing bars shall usually not be less than the greatest of the following.
   1) The diameter of the bars, if the diameters are equal.
   2) The diameter or larger bar, if the diameters are unequal, and
   3) 5 mm more than the nominal maximum size of coarse aggregate (by using reduced size of aggregate in congested reinforced area, conditions given hereof should be overcome)

b) Greater horizontal distance should be provided. But when needle vibrators are used, distance between bars of a group may be reduced to two-third of the nominal maximum size of the coarse aggregate, provided sufficient space is left between groups of bars to enable the vibrator to be immersed.

c) Where there are two or more rows, the bars shall be vertically in line and the minimum vertical distance between the bars shall be 15 mm two third the nominal maximum size of the aggregate or the maximum size of bar, whichever is more.

20.12 COVER TO REINFORCEMENT

Reinforcement shall have concrete cover and the thickness of such cover (exclusive of plaster or other decorative finish) shall be as specified in drawing or as directed by the EIC. The following guidelines are to be observed in the absence of the above.

i. At each end of the reinforcing bar, not less than 25 mm, nor less than twice the diameter of such bar.

ii. For a longitudinal bar in a column, not less than 40 mm, nor less than the diameter of such bar. In case of columns of minimum dimension of 200mm or under, whose reinforcing bars do not exceed 12 mm, a cover of 25 mm.

iii. For longitudinal reinforcing bar in beam, not less than 25 mm, nor less than the diameter of such bar.

iv. For tensile, compressive, shear or other reinforcement, in slab not less than 15 mm, nor less than the diameter of such bar and

v. For any other reinforcement, not less than 15 mm, nor less than the diameter of such bar.

vi. Increased thickness shall be provided in case the concrete members are in the surrounding of harmful chemicals; saline atmosphere etc. and the cover shall be 50 mm or more as directed by the EIC.

vii. For concrete members totally immersed in seawater, the cover shall be 40 mm more than specified above (a) to (f).
This shall be 50 mm more for periodical immersion in seawater.

viii. Concrete cover should not exceed 75 mm in any case. Cover to reinforcement shall be as specified in the drawing or as directed by the EIC.

Details given in sub Para (a) to (h) are for guidance and shall be followed in absence of any specific direction.

20.13 <u>OPENING / INSERTS</u>

All required openings and pockets should be provided as detailed in the drawing. They may be enumerated or paid on area basis as detailed in the BOQ. The contractor shall provide for the required materials, labour, for fixing and supporting during concreting. In his quoted price. It is imperative that all openings and pockets shall be de-shuttered with care and all corners of openings shall be preserved. All openings/pocked shall be in a correct line and level. After concreting, the openings shall be secured against any accident by proper covering and guardrail and warning notice, if any.

The contractor shall clean and grout the pocket at a later date with a non-shrinking compound added to the grout mix or non-shrinking cement shall be used. It shall be well cured and protected to correct line and level till handling over.
Inserts are material such as timber, steel, plastic, and dowels. Bolts, locks, brackets, pipes, etc. left in concrete partly or fully embedded to receive connection with foreign member at a later date. These may be fabricated by the contractor or provided by the owner as received from specialist, manufacturer, etc. These shall be protected from weathering and damage in course of the construction. The cleaning required after concreting and any treatment such as oiling, greasing or covering with paint etc. shall be carried out by the contractor at his cost.

It is very important that the providing and fixing as contemplated in the BOQ shall be carried out with the “utmost precision” and to the entire satisfaction of the EIC. The

contractor at his own cost and responsibility shall rectify any deviation from that as shown in the drawings or instructions.

20.14 Measurement

Reinforcement shall be measured in length, separately for different diameters, as actually used in the work including authorised overlaps, chairs/separators specified in the drawings and due to limitations of available bar length. From the length so measured the weight of reinforcement shall be calculated in tones on the basis of standard weights specified in IS: 1732. Lengths shall also include hooks at ends. Wastage, avoidable overlaps, coupling, welded joints and annealed steel wire for binding and cover blocks shall not be measured and cost of these items shall be deemed to be included in the rates for reinforcement.

Price build-up shall include, in addition to cost of material.

a) Cover blocks of PVC or concrete.
b) Spacer bars, chairs and unauthorized overlaps (Allowed for convenience).They will not be paid; however, they are to be measured separately
c) Cutting, bending, placing and fixing in position.
d) Binding wire as approved.
e) Wastage / Rolling margin.
f) Cleaning of bars.

For purpose of reconciliation, maximum wastage permitted shall be 5% of the actual material used. Balance shall be charged at 1.5 times the actual market rates as penalty.

20.15 Rate

Rate for reinforcement shall include cost of all steel, its bending, binding and fixing in position as shown on the drawings and as directed by the Engineer-in-charge. It shall also include cost of all devices for keeping reinforcement in approved position, cost of jointing as per approved method, and all wastage, overlaps and spacer bars etc.

21 Form Work, False work and Scaffolding, Form, Centring and Temporary Works

All Centring, formwork and temporary works shall be constructed according to drawings and specifications prepared by the Contractor and approved by the Engineer-in-charge. The design criteria and loading for these works shall be as per American Concrete Institutes' relevant specifications.

As soon as practicable after the acceptance of his tender the contractor shall submit a scheme showing the order of the procedure and methods by which he proposes to carry out the work together with such details as are necessary to demonstrate the adequacy, stability and safety of the methods which the contractor proposes to adopt. The approval to this general scheme of Centring as well as design criteria and loading shall be obtained in good time to facilitate all preparatory work. Any delay on this account shall be the responsibility of the contractor.

After approval of the general scheme the contractor will prepare detailed designs and drawings for execution of the work, Centring and temporary works. These shall also be

forwarded for approval. No work shall be carried out without prior approval of the Engineer-in-Charge.

Notwithstanding the approval given to design criteria and loading and the general scheme for the Centring, the entire responsibility for the satisfactory execution of the Centring and all temporary works shall rest with the contractor and he shall be liable to pay all claims and compensations arising from any loss or damage to life and property due to any deficiency, failure or malfunctioning of the centring or any of the temporary works.

21.1 Re-use Of Forms, etc.

Forms required to be used more than once shall be maintained in serviceable condition and shall be thoroughly cleaned and repaired before reuse. Where Metal sheets are used for lining forms the sheets shall be placed and maintained in the forms with minimum amount of wrinkles, lumps or other imperfections. All forms shall be checked for shape and strength before reuse. Steel forms shall be cleaned by buffing before reuse.

21.2 Execution and Removal of Forms

i. Before placing concrete the surface of all forms shall be coated with suitable non-staining form releasing agents such as raw linseed oil so as to prevent adhesion of concrete and to facilitate removal of forms.

ii. The form releasing agent shall cover the forms fully and evenly without excess over drip. Care shall be taken to prevent form releasing agents from getting on the surface of the construction joints and on reinforcement bars. Special care shall be taken to thoroughly cover form strips for narrow grooves, so as to prevent swelling of the forms and the consequent damage to concrete prior to or during removal of forms.

iii. Immediately before concrete is placed care shall be taken to see that all forms are in proper alignment and the supports and fixtures are properly secured and tightened.

iv. Where forms for continuous surfaces are placed in successive units, the forms shall lap and fit tightly over the completed surface so as to prevent leakage of cement slurry from the fresh concrete and to maintain accurate alignment of the surface.

v. Forms shall be left in place until their removal is authorised and shall then be removed with care so as to avoid injury to concrete.

vi. Removal of forms shall never be started until the concrete is thoroughly set and adequately hardened such that it can carry its own weight, besides the live load which is likely to come on the work during construction. The length of time for which the forms shall remain in place shall be decided by the Engineer-in-Charge, with reference to weather conditions, shape and position of the structure or structural member and nature and amount of dead and live loads.

In normal circumstances and where ordinary Portland cement is used, forms can be allowed to be struck as under:

a) Beam sides, walls, unloaded columns - after 24 hours
b) Slabs and arches (props left under) - after 4 days
c) Props to slabs and arches - after 10 days
d) Beam soffit (props left under) - after 8 days
e) Props to beams - after 21 days
f) Lean concrete (sides) - after 2

Note: Time shall be measured from last batch concreted in respect to the structural member under consideration.

In no case shall forms be removed until there is an assurance that removal can be accomplished without damaging the concrete surface. Heavy loads shall not be permitted until after the concrete has reached its design strength. The forms shall be removed with great caution and without jerking the structure.

21.3 Settlement of Formwork and Camber

Due to various reasons such as closure of form joints, shrinkage of timber, dead load deflections, elastic shortening of form members or formwork, deflections, settlement may occur. The contractor shall take precautions, including using adequately rigid formwork, in order to prevent excessive settlement/deflection; the usual acceptable limit being 1/500 of the spans of the formwork.

In the absence of any specified camber on the drawings, soffit of all beams more than 5 m. in span and other than pre-stressed concrete beams shall be laid to a camber, the amount of which at mid span shall not be less than 1/500 of the span of the structure. The profile of soffit shall be parabolic.

21.4 Mock-ups

The method for pouring difficult zones of concrete will be pre-studied on mock-ups. Mock-ups will be particularly necessary for the following:

i) Zones around penetrations and openings.
ii) Behind anchorage of pre-stressed members.
iii) Dome and shell in general requiring single and double forms.
iv) Various zones of large thickness for studying placement temperatures in relation to internal temperature build-ups.

Work involved in mock-up pours will be paid for at the rates entered under relevant items of work. Sampling and testing of all samples will be done by the Contractor. Unsuccessful mock-ups may have to be repeated in full or in part as required by the Engineer.

21.5 TOLERANCE

All works will be carried out true to the lines, levels and grades shown on the drawings and within the tolerances specified below. The contractor shall establish, erect and maintain in an undisturbed condition until final completion and acceptance of

the project control, points and benchmarks necessary and adequate to establish these tolerances.

For all elements, departure from

Established alignment	: 30 mm
Departure from established grades	: 10 mm
Variation from plumb or specified batter in lines and surfaces of piers, wall and abutments	12 mm in 3 m exposed 25 m in 3 m. if backfilled
Variation from level or indicated grade in slabs, beams, horizontal and railing offsets	12 mm in 3 m exposed 25 m in 3 m. if backfilled
Variation in cross sectional dimensions of columns, piers, slabs, walls, beams and similar parts	-6 mm, +12 mm
Variation in slab thickness:	-3 mm, +6 mm
Footing: Plan dimension:	-15 mm, +30 mm
Misplacement or eccentricity:	2% of footing width in the direction of misplacement and not exceeding 30mm.
Reduction in thickness:	5% of specified thickness
Variations in size and locations of slab or wall openings	12 mm

Pre-stressed concrete cables - will be laid such that their profile is a smooth curve unless otherwise specified.

The alignment tolerances shall be as under:

Member with a depth of up to	Tolerance in direction of depth'd' of members.
Up to 200 mm	±d/40
200 - 1000 mm	± 5 mm
More than 1000 mm	± 10 mm
Tolerance in direction of width of Member @ the level of tendon.	
Up to 200 mm wide	±5 mm
200 - 1000 mm wide	±10 mm
Slabs and beams of more than 1000 mm wide	±20 mm

Tendon extensions will be measured up to 1 mm accuracy. The total pre-Stressing force applied to a beam shall not vary more than ± 3% from the design force specified and ensured in terms of the total elongation of all the tendons in that member.

In the case of slabs this variation shall be measured and restricted over a range of 5 consecutive tendons.

22 <u>VACUUM DEWATERING</u>

The RCC/PCC in slabs and floors should be vacuum dewatered using vacuum dewatering system consisting of vibrating screed, filter pads, suction mat, skim floater cum traveller with necessary safety mechanism etc. as per manufacturer's specification.

The specification of work should conform to those specified by the manufacturer (Tremix or equivalent), as to achieve the desired results but in no case shall be lesser than as mentioned hereunder. 1. General the Contractor shall submit the plan of work going to be followed by him, well in advances (at least a week). A sketch shall be accompanied giving details of the construction joint locations, sequence of floor casting, etc. The work shall be planned and executed so that there is no delay between the placement, screeding, de-watering and floating of concrete.

Concrete in Floor The surface where the concrete is going to be laid for the floor shall be thoroughly cleaned of all dust, loose particles etc. It shall then be wetted to have just a moist surface and sprinkled with cement slurry. Then two sidetrack rails on which levelling beam and a surface vibrator be mounted, shall be erected to proper/desired levels and gradient as to have the specified thickness of concrete and the required slope in the floor. A stop end then is placed at the starting end. Both track rails and stop ends should be preferably of mild steel. The concreting then is started with desired/specified grade of concrete. However it is advisable to use M20 grade concrete minimum for better final results using 350 kg of cement per cum. Of concrete and maintaining water cement ratio of 0.53 to 0.54 (unless otherwise specified). The placing of machine mixed concrete begins from starting end and is continued in horizontal manner. Poker vibrators will be used to vibrate the laid concrete thoroughly with minimum 40 mm dia. Needless. On completion of laying of approximate 5/6 Sqm area the surface vibrator then be run over the concrete. Surface to achieve better overall compaction of concrete. This process is continued and the surface vibrator be run the second time along with levelling beam on the finished concrete surface. Then the vacuum mat be placed on this levelled concrete and the excess water from the concrete is sucked off. It should be done in accordance with the manufacturer’s recommendation, paying special attention over the edges. A time of approximate 1.5 to 2.0 minutes per centimeter thickness of concrete slab is normally adopted for Vacuum treatment. As a result of which the water cement ratio shall be reduced to in the order of 0.42 to 0.43, thereby reducing the total water content in the concrete by 15 to 25% care should be taken at this stage to avoid curling at the ends due to excess use of vacuum mats. Immediately thereafter normal floating operation should begin or if special topping is specified then the same is worked into the concrete surface with the float disc. The floater suggested here is power operated skim floater. The floating is continued till desired finish is obtained. The curing of the surface shall be done by pounding method for at least 7 clear days prior to putting the surface to use.

Reinforcement 8 TOR at spacing of 250mm C/c, both ways shall be placed in concrete, unless otherwise specified, 50mm below the top surface of concrete. This mesh shall be for individual panels formed by side construction joint and expansion joint. Tie bars, 400 mm long, shall be provided at construction joints using 10 TOR @ 250 c/c. Dowel bars, 400 mm long, and shall be provided at expansion joints using 16 or 20 dia. MS bars @ 300 c/c. 3. Joints in Floor a) The contraction (dummy) joints in concrete shall be spaced at approximately 40 Sqm area and / or as per item and shall be made by sawing the already laid and finally cured concrete to obtain 4mm x 35mm deep joints. These joints shall be cleaned of all dust and be filled in with clean dry sand up to full depth. The top 10mm deep layer of sand then be removed by appropriate tools/templates and the same shall be sealed properly by Polysulphide joint sealant 4mm x 10 mm deep.

The Expansion joints shall be spaced at approximately 120 sqm. Area and/or as specified and shall constitute formation of 12/20/25 mm clear joint between the two concretes. This joint is formed by placing the Shalitex board in position against the old concrete leaving 12/20/25mm x 10mm deep joint at top, which shall be filled in by Polysulphide joint sealant. The 16/20mm dia. MS dowel bars shall be so placed that the half length of bar be bonded in to concrete on one side of the joint and the other half shall be prevented from bonding with concrete. In addition, a recess at its slip end shall be provided to accommodate the movement of the slab during expansion of the concrete. The un-bonded portion of the dowel bar shall be covered with an expansion cap using 25mm dia. PVC pipe, 225mm long (unless otherwise specified). c). The side construction joints shall be buttered against each other and later on a joint groove shall be cut as specified in ‘a)’ above.

23 <u>Testing of Underground Water Tank / Septic Tank / Underground structures:</u>

The tank will be tested after the completion according to the procedure laid down here:

The middle compartment shall be filled first to its full height and the leakage if any shall be checked on its outer surfaces if found, the same shall be examined carefully and defects rectified / grouted if necessary. The drop in level exceeds 20mm and shows any leakage in the said walls, necessary steps shall be taken in consultation with the Engineer-in-charge.

After this compartment is tested to the satisfaction of the Engineer-in-charge, all water from middle compartment shall be stepped into side compartment to the full height and checked for water leakages from the outer surfaces of the tank as inner surface of the middle compartment. The drop in level of surface of water shall also be checked as stated and defects rectified.

The external surface of the tank shall the be plastered and cured as per the specifications and back filling shall be taken up thereafter. The water from the compartments shall then be pumped out and the inner surface of the tank in all compartments then be checked and defects rectified.

After satisfactory completion of checks, internal plaster shall be taken up as specified in the specifications.

The contractor shall be responsible for carrying out the complete test, rectifying the leakages if any. The cost of providing equipments, labour for carrying out tests shall be borne by the contractor. The rates quoted for concreting items for constructing underground water tank shall be inclusive of testing of RCC tank for water tightness as per above specifications. Contractor shall make his own arrangement for filling the tank. The contractor shall make his own arrangement for water required for construction and labour etc. as per contract conditions at his own cost.

TABLE – 1 LIMIT OF DELETERIOUS MATERIALS (AGGREGATES)

[IS 383 – Table 1]

SR. NO.	DELETERIOUS SUBSTANCE	METHOD OF TEST	FINE AGGREGATE PERCENTAGE BY		COARSE AGGREGATE PERCENTAGE BY	
(1)	(2)	(3)	(4) Weight, Max Uncrushed	(5) Weight, Max Crushed	(6) Uncrushed	(7) Crushed
i)	Coal and lignite	IS : 2386 (Part – II)	1.00	1.00	1.00	1.00
ii)	Clay Lumps	IS : 2386 (Part – II)	1.00	1.00	1.00	1.00
iii)	Material finer than 75 – (MU) IS Sieve	IS : 2386 (Part – I)	3.00	15.00	3.00	3.00
iv)	Soft fragments	IS : 2386 (Part – II)	--	--	3.00	--
v	Shale	IS : 2386 (Part – II)	1.00	--	--	--
vi)	Total of percentage of all deleterious materials (except mica) including Sl. No. (i) to (v) for Col. 4, 6 and 7 and Sl. No. (i) and (ii) for Col. 5 only	---	5.00	2.00	5.00	5.00

Note :-1 The Presence of mica in the fine aggregate has been found to reduce considerably the durability and compressive strength of concrete and further investigations are underway to determine and extent of the deleterious effect of mica. It is advisable, therefore, to investigate the mica content of fine

aggregate and make suitable allowance for the possible reduction in the strength of concrete mortar.

Note:-2 The aggregate shall not contain harmful organic impurities (tested in accordance with IS: 2386 [part – ii]) in sufficient quantities to affect adversely the strength or durability of concrete. A fine aggregate which fails in the test for organic impurities may be used, provided that, when tested for the effect of organic impurities on the strength of mortar, the relative strength at 7 and 28 days, reported in accordance with 7 of IS : 2386 [Part – VI] – 1963 is not less than 95%.

IS Sieve Designation	**Percentage passing for single – sized Aggregate of Nominal Size**						**Percentage passing for Graded Aggregate of Nominal Size**			
	63 mm	40 mm	20 mm	16 mm	12.5 mm	10 mm	40 mm	20 mm	16 mm	12.5 mm
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
80 mm	100	--	--	--	--	--	100	--	--	--
63 mm	85 to 100	100	--	--	--	--	--	--	--	--
40 mm	0 to 30	85 to 100	100	--	--	--	95 to 100	100	--	--
20 mm	0 to 5	0 to 20	85 to 100	100	--	--	30 to 70	95 to 100	100	100
16 mm	--	--	--	85 to 100	100	--	--	--	90 to 100	--
12.5 mm	--	--	--	--	85 to 100	100	--	--	--	90 to 100
10 mm	0 to 5	0 to 5	0 to 20	0 to 30	0 to 45	85 to 100	10 to 35	25 to 55	30 to 70	40 to 85
4.75 mm	--	--	0 to 5	0 to 5	0 to 10	0 to 20	0 to 5	0 to 10	0 to 10	0 to 10
2.36 mm	--	--	--	--	--	0 to 5	--	--	--	--

TABLE – 3 ALL-IN-AGGREGATE GRADING

[IS 383 – Table 5]

IS Sieve Designation	Percentage for ALL IN Aggregate of	
	40 mm Nominal size	20 mm Nominal size
1	2	3
80 mm	100	--
40 mm	95 to 100	100
20 mm	45 to 75	95 to 100
4.75 mm	25 to 45	30 to 50
600 micron	8 to 30	10 to 35
150 micron	0 to 6	0 to 6

TABLE – 4 GRADING OF FINE AGGREGATES
[IS 383 – Table 4]

IS Sieve Designation	Percentage Passing for			
	Grading Zone I	Grading Zone II	Grading Zone III	Grading Zone IV
10 mm	100	100	100	100
4.75 mm	90 to 100	90 to 100	90 to 100	95 to 100
2.36 mm	90 to 100	75 to 100	85 to 100	95 to 100
1.18 mm	30 to 70	55 to 90	75 to 100	90 to 100
600 micron	15 to 34	35 to 59	60 to 79	80 to 100
300 micron	5 to 20	8 to 30	12 to 40	15 to 50
150 micron	0 to 10	0 to 10	0 to 10	0 to 15

NOTE – 1 For crushed stone sands, the permissible Limit on 150 micron IS Sieve is increased to 20 percent. This does not affect the 5 percent allowance permitted in 4.5 applying to other sieve sizes.

NOTE – 2 Fine Aggregate complying with the requirements of any grading zone in this table is suitable for concrete but the quality of concrete produced will depend upon a number of factors including proportions.

NOTE – 3 Where concrete of high strength and good durability is required, fine aggregate conforming to any one of the four grading zones may be used, but the concrete mix should be properly designed. As the fine aggregate grading becomes progressively finer, the is, from Grading Zones I to IV, the ratio of fine aggregate to coarse aggregate should be progressively reduced. The most suitable fine to coarse ratio to be used for any particular mix will, however, depend upon the actual grading, particle shape and surface texture of both fine and coarse aggregates.

NOTE – 4 It is recommended that fine aggregate conforming to Grading Zone IV should not be used in reinforced concrete unless tests have been made to ascertain the suitability of proposed mix proportions.

TABLE – 5 MOISTURE CONTENT & BULKING PERCENTAGE RELATION FOR SAND

Moisture - Content % by weight	Bulking & (Volume)
2	15
3	20
4	25
5	30

TABLE – 6 PERMISSIBLE LIMITS FOR SOLIDS (in water)

	Permissible Limit, Maximum
Organic	200 mg/L
Inorganic	3000 mg/L
Sulphates (as SO4)	500 mg/L
Chlorides (as C1)	2000 mg/l for plain concrete work and 1000 mg/l for reinforced concrete work
Suspended matter	2000 mg/L

TABLE – 7 GRADE OF CONCRETE
[IS 456 – TABLE 2]

GRADE DESIGNATION	SPECIFIED CHARACTERISTIC COMPRESSIVE STRENGTH AT 28 DAYS
(1)	(2) [N/ Sq mm]
M10	10
M15	15
M20	20
M25	25
M30	30
M35	35
M40	40
M45	45
M50	50

NOTE – 1 In the designation of a concrete of mix, letter M refers to the mix and the number to the specified characteristic compressive strength of 15 cm cube at 28 days, expressed in N/Sq mm.

NOTE – 2 M 5 and M 7.5 grade of concrete may be used for lean concrete bases and simple foundations for masonry walls. These mixes need not be designed.

NOTE – 3 Grades of concrete lower than M 15 shall not be used in reinforced concrete.

TABLE – 8 MINIMUM CEMENT CONTENT REQUIRED IN CEMENT CONCRETE TO ENSURE DURABILITY UNDER SPECIFIED CONDITIONS OF EXPOSURE
[SP – 23 – Table 23 & IS 456 – Table 19]

EXPOSURE	PLAIN CONCRETE		REINFORCEMENT	
	MINIMUM CEMENT CONTENT	MAXIMUM WATER CEMENT RATIO	MINIMUM CEMENT CONTENT	MAXIMUM WATER CEMENT RATIO
1	2 Kg/m3	3	4 Kg/m3	5
Mild – for example, completely protected against weather, or aggressive conditions, except for a brief period of exposure to normal weather conditions during construction.	220	0.7	250	0.65
Moderate – for example, sheltered from heavy and wind driven rain and against freezing, whilst saturated with water; buried concrete in soil and concrete continuously under water.	250	0.6	290	0.55
Severe – For example, exposed to sea water, alternate wetting and drying and to freezing whilst wet, subject to heavy condensation or corrosive fumes.	310	0.5	360	0.45

NOTE – 1 When the maximum water cement ratio can be strictly controlled, the cement content in the above table may be reduced by 10 percent.

NOTE – 2 The minimum cement content is based on 20 mm, aggregate. For 40 mm aggregate, it should be reduced by about 10 percent; for 12.5 mm aggregate, it should be increased by about 10 percent.

TABLE – 9 REQUIREMENTS FOR CONCRETE EXPOSED TO SULPHATE ATTACK
[SP – 23 – Table 24 & IS 456 – Table 20]

CLASS	CONCENTRATION OF SULPHATES EXPRESSED AS SO3			TYPE OF CEMENT	REQUIREMENTS FOR DENSE FULLY COMPACTED CONCRETE MADE WITH AGGREGATE COMPLYING WITH IS : 383-1970*	
	IN SOIL		IN GROUND WATER			
	TOTAL SO3 (PERCENT)	SO3 IN 2:1 WATER EXTRACT g/l	(PARTS PER 100 000)		MINIMUM CEMENT CONTENT	MAXIMUM FREE WATER / CEMENT RATIO
(1)	(2)	(3)	(4)	(5)	(6)	(7)
1	Less than 0.2	--	Less than 30	Ordinary Portland cement or Portland slag cement or Portland Pozzolana cement	280 kg/m3	0.55
2	0.2 to 0.5	--	30 to 120	Ordinary Portland cement or Portland slag cement or Portland Pozzolana cement Super sulphated cement	330 kg/m3 310 kg/m3	0.50 0.50
3	0.5 to 1.0	1.9 to 3.1	120 to 250	Super sulphated cement	330 kg/m3	0.50

TABLE – 10 COMPRESSIVE STRENGTH OF CUBE EXPECTED FOR PRELIMINARY AND WORK SITE

CONCRETE MIX	SPECIFIED STRENGTH	28TH DAY CUBES TEST		7TH DAY WORK
	Kg/Sq cm.	PRELIMINARY TEST Kg/Sq cm.	WORKSITE TEST Kg/Sq cm.	Kg/Sq cm.
M10	100	135	100	70
M15	150	200	150	100

M20	200	260	200	135
M25	250	320	250	170
M30	300	380	300	200
M40	400	510	400	265
M50	500	--	500	340

NOTE – 1 This table applies only to concrete made with 20 mm aggregate complying with the requirement of IS : 383 – 1970* placed in near-neutral ground water of pH 6 to 9, containing naturally occurring sulphates but not contaminants, such as ammonium salts. For 40 mm aggregate the value may be reduced by about 15 percent and for 12.5 mm aggregate, the value may be increased by about 15 percent. Concrete prepared from ordinary Portland cement would not be recommended in acidic conditions (pH 6 or less). Super sulphated cement gives an acceptable life, in minerals acids, down to pH 3.5, provided that the concrete is dense and prepared with water / cement ratio of 0.4 or less.

NOTE – 2 The cement contents given in class 2 are the minimum recommended. For SO3 contents near the upper limits of class 2, cement contents above these minimum are advised.

NOTE – 3 Where the total SO3 in Col. 2 exceeds 0.5 percent, then a 2:1 water extract may result in a lower site classification if much of the sulphate is present as low solubility calcium sulphate.

NOTE – 4 For severe conditions such as thin sections under hydrostatic pressure on one side only and sections partly immersed, considerations should be given to a further reduction of water-cement ratio, and if necessary an increase in the cement content to ensure the degree of workability needed for full compaction and thus minimum permeability.

NOTE – 5 Portland slag cement conforming to IS: 455 with slag content more than 50 percent exhibits better sulphate resisting properties.

NOTE – 6 Ordinary Portland cement with the additional requirement that C3 A content be not more than 5 percent and 2 C3 A + C4 AF (or its solid solution 4 Cao, Al2 O3, Fe2 O3 + 2CaO, Fe2 O3) be not more than 20 percent may be used in place of super sulphated cement.

* Specification for coarse and fine aggregates from natural sources for concrete (second revision).

TABLE – 11 MECHANICAL PROPERTIES OF BARS MILD STEEL & MEDIUM TENSILE STEEL BARS [IS 432 Table – 1]

SR. NO.	TYPE AND NOMINAL SIZE OF BARS	ULTIMATE TENSILE STRESS	YIELD STRESS	ELONGATION* PERCENT
		MIN	MIN	MIN
	Mild Steel Grade I For bars up to and including 20 mm For bars over 20 mm, up to and including 50 mm	410 410	250 240	23 23
	Mild Steel Grade II For bars up to and including 20 mm For bars over 20 mm, up to and including 50 mm	370 370	225 215	23 23
	Medium Tensile Steel For bars up to and including 16 mm For bars over 16 mm, up to and including 32 mm For bars over 32 mm, up to and including 50 mm	540 540 510	350 340 330	20 20 20

- Elongation on a gauge length 5.65 √So where so is the cross sectional area of the test piece.

TABLE – 12 CHEMICAL COMPOSITIONS HIGH STRENGTH DEFORMED BARS [IS 1786]

Constituent	For ladle analysis of steel when made as per relevant parts of IS 228 Percent Maximum*			For product analysis Variation, Over Specified Maximum Limit, Percent, Max
	Fe 415	Fe 500	Fe 550	Limit % Maximum
Carbon	0.30	0.300	0.300	0.020
Sulphur	0.06	0.055	0.055	0.005
Phosphorus	0.06	0.055	0.050	0.005
Sulphur & Phosphorus	0.11	0.105	0.100	0.010

* NOTE – 1 For guaranteed weld ability, the percentage of carbon shall be restricted to 10.25 percent maximum.

* NOTE – 2 Addition of micro alloying elements is not mandatory for any of the above 2 grades. When strengthening elements like Nb, V, B and Ti are used individually or in combination, the total contents shall not exceed 0.30 percent; in such case manufacturer shall supply the purchaser or his

authorised representative a certificate stating that the total contents of the strengthening elements in the steel do not exceed the specified limit.

TABLE – 13 MECHANICAL PROPERTIES OF HIGH STRENGTH DEFORMED BARS AND WIRES [IS 1786 Table – 3]

SR. NO.	PROPERTY	GRADE		
		Fe 415	Fe 500	Fe 550
1	2	3	4	5
(i)	0.2 percent proof stress/yield stress, Min, N/Sq mm.	415.0	500.0	550.0
(ii)	Elongation, percent, Min, on gauge length 5.65 VA, where A is the cross sectional area of the test piece.	14.5	12.0	8.0
(iii)	Tensile strength, Min	10 percent more than the actual 0.2 percent proof stress but not less than 485.0 N/Sq mm.	8 percent more than the actual 0.2 percent proof stress but not less than 545.0 N/Sq mm.	5 Percent more than the actual 0.2 percent proof stress but not less than 585.0 N/Sq mm.

8 STRUCTURAL STEEL WORKS

CONTENTS

STRUCTURAL STEEL WORKS

1. SCOPE

These specifications cover the requirements of material, workmanship, and protective measures etc., of structural steel work in general. Specifications for special items of work used in structural steel construction are given separately.

2. GENERAL

The provisions of the latest Indian Standards listed below, but not restricted to, form part of these specifications:

IS 104 - Ready mixed paint, brushing, zinc chrome, priming

IS 123- Ready mixed paint, brushing, finishing, semi-gloss, for general Purposes, to Indian Standard Colours and red oxide (Colour unspecified)
No. 445 Venetian Red
No.449 light Purple brown
No.446 Red Oxide
No. 451 Chocolate
No.448 Deep Indian red
No.473 Gulf Red and Red Oxide (Colour Unspecified)

IS 226 - Structural Steel (Standard Quality)

IS 800 - Code of practice for use of structural steel in general building construction.

IS 813 - Scheme for symbols for welding.

IS 814 - Covered electrodes for metal are welding of structural steel (Part 1 and 11).

IS 815 - Classification and coding of covered electrodes for metal are welding of structural steels.

IS 816 - Code of practice for use of metal arc welding for general construction in mild steel.

IS 817 - Code of practice for training and testing of metal arc welders.

IS 822 - Code of procedures for inspection of welds.

IS 823 - Code of procedure for manual metal are welding of mild steel.

IS 961 - Structural steel (high tensile).

IS 1024 - Code of practice for use of welding in bridges.

IS 1148 - Hot rolled steel riveting bars (up to 40 mm diameters) for structural purposes.

IS 1387- General requirements for the supply of metallurgical material.

IS 1477- Part I, Code of practice for painting of ferrous metals in buildings - pre-treatment.

IS 1599 - Method for bend test for steel products other than sheets, strip, wire and tube.

IS 1 608 - Method for tensile testing of steel products.

IS 1731 - Dimensions for steel flats for structural and general engineering purposes.

IS 1852 - Rolling and cutting tolerances for hot-rolled steel products.

IS 191 5 - Code of practice for steel bridges.
IS 2074 - Ready Mixed paint, air drying red-oxidezine chrome, priming
IS 2102 - Allowable deviations for dimensions without specified tolerances.
15 3757 - High tensile friction grip bolts.
IS 4000 - Code of practice for assembly of structural joints rising high tensile friction grip fasteners.
IS 7318 - Part I Fusion welding of steel.

Other I.S. Codes and I.R.C. codes pertaining to the items of structural steel not specifically listed shall also be deemed to come under the purview of this clause.

3. MATERIALS, INSPECTION and TESTING

All supplies of structural steel and other materials specified shall be supported by manufacturers test certificates showing that the materials meet the requirements of these specifications.

The engineer-in-charge may require getting further samples tested and all the cost of taking samples and testing the same by the approved agency shall be borne by the Contractor.

4. FABRICATION

4.1. Fabrication Drawings and Approval:

The fabrication drawings shall be prepared on the basis of design drawings supplied by the designer. The fabrication drawings showing details of connection are required to be supported by the calculations showing adequacy of the connections. The fabrication drawings and calculations shall be prepared by qualified consulting engineer and fabricators. All charges required to be made by the Engineer-in-Charge shall be incorporated at no extra cost.

4.2. Workmanship:

Workmanship shall be equal to the best general practice in current fabrication practice. The methods followed in cutting, straightening, finishing and shaping, bindings of members and holing for rivets, bolts or pins etc., and any other operations shall be performed in such a way as not to adversely affect the structural members in any way. The machinery and equipment's as well as the method of working, shall be approved by the Engineer-in-charge. The fabrication work shall be carried out by the qualified operators.

4.3. WELDING:

Welding and weld procedure qualifications should be done in accordance with applicable provisions of the IS standards. All the welders should be got qualified before employing them on the job and re-qualified at frequent intervals.

5. TEMPORARY STORAGE

a) No dragging of steel shall be permitted. All steel shall be stored 30 cm above ground on suitable packing to avoid damage during the monsoons. Steel shall be stored in the order of erection with erection marks visible. Long members shall be supported on skids placed near enough together to prevent injury from deflection. Storage areas shall be prepared and maintained by the Contractor. Any steel stored near excavations shall be removed immediately to a safe distance to avoid burial under debris.

b) Adequate handling facilities shall be available at Storage place. The temporary protective paint shall not be damaged and if so damaged shall be immediately made good.

6. PAINTING

6.1. Surface Preparation

Steel surface to be painted shall be prepared in thorough manner with a view to ensuring complete removal of mill scale. Primary coat shall be applied as soon as practicable after the surface preparation is completed. All slag from welds shall be removed before painting. Care shall be taken to brush the surface clean prior to painting. Surfaces shall be maintained dry and free from dirt and oil. Working out- doors in frosty or humid weather shall be avoided. The undercoat and finishing coat shall be of the same manufacturer. Successive coats of paints shall be of different shades and colours and each shall be allowed to dry thoroughly before the next is applied. Particular care shall be taken with the priming and painting of edges corners, welds and rivets.

6.2. Priming

The rates quoted by the Contractor shall include the following:

a) Applying one coat (40 microns) of red oxide zinc chromate primer paint coating to all surfaces of steel that are scratched in transit or unloading prior to storage before erection.

b) Applying one coat (40 microns) of red oxide zinc chromate primer paint and two coats of finishing paint as specified in schedule to all surfaces which will be inaccessible after erection, except surfaces coming in contact with concrete. It should be noted that all steel work such as Trusses, Purlins etc., are considered inaccessible.

c) After steel has been erected, all burrs and abraded spots, scratched surfaces, field welds, bolt heads and nuts shall receive one coat of primer paint. Before the paint is applied the surface shall be dry and free from dust, dirt, scale and grease. No paint shall be applied to bolt or field welds until these bolts or field welds have been approved by the Engineer-in-Charge.

d) All steel material except surfaces coming in contact with concrete shall receive one coat of primer paint after erection after having been thoroughly cleansed of dust and foreign matter. No paint shall be applied when humidity is such as to cause condensation on the surfaces to be painted. Paint shall be stirred frequently to keep the pigment in suspension.

6.3. Final Paint:

The final painting of structural steel shall be as specified by the Engineer-In-Charge or as specified in schedule

After materials have been accepted by the Contractor as being improper condition for erection, he shall be responsible for their safety and protection from loss or damage of any nature until the completion of work. The contractor shall be similarly responsible for surplus materials until they are returned and accepted by the Engineer-in-Charge.

7. ERECTION:

7.1. Preliminaries:

a) The Contractor shall complete all preliminary works at site, well before the arrival of structural steel, such as keeping in readiness electrical winches, mobile cranes, gin poles, compressors, all tools and tackles, rivet guns, welding sets, torque wrenches etc. and work that may be necessary so as to start erection immediately after the arrival of steel at site.

b) The contractor shall furnish at his own expenses, the necessary non-inflammable staging and hoisting or equipment's required for the erection work and shall remove and take them away after the completion of the job. The contractor shall also provide necessary passage ways, fences, safety belts, helmets, lights and other fittings to the satisfaction of the Engineer-in-Charge and for protection of his men and materials.

7.2. Approval of Erection Scheme:

All structures shall be erected as shown on drawings. The contractor shall carry out all erection work in the sequence required by the Engineer-in-Charge. The method of erection and complete erection scheme shall be subject to the approval of the Engineer-in-Charge and shall be modified as required by the Engineer-in-Charge. This, however, will not relieve the Contractor of the responsibility for safe and expeditious completion of the work, its quality and accuracy.

7.3. Workmanship:

a) Unless specified herein, all erection work will be carried out in accordance with the latest edition of Indian Standard code of practice for use of structural steel in General Building Construction IS 800 and AISC code wherever applicable.

b) Drifts should be used only for drawing the work into position and must not be used to such an extent so as to destroy the holes. Drifts of a larger size than the nominal diameter of the holes or burrs must be rectified to the

satisfaction of the Engineer-in-Charge. Correction of minor reasonable amount of reaming and cutting of excess stock from field rivets, if any, shall be considered as a part of erection. Any error in shop work which prevents proper fit on a moderate amount of reaming and slight chipping or cutting shall be immediately reported to the Engineer-in-Charge. The contractor's work shall also include straightening and repairing of materials slightly damaged and drilling some holes in members where required. This shall all be included in the unit rate quoted.

c) Structural steel frames shall be erected plumb and true to tolerances indicated elsewhere in these specifications. All steel columns and beams shall be checked for plumb and level individually before and after connections are made. Temporary bracings shall be introduced wherever necessary to take care of all loads to which the structure may be subjected including erection equipment and the operation thereof. Such bracings shall be left in place as long as may be required for safety. Proper size steel cables, slings etc., shall be used to avoid any damage due to accidents.
d) As erection progresses, the work shall be securely bolted to take care of all dead load, wind and erection stresses. No final welding or bolting shall be done until the structure has been properly aligned and approved by the Engineer-in-Charge.
e) The Engineer-in-Charge shall be immediately informed of any errors observed/found in the fabricated steel which prevents proper assembling and fitting up of parts in field by a moderate amount of repairing.
f) The contractor shall protect all existing plants, embedded parts, all piping, conduits, equipment and facilities against damage during erection. The contractor shall perform his work in a manner which in no way endangers the operations of any existing plant or structures or hinders other construction activities.
g) Holes may be required to be drilled at site for installing equipment or steel furnished by other manufacturers or other contractors. The information for this will be supplied to the Contractor by the Engineer-in-Charge before or after erection of the steel.
h) In case of any faulty erection, all such dismantling and re-erection required will be at Contractor's cost.
i) Shim stock of mild steel plates required for erection will be set, levelled and prepared for grouting. Where flat bearing beams occur, bearing plates shall be set, levelled and prepared for grouting.

7.4. Tolerance:

The erection shall be carried out to the requirements stated in Section 7 (h) of AISC Code Standard practice, except that Structural Steel members be

erected plumb with a tolerance not exceeding in 1000. Column splices and other compression joints which depend upon contact bearing, upon completion, shall bear with respect to the centred of the contact area.

At least 65% of the entire contact area shall be in full bearing and the separation of any remaining portion shall not exceed 0.5 mm except locally at toes of flanges where a 50% greater separation is permissible. Otherwise corrective measures as specified by the Engineer-in-Charge shall be taken.

7.5. Connection:

a) H.S.F.G. Bolts :

The Contractor shall obtain the prior written approval of the Engineer-in-Charge for the method proposed to be adopted for tightening the High Strength Friction Grip bolts. For preliminary assembly and before use of these bolts he shall use his own erection bolts.

b) Bolting / Riveting:

In general bolts and rivets will conform to the relevant Indian Standards. The methods of establishing connections use of equipment, etc., shall be as approved by the Engineer-in-charge.

c) Welding :

Welding where specified shall be performed by the shielded electric are, gas or other approved methods, using coated electrodes and/or low hydrogen electrode conforming to IS:814. The welding process and the qualification of the welding operators shall conform to IS: 81 7 and IS: 823 and shall be got approved before commencement of any work of welding.

All field assembly and welding shall be executed in accordance with the requirements for shop fabrications excepting which manifestly apply to shop conditions only. Where the steel has been delivered, painted, the paint shall be removed before field welding for a distance of at least 50 mm on either side of the joints. All welds should be free from defects like blow holes, lack of penetration, slag intrusion etc. All welds shall be cleaned of slab or flux and shall show uniform smoothness of weld metal, feather edges without overlap and free from porosity. Where a thick weld is required the weld metal shall be deposited in successive layers. Each layer except the last shall be preened moderately before the next layer is applied. The contractor shall be responsible for the quality of the work performed by his welding group.

If required, the Engineer-in-Charge may test the welds by non-destructive tests. Any defective welds shall be made good by the Contractor at no extra cost and the cost of non-destructive testing for such defective welds shall be borne by the Contractor.

d) Specification for pin and pinned connections:

Pin Material:

Rolled steel pins and rollers, including those made from slabs shall comply with the requirements of IS: 226 - Specification and structural steel and IS: 2062 - Specification for structural steel (fusion welding quality) or IS: 961 - Specification for high tensile structural steel.

Forged steel pins shall have a tensile strength of 44 to 50 kg/Sq.mm. or 57 to 63 kg/sq.mm. to conform to IS:1875 - Specification for carbon steel billets, blooms and slabs for forging. Steel casting for cast steel pins shall conform to grade 1 or 3 of IS: 1 030.

Pin Holes:

Pin holes shall be bored true to gauge, smooth, straight, at right angle with the axis of the member and parallel with each other unless otherwise required, in built up members the boring shall be done after the members have been welded. The specified dia. of pin shall be its minimum dia. Hole dia. can be maximum + 0.5 mm more than pin dia.

Pins:

The pins shall be parallel throughout and shall have a smooth surface free from flaws. At ends of pins there shall be slot to facilitate in driving the pin.

Pins more than 175mm in length of diameter shall be forged and annealed. offer pins shall be provided on both sides of the pin.

8. MEASUREMENTS and RATES:

The contractor will be paid on the basis of unit rates quotes for structural steel work. Measurements will be based on the actual weight of structural steel erected as shown on drawings or as specified.

The weight of the temporary bracings, shims and erection bolts, fields welding, if any will not be taken into account for purpose of payment. The rate for erection shall be inclusive of structural welding wherever specified and painting as called for the specification and drawings. All bolts, nuts and washers which are permanently incorporated in the structures other than those specifically paid for separately shall be provided by the contractor and the rate quoted for the erection of structural steel shall include the cost of supply and erection of such bolts, nuts and washers.

The unit rates shall include all materials, labour, supervision, tools and plant, apparatus, conveying equipment, incidental expenses etc., other than those supplied free by Engineer-in-Charge, nuts, bolts and washers etc. The unit rate also includes removal of paint from members encased in concrete.

8.1. Grouting of Foundation Pockets

This specification refers to the grouting of pockets left in the machine foundation to be filled up later after the installation of the machinery and also the grout injected below the base plates.

The pockets are to be grouted with concrete grit made of 1 part of cement with 2 part of grit (size 10mm and below) by weight. The water added shall be just sufficient to make the mix workable. In any case water cement ratio should not exceed 0.4 to 0.45. The grit is nothing but smaller particles of the coarse aggregate.

Non-shrinkage additive should be added to the six as per manufactures specifications. The mix shall be poured into the pockets layer by layer, with each layer not exceeding 10 cm in depth. Each layer shall be well vibrated before the next layer is laid, after the pocket is completely filled. The top shall be trowelled smooth. Curing shall start 12 hours after the finishing of work and shall be continued for 15 days. Curing shall be done as per the good practices.

8.2. Measurement and Payments

The measurement is based on volume of the pocket grouted or the volume of grout filled up below the plates, as the case may be rounded off to the nearest 0.01 Cu. m. The unit of payment is in Cu. m of grout.

9. MILD STEEL TUBULAR WORKS:

All mild steel tubular members shall confirm to IS: 1161-1979, grade of steel shall be Yst-210. All other specifications including fabrication, erection, painting, measurements etc. shall conform to the detailed specification given under structural steel works.

10. STAINLESS STEEL TUBES and PLATES

Stainless steel tubes and plates shall comply standard of type No. 304 according to American Iron and Steel Institute. It should contain Nickel @ 8 to 10.50% and Chromium @ 18 to 20%. It should be non magnetic type with minimum wall thickness of 1.50mm for the railing pipes. The fixing of railing pipe with vertical SS pipe and SS plate shall be carried out by welding with special electrodes used for stainless steel welding. SS plate shall be fixed to the concrete with the help of wedge bolts.

11. GRILLS/RAILING

Materials:

All structural steel shall conform to IS 226-1963 sections for grills and shall be free from loose mill scales, rusts, pitting or any other defects affecting its strength and durability.

Fabrication:

The grill/railing shall be fabricated to the design and pattern shown in the drawings. All joints shall be made in best workman like manner with slotting and welding as required to the specified size and shape. The edge of the M.S. flats shall be suitably mitred before welding to get the desired shape. The joints shall be filled to remove excess stay after

welding screws, nuts, washers, bolts, rivets and any other miscellaneous fastenings devices shall be of steel and shall be provided by the contractor.

Manufactured Rails then be fixed in between the posts, balusters, M.S. frame work etc. to correct alignment. Any undulations, bends etc. found shall be rectified by the contractor at his own cost. The complete assembly of railing so fixed shall be firm and there shall not be any lateral movements. All welds on fabricated elements, that will be exposed to view at completion of construction, shall be ground smooth prior to application of primer.

Samples:
Samples of grill and railings shall be submitted for approval of the Engineer-in-charge and to be got approved before taking up for mass fabrication.

Installation:
The approved grills shall be fixed in position where specified and shown in drawings including in masonry walls, teakwood frames, hand railings etc. Any damages to walls, frames etc. caused during fixing the grills shall be made good by grouting with cement mortar/packing /repairing properly at the contractors cost.

Painting:
Painting shall be done as per the specification specified under painting.

Mode of measurement:
The railing shall be measured correct to two decimal places. Only the running length of the railing shall be considered for payment. Individual rails not to be measured separately.
The rate is to include the cost of all materials, labour, transporting, fabricating, installing, scaffolding if necessary, painting, grouting etc. complete.

12. GRATINGS

MS Grating

Grating shall be fabricated from MS angles and MS hollow pipes. Other specifications shall be as below.

- Periphery: ISA 75x75x6mm or ISA 50x50x6mm
- Main bearing bars : MS hollow pipes 2mm thick, 25mm dia or 50mm dia or 75mm dia

13. GATES

M.S. Sliding gate shall be made from 75mm x 50mm x 3mm M.S. pipe with 14g M.S. perforated sheet on both sides and 3mm S.S. plate for Logo encased in 75mm x 75mm x 3mm M.S. pipe frame, as per the specifications and drawings, with all necessary fixtures and accessories in best workmanship with one coat of red oxide primer.

Sliding gate operator comprising of the rugged and powerful drive unit, integral electronic control unit, in built limit switch, with imported galvanized rack (duly hardened and tempered), with pre-cast wall anchors and Key selector.

9 MASONRY – CONCRETE BLOCK WORK

CONTENTS

MASONRY – CONCRETE BLOCK WORK

1. SCOPE

These specifications cover the use of Concrete Block Masonry for the structural / non structural purposes.

2. GENERAL

The provision of the latest Indian Standards listed below form part of these specifications:

All relevant Standards as specified elsewhere in this Volume are also applicable.

a) IS 269 Specification for ordinary and low heat Portland cement
b) IS 383 Specification for coarse and fine aggregates from natural sources for concrete.
c) IS 455 Specification for Portland slag cement
d) IS 456 Code of Practice for plain and reinforced concrete.
e) IS 2185 (Part I) Solid cement concrete blocks.
f) IS 2572 Code of practice for construction of hollow concrete block masonry.
g) IS 2645 Specification for integral waterproofing compound.
h) IS 9103 Specification for admixtures for concrete.

3. MATERIAL

3.1 Cement

Ordinary Portland cement complying with IS 269 shall be used unless specified. Cement complying with any of the following Indian Standards may be used at the discretion of the Engineer-in Charge: IS 269-1989. 455-1989, 1489-1999, 6909-1990, 8041-1990, 8043-1991. When cement conforming to IS: 269-1989 is used, replacement of cement by fly ash conforming to 1S:3812-1981 may be permitted up to a limit of 20%. However, it shall be ensured that blending of fly ash with cement is as intimate as possible, to achieve maximum uniformity.

3.2 Aggregates

Aggregates shall conform to IS 383. Grading shall be as indicated in IS 383. Fineness modules of the combined aggregates shall be between 3.6 and 4. The aggregates used in the manufacture of block shall be clean and free from all deleterious matter, and shall conform to the requirements of IS: 383-1970. Maximum size of the coarse aggregate shall be 10 mm. Sand used in the manufacture of blocks shall be well graded, clean and free from deleterious matter, and shall conform to the requirements of IS: 383-1970. Besides it shall have fine particles 15 to 20% passing 300 micron IS Sieve and 5 to 15% passing 150 micron IS Sieve.

3.3 Water

Water conforming to IS 456 and as approved by the EIC shall be used.

3.4 Admixtures

Additives or admixtures may be added to the cement or concrete mix conforming to the IS specifications. Admixtures shall be chloride free and melamine polymer based. Other additives or admixtures not being governed by Indian Standards shall be tested and checked that the same are not detrimental to durability. However any addition shall only be after approval of the EIC.

3.5 Fly ash

Fly Ash conforming to IS: 38121981 may be used for part replacement of fine Aggregate up to a limit of 20%.

4. MANUFACTURE:

4.1 Concrete blocks may be hollow (open or closed cavity) or solid and shall be referred to by its nominal dimension. The term nominal dimension includes the thickness of the mortar joint. All specifications of solid concrete blocks including specifications for actual dimensions, tolerances, sizes, shapes and webs, grades of blocks etc. shall conform to IS: 2185. Blocks may be manufactured either at construction site or in factory on a central casting platform using steel moulds with or without surface vibration for compaction of cement concrete.

4.2 Mould: - Moulds shall be fabricated using mild steel plates and mild steel angles for stiffening the plates. The mould shall pc either fixed type (box with four side walls fixed at corners, and top and bottom open) or split type. Split type may be either individual or gang mould. Where the compaction of the concrete is done manually, the mould may be either fixed type or split type. When the compaction of the blocks is done with surface vibrator, the mould shall be only split type (individual• or gang mould).

4.3 Concreting:- Concrete mix used for blocks shall be pre-designed to give a minimum crushing strength as specified in table 2 given below. Concrete shall be mixed in the mechanical mixer. Blocks shall be moulded, laid and compacted with automatic machines table vibrator. Care shall be taken to see that the mix mould is properly filled up. .Block shall be protected until they are sufficiently hardened to permit handling without damage. The cement concrete mix for concrete masonry blocks shall not be richer than one part by volume of cement to 9 parts by volume of combined fine and coarse aggregates, and shall not be leaner than

one part by volume of cement to 13 parts by volume of combined fine and coarse aggregates.

In case of blocks where compaction is done manually, concrete mix of medium Consistency (10-12 mm slump) shall be used in order to enable proper compaction and de-moulding. The consistency of the mix should be such that it may cohere when compressed in the hand without free water being visible.
In case of blocks where compaction is done by external vibrator, concrete mix of very low consistency (zero slump) shall be used in order to vibrate and compact the concrete under pressure.

Mixing: - Concrete shall normally be mixed in a mechanical mixer unless otherwise permitted by Engineer-in-charge. In case of hand mixing 10% extra cement shall be used without any extra payment. Mixing shall be continued until there is a uniform distribution of the materials, and the mass is uniform in colour and consistency.
De-moulding shall be done 5 to 10 minutes after compaction. In case of fixed type mould it shall be pulled up with side handles while pressing down the block with the plate at top with thumb. In case of split type mould, the sides shall be removed first and the partition plates (gang mould) shall be pulled up subsequently.

After de-moulding, the blocks shall be protected until they are sufficiently hardened to permit handling without damage.

4.4 Curing and Drying:- Blocks shall be cured in the curing yard by keeping them continuously moist for at least 14 days. Steam-cured blocks shall be preferred. Cured blocks shall be allowed to dry for a period of 4 weeks before being used. The blocks shall be allowed to complete their initial shrinkage before they are laid in the wall.

4.5 Physical requirements:- All blocks shall be sound and free of cracks or other defects. For exposed construction face or faces shall be free of chips, or other imperfections, and the overall dimensions of the blocks shall be in accordance to tolerance as specified. Minimum compressive strength shall be as per table 2 below, maximum permissible water absorption shall not exceed the limit specified in I.S.: 2185, dimensional variations shall conform to I.S. 2185.
The minimum compressive strength at 28 day being the average of eight blocks, and the minimum compressive strength at 28 days of Individual blocks, when tested in the manner described in Appendix B, of IS: 12440-1988, shall be as prescribed in Table 2.

Table- 2

COMPRESSIVE STRENGTH OF CONCRETE STONE MASONRY BLOCKS

Class Designation	Minimum average Compressive Strength of blocks (N/mm2)	Minimum strength of individual blocks N/mm2
5	5.0	3.5
6	6.0	4.2
7	7.0	5.0
9	9.0	6.3
10	10.0	7.5

For 100 mm wide blocks (for 100 mm thick walls), the minimum strength may be 3.5 N/mm2

4.6 Testing:-Tests as indicated in Appendices A to F of IS 2185 shall be conducted on samples of units selected according to the sampling procedure given here under to ensure conformity with the physical requirements as specified.

4.7 Sampling:- A sample of 20 blocks shall be taken from every consignment of 5000 blocks or part thereof of the same size and same batch of manufacture. From these samples, the blocks shall be taken at random for conducting the test.
The blocks shall be taken at regular intervals during the course of work, preferably while being loaded or unloaded. In case samples are to be taken from the stacks, blocks shall be taken at random from across the top of the stacks, the sides accessible and from the interior of the stacks.

4.8 The blocks shall be kept under cover and protected from extreme conditions of temperature, relative humidity and wind until they are required for test. The test shall be conducted as soon as the sample has been taken.

4.9 Number of Tests:- All the 20 blocks shall be checked for dimensions and inspected for visual defects. Out of the 20 blocks, 3 blocks shall be subjected to the test for block density, 8 blocks to the test for compressive strength, 3 blocks to the test for water absorption and 3 blocks to the test for drying shrinkage and later to the test for moisture movement. The remaining 3 blocks shall be reserved for retest for drying shrinkage and moisture movement if a need arises.

4.10 Blocks shall be approved if requirements of conditions mentioned in 11.2 to 11.5 (as given below) of IS 2185 (Part I) are satisfied.

a) The number of blocks with dimensions outside the tolerance limit and / or with visual defects, among those inspected shall not be more than two.

b) For Block density and compressive strength, the mean value determined shall be greater than of equal to the minimum limit specified in Table 2 of IS 2185 (Part I) and reproduced as Table 27 of Annexure.

c) For drying shrinkage and moisture movement, all the test specimens shall satisfy the requirements of the test. If one of more specimens fails to satisfy the requirements, the remaining 3 blocks shall be subjected to these tests. All blocks shall satisfy the requirements. Drying shrinkage shall not exceed 0.1 percent.

d) For water absorption, the mean value determined shall not be more than 10 percent by mass.

4.11 Hollow and solid concrete block masonry:- Hollow and solid concrete blocks- Shall conform to the requirements of IS: 2185--1979.
Specification for hollow and solid concrete blocks except with regard to the mix of cement concrete and sizes of aggregates which shall be as indicated. Hollow blocks shall be sound, free from cracks, broken edges, honey combing and other defects that would interfere with the proper placing of block or impair the strength or performance of construction.

Concrete Block-hollow (open or closed cavity) or solid shall be referred to by its nominal dimensions. The nominal dimensions of concrete block shall be, as follows:
Length 400, 500 or 600 mm
Height 200 or 100 mm
Width 50, 75, 100, 150, 200, 250 or 300mm
In addition, block shall be manufactured in half lengths of 200, 250 or 300 mm to correspond to the full lengths. The maximum variation in the length of the units shall be not more than ±5mm and maximum variation in height and width of unit, not more than ±3mm.

5. WORKMANSHIP

5.1 In total dry climate top and sides may be slightly moistened to avoid absorption of water from mortar.

5.2 Joints shall not be bigger than 10mm and will be perfectly horizontal and vertical. Joints shall be raked 10mm deep while mortar is wet.

5.3 Cut blocks shall not be used. Special solid pre-cast blocks at site shall be cast well in advance to be used as spacers and to adjust breaking of vertical joints.

5.4 Cracks in block masonry are due to shrinkage or expansion of blocks or due to settlement, thermal expansion or changes in moisture content in the structural members enclosing the block walls. The following measures are recommended to prevent formation of cracks.

a. While curing, the block masonry should be lightly sprinkled with water and not made excessively wet.
b. Expansion joints shall be provided in walls exceeding 30 m in length.
c. Reinforcement should be provided in the bed joints in block work, one course above and course below windows and above doors in order to distribute the shrinkage/ temperature stresses occurring at the corners of openings, more uniformly throughout the walls.
d. R.C.C. band (Patlis) 100 mm thick and width equal to block masonry and having 8 mm dia. two bars with 8 mm dia links @ 300 mm c/c shall be provided at every 1000mm interval in the block masonry. The gap between the topmost layer of block and the soffit of the beam shall be packed by lightly hammering flat pieces of shahabad/ kota tiles and then the gaps will be covered by weld mesh before closing them by cement plaster. The weld mesh will be extended at least 150 mm on the R.C.C. beam and 150 mm on block masonry and nailed to them with strong nails.
e. Provisions for door and window frames: - A course of solid concrete block masonry shall be provided under door and window openings (or a 10em thick pre-cast concrete sill block under windows). The solid course shall extend for at least 20cm beyond the opening on either side. For jambs of very large doors and windows either solid unit are used, or the hollows shall be filled in with concrete of mix 1:3:6 using 12.5 mm nominal size aggregates.
f. Provisions for Roof/ceiling: - The course immediately below the roof slab shall be built with solid blocks: The top of the roof course shall be finished smooth with a layer of cement and coarse sand mortar 1:3, 10mm thick and covered with a thick coat of white wash or crude oil, to ensure free movement of slab.
g. Intersecting walls: - When two walls meet or intersect and the courses are to be laid up at me same time, a true masonry bond between at least 50% of the units at the intersection is necessary. When such intersecting walls are laid up separately, pockets with 20mm maximum vertical spacing shall be left in the first wall laid. The corresponding course of the second wall shall be built into these pockets. Fixtures, fittings, etc. shall be built into the masonry in cement and coarse sand mortar 1:3 while laying the blocks where possible. Hold fasts shall be built into the joints of the masonry during laying. Holes, chases, sleeves, openings, etc of the required size and shape shall be formed in the masonry with special blocks while laying, for fixing pipes, service lines, passage of water etc. After service lines, pipes etc are fixed, voids left, if any, shall be filled up with

cement concrete 1:3:6(1 cement 3 coarse sand: 6 stone aggregate 20mm nominal size) and neatly finished.

6. SCAFFOLDING

Scaffolding shall be **double** and shall be erected with steel sections or pipes of adequate strength so as to be safe for construction operations. The contractor shall take all measures to ensure the safety of the work and working people. Any instructions of the Engineer in this respect shall also be complied with. The contractor shall be entirely responsible for any damage to properly or injury to persons resulting from ill erected scaffolding, defective ladders and materials or otherwise arising out of his default in this respect. Proper scaffolding shall be provided to allow easy approach to every part of the work. Overhead work shall not be allowed. Block work shall be carried out with double scaffolding only. Making holes of any kind for the purpose of supporting the scaffolding shall not be permitted.

7. MEASUREMENT

Hollow or solid cement concrete block work shall be measured in sq. meter for the specified width.

8. RATES

Rates for concrete block masonry item shall include the following:

i) Material and labour, for the completion of items as specified including any Centring, shuttering, curing etc.
ii) Raking out of joints.
iii) Preparation of the tops and sides.
iv) Forming and preparing expansion, contraction or construction joints as detailed above or specified in the BOQ or drawings.
v) Making holes, openings, etc. for outlets, embedding down take pipes, etc. wherever necessary during construction and finishing exposed surfaces as per instruction of the EIC.
vi) Curing and protection as specified.
vii) Making holes, openings, outlets, etc. embedding pipes, ends of beams, joints, slabs, trusses, sills, etc. whatever required during construction and neatly finishing the exposed surfaces and opening as per instructions of the EIC.

9. AERATED LIGHT WEIGHT CONCRETE BLOCK

The Basic raw materials used in the production of Aerated light weight concrete blocks are cement, fly ash, lime and water. The production process begins by mixing fly ash and water, which forms slurry. This is heated and fed into a high speed mixer where cement, lime and aluminium powder are added. This causes a chemical reaction generating minute bubbles in the mixture which form the characteristic cellular or air

Crete structure. When the mixture is partially set, it is wire cut into pre-determined sizes. The cut cakes are then transferred into autoclaves for high pressure steam curing .During this autoclaving the ingredients combine to form the Calcium Silicate hydrate which establishes the special properties of Aerated. Autoclaving gives strength and dimensional stability to the blocks. Properties:

- Fire Resistant: Aerated Light weight concrete blocks have a remarkable level of fire resistance. These blocks are fire proof up to 1100c. These blocks are completely inorganic and incombustible.

- Excellent Sound insulation: The inherent sound insulating properties of light weight concrete block make it ideal for controlling adjoining rooms- a significant factor governing resident quality of life. The high level of acoustic performance makes light weight blocks an ideal choice for auditoriums, studios, cinema halls, offices etc.

- Aerated Light weight concrete blocks are extremely light, just one-third the weight of clay bricks. They are much easier to handle on the site.

- Aerated Light weight concrete block's excellent thermal properties help in saving recurring costs of heating and cooling.

- It is fire resistant.

- It is moisture resistant.

- It has exceptional good workability.

Technical Data:

Face Size (L X H in mm) 600 x 200			
Dry Weight (in Kg)	7.8	11.7	15.6
Wall Thickness (in mm)	100	150	200
Normal Dry Density (kg/m3)	650		
Thermal Conductivity	0.16		
Sound Reduction (in decibels)			
38-50 db depending on thickness			
Fire Resistance (in hours)			
NLB (Non load bearing)	4	6	6
LB (load bearing)	2	4	4
Maximum Overhang,			
Unsupported 300mm			

10. Cavity Wall :-

A wall comprising two leaves, each leaf being ,built of masonry units and separated by a cavity and tied together with metal ties or bonding units to ensure that the two leaves act as one structural unit, the space between the leaves being either left as continuous cavity or filled with a non-load bearing insulating and water-proofing material.

The construction of the cavity wall shall be as per the technical specifications for a single wall as specified in the relevant specifications given above. The thickness of individual blocks, laying mortar, laying of blocks to be as per the specifications given above. The outer and inner masonry will have hold fasts @ 600mm c/c to hold both the walls using elongated MS Z sections, 300mm long of size 25x3mm

11. Damp proof Coarse:-

The work covered under this specification consists supplying and laying plain cement concrete as damp proof course with or without waterproofing admixture with this specification ad applicable drawings. Surface to receive damp proof course shall be cleaned ad carefully wept to remove all dust, laitance etc. and shall be approved by the Engineer-in-charge Damp proof course shown shall be cement concrete as per proportion indicate din the schedule. Approved water proofing compound @ 2% by weight of cement or as directed by the manufacturer shall be mixed in cement mortar for this concrete. The damp proof course shall be laid to the full width of the walls ad the edges shall be straight, even and truly vertical. Wooden forms shall be used to obtain good edges. No masonry work shall be commenced on freshly laid damp proof course unless it is cured for 48hours of its laying by the curing of cement concrete shall be continued along with the masonry work. Specification for cement, sand, aggregate and water shall be as described herein before for concrete works.

10 BRICK WORK

CONTENTS

BRICK WORK

1. SCOPE

These specifications cover the use of Brick Masonry for the structural purposes.

2. GENERAL

The provision of the latest Indian Standards listed below form part of these specifications:

IS: 1077 Specifications for common burnt clay building bricks
IS: 1200 Measurement 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:2250 Code of practice for preparation and use of masonry mortar.
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 rent able areas of buildings.
IS:3952 Specification for burnt clay hollow blocks for walls and partitions.
IS:4098 Specification for lime-puzzolona 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.
IS: 5495 Size and shape for fire bricks

Other I.S. Codes not specifically mentioned here but pertaining to the use of bricks for structural purposes forms part of these specifications.

3. MATERIALS

3.1 Bricks

Bricks shall be of regular and uniform size, shape and colour, uniformly well burnt throughout but not over burnt. They shall have plane rectangular faces with parallel sides and sharp straight and right angled edges. They shall be free from cracks or other flaws. They shall have a frog of 10 mm. depth on one of their flat faces.

They shall give a clear metallic ringing sound when struck. They shall show a fine grained, uniform homogeneous and dense texture on fracture and be free from lumps of lime, laminations, cracks, air holes, soluble salts causing efflorescence or other defects which may in any way impair their strength, durability, appearance or

usefulness for the purpose intended. They shall not have any parts under-burnt. They shall not break when thrown on the ground on their flat face in a saturated condition from a height of 60 cm.

Size of bricks

a) The size of the conventional bricks may vary from 8 3/4" x 4 3/16" x 2 5/8" to 9" x 4 1/4" x 3". Only bricks of one standard size, shall be used on one work unless specially permitted by the Engineer. The following tolerances are permitted in the standard conventional size adopted on a particular work:
   Length - plus or minus 3 mm (about 1/8")
   Breadth - plus or minus 1.5 mm (about 1/16")
   Depth - plus or minus 1. 5 mm (about 1/16")
b) When metric bricks are used they shall comply with I. S: 1077 - 1976.
   Absorption
   After immersion in water, absorption by weight shall not exceed 20% of the dry weight of the brick when tested according to IS: 1077-1976.
   Compressive Strength
   The load to crush the brick when dry shall not be less than 50 Kg/sq.cm. and when thoroughly soaked shall not be less than 35 Kg/sq.cm. Please see table given below for details

Class Designation	Average compressive strength			
	Not less than		Not less than	
	N/mm2	(Kgf/cm2)	N/mm2	(Kgf/cm2)
10 (100)	10.0	100	12.50	125
7.5 (75)	7.5	75	10.00	100
5 (50)	5.0	50	7.50	75
3.5 (35)	3.5	35	5.00	50

3.2 Mortars

Cement and sand shall be mixed in specified proportions given on the drawings. Cement shall be proportioned only by weight, by taking its unit weight as 1440 kg per cubic metre and the sand shall be proportioned by volume after making due allowance for bulking. The required quantity of water shall then be added and the mortar mixed to produce workable consistency.

The mixing shall be done intimately in a mechanical mixer unless hand-mixing is specifically permitted by the Engineer. If hand mixing is done, the operation shall be carried out on a clean watertight platform and cement and sand shall be first mixed dry in the required proportion to obtain a uniform colour and then the mortar shall be mixed for at least two minutes after addition of water. The mortar so prepared shall be used within 30 minutes of adding water. Only such quantity of mortar shall be prepared

as can be used within 30 minutes. The mortar remaining unused after that period or mortar, which has partially hardened or is otherwise damaged shall not be retempered or remixed. It shall be destroyed or thrown away.

In case of cement mortar that has stiffened because of evaporation of water the same shall be retempered by adding water as frequently as needed to restore the requisite consistency, but this retempering shall be permitted only within thirty minutes from the time of addition of water at the time of initial mixing.

Necessary tests to determine compressive strength of the mortar, for consistency of the mortar and its water retentively shall be carried out in accordance with IS-2250. The frequency of testing shall be one cube for every 2 cubic metre of mortar prepared subject to a minimum of 3 cubes for a day's work.

4. CONSTRUCTION

4.1 Soaking of Bricks

Bricks shall be soaked in water for a minimum period of one hour before use so that they will be saturated and will not absorb water from the mortar. When bricks are soaked they shall be removed from the tank sufficiently in advance so that at the time of lying they are skin-dry. Such soaked bricks shall be stacked on a clean place where they are not spoil by dirt, earth, etc,

4.2 Laying of Bricks

All brick work shall be laid in English bond, even and true to line, plumb, level and all joints accurately kept. The bricks used on the face shall be selected whole ones of uniform size and with true rectangular face. Brick shall be laid with frogs up, if any, on a full bed of mortar. When laying, bricks shall be slightly pressed so that the mortar gets into all the surface pores of bricks to ensure proper adhesion. All joints shall be properly flushed and packed with mortar so that no hollow spaces are left.

Before laying bricks in foundation, a layer of not less than 12 mm of mortar shall be spread to make the surface on which the brickwork will be laid even. Immediately thereafter, the first course of bricks shall he laid.

The brickwork shall be built in uniform layers, corners and other advanced work shall be raked back. Brickwork shall be done true to plumb or in specified batter. No part of it, during construction, shall rise more than one meter above the general construction level, to avoid unequal settlement and improper joining. The height of brick works constructed shall not exceed one metre in a day.

Toothing may be done where future extension is contemplated but shall be used as an alternative to raking back.

4.3 Joints

The thickness of joints shall not exceed 10mm and this thickness shall be uniform throughout.

4.4 Joining with existing structure

When fresh masonry is to be placed against existing surfaces of structures, these shall be cleaned of all loose material, roughened and wetted as directed by the Engineer so as to affect a good bond with the new work.

4.5 Curing

Green work shall be protected from rain by suitable covering. Masonry work in cement or composite mortar shall be kept constantly moist on all faces for a minimum period of seven days. The top of the masonry work shall be left flooded with water at the close of the day. During hot weather all finished or partly completed work shall be covered or wetted in such manner as will prevent rapid drying of the brick work.

4.6 Scaffolding

The scaffolding shall be sound and strong to withstand all loads likely to come upon it and will be double or single as is warranted for the particular work. The holes, which provide resting space for horizontal members, shall not be left in masonry under one metre in width or immediately near the skew backs of arches. The holes left in the masonry work for supporting the scaffolding shall be filled and made good with 1:4:8 cement concrete.

4.7 Condition of Equipment

All equipment used for mixing or transporting mortar and bricks shall be clean and free from set mortar, dirt or other injurious foreign substances.

4.8 Finishing of Surfaces

For a surface which is to be subsequently plastered or pointed the joints shall be squarely raked out to a depth of 15mm while the mortar is still green. The raked joints shall be well brushed to remove dust and loose particles and the surface shall be thoroughly washed with water, cleaned and wetted.

5. Weep Holes

In case of abutment retaining walls and wing walls, weep holes as shown on the drawings or directed by the Engineer shall be provided in the masonry to drain moisture from the backfilling Weep holes shall be 8 cm wide, 15 cm high and shall extend through the full width of the masonry with slope of about 1 vertical to 20 horizontal towards the draining face.

The spacing of weep holes shall be as shown on the drawings with the lowest one at about 15cm above the low water level or ground level whichever is higher or as directed by the Engineer.

6. Measurement for Payment

6.1 Brick work shall be measured in cubic metres unless otherwise specified-. Any extra work over the specified dimensions shall be ignored. Dimensions shall be measured correct to the nearest 0.01m i.e. l cm. Areas shall be calculated to the nearest 0.01 sqm and the cubic contents shall be worked out to the nearest 0.01 cubic metres

6.2 Brick work shall be measured separately in the following stages:

a) From foundation to floor one level (plinth level)
b) Plinth (floor one) level to floor two level
c) Between two specified floor levels above floor two levels.

Note: Brick work in parapet walls, mumty, lift machine room and water tanks constructed on the roof up to 1.2m height above roof shall be measured together with the corresponding work of the floor next below:

6.3 No deductions or additions shall be done and no extra payment made for the following-

Note: Where minimum area is defined for deduction of an opening, void or both, such areas shall refer only to opening or void within the space measured.

a) Ends of dis-similar materials{that is, joists, beams, lintels, posts, girders, rafters, purlins, trusses, corbels, steps, etc.; up to 0.l m2 in section;
b) Opening up to 0.lm2 in area
c) Wall plates, bed plates, and bearing of slabs, chajjas and the like, where thickness Does not exceed. 10cm and bearing does not extend over the full thickness of wall;

6.4 Rate:- The contract unit rate for brick work shall include the cost of all labour, materials, tools and plant, scaffolding and other expenses incidental to the satisfactory completion of the work as described herein above and as shown on the drawings. The rate for work shall also include:

a) Dewatering required for completing this item and till the mortar of masonry pointing and plastering is properly set.
b) watering the masonry and
c) cleaning the site round the brick-work so as to restore the area to its original condition.

The rate for work shall also include full compensation for using specially moulded bricks on the face of walls with batter and provision of weep holes.

7. All other specifications under Brick Work for Construction and Measurements will be applicable.

11 PLASTERING AND POINTING

CONTENTS

PLASTERING AND POINTING

1. SCOPE

These specifications cover the use of plastering for masonry and RCC work, pointing for brick and stone masonry work.

2. APPLICABLE INDIAN STANDARDS

The provision of the latest revisions of the following IS codes shall form a part of this specification to the extent they are relevant.

IS: 269 Specification for ordinary rapid hardening and low heat Portland cement
IS: 712 Building Lines
IS: 1200 (Part XII) Method of measurement of building and Civil Engg. Works - Plastering and Pointing
IS: 1542 Specification for sand for plaster
IS: 1630 Mason's Tools for Plaster work and pointing work.
IS: 1661 Code of practice for application of cement lime plaster finishes
IS: 10067 Material Constants for Building Works

Other I. S. Codes, not specifically mentioned here, but pertaining to plastering work, form part of these specifications.

3. GENERAL

3.1 Cement Mortar

Cement mortar shall have the proportion of cement to sand as specified and shall comply with relevant clauses of concrete specifications.

Cement: Cement shall conform to IS: 269 Ordinary Portland cement shall be used. The weight of ordinary Portland cement shall be taken as 50 kg per bag. The Contractor shall ensure that the cement is of sound and requiring quality before using it. Any cement which has deteriorated caked or which has been damaged shall not be used. The specifications covered under the section Concrete' shall be applicable in addition.

Water: Water for mixing cement mortar or concrete shall not be salty or brackish and shall be clean, reasonably clear and free from objectionable quantities of silt and races of oil, acid and injurious alkali, salts, organic matter and other deleterious material which will either weaken the mortar or concrete or cause efflorescence. Sea water shall not be used. Water fit for drinking shall generally be found suitable for mixing cement mortar. Water fit curing mortar or concrete shall not be too acidic or alkaline. It shall have pH value above 6. Sea water shall not be used for curing purpose.

Fine Aggregate: All fine aggregate shall conform to IS: 383 - 1963 and relevant portion of IS: 515-1959. Sand shall be clean, well graded, hard, strong, durable and gritty particles free from injurious amounts of dust, clay, kankar nodules, soffit or flaky particles, shale, alkali, salts, organic matter loam mica or other deleterious substances

and shall be approved by the Engineer. The maximum size of particles shall be limited to 5 mm (about 3/16"). If the fine aggregate contains more than 4 per cent of clay, dust or silt, it shall be washed.

The fine aggregate for cement mortar for masonry and first coat of plaster should generally satisfy the following grading:

IS Sieve	**Percentage by wt. passing sieve**
4.75 mm	100
2.36 mm	80 - 95
1.18 mm	70 - 90
600 microns	40 – 85
300 microns	5 - 50
150 microns	0 - 10

The fineness modulus shall not exceed 3.00.

The fine aggregate for cement mortar for fine joints of ashlar masonry, pointing and second coat of plaster may have the following grading:

IS Sieve	**Percentage by wt. passing sieve**
4.75 mm	100
2.36 mm	80 - 95
1.18 mm	70 - 90
600 microns	40 - 85
300 microns	5 - 50
150 microns	0 - 10

The fineness modulus shall not exceed 1.6 IS: 2116 - 1980 shall generally apply for sand for plaster. The fine aggregate should be stacked carefully on a clean, hard surface so that it will not get mixed up with deleterious foreign materials.

3.2 Scaffolding,

Scaffolding shall be double and shall be erected with steel sections or pipes of adequate strength so as to be safe for construction operations. The contractor shall take all measures to ensure the safety of the work and working people. Any instructions of the Engineer in this respect shall also be complied with. The contractor shall be entirely responsible for any damage to properly or injury to persons resulting from ill erected scaffolding, defective ladders and materials or otherwise arising out of his default in this respect. Proper scaffolding shall be provided to allow easy approach to every part of the work. Overhead work shall not be allowed.

3.3 Tools and Accessories

Tools and accessories used in plaster work shall conform to IS: 1630. All tools shall be cleaned by scrapping and washing at the end of each day's work or after use. Metal tools shall be cleaned after each operation. All tools shall be examined to see that they are thoroughly cleaned before plastering is begun.

3.4 Programme of work in relation to plastering

The programme of other building operations before, during and after plastering shall be according to the instructions contained in clause 9 of IS: 1661.

3.5 General Precaution in plastering

All general precautions as specified in IS. 1661, Clause 9, shall be taken and preparation of the background shall be done as laid down in IS: 1661, Clause 13. Care shall be taken to see that other parts of the work or adjacent works are not damaged while plastering.

3.6 Preparatory work

All joints in the face work that is to be plastered shall be raked out to depth equal to not less than the width of the joints or as directed by the Engineer. The raking shall be done taking care not to allow by chipping of masonry. In new work the raking out shall be done when the mortar in the joints is still green. Smooth surfaces of concrete, old plaster, etc. must be suitably roughened to provide necessary bond for the plaster. All dirt, soot, oil paint or any other material that might interfere with satisfactory bond shall be removed. In the case of stone masonry, scrubbing on the walls to receive the plaster shall not be more than 12 mm (1 ½"). The surface to be plastered shall be cleaned and scrubbed with fresh water and kept wet for 6 hours prior to plastering. It shall be kept damp during the progress of the work. The plastering shall not be commenced unless the preparatory work is passed in writing by the Engineer.

In hand mixed mortar, cement and sand in the special proportions shall be thoroughly mixed dry on a clean impervious platform. Fresh and clean water as specified above shall be added gradually and thoroughly mixed to form a stiff plastic mass of uniform colour so that, each particle of sand shall be completely covered with a film of wet cement. The water cement ratio may be as under or as directed by the Engineer.

Cement	Sand	Water-Cement Ratio	Qty of Water per 50 kg of cement (Litres)
1	1	0.25	12.5
1	1- 1/2	0.28	19
1	2	0.3	15
1	2- 1/2	0.35	17.5
1	3	0.4	20
1	4	0.53	26.5
1	5	0.6	30

1	6	0.7	35
1	8	0.9	45

Machine mixed mortar shall be prepared in an approved mixer. Water cement ratio shall be as per hand mixed mortar. The mortar so prepared shall be within 30 minutes of adding water should be used in the work. The mortar remaining unused after that period mortar which has partially hardened or is otherwise damaged shall not be retermpered or remixed. It shall be destroyed or thrown away.

3.7 Gauges

Patches of plaster 15cm x 15cm shall be put on about 3 m apart as gauges to ensure even plastering in one plane.

3.8 Workmanship

Plastering:

In all plaster work the mortar shall be firmly applied with somewhat more than the required thickness and well pressed into the joints and on the surface and rubbed and levelled with a flat wooden rule to give required thickness. Long straight edges shall be freely used to give perfectly plane and even surface. All corners must be finished to their true angles or rounded as directed by the Engineer. The surface shall be finished to plane or curved surface as shown on the plan or directed by the Engineer, and shall present a neat appearance. The mortar shall adhere to the masonry surface intimately when set and there should be no hollow sound when struck. Cement plastering should be done in squares or strips as directed. Plastering shall be done from top downward.

First or Backing Coat

The first coat of the specified thickness shall be applied as described above. The subsequent coat shall be applied after this coat has been allowed to set for 3 to 5 days depending upon weather conditions. The surface shall not be allowed to dry during this period.

3.9 Plastering to Ceiling

Projecting burrs of mortar formed due to the gaps at joints in shuttering shall be removed. The surface shall be scrubbed clean with wire brushes. In addition concrete surface shall be poke marked with a pointed tool at spacing of not more than 50 mm centres, the pokes being made not less than 3 mm deep, to ensure a proper key for the plaster. The mortar shall be washed off and surface cleaned of all oil, grease etc., and well wetted before the plaster is applied.

4. SAND FACED PLASTER IN CEMENT MORTAR

4.1 Base Coat:

The base coat plaster shall be of cement mortar 1:4. Waterproofing compound of approved make shall be added according to the makers' instructions to make the mortar waterproof.

The plaster with this mortar shall be laid as specified above with a thickness of not more than 12 mm for brick work and concrete surfaces, and 15 mm for rubble stone masonry. Keys shall be formed on the surface by thoroughly combing it with wavy horizontal lines about 12 mm apart and about 3 mm deep when the mortar is still plastic. The base coat shall be cured for not less than 2 days.

4.2 Sand. Faced Treatment

The cement mortar for sand faced plaster shall have washed Kharasalis or similar type of approved sand with slightly larger proportion of coarse material. The proportion of cement to sand shall be 1:4. The water is added gradually to make the mixture homogeneous. The thickness of finishing coat shall not exceed 7 mm. After application, the surface should be finished with a wooden flat, lined with cork and tapped gently to retain a coarse surface texture. When the finishing coat has hardened, the surface shall be kept moist continuously for 14 days.

5. ROUGH COAT CEMENT PLASTER WITH CEMENT MORTAR

5.1. Base Coat

The first coat of plaster shall be of cement mortar of 1:4 mix and applied according to the relevant provisions of IS: 1661 Clause 14. 1. The finished thickness of the first coat shall be 12 mm for brick masonry or concrete surface and 1 5 mm for rubble stone masonry. The plaster shall be laid by throwing the mortar (by using a strong whipping motion) on the prepared surface with a trowel in a uniform layer, and pressed to form a good bond. The surface shall be roughened.

5.2. Second Coat

The second coat shall be the rough coat mixture consisting of aggregate, which may vary in size from 5 to 8 mm and may consist of specially graded mixture mixed with fine sand and cement. The proportion of cement to sand and aggregate shall be 1:11/2:3. It shall be flung upon the first coat with large trowels to form an even protective coat. The second coat must be applied while the first coat is still soft and plastic. The work shall generally conform to clause 16.5 of IS: 166. The thickness of the coat shall be about 12 mm.

6. NEERU FINISH

6.1 Materials

Cement, sand and other materials shall generally conform to relevant clauses of concrete specifications and Neeroo shall conform to clause c (i.e. pure fat lime) of IS: 712. All sand shall pass through IS sieve no. 60.

6.2 Preparation of Neeroo

Lime shall be slaked and mixed with sufficient water to form a thick paste. It shall be reduced to a fine paste by grinding. It shall then be passed through a fine sieve (3 mm mesh) to remove all unslaked particles and foreign matter and allowed to mellow under water for at least 10 days in large slaking tanks. The surplus water on the top shall be allowed to run off. The slaked lime paste thus formed shall be used for preparing Neeroo.

The Neeroo shall be prepared by mixing together 4 parts of this lime paste and 1part of fine sieved sand by volume. Jute fibre finely chopped shall be added to the above mortar at the rate of 4 kg of jute to every cu. meter of lime-sand mixture. The mixture shall then be properly ground to a fine paste between two stones or a mill. The Neeroo thus prepared shall be kept moist until used and no more than what can be consumed in 15 days shall be prepared at a time.

Ready mix Neeroo conforming to I.S or any other equivalent code shall be used with the approval of Engineer-in-charge.

6.3 Preparation of surface

The plaster surfaces shall be combed lightly with wire brushes or nails before it is completely set to form hey for Neeroo. The undercoat shall be only damped evenly but not soaked before the application of Neeroo.

6.4 Application

Neeroo shall be applied to the prepared and partially set but somewhat plastic surfaces with steel trowel to a thickness slightly exceeding 1.5 mm and rubbed down to I.5mm thickness and polished to a perfectly smooth and even finish working from top to bottom. While trowelling is going on, soap stone powder contained in thin muslin bags shall be dusted over the surface and worked in. Moistening shall be commenced as soon as the plaster has hardened sufficiently and is not susceptible to injury. Soaking of wall shall be avoided and only as much water as can be readily absorbed shall be used. The surface shall be kept sprinkled with water for 14 days. The finished surface shall be true and even and present a uniform texture throughout and all jointing marks shall be eliminated.

7. MESH TO WALLS:

a) Netlon Mesh:

Single layer "Netlon" Mesh (Diamond) of HDPE 105 gms/sqm, 300 mm wide shall be provided at junctions of brick masonry and concrete members to be plastered and other locations with overlap of 150 mm on either sides of the junction, properly stretched and nailed, ensuring equal thickness/width of plaster on both sides of the mesh.

b) GI Plaster Mesh:

Single layer of GI expanded metal mesh of 0.35 mm nominal thickness and 125 mm width shall be provided at junctions of brick masonry and concrete members to be plastered and other locations with equal overlap on either sides of the junction, properly stretched and nailed, ensuring equal thickness/width of plaster on both sides of the mesh.

8. POINTING

8.1 General

When the type of pointing is not mentioned in the item, sunk pointing is described below shall be carried out. All pointing shall be done with cement mortar 1: 2. The sand to be used shall be fine, passing through 600 Micron IS Sieve (IS 460 - 1962) and conforming in all other respect to IS 2116 - 1965. The mortar shall be pressed into raked out joints with a pointing trowel and finished either flush, sunk or raised according to type of pointing specified in the item. The lines and the surface shall be cleaned of all mortar. Finish shall be free of slick spots, cut faces and other blemishes. The pointing shall be done within three days of raking of joints so as to ensure good adhesion between the two mortars. The joints shall be neat, define, regular of the uniform width. The pointing shall be kept wet for 10 days. During this period it shall be suitably protected from all damages.

8.2 Preparation of surface

The joints in the masonry shall be raked out to a depth not less than the width of the joint as directed, preferably when the mortar is green. The joints are to be brushed clean of dust and loose particles with stiff brush. The area shall then be washed and the joints thoroughly wetted before pointing is commenced. All dust and oil matters, if any, shall be removed.

8.3 Proportion of mortar

The proportion of cement mortar shall be as described in item. The sand shall be from approved source free from foreign matter, washed clean if necessary and shall conform to IS 1542 - 1977. No excess cement mortar shall be prepared than that can be used within half an hour. The mortar may be hand mixed or machine mixed. In hand

mixed mortar, cement and sand in the specified proportion shall be thoroughly mixed dry on a clean impervious platform by turning over for at least 3 times or more till a homogenous mixture of uniform colour is obtained. Fresh and clean water shall be added gradually through a hose and thoroughly mixed so that mix becomes homogenous and each particle of sand shall be completely covered with a film of wet cement. Mixing platform shall be so arranged that no deleterious, extraneous material shall get mixed with mortar, .nor the mixing water of the mortar shall flow out. e) Application & finishing the mortar shall be pressed into racked out joints with a pointing trowel and finished either flush, sunk or raised according to type of pointing specified in the item or as directed. The superfluous mortar shall be cut off from the edges of the lines and the surfaces of masonry shall be cleaned of all mortar. Finish shall be free of slick spots, cut faces and other blemishes. The joints shall be neat & clean, define, regular of the uniform size and shape. No smearing of cement mortar shall be allowed and the entire work shall be carried out in most workmanlike manner. The pointing shall be kept wet for 7 days during this period it shall be suitably protected from all damages. Pointing shall be measured and paid for on area basis of masonry surfaces involved

8.4 Types of pointing

Pointing shall be of a type specified in the item, such as recessed, flush, ruled. Raised and cut, etc.

Recessed pointing

Water-proofing compound as approved, shall be added according to manufacturer's specifications to make the mortar waterproof. The raked out joints shall be filled with mortar of the specified mix and the required consistency and well pressed and rubbed smooth. A semicircular depression of 3mm dia. shall be made in the joint by pressing clean string with trowel keeping the string exactly horizontal and at the centre line of the joint. The vertical joints shall be similarly marked. These depressed lines will then be immediately rubbed with a 'nayla' till they become uniformly deep and 6mm wide and assume fairly blackish colour. Intersections of the horizontal and vertical joints shall be finished neatly with the vertical just touching the horizontal line, but not crossing it. All superfluous mortar shall be removed with the trowel. The brick surface shall be cleaned and no stain shall be allowed to remain. When joints are not horizontal or vertical as in the case of un-coursed rubble masonry, the pointing shall be made along the centre line of joints to uniform width and depth as directed and junctions of pointing made neatly. The pointing mortar shall not spread over the adjoining stones. Mortar pointing shall be restricted to the width of the joints and all superfluous mortar shall be removed with a trowel.

Flush pointing

This item shall be carried out when joints are not struck, while the masonry is being laid. All the specifications of recessed pointing shall apply to this as well, except making the lines with string and forming groove, etc. The joints shall be kept flush with face of joints in the masonry. The edges shall be neatly trimmed with trowel and straight edge. Ruled pointing The joint shall be initially formed as for flush pointing and then while the mortar is still green, a groove of shape and size shall be formed, by running a forming tool, straight along the centre line of joints, till a smooth and hard surface is obtained. The vertical joints shall also be finished in a similar way. The pointing line shall be uniform in width and truly horizontal and parallel in case of floors and ceilings.

Raised and cut pointing

This type of pointing shall project from the wall facing with its edges cut parallel so as to have a uniformly raised band, about 6mm raised and width 10mm or more as directed. The pointing shall be finished to a smooth, but hard surface

8.5 Raking Out Joints

Where the joints have not been raked out when the mortar is green, the joint shall be chipped (without damaging the masonry) to such a depth that the minimum depth of new mortar measured from either the sunk surface of the finished surface of the finished pointing or from the edge of the brick shall not be less than 12 mm, thoroughly cleaned off all loose particles with a stiff brush and thoroughly wetted.

8.6 Pointing

The mortar shall be pressed into the raked out joints with a pointing trowel. The mortar shall not spread over the corners, edges or the surface of the masonry. With a pointing tool, the mortar shall be neatly pressed back to about 3 mm or as directed. The vertical 'joints shall be pressed back similarly to match the horizontal joints. The surface of masonry shall be cleaned of all mortar.

8.7 Curing

The pointed face shall be kept continuously wet for 7 days suitably protected from all damage.

9. MEASUREMENT AND RATE

The item shall be measured in sq. metre areas as per IS: 1200 (Part XII). The rate shall include erecting and removal of scaffolding all labour, materials, equipment, plants, tools and all incidental expenses to complete plastering pointing rubbing out joints, cleaning, wetting, filling with cement mortar, trowelling etc. and making of drip moulds, grooves, etc.

Area of plastering will be measured net and shall be paid for. The measurement of length of wall plastering shall be taken between walls or partitions (dimensions before plastering shall be taken) for the length and from top of the floor or skirting or dado as the case may be to the under side of ceiling for the height.

The rate shall include the cost of finishing all the edges, corners, cost of all materials, labour, transport, scaffolding, curing etc. and grooves if so specified in the item of schedule of quantities.

12 FLOOR FINISHES

CONTENTS

17.0 Epoxy Coating

18.0 Polished Concrete Floor

FLOOR FINISHES

1.0 SCOPE

These Specifications covers flooring, skirting, dado or cladding works using different types of stone/ slabs/ tiles as detailed hereunder:

2.0 GENERAL

The provision of the latest revisions of the following IS Codes shall form a part of this specification to the extent they are relevant:

IS: 269	Specification for ordinary, rapid hardening and low beat Portland cement.
IS: 383	Specification for coarse and fine aggregate from natural sources for concrete
IS: 777	Specification for glazed earthenware tiles.
IS: 1200	(Part XI) Method of measurements for Building and Civil Engg. Works, paving, floor finishes, dado and skirting.
IS: 1237	Specification for cement concrete flooring tiles.
IS: 1443	Code of practice for laying and finishing of cement concrete flooring tiles.
IS-. 2541	Code of practice for use of lime concrete' in buildings.
IS: 2571	Code of practice for laying in situ cement concrete flooring
IS: 10067	Material Constants in Building Work

Other I.S Codes not specifically mentioned here, but pertaining to Floor Finishes form part of these specifications.

3.0 INDIAN PATENT STONE FLOORING.

3.1. Materials

Cement concrete: The cement concrete shall generally conform to specifications for ordinary concrete. The coarse aggregates shall be carefully selected, sufficiently tough and hard stone pieces broken in a manner that will provide particles of approximately cubical shape affording good interlocking. The maximum size of coarse aggregate shall be 12 mm. The fine aggregate shall consist of properly graded particles. The proportion of mix shall be M15. The least amount of mixing water that will produce a workable mix and will allow finishing without excessive trowelling shall be used. Generally a water cement ratio of 0.5 should suffice.

3.2. Workmanship:

The sub-grade in all cases shall be formed to proper levels and slopes, well compacted and cured. The top surface shall be kept slightly rough.

The surface of the sub-grade shall be cleaned off all loose materials and moistened immediately before laying the concrete floor. The concrete flooring shall be laid in alternate bays not exceeding 6.25 sq.m (about 64 sf.ft) each. The edge of each panel into which the floor is divided should be supported by flat bars of steel or wood duly oiled to prevent sticking. Their depth shall be the same as that proposed for the finished floor as mentioned in the item. The bars should be removed before filling in the adjoining panels. At least 48 hours shall elapse before the concreting in the adjacent bays is commenced.

The concrete shall be laid immediately after mixing. While being placed the concrete shall be vigorously sliced and spaded with suitable tools to prevent formation of voids or honey comb pockets. The concrete shall be brought to the specified levels by means of a heavy straight edge resting on the side forms and drawn ahead with a sawing motion in combination with a series of lifts and drops alternating with small lateral shifts. While concreting the adjacent bays care shall be taken to ensure that the edges of previously laid bays are not broken by careless or hard tamping.

Immediately after laying the concrete, the surface shall be inspected for high or low spots and any needed correction made up by adding or removing the concrete. After striking off the surfaces to the required grade concrete shall be compacted with a wooden float. The blows shall be fairly heavy in the beginning but as consolidation takes place, light rapid strokes shall be given to complete the ramming. The floating shall be followed by steel trowelling after the concrete has hardened sufficiently to prevent excess of fine material from working to the surface, The finish shall be brought to a smooth and even surface free from defects and blemishes and tested with straight edges. No dry cement or mixture of dry cement and sand shall be sprinkled directly on the surface of the concrete to absorb moisture or to stiffen the mix. After the concrete has been thoroughly rammed and has dried sufficiently to allow rendering to be worked up, surface shall be rendered with a thin coat of 1:1 cement mortar with fine sand and uniformly floated. If so directed by the Engineer-in-Charge, approved mineral colour pigment conforming to appendix-B of IS 657 shall be added to the cement mortar to give the required colour and shade to the flooring. When the cement mortar rendering is sufficiently stiff, lines shall be marked on it with strings or by any other device to give the appearance of tiles 30 x 30 cm or of any other size laid diagonally or square as directed by the Engineer-in-Charge. The junctions of floor and walls shall be rounded off if so directed, without any extra payment.

After the concrete in the bays has set, the joints of the panels shall be filled with cement cream or with suitable bitumastic compound as shown on the drawings or directed by the Engineer-in-Charge. Vertical edge of the bays shall be neatly marked on the surface of the concrete with a pointed trowel after filling the joints.

Finishing: When the rendering is somewhat stiff, neat cement may be sprinkled on sparingly through a paper pot on the surface and rubbed lightly to give smooth polished ordinary cement coloured surface. If coloured flooring is required by the Engineer-in-Charge the approved coloured cement shall be used. Surface shall be protected from direct sun when it is green.

Curing: Curing shall start on the next day after finishing and shall be continued for 14 days.

3.3. Cement Concrete Floor With Metallic Hardener Topping

Cement concrete flooring of specified thickness and mix as per 'Itemised Schedule of Quantities' shall be laid as specified under the specification of cement concrete flooring. The top surface shall be roughened with brushes while the concrete is still green and the forms shall be kept projecting up 12mm. Over the concrete surface to receive the metallic hardening compound topping. Metallic concrete hardener topping shall consist of 12mm thick layer of cement hardener of mix 1:2 (1 cement hardener: 2 stone aggregate 6mm nominal size by volume). The metallic concrete hardening compound of approved quality is mixed in the ratio of 1:4 (1 metallic concrete hardener: 4 cement by weight). Concrete hardener shall be fry mixed with cement and then with stone aggregate. The mixture by adding water so obtained shall be laid in 12mm thickness after putting cement slurry on cement concrete under-layer but within 2 to 4 hours of laying the under-layer. The surface shall be finished smooth and true to slope with steel floats. 3. RCC Floor Slab this shall be of RCC 1:2:4 nominal mix (M15 grade) of thickness 130mm or as indicated otherwise. The slab shall be reinforced with 8 mm MS bars at 200mm. Spacing both ways. The water cement ratio shall be adjusted suitably to provide a Slump of not more than 35mm. The flooring shall be laid in continuous panels of about 3 metre width dummy joints at every 6 metre length and full depth transverse expansion joints at every 30 to 40 metres. The expansion joints shall be filled with compressible pre-moulded joint filler such as Choksi or other approved make. The floor slab shall be laid in a workmanlike manner by workers skilled in this trade. Proper slopes and levels as indicated shall be maintained. Shuttering to sides of panels shall be of steel channels only. Concrete shall be vibrated after pouring with needle type vibrators. The work shall be measured and paid for as per IS 1200 inclusive of form work. Reinforcement shall be measured and paid for separately.

4.0 MARBLE STONE SLAB / GRANITE STONE/LIMTESTONE SLAB FLOORING

4.1. Material

Machine cut marble stone / granite stone slabs shall be of 20, 25, 30, thickness as specified in the item description. Colour shall be uniform and the slabs free from all defects. Tiles used at site shall be machine-cut. The slabs shall be made from selected stock, which are hard, sound, homogeneous and dense in texture and free from

flaws, angles and edges shall be true, square, and free from chipping and surface shall be plane. The slabs shall preferably to machine cut the required dimensions. Tolerance of +- 5mm in dimensions and +- 2mm in thickness will be allowed.

In machine-cut tiles, edges shall be protected from any damage in transit. No breakage shall be permitted. All edges shall be sharp, perfectly rectangular. Edges shall be pencil-rounded and polished for exposed corners and faces.

At its thinnest part, no stone shall be thinner than 25 mm. The flagstones shall be hard, sound, durable and wear resistant. Uniformity of size shall generally be maintained for the flags used in any one room. The stone flags shall be without any soft veins cracks or flows and shall have a uniform colour. They shall have even natural surfaces free from broken flakes on top and shall be true and square to ensure uniform width of joint. Samples of stone slabs to be used shall be got approved by the Engineer and the slabs to be used shall conform to the approved sample.

4.2. Bedding

Bedding shall be of cement-sand-mortar mix in a ratio of 1:6 unless specified otherwise in the BOQ/drawings. The base of cement or lime concrete shall be laid and compacted to a reasonably true plain surface and to the required slopes and level. The amount of water added shall be the minimum necessary to give just sufficient plasticity for laying and satisfactory bedding. Before spreading mortar, the sub-floor or base shall be cleaned off all dirt, scum or laitance and of loose material and then well wetted without forming any pools of water on the surface. In case of R.C.C floors, the top shall be left a little rough. The mortar shall then be evenly and smoothly spread over so much area as will be covered with slabs within half an hour. The thickness of the mortar bedding shall not be less than 12 mm and not more than 25 mm.

4.3. Laying

Laying of marble /granite stone slab flooring shall be as follows:-

Before laying, the stone slab shall be thoroughly wetted with clean water. Neat cement grout (pigmented to match the shade of the stone slab) of honey like consistency shall be spread on the mortar bed over as much areas as could be covered with the slabs within 15 to 20 minutes. Each stone slab shall be gently tapped with a wooden mallet till it is firmly and properly bedded. If there is a hollow sound on gentle tapping of the slabs such slabs shall be removed and reset properly. The joints shall be as thin as possible and limited to 2mm at the maximum. The stone slab shall be laid so as to give continuous parallel long joints with cross joints at right angles to them. The edges of the adjoining slabs shall be in one plane. Where the slabs cover open edges of floor or window sills the edges shall be neatly rounded off.

Laying shall start after due consideration is given to following points and approved by the Engineer.

I. Datum levels of floors in rooms, adjacent rooms, passages, etc.
II. Slopes, if provided, the flooring should be given by adjusting thickness of mortar.
III. Tiles in openings and doors are equally placed.
IV. Passage may be laid first to achieve evenness in doors.
V. Tiles in room shall be symmetrical and equal cut tiles shall be around the edges.
VI. In case of differently coloured tiles in passages and rooms, a dividing strip shall be provided and change over of colour shall be under the shutter.
VII. In case there is any other architectural or structural feature, the same shall be considered and the pattern adjusted accordingly.
VIII. Tiles may be allowed to go under plaster or dado about 10mm.

After the tiles are laid, surplus cement slurry from the joints shall be cleaned. The following day the joints shall again be cleaned, washed and wire brushed.

Grouting of joints shall be carried out with coloured (pigmented cement) cement or gray cement that matches the colour of tiles. Grout shall be worked into joint. Excessive grouts shall be cleaned off.

The floor shall be kept wet for a period of 7 days. No traffic shall be allowed on the bedding and bedded tiles for at least 2 days.

4.4. Polishing

Polishing and grinding shall be done only after 14 days. Machine cutting or grinding shall be carried out. At first the grinding shall be with rough stone of grade 48 to 60. All chips shall be visible and grinding shall be uniform. It shall be cleaned with water. All pin-holes and opened out joints shall be grouted with matching coloured cement grouts supplied by the tile manufacturer. It shall be cured for a period of 7 days by keeping it moist.

Second coat cutting/grinding shall be done with carbon-dum stone of grade 120. The same procedure as for the first coat shall be repeated till curing is completed.

The final cutting/grinding shall be with a fine stone of 220-320 grade and shall be done with ample water.

Oxalic acid powder shall be spread 33 gm/sq.m. And polished by machine fitted with Hessian bobs. The floor shall then be washed, cleaned and dried with a soft cloth or linen. Wherever corners of tiles are slightly low and remain unpolished, they should be hand polished by using rubbing stone.

In case of wax polishing, wax polish shall be applied to the surface. It shall be rubbed with machine. Then clean saw-dust shall be spread over the floor and rubbed with polishing machine. This will remove wax, leaving a glossy surface under-neath.

4.5. Measurement shall be done in square metres. Steps and risers for specified width and height shall be measured in running metres or as detailed in BOQ. Rates shall include costs for all labour, material, cutting, dressing, polishing of exposed faces and edges, wastage etc. including dry laying in pattern, providing dividing strips, special cut pieces of various sizes to create the pattern as shown in the drawing and polishing to required standard etc. No extras shall be permitted on any account.

5.0 MARBLE STONE / LIMESTONE / OTHER STONE SLAB FLOORING FOR TREADS:

The method of laying, bedding etc. for marble / other stone flooring in treads shall be similar to that for marble stone slab / granite stone slab flooring as specified in 4.0 above. Chamfering of the treads shall be rounded as directed. Final polishing may be done by hand.

6.0 SKIRTING / DADO OR CLADDING OF POLISHED STONE SLAB:

The backing for skirting / dado or cladding shall be cement plastered mentioned in the item, 12 mm to 20 mm thick and this plastering shall be done in a single coat. Thickness of joints shall not exceed 1.5 mm. Final polishing may be done by rubbing. The top of skirting or dado shall be jointed neatly with the plaster above as directed. The joints between the two slabs shall be filled with neat white cement and matching coloured pigment grout of appropriate consistency. All cutting joints to be in 450 machine cut, only for the staircase.

7.0 MEASUREMENT

Flooring shall be measured in Square Metres correct to two places of decimal while the individual dimensions shall be measured correct to one centimetre before laying skirting, dado or wall plaster. No deduction shall be made nor extra paid for any opening in the floor area up to 0. 1 sq. m. Nothing extra shall be paid for use of outlines nor for laying the floor at different levels in the same room. Treads of stairs and steps without nosing shall also be measured under flooring.

Risers of steps, skirting, cladding and dado shall be measured in square metres correct to two places of decimal. Length shall be measured in centimetre along finished face of the riser, skirting, cladding or dado correct to a centimetre. Height shall be measured from the finished level of tread or floor to the top.

8.0 JOINTS IN FLOORING

8.1 Joints:

Joints shall be provided in flooring to take care of expansion and contraction due to variations in temperature. In addition, construction joints shall also be provided in case of compulsory break in continuity of slabs due to the close of day's work and the commencement of the same the next day. The location and type of joints provided shall be as shown in the drawing or as directed by Engineer-in-charge. The edge of the slab at all joints shall be rounded with an edging tool having radius not greater than 6mm. It should be carefully ensured by proper vibration, that concrete at joints is free from honeycomb.

8.2 Transverse Joints .

Transverse joints shall be expansion, contraction or construction joints and shall be provided as shown in the drawing or as directed by Engineer-in-charge. They shall be at right angles to longitudinal joint surface of the floor. Contraction and expansion joints shall be continuous from edge to edge.

8.3 Transverse Expansion Joints :

These joints shall be provided at an interval or spacing of 30 m. They shall be pre moulded type and shall extend the entire width of the pavement and form sub-base to 25mm below the surface of the pavement. The gap width for this type of Joint shall be approximately 20 to 25mrn. The filler shall be held accurately in place during the placing of the concrete by a metal bulkhead, a metal channel cap or other approved method, Load transfer is effected through a system of reinforcement called dowel bar. Dowel bars are embedded and kept fixed in concrete at one end and is kept free to expand or contract by providing a thin coating of bitumen over it. Metal cap is provided at this end to offer a space of about 25mrn for movement during expansion.

8.4 Transverse Contraction Joints

These joints shall be provided at an interval on spacing of 10m, depending upon the type of aggregates. They shall be placed as shown in the drawing or as directed by the Engineer-in-charge. They shall be constructed by forming in the surface of the slab, a slot not less than 6mm wide and having a depth equal to one fourth depth of the concrete slab. This slot may be formed such as by pushing into concrete a flat bar or the web of a 'T' bar and keeping the slot open or any manner approved by the Engineer-in-charge. It shall be filled flush with top surface by using approved sealant.

8.5 Longitudinal Joints

Longitudinal joints, parallel to longer side of floor slab shall be of plain type and shall be formed by placing the concrete against the faces of the slabs concreted

earlier. The faces of the old concrete shall be painted with bitumen before placing fresh concrete.

The bar shall be used at longitudinal joints and they shall be of the dimensions and at spacing as shown in drawing or as directed by the Engineer-in-Charge. Tie bars shall be fairly well supported so as not to be displaced during construction operations.

9.0 CHINA MOSAIC FLOORING

9.1 General

The item refers to the provision of china mosaic surface (broken glazed tile pieces) set in cement mortar over waterproofing treatment well compacted and finished and laid in the required positions with white cement float as mentioned in the item.

9.2 Materials

a) Broken glazed tile pieces: These shall be obtained from broken glazed tiles of approved shade and manufacture and conforming to I.S. 777. The sizes of pieces should be suitable to obtain the correct pattern of flooring as shown on the drawings or as directed by the Engineer.

b) Cement: Cement in cement float shall be white cement or coloured as specified in the item.

c) Mortar bedding: Cement mortar bedding shall be laid as described in the water proofing item, the thickness of bedding being about 20mm laid to the required slopes shown on the drawings or directed by the Engineer.

d) Broken glazed tile pieces: These pieces shall be thoroughly wetted before fixing them. White cement grout as required of honey like consistency shall be spread over the mortar bedding when the mortar is still plastic. In this cement float glazed tile pieces shall be fixed piece by piece to the pattern as required. The fixing shall be done by keeping the joints between the pieces as thin as possible. The flooring shall be laid to correct level and slopes and compacted by striking the surface with hand thappies and straight screed tamper. The grout shall cream up to the surface. The junctions of the flooring and the parapet wall shall be rounded and the flooring shall be extended up the wall for 15cm or as specified. After the flooring has been laid or the day's fixing work is completed, surplus cement grout that may have come out of the joints on compacting shall be cleaned off. The flooring laid shall be kept moist and allowed to mature undisturbed for 10 days to allow the bedding and flooring to set properly.

9.3 Cleaning

Once the floor has set, it shall be carefully washed clean and dried. When dry, the floor shall be covered with oil free dry saw dust which shall be removed only after the construction work is completed.

9.4 Rate

The rate shall include all labour, materials, tools and equipment required for the following operations to carry out the item as specified above.

a) Fixing the broken glazed tile pieces in white cement float on the bedding (final coat of water proofing treatment) to the required pattern and compacting.
b) Curing
c) Cleaning the floor

9.5 Mode of Measurement

The length and breadth shall be measured along the rounding up to the top of the edge of the flooring, overlaps at the corner's being neglected.

10.0 GLAZED TILE FLOORING AND DADO

Glazed tiles shall, unless otherwise indicated, be 150mm x 150mm x 6mm thick in size and of best quality, Indian make obtained from approved sources. Glazed tiles shall be pure white or of colour as indicated. The tiles shall be sound hard, well and evenly glazed, free from twist, with fine and sharp edges. Different makes of tiles shall be brought for approval and samples of tiles shall be first got approved by the Engineer and all the tiles which shall be used in the work shall strictly conform to the approved sample otherwise all the tiles will be rejected. The surface to be laid for flooring or dado shall be thoroughly hacked; joints of masonry raked cleaned of all mortar scales, concrete lumps, loose materials, etc., and washed to remove mud, dirt, etc., from the surface. Unless and until the surface is approved by the Engineer, the flooring or dado shall not be started. The prepared surface shall be thoroughly drenched with water. The glazed tiles and all specials shall be soaked in water for a minimum period of 6 hours before use.

10.1 Flooring:

A bedding of 20 mm thick (unless otherwise specified) cement mortar 1:3 shall be laid evenly to levels or slope as directed. The tiles shall then be laid on the bedding with a backing of thin cement paste. All tiles shall truly and evenly set and pressed in position to obtain a uniform plane surface. The tiles shall be close jointed and all joints shall be uniform and run in perfect straight lines. The joints shall be staggered or continuous as directed. The other specials like, corner angles, elephant foots, bull eyes etc. shall be used at the proper places whenever required and as directed. The entire finished surface shall be thoroughly cleaned to remove all cement stains etc. The joints shall be kept wet for 7 days.

10.2 Dado:

The prepared surface shall be plastered with cement mortar 1:3 to get bedding of 12mm thick. The plastered surface shall be even uniform and true to plumb. The tiles shall be fixed in position with a backing of cement paste. All tiles shall be evenly set and pressed in position to a true plane surface. The specifications for workmanship regarding joints, specials, cleaning, pointing, curing etc. shall be exactly similar to tile flooring. The flooring and dado shall be finally cleaned with diluted hydrochloric acid and water to produce a clean white and shining surface. Measurement shall be for the actual area. The dimensions shall be taken on the glazed tiled surface. The rate shall include for all specials such as comer angles, elephant foots, bulls eyes etc. The unit of measurement shall be 1 Sq. m.

10.3 Ceramic Tiles /Vitrified tiles

Ceramic tiles shall be 300mm x 300mm x 7mm thick in size, Vitrified tiles to be 600x600x10mm thick or as specified in the Item and of best quality, Indian make obtained from approved manufacturer. The tiles shall be sound, hard, well and evenly treated, free from twist, with fine and sharp edges. Sample of the tiles shall be first got approved by the Engineer in case of the Contractor's supply and all the tiles which shall be used in the work shall strictly conform to the approved sample otherwise all the tiles will be rejected. The surface to be laid for the flooring or dado shall be thoroughly hacked, joints of masonry racked, cleaned of all mortar scales, concrete" lumps, loose materials, etc. and washed to remove mud, dirt, etc. from the surface. Unless and until the surface is approved by the Engineer, the flooring and dado shall not be started. The prepared surface shall be thoroughly drenched with water.

10.4 Flooring

A bedding 20 mm thick (unless otherwise specified) of cement mortar 1:3 shall be laid evenly to levels or slope as directed, The tiles shall then be laid on the bedding with a backing of thin cement paste. All tiles shall be truly and evenly set and pressed in position to obtain a uniform plane surface. The tiles shall be closed jointed and ail joints shall be uniform and run in perfect straight lines. Joints shall be filled with matching cement paste. Entire finished surface shall be thoroughly cleaned to remove all cement stains, etc. The joints shall be kept wet for 7 days. Epoxy joints can also be used as a substitute for cement paste. If adhesive are used for flooring, use

10.5 Dado:-

The prepared surface shall be plastered with cement mortar 1:3 to get a bedding of 12mm thick. The plastered surface shall be even, uniform and true to

plumb. The tiles shall be fixed in position with a backing of cement paste or water proof adhesive of approved manufacturer as specified in the item. All tiles shall be evenly set and pressed in position to a true plane surface. The specifications for workmanship shall be exactly similar to tile flooring. The joints shall be filled with matching cement paste or with joint filler material of approved manufacturer as specified in the item.

11.0 TWIN GRANITE/MARBLE STONE FRAMES

Bedding shall be of grey cement-paste with minimum cement consumption of 0.21 bags per smt. of applied area, unless specified otherwise in the BOQ/drawings. The base of cement shall be compacted to a reasonably true plain surface and to the required and level. The amount of water added shall be the minimum necessary to give just sufficient plasticity for laying and satisfactory bedding. Before spreading paste, the sub- base shall be cleaned off all dirt, scum or laitance and of loose material and then well wetted without forming any pools of water on the surface. The paste shall then be evenly and smoothly spread over so much area as will be covered with slabs within half an hour. The thickness of the paste shall not be less than 6 mm and not more than 12 mm.

The joints shall be cleaned & properly grouted with a neat paste of white cement with minimum cement consumption of 0.55 kg per smt

The proportion of mortar bedding shall be 1:4, unless & otherwise prescribed any other proportion and shall be as per IS 2116-1965, as applicable to non-reinforced masonry work. The adhesion of two slab frames overlay shall be ensured with approved adhesive.

Laying: Laying of marble /granite stone slab frame shall be as follows:-
Before laying, the stone slab shall be thoroughly wetted with clean water. 20mm thick marble slab / tiles shall be fixed with polymer modified cement adhesive or cement paste (as per BOQ) each stone slab then shall be gently tapped with a wooden mallet till it is firmly and properly bedded. If there is a hollow sound on gentle tapping of the slabs such slabs shall be removed and reset properly. The joints shall be as thin as possible and limited to 2mm at the maximum. Unless & until detailed in the BOQ or Drg, exposed edges of window sills/door frames, the edges shall be neatly rounded off.

Laying shall start after due consideration is given to following points and approved by the Engineer.

The vertical surface for frame cladding work should be rough, fairly in plumb & in right angles with each other,

Concealed plumbing & electric conducting shall be complete before the execution of frame cladding work.

Check all the right angles of the corners of bath/W.C. /toilet or pantry area. Please ensure that the plaster is in plumb.
Check the level of the wooden Patti with spirit level before commencing the cladding work.

After the frames are laid, surplus cement slurry from the joints shall be cleaned. The following day the joints shall again be cleaned, washed and wire brushed.
In case not specified in the Drawing or BOQ, and if the projection is not recommended, 6mm groove to be provided at the junction of the wall & stone frame.

Polishing and grinding shall be completed on the surfaces & edges before the laying of the stone frames. At first the grinding shall be with rough stone of grade 48 to 60. All chips shall be visible and grinding shall be uniform. It shall be cleaned with water. All pin-holes and opened out joints shall be grouted with matching coloured cement grouts supplied by the tile manufacturer. It shall be cured for a period of 7 days by keeping it moist.

Second coat cutting/grinding shall be done with carbon-dum stone of grade 120. The same procedure as for the first coat shall be repeated till curing is completed.

The final cutting/grinding shall be with a fine stone of 220-320 grade and shall be done with ample water.

Oxalic acid powder shall be spread 33 gm/sqm. and polished by machine fitted with Hessian bobs. The floor shall then be washed, cleaned and dried with a soft cloth or linen. They should be hand polished by using rubbing stone.

In case of wax polishing, wax polish shall be applied to the surface. It shall be rubbed with machine. Then clean saw-dust shall be spread over the slab and rubbed with polishing machine. This will remove wax, leaving a glossy surface underneath.

Rates:
Apart from other factors mentioned elsewhere in this contract, the rate shall include for the following:
All labour, materials(except for owner supplied ones), equipments, cleaning of the sub-base, laying mortar bed and adhesives, grout, fixing marble slabs as specified above and making up the joints.

Transportation of material / equipment

Any cutting and wasting if required

Mouldings & edge polishing

All adhesives and grouts and mastic sealants etc.

Curing

Cleaning the floor & surrounding areas all stains, etc.

12.0 Terrazzo / Cement Tile Flooring, Skirting /Dado etc.

In-situ Terrazzo flooring, the under layer shall consist of cement concrete mix 1:2:4, (the max size of aggregate shall not exceed 10mm), the thickness of which shall not be less than 40mm.

The Terrazzo topping shall be white or grey cement based whichever is specified in the BOQ, with or without pigment, marble chips of best approved quality, as specified in IS 2114.

The floor surface to be cleaned of all dirt, dust, laitance and loose material, thoroughly wet with water and then smeared with cement slurry. Cement concrete underlay should be laid in bays not exceeding 1.5sqm in area. The top surface of the screed shall be well scratched while it is not sufficiently hard to form key for terrazzo topping. 3mm Glass jointing strips shall be placed to form bays as directed. When the screed has sufficiently hardened, but not later than 24 hours, it shall be thoroughly cleaned, washed with water. Terrazzo top layer shall then be laid in alternate bays in plastic condition, well trowelled in position. Surplus moisture and cement slurry from surface shall then be removed and allowed to set. The entire surface to be kept wet for 7 days. Initial grinding to be done with 24 or finer grit stones followed by grinding with 80 or finer grit stones (or comparable diamond plates). Cleanse terrazzo with clean water and rinse. Apply grout using identical cement and colour pigments as used in topping, taking care to fill voids. Allow grout to cure. Grind with 80 or finer stones until all grout is removed from surface, terrazzo should show a minimum of 70% of marble chips. Wash with neutral cleaner, rinse and dry, apply clear terrazzo sealer. The rate to include cleaning, and applying Oxalic acid.

For skirting/Dado:- The surface shall be prepared on plastering work, wherever required. If shown in the drawings, the junction of floor and dado shall be rounded off. After the work is complete it should be kept wet for 7 days. Terrazzo skirting and dado shall consist of an under coat of cement sand plaster 1:4, of thickness not exceeding

12mm. This shall be laid simultaneously to the floor and maintaining the joints.. Joints shall be filled with 3mm glass strips.

Proportion of material:-

The Dry polymers that would go into the mortar for Insitu Terrazzo Floors. Ratio in which these dry polymers are to be added: For 100 sqft. Flooring you would require: 2 bags White Cement 100 kg 1 bag Dolomite Powder 50 kg 3 bags Marble Chips 150 kg

1) Agitan P 840 - 0.2 - 0.5 %

2) Metolat P 871 - 0.2 - 0.4%

3) Melment F 10 - 0.5 - 1 % of the total weight of the binder (OPC) Kindly note that the above mention raw materials are required to make 100 sqft of Terrazzo flooring at an average thickness of 8 - 10 mm.

13.0 INTERLOCKING PAVING BLOCKS:-

The cement used in the manufacture of high quality pre-cast concrete paving blocks shall be conforming to IS 8112 (43 grade Ordinary Portland cement) or IS 12269 (Ordinary Portland Cement). The minimum cement content in concrete used for making Paver blocks should be 380 Kg/cum.

The fine and coarse aggregates shall consist of naturally occurring crushed or uncrushed materials which apart from the grading requirements comply with IS-383-1970. The fine aggregate used shall contain a minimum of 25% natural silicon sand. Lime stone aggregates shall not be used. Aggregates shall contain no more than 3% by weight of clay & shall be free from deleterious salts and contaminants..

The water shall be clean and free from any deleterious mater. It shall meet the requirements stipulated in IS: 456-2000. Any other materials/ingredients used in the concrete shall conform to IS specifications.

<u>Paver Block Characteristics</u>

The concrete pavers should have perpendicular ties after release from the mould and the same should be retained until the laying.

The surface should be of anti skid and anti glare type.

The Paver should have uniform chamfers to facilitate easy drainage of surface run off.

The pavers should have uniform interlocking space of 2mm to 3mm to ensure compacted sand filling after vibration on the Paver surface.

The concrete mix design should be followed for each batch of materials separately and automatic batching plant is to be used to achieve uniformity in strength and quality.

The pavers shall be manufactured in single layer only.

Skilled labour should be employed for laying blocks to ensure line and level of laying, desired shape of the surface and adequate compaction of the sand in the joints.

The pavers shall be of cement grey colour without any pigment.

The bedding sand shall consist of clean well graded sand passing through 4.75 mm sieve and suitable to concrete manufacture. The bedding should be from either a single source or blended to achieve the following grading.

SIEVE SIZE	% PASSING
9.52mm	100
4.75mm	95-100
2.36mm	80-100
1.18mm	50-100
600 microns	25-60
300 microns	10-30
150 microns	5-15
75 microns	0-10

Contractor shall be responsible to ensure that single sized, gap graded sands or Sands containing an excessive amount of fines or plastic fines are not used. The sand particles should preferably be sharp not rounded, as sharp sand possess higher strength and resist the migration of sand from under the block to less frequently area. Even though sharp sands are relatively more difficult to compact than rounded sands, the use of sharp sands is preferred for the more heavily trafficked driveways. The sand use for bedding shall be free of any deleterious soluble salts or other contaminants likely to cause efflorescence. The sand shall be of uniform moisture content and within 4% - 8% by weight when spread and shall be protected against rain when stockpiled prior to spreading. Saturated sand shall not be used. The bedding sand shall be spread loose in a uniform layer as per drawing. The compacted uniform thickness shall be of 50mm and within + 5 mm. Thickness variations shall not be used to correct irregularities in the base course surface. The spread sand shall be carefully maintained in a loose dry condition and protected against pre-compaction both prior to and following screeding. Any pre-compacted sand or screeded sand left overnight shall be loosened before further laying of paving units take place. Sand shall be slightly screeded in a loose condition to the pre determined depth only slightly ahead of the laying of the paving

unit. Any depressions in the screeded sand exceeding 5mm shall be loosened, raked and re-screeded before laying of paving units.

Laying of Paving Units:

Paving units shall be laid in the approved design pattern throughout the pavement. Once the laying pattern has been established, it shall continue without interruption over the entire pavement surface. Cutting of blocks, the use of infill concrete or discontinuities in laying pattern is not be permitted in other than approved locations.

Paving units shall be placed on the un-compacted screeded sand bed to the nominated laying pattern, care being taken to maintain the specified bond through Out the job. The first row shall be located next to an edge restraint. Specially manufactured edge paving units are permitted or edge units may be cut using a power saw, a mechanical or hydraulic guillotine, bolster or other approved cutting Machine.

Paving units shall be placed to achieve gaps nominally 2 to 3mm wide between adjacent paving joints. No joint shall be less than 1.5 mm nor shall more than 4 mm. frequent uses of string lines be used to check alignment. In this regard, the “laying face” shall be checked at least every two meters as the face proceeds. Should the face become out of alignment, it must be corrected prior to initial compaction and before further laying job is proceeded with. In each row, all full units shall be laid first. Closure units shall be cut and fitted subsequently such losure units shall consist of not less than 25% of a full unit. To infill spaces between 25mm and 50mm wide, a concrete having screened sand, coarse aggregate mix and strength of 45 N/Sq.mm shall be used. Within such mix the nominal aggregate size shall not exceed one third the smallest dimension of the infill spaces. For smaller spaces dry packed mortar shall be used. Except where it is necessary to correct any minor variations occurring in the laying before the paving units shall not be hammered into position. Where adjustment of position necessary care shall be taken to avoid premature compaction of the sand bedding.

Joint Filling

As soon as practical after compaction and in any case prior to the termination of work on that day and prior to the acceptance of construction traffic, sand for joint filling shall be spread over the pavement. The jointing sand shall be broomed to fill the joints. Excess sand shall then be removed from the pavement surface and the jointing sand shall be compacted with not less than one (1) pass the plate vibrator and joints refilled with sand to full depth. This procedure shall be repeated until all joints are completely filled with sand. No traffic shall be permitted to use the pavement until al joints have been completely

filled with sand and compacted. Both the sand and paving units shall be dry when sand is spread and broomed into the joints to prevent premature setting of the sand.

14.0 PRESSED CEMENT TILE FLOORING :-

The cement tiles for flooring and skirting shall be hydraulically pressed under a minimum pressure of 140 kg / sqcm/ and shall conform to IS 1237-1959 in respect of constituent materials manufacture, shape, tolerances, wearing layers, colour, appearance, general quality of tiles, strength, resistance to wear, water absorption and other tests. The tile shall be nominal size and thickness as specified in the schedule for flooring, skirting, dado work etc. and shall be of approved make. The Architect/PMC shall be at liberty to inspect the manufacture of tiles even at the factory to ascertain whether the manufacture is as per the approved tiles for its quality of materials and manufacture.

15.0 IPS WITH NON METAL HARDNERS:-

Cement concrete flooring of specified thickness and mix as per 'Itemized Schedule of Quantities' shall be laid as specified under the specification of cement concrete flooring. The top surface shall be roughened with brushes while the concrete is still green and the forms shall be kept projecting up 12mm. Over the concrete surface to receive the metallic hardening compound topping.

The non metal hardeners shall be as per the manufacturer's specifications. All installation procedure, mixing, laying procedure shall be as per manufacturer's specifications

16.0 Epoxy Coating:-

Epoxy coating should be based on carefully selected solvent less Epoxy resin composition. It should be a 3 component system consisting of base, hardener and hard wearing quartz fillers. It should be self levelling composition and forms a very smooth, attractive hygienic, hard wearing and chemical resistant floor topping.

It should provides a joint less flooring making it dust free and is easy to clean because of smooth surface.

Chemical Resistant – It should have excellent chemical resistance to most chemicals

Wear Resistant – It should provide a tough floor topping to withstand foot and light vehicular traffic.

<u>SURFACE PREPARATION</u>

The long term durability of the applied Epoxy topping is dependent upon the adhesive bond achieved between the flooring material and substrate. It is most important therefore, that substrate surface is correctly prepared prior to application.

Substrate must be of sufficient strength to support loads applied through the topping. New concrete or cementitious substrates should have been placed for at least 28 days and have a moisture content of less than 5% before topping. Before application, the surface to be coated should be free from loose particles, rust, oils, Grease or earlier coatings and should be thoroughly dry. After surface is dry, all repair work like sealing of joints, cracks filling of cavities and crevices should be carried out. 5. The self leveling action is much localised and does not eradicate irregularities of level present in the original substrate. It is most important, therefore, that adequate surface preparation and repair is undertaken prior to application of flooring systems.

PRIMING

To be as per manufacturer's specifications.

MIXING

To be as per manufacturer's specifications.

LAYING

Spread the mixture on the floor immediately to the required thickness by means of rollers and serrated trowels. The floor should be rolled by a spike roller to remove trapped air. The floor shall self level to uniform colour and smoothness.

17.0 Polished Concrete Floor :-

Polishing concrete is similar to sanding wood. Heavy-duty polishing machines equipped with progressively finer grits of diamond-impregnated segments or disks (akin to sandpaper) are to be used to gradually grind down surfaces to the desired degree of shine and smoothness.

Contractors can polish concrete using wet or dry methods, but typically they use a combination of both.

The wet process uses water to cool the diamond abrasives and eliminate grinding dust. Because the water reduces friction and acts as a lubricant, it increases the life of the polishing abrasives, particularly the resin-bonded disks, which can melt at high temperatures. A disadvantage of the wet process is the mess. Crews must collect and dispose of the slurry that's generated, which slows productivity.

Dry polishing requires no water. Instead, contractors use machines equipped with dust-containment systems that eliminate virtually all of the mess. Typically dry polishing is used for the initial grinding steps, when more concrete is being removed. As the surface becomes smoother, and crews switch from the metal-bonded to the finer resin-bonded diamond abrasives, they generally change to wet polishing. However, some manufacturers have introduced resin-bonded disks that are designed to withstand the friction of dry polishing, allowing the entire process to be done dry.

13 PAINTING

CONTENTS

PAINTING

1. SCOPE

These specifications cover the use of paints for the plastered and concrete surfaces. It also includes the painting of wood and metal surfaces. The paint to be low VOC. Conventional paints contain Volatile Organic Compounds (VOC), which are petroleum-based solvents that evaporate from paint films while the paint is drying. These compounds are the unpleasant solvent fumes that may trigger respiratory reactions including asthma and breathing discomfort, when using conventional paints. They also contribute to greenhouse gas emissions.

Traditional oil based paints (also known as alkyd enamels) have a solvent level of approximately 50% or more. This means that for every four-litre can of enamel, two litres go straight into the atmosphere, compounding the “Greenhouse Effect”. Conventional water-borne paints have a solvent level of around 7%, so obviously using water-borne paints is a far more environmentally responsible option.

Additives classified as VOCs are included to achieve some of the positive attributes of paint, such as good coverage, easy application and washability. The challenge for manufacturers, is delivering the quality of paint finish customers have come to expect, whilst reducing the overall environmental impact of each tin.

Low VOC paints, stains and varnishes use water as a carrier instead of petroleum-based solvents. As such, the levels of harmful emissions are lower than solvent-borne surface coatings. These certified coatings also contain no, or very low levels, of heavy metals and formaldehyde. The amount of VOC's varies among different "low-VOC" products, and is listed on the paint can or MSDS. Paints and stains, to meet EPA standards. must not contain VOCs in excess of 200 grams per litre. Varnishes must not contain VOCs in excess of 300 grams per liter.

As a general rule, low VOC paints marketed by reputable paint manufacturers usually meet the 50 g/L VOC threshold. Paints with the Green Seal Standard (GS-11) mark are certified lower than 50 g/L.

Low VOC paints will still emit an odor until dry. If you are particularly sensitive, make sure the paint you buy contains fewer than 25 grams/liter of VOC's

2. GENERAL

The provisions of the latest revisions of the following IS: Codes shall form a part of this specification.

IS: 63 Whiting for Paints Ready mixed paint, brushing, grey filler, for Enamels, for use over primers.

IS: 426 Specification for paste filler for colour coats.

IS: 428 Specification for Distemper, Oil Emulsion, and colour as required.

IS: 710 Marine Plywood

IS: 1200 (Part XIII) Method of Measurement of Building and Civil Engg Works - White Washing, colour washing, distempering and other finishes.

IS: 1477 (Part 1) Code of practice for painting of ferrous metals in buildings Pre-treatment

IS: 1477 (Part 11) Code of practice for finishing of ferrous metals in buildings Painting

IS: 2338 (Part 1) Code of practice for finishing of wood and wood based materials Operations and workmanship for finishing.

IS: 2338 (Part 11): Code of practice for finishing of wood and wood based materials, Schedule.

IS: 2395 (Part 1): Code of practice for painting concrete masonry and plaster surfaces. Operation and workmanship

IS: 2395 (Part 11) Code of practice for painting concrete, masonry and plaster surfaces. Schedule.

IS: 159 Specification for ready mixed paint, brushing, acid resistant.

IS: 2524 (Part 1) Code of practice for painting of non-ferrous metal in buildings Pre-treatment

IS: 2524 (Part ll) Code of practice for painting of non-ferrous metal in buildings Painting

IS: 3140 Code of practice for painting asbestos cement buildings:

IS: 5410 Specification for cement paints, colour as required.

Other IS Codes not specifically mentioned here, but pertaining to painting form part of these specifications.

3. MATERIALS

Materials shall strictly conform to the relevant IS: Specifications.

4. PLASTERED OR CONCRETE SURFACES

4.1 <u>General</u>

Wherever scaffolding is necessary, it shall be erected in such a way that as far as possible no part of scaffolding shall rest against the surface to be painted. Properly secured and well tied suspended platforms (JHOOLA) may be used for painting. Where ladders are used, pieces of old gunny bags shall be tied at top and cotton to

prevent scratches to the walls and floors. For painting of ceilings, proper stage scaffolding shall be erected, where necessary.

Please note that the figures below are a guide only, as the actual VOC rating will depend on gloss level selected. All figures exclude tinting. -Note that the exact VOC rating will vary depending on the sheen level, so the range is given to cover all.

All measurements are in grams per litre for untainted product

The surface shall be thoroughly cleaned off all dirt, dust, mortar dropping and other foreign matter, before paint is to be applied. New plaster surfaces shall be allowed to dry for at least 2 months, before applying paint. All unnecessary nails shall be removed. Pitting in plaster shall be made good with putty. The surface shall then be rubbed down again with a fine grade sand paper and made smooth.

The surface shall be allowed to dry thoroughly before the regular cost of paint is allowed.

The surface affected by moulds moss, fungi, algae, linens, efflorescence shall be treated in accordance with IS 2395 (Part 1) before applying paint.

4.2 Oil-Bound Distempering

a) Preparation of Surfaces:
Any unevenness shall be made good by applying putty, made of plaster of Paris mixed with water on the entire surface including filling up the undulation and then sand papering the same after it is dry.

b) Primer Coat:
The primer where used as on undercoated surfaces shall be alkali resistance primer or distemper primer as specified in the item. These shall be of the same manufacture as of oil bound distemper. If the wall surface plaster has not dried completely alkali resistance primer shall be applied before distempering the walls. But if the distempering is done after the wall surface is dried completely, distemper primer shall be applied.

c) Application:
Primer shall be applied with a brush on the clean dry and smooth surface. Horizontal strokes shall be given first and vertical strokes shall be applied immediately afterwards. This entire operation will constitute one coat. The surface shall be finished as uniformly as possible leaving no brush marks. It

shall be allowed to dry for at least 48 hours, before oil bound distemper or paint is applied.

d) Preparation of oil bound distemper:

The distemper shall be diluted with water or any other prescribed thinner in a manner recommended by the manufacturer. Only sufficient quantity of distemper required for days work shall be prepared.

e) Application of distemper coat:

After the primer coat has dried for at least 48 hours, the surface shall be lightly sand papered to make it smooth for receiving the distemper, taking care not to rub out the printing coat. All loose particles shall be dusted off after rubbing. Minimum two coats of distemper shall be applied with brushes in horizontal strokes followed to immediately by vertical which together shall constitute one coat. The subsequent coats shall be applied after a time interval of at least 24 hours between consecutive coats to permit the proper drying of the preceding coat.

The finished surface shall be even and uniform without patches, brush marks, distemper, drops, etc.

Sufficient quantity of distemper shall be mixed to finish one room at a time. The application of a coat in each room shall be finished in one operation and no work shall be started in any room, which cannot be completed the same day.

15 cm. double bristled distemper brushes shall be used. After each days work, brushes shall be thoroughly washed in hot water with soap solution and hung down to dry. Old brushes which are dirty and caked with distemper shall not be used on the work.

4.3 Water Proof Cement Paint

a) Preparation of Surfaces:

The surfaces shall be thoroughly wetted with clean water before the water proof cement paint is applied.

b) Preparation of Paint:

Portland cement paints are made readily by adding paint power to water and stirring to obtain a thick paste which shall then be diluted to a brushable consistency. Generally equal volumes of paint powder and water make a satisfactory paint. In all cases the manufacturer's instructions shall be followed.

The paint shall be mixed in such quantities as can be used up within an hour of mixing as otherwise the mixture will set and thicken, affecting flow and finish.

The lids of cement paint drums shall be kept tightly closed when not in use, as by exposure to atmosphere the cement paint rapidly becomes air set due to its hydroscopic qualities.

c) Application of Paint:

No painting shall be done when the paint is likely to be exposed to a temperature of below 7 degree within 48 hours after application.

When weather conditions are such as to cause the paint to dry rapidly, work shall be carried out in the shed as far as possible. This helps the proper hardening of the paint film by keeping the surface moist for a longer period.

To maintain a uniform mixture and to prevent segregation the paint shall be stirred frequently in the bucket.

For undecorated surfaces, the surface shall be treated with minimum two coats of water-proof cement paint. Not less than 24 hours shall be allowed between two coats and the second or subsequent coat shall not be started until the preceding coat has become sufficiently hard to resist marking by the brush being used. In hot dry weather the preceding coat shall be slightly moistened before applying the subsequent coat.

The finished surface shall be even and uniform in shade without patches, brush marks, paint drops, etc.

Cement paints shall be applied with a brush with relatively short stiff hog or fibre bristles. The paint shall be brushed in uniform thickness and shall be free of excessively heavy brush marks. The laps shall be well brushed out.

d) Curing

Painted surfaces shall be sprinkled with water two or three times a day. This shall done between coats and for at least two days following the final coat. The curing shall be started as soon as the paint has hardened so as not to be damaged by the sprinkling of water say about 12 hours after its application.

5. PAINTING WOOD AND METAL SURFACES

5.1 General Requirement:

The materials required for the execution of painting work shall be obtained directly from approved manufacturers and brought to the site in maker's drums, with seals unbroken. All paints shall conform to relevant Indian Standards as mentioned under sub-head "Material".

All materials not in actual use shall be kept properly protected. Lids of containers shall be kept closed and surface of paint in open or partially open containers covered with a thin layer of turpentine to prevent formation of skin. Materials which have become stale or fat due to improper and long storage shall not be used. The paint shall be stirred thoroughly in its container before pouring into small containers. While applying also, the paint shall be continuously stirred in the smaller container. No left over paint shall be put back into stock tins. When not in use, the containers shall be kept properly closed.

If for any reason thinning is necessary, in case of ready mixed paint, the brand of thinner recommended by manufacturer shall be used.

Painting except the priming coat shall generally be taken in hand after all other builder's work is practically finished. The rooms shall be thoroughly swept out and the entire building cleaned up at least one day in advance of the paint work being started. The surface to be painted shall be thoroughly cleaned and dusted. All rust, dirt scales, smoke and grease shall be thoroughly removed before painting is started.

No painting on exterior or other exposed parts of the work shall be carried out in wet, humid or otherwise unfavourable weather and all the surfaces must be thoroughly dry before painting work is started.

a) Brushing of Paint:

The brushing operations are to be adjusted to the spreading capacity advised by the manufacturers of the particular paint. The painting shall be applied evenly and smoothly by means of crossing and laying off, the later in the direction of the grain 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 alternatively in the opposite directions 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.

During painting, every time after the paint has been worked out of the brush bristles or after the brush has been unloaded, the bristles of the brush. (Which are drawn together due to the high surface tension) shall be opened up by striking the brush against a portion of the unpainted surface with the end of the bristles held at right angles to the surface, so that bristles thereafter will collect the correct amount of paint when dipped again into the paint container.

b) Spraying:

Where so stipulated, the painting shall be done with spray. 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 employed for this class of work. Paints used shall be brought to the requisite consistency by adding a suitable thinner.

Spraying should be done only when dry conditions prevails. During spraying the spray gun shall be held perpendicular to the surface to be coated and shall be passed over the surface in a uniform sweeping motion. Different air pressures and fan adjustment shall be tried so as to obtain the best application with the minimum wastage of paint. The air pressure shall not be kept too high as otherwise the paint will clog up and will be wasted.

Spots that are inaccessible to the spray pattern shall be touched up by brush after spraying.

At the end of the job, the spray-gun shall be cleaned thoroughly so as to be free from dirt. Incorrect adjustments shall be set right, as otherwise they will result in variable spray patterns, runs, sags and uneven coats.

Each coat shall be allowed to dry completely and lightly rubbed with very fine grade of sand paper and loose particles brushed off before next coat is applied. Each coat shall vary slightly in shade and shall be got approved `from the Engineer-in-charge before next coat is started.

Each coat except the last coat shall be lightly rubbed down with sand paper or fine pumice stone and cleaned off dust before the next coat is applied.

No hair marks from the brush or clogging of paint puddles in the corner panels, angles of moulding, etc. shall be left on the works. In painting doors and windows, the putty round the glass panes shall also be painted but care shall 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.

In painting steel work, special care shall be taken while painting over bolts, nuts, rivets, overlaps etc.

The additional specifications for primer and other coats of paints shall be according to the detailed specifications under the respective headings.

c) Brushes and containers:

After work, the brushes shall be completely cleaned off paint and linseed oil by rinsing with turpentine. After cleaning, the brushes are wrapped in heavy paper or water proof paper for storage. It is to be used the next day; it shall be hung in a thinner or linseed oil in a container. On no account shall brushes to be made to stand on bristles. 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 guarded from dust. When the paint has been used, the containers shall be washed with turpentine and wiped dry with soft clean cloth, before they can be used again.

5.2 Steel and other Metal Surfaces

a) Preparation of Surfaces:

The surface before painting shall be cleaned of all rust, scale, dirt and other foreign matter sticking to it with wire brushes, steel wool, scrappers, sand papers etc. The surfaces shall then be wiped finely with mineral turpentine which shall also remove grease and perspiration of hand marks. The surface shall then be allowed to dry.

The surface shall be treated with Mordant Solution (5 litres for about 190 sq.m) by rubbing the solution generously, with a brush or bundle of rags on a stick. After about half an hour, the surface will turn grey and parts remaining bright shall be retouched and the extra surface washed down thoroughly with clean cold water and allowed to dry.

b) Application of primers and paints:

After preparation of the surface, the priming coat shall be applied immediately. The specifications for application shall conform to Para 5.1 above.

5.3 Wood and wood Based Materials:

a) Preparation of Surface:

All wood work shall be dry and free from any foreign matter, incidental to building operation. Nails shall be punched well below the surface to provide a firm key for stopping. Moulding shall be carefully smoothened with abrasive paper and projecting fibres shall be removed. Flat portions shall be smoothened off with abrasive paper used across the grain prior to painting. Any knots, resinous, streaks or bluish sap wood that are large not enough to justify cutting out shall be treated with two coats of pure shellac knotting, applied thinly and extended about 25 mm beyond the actual area requiring treatment.

b) Plywood and Block Board:

This shall be treated as for solid wood, described above.

c) Hard Boards:

The surface shall be dusted off and painted with a coat of plastic emulsion paint thinned with water or with a coat of shellac varnish as specified. The surface shall then be rubbed down with fine grade abrasive paper and followed with required under coating and finishing coat as for soiled wood.

d) Particle Board:

The surface shall be filled with thin brushable filler and finished as for solid wood.

e) Insulation Boards:

Two thin coats of water based paints shall be applied by spraying.

f) Priming Coat:

The dirt or any other extraneous material shall be removed from the surface to be painted. In case the surface is already finished with printer coat but unsatisfactory, it shall be rubbed down to bare wood and surface re-primed. Primer shall be applied by brushing.

g) Application for transparent wood filler:

The filler shall be applied with brush or rag in such a way that it fills up all the pores and indentations and levels up the surface. It shall be allowed to dry for 24 hours and it shall then be cut and rubbed with emery paper so that the surface of the wood is laid bare, with, the filler only in the pores and crevices of the wood.

h) Stopping:

All holes, cracks, crevices, etc. shall be stopped carefully to true and level surface with putty before the main undercoat is applied and after the application of the priming coat, stopping shall be prepared as below:

Bees wax, resin and lac (orange in colour) in the proportion of 1: 1: 16 by weight shall be melted down together in a suitable pot using slow heat, the mix being kept well stirred. Colouring materials to produce the required shade shall be added into molten mixture and stirred. Stopping shall on cooling be rolled into stick forms for use.

i) Application of Paints:

This shall conform to specifications under Para 5. 1

j) Applying wood preservatives:

The preservatives of specified quality shall be applied in two coats. On new wood work, it shall be applied liberally with a stout brush and not doubled with rags or cotton waste, the first coat shall be allowed at least 24 hours to soak in before the second coat is applied. The excess of preservative which does not soak into the wood shall be wiped off with a clean dry piece of cloth.

6. WHITE WASHING

6.1. General

The item refers to white-washing over old and new concrete, stone masonry brick plastered surfaces and asbestos cement sheets.

White wash shall be prepared from fresh burnt white stone lime or shell lime. This lime shall be of class C type as per IS: 712. Surkhi lime or lime of equivalent quality may be used. The lime shall be dissolved in a tub with sufficient quality of water (about 4.5 litres/Kg. of lime) and the whole shall be thoroughly mixed and stirred until it attains the consistency of thin cream. The white wash shall be taken out in small quantities and strained through a clear course cloth. Alternatively with IS: 63 may also be used. Clean gum dissolved in hot water shall then be added in suitable proportion of 2 gm of gum Arabic to a litre of lime or whiting to prevent the white- wash coming off easily when rubbed. Rice may be used instead of gum.

6.2. Scaffolding:

This may be double or single according to requirements. If ladders are used, pieces of old gunny bags or cloth rags shall be tied on their tops to avoid damage or scratches to the wall. Proper stage scaffolding shall be created when white-washing ceiling. The contractor shall be responsible for accidents if any taken place.

6.3. Preparation of Surface:

The surface shall be prepared by removing all mortar dropping and foreign matter and thoroughly cleaned with wire or fibre brush or other means as may be ordered by the Engineer to produce an approved clean and even surface. All loose pieces and the scales shall be scraped off and holes stopped with mortar. In case where the surface have been previously coloured-washed, the old colour wash must be entirely removed before the white-wash is applied. In the case of surface which have once been white-washed, the old loose white-wash shall be broomed down. In case, the loose white-wash cannot be removed by brooming, the Engineer may order scraping of the surface.

After cleaning the surface as specified above, the unwanted nails shall be removed and all nail holes, cracks and crevices stopped with mortar similar in composition to the surface to be stopped. The mortar should be cured.

6.4. Application of white-wash:

On the surface so prepared, the white-wash shall he laid. Each coat shall be laid on with a brush. The first stroke of the brush shall be from the top downwards, another from bottom upwards over the first stroke, and similarly, one stroke from the right and another from the left over the first brush before it dries. This will form one coat. Each coat must be allowed to dry and shall be subject to inspection before the next coat is applied. When dry, the surface shall show no signs of cracking. It shall present a smooth and uniform finish free from brush marks and it should not come off easily when rubbed with a finger.

No portion in the surface shall be left out initially, to be patched up later on. For new work, the white washed surface shall present a smooth and uniform finish.

For old work, patches and repairs shall be white washed first. Thereafter, the whole surface shall be white washed with the required number of coats.

Doors, windows, floors and other articles of furniture, etc., shall be protected from being splashed upon. Splashing and droppings, if any, shall be removed and the surfaces cleaned.

Preparing the surface for white wash including the scaffolding.

Applying the white wash in required number of coats as specified above and prior white washing of repaired patched.

6.5. Mode of Measurement:

The contract rate shall be per unit area covered.

7. CONSUMPTION OF PAINT FOR DIFFERENT PAINTING ITEMS:

Sl no.	Brief description of painting work	Consumption per 10 sqm. Of net area
A	**Oil bound distemper on plastered surfaces:**	
1.	Cement primer (one coat)	0.91 litres
2.	Two finishing coats	1.60 kg
3.	Three finishing coats	2.4 kg
B	**Flat oil paint to plastered surfaces:**	
1.	Cement primer (one coat)	0.91 litres
2.	Cement primer (two coats)	1.82 liters
3.	Two finish coats	1.72 litres
C	**Acrylic emulsion paint:**	
1.	Cement primer (one coat)	0.91 litres
2.	Two finishing coats (two coats)	0.87 litres
3.	Three finish coats	1.30 litres
D	**Cement paint (old surface):**	
1.	Two coats on sand faced plastered surface	4.10 kg
2.	Two coats on rough cast plastered surface	7.70 kg
E	**Cement paint (old surface):**	
1.	Two coats on sand faced plastered surface	4.50 kg
2.	Two coats on rough cast plastered surface	8.50 kg
F	**Enamel paint to wood / steel:**	
1.	Wood primer (one coat)	0.90 litres
2.	Steel primer (one coat)	0.75 litres
3.	Two finishing coats on wood	1.40 litres
4.	Two finishing coats on steel	1.35 litres
G	**Flat oil paint to wood /steel work:**	
1.	Wood primer (one coat)	0.90 litres
2.	Steel primer (one coat)	0.75 litres
3.	Two finishing coats on wood	1.70 litres
4.	Two finishing coats on steel	1.70 litres
Sl no.	**Brief description of painting work**	**Consumption per 10 sqm. Of net area**
H	**External painting with flat oil paint:**	
1.	Cement primer (one coat)	1.00 litres

2.	Two finishing coats	1.74 litres
I	**Re-painting old painted surfaces:**	
1.	Two coats of emulsion paint	0.86 litres
2.	Two coats of flat oil paint	1.59 litres
3.	Two coats of enamel paint	1.35 litres

8. MEASUREMENT

Painting on plastered or concrete surface shall be measured as for plastering. Painting on wooden or metal surfaces shall not be measured separately and is deemed to be included in the respective item.

14 ROADS AND PAVEMENTS

SPECIFICATIONS FOR ROAD WORKS

1. APPLICABLE CODES AND SPECIFICATIONS

The following IS (Indian Standard) Codes and IRC (Indian Road Congress) Codes, specifications etc. shall be applicable. In all cases the latest revision of the codes and specifications shall be referred to:`

Sr. Nos.	IS / IRC Code Nos.	Description
1.	IRC : 86	Geometric Design standard for Urban roads in plans.
1a.	IRC : 92 :	Guidelines for the design of Interchanges for Urban areas.
2.	IRC : 16 :	Specification for priming of base course with Bituminous Primers.
3.	IRC : 29 :	Specification for Asphaltic Concrete.
4.	**MOST**	standard specifications for Road and Bridge works.
5	IS : 215;	Specifications for Road Tar.
6.	IS : 73 ;	Specifications for Paving Bitumen.
7.	IS : 454 :	Specification for Digboi type cut back Bitumen
8.	IS : 217 :	Specification for cut back Bitumen
9.	IS : 400 :	Specification for Test Sieve
10.	IRC : 17 :	Tentative specification for Single coat Bituminous Surface Dressing.
11. bound	IRC : 19 :	Standard specification and code of practice for water macadam.
12.	IS : 1195 :	Specifications for Bitumen mastic for Flooring
13.	IS : 2720 :	(Part 5) Method of Test for Soils: Determination of Liquid and Plastic Limit
14. road	IS : 6241 :	Method of Test for determination of stripping value of aggregates.
15.	IS : 1124 :	Method of Test for determination of water Absorption, apparent specific gravity &porosity of Building stone.
16.	IS : 456 :	Specifications for plain and reinforced concrete.
17.	IRC : 37 :	Guidelines for the Design of flexible Pavements.

NOTE

1. Relevant clauses of Ministry of Surface Transport (MOST) Specifications for Roads and Bridges relevant to this tender only are reproduced.
2. In case of any variation between the reproduced specification and the original specification of MOST Publication, the reproduce publication shall prevail and shall be construed accordingly.
3. If MOST clauses referred to in the reproduced specifications herein are not included in the latter, the same shall be read from MOST specifications.

2. CLEARING AND GRUBBING

2.1 SCOPE

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. which in the opinion of the Engineer are unsuitable for incorporation in the works, from the area of road land containing road embankment, drains, cross-drainage structures 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.

2.2 PRESERVATION OF PROPERTY/AMENITY

Roadside trees, shrubs, any other plants, pole lines, fences, signs, monuments, buildings, pipelines, sewers and all highway facilities within or adjacent to the highway 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.

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 Clause 306. 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.

2.3 METHODS, TOOLS AND EQUIPMENT

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 tyre 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 500mm of the sub-grade bottom. Also, all vegetation such as roots, under-growth, grass and other deleterious matter unsuitable for incorporation in the embankment/sub-grade shall be removed between fill lines to the satisfaction of the Engineer. On areas beyond these limits, trees and stumps required to be removed as directed by the Engineer, shall be cut down below ground level so that these do not present an unsightly appearance.

All branches of trees extending above the roadway shall be trimmed as directed by the Engineer.

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 at these points conform to the surrounding areas. Anthills both above and below the ground as are liable to collapse and obstruct free sub-soil water flow shall be removed and their workings, which may extend to several metres, shall be suitably treated.

2.4 DISPOSAL OF MATERIALS

All materials arising from clearing and grubbing operations shall be the property of Owner and be disposed of by the Contractor as hereinafter provided or directed by the Engineer. Trunks, branches and stumps of trees shall be cleaned of limbs and roots and stacked. Also boulders, stones and other materials usable in road construction shall be neatly stacked as directed by the Engineer. Stacking of stumps, boulders, stones, etc. shall be done at specified spots with all leads and lifts.

All products of clearing and grubbing which in the opinion of the Engineer cannot be used or auctioned shall be cleared away to waste areas and burnt, if so desired, at locations away from the road side in a manner as directed by the Engineer. Care shall be taken to see that unsuitable waste materials are disposed of in such a manner that there is no likelihood of these getting mixed-up with the materials meant for embankment, sub-grade and road construction.

2.5 MEASUREMENT FOR PAYMENT

Clearing and grubbing for road embankment, drains and cross-drainage structures shall be measured on area basis in terms of Square metres. Clearing and grubbing of borrow areas shall be deemed to be a part of works preparatory to embankment construction and shall be deemed to have been included in the rates quoted for the embankment construction item and no separate payment shall be made for the same. Cutting of trees up to 300 mm in girth including removal of stumps and roots, and trimming of branches of trees extending above the roadway shall be considered incidental to the clearing and grubbing operation. Removal of stumps left over after trees have been cut by any other agency shall also be considered incidental to the clearing and grubbing operation.

Cutting including removal of stumps and roots of trees of girth above 300 mm and backfilling to required compaction shall be measured in terms of number according to the sizes given below: -

i) Above 300 mm to 600 mm
ii) Above 600 mm to 900 mm
iii) Above 900 mm to 1800 mm
iv) Above 1800 mm

For this purpose, the girth shall be measured at a height of 1 metre above ground or at the top of the stump if the height of the stump is less than one metre from the ground.

2.6 RATE

2.6.1 The contract unit rates for the various items of clearing and grubbing shall be payment in full for carrying out the required operations including full compensation for all labour, materials, tools, equipment and incidentals necessary to complete the work. These will also include excavation and backfilling to required density, where necessary, and for handling, salvaging, piling and disposing of the cleared materials with all leads and lifts.

2.6.2 The Contract Unit rate for cutting (including removal of stumps and roots) of trees of girth above 300 mm shall include excavation and backfilling to required compaction, handling, salvaging, piling and disposing of the cleared materials with all leads and lifts.

2.6.3 Where a contract does not include separate items of clearing or grubbing, the same shall be considered incidental to the earthwork items and the contract unit prices for the same shall be considered as including clearing and grubbing operations.

3. EXCAVATION FOR ROADWAY AND DRAINS

3.1 SCOPE

This work shall consist of excavation, removal and satisfactory disposal of all materials necessary for the construction of roadway, side drains and waterways, in accordance with requirements of these specifications and the lines, grades and cross–section shown in the drawings or as indicated by the Engineer. It shall include the hauling and stacking of or hauling to sites of embankment and sub-grade 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.

3.2 CLASSIFICATION OF EXCAVATED MATERIAL

3.2.1 **Classification.**

All materials involved in excavation shall be classified by the Engineer in the following groups:

a) Soil:

This shall comprise topsoil, turf, sand, silt, loam, clay, mud, peat, black cotton soil, soft shale or loose murum, a mixture of these and similar material which yields to the ordinary application of pick, spade and/or shovel, rake or other ordinary digging implement. Removal of gravel or any other nodular material having diameter in any one direction not exceeding 75 mm occurring in such strata shall be deemed to be covered under this category.

b) Ordinary Rock (not requiring blasting) :

This shall include:

i) rock types such as laterite, shales and conglomerates, varieties of limestone and sandstone etc., which may be quarried or split with crow bars, also including any rock which in dry state may be hard, requiring blasting but which, when wet, becomes soft and manageable by means other than blasting.

ii) macadam surfaces such as water bound and bitumen/tar bound; soling of roads, paths, etc. and hard core; compact murum or stabilised soil requiring grafting tool or pick or both and shovel, closely applied; gravel and cobble stone having maximum diameter in any one direction between 75 and 300 mm;

iii) lime concrete, stone masonry in lime mortar and brick work in lime/cement mortar below ground level, reinforced cement concrete which may be broken up and crow bars or picks and stone masonry in cement mortar below ground level; and

iv) boulders which do not require blasting having maximum dimension in any direction of more than 300 mm, found laying loose on the surface or embedded in river bed, soil, talus, slope wash and terrace material of dissimilar origin.

c) Hard Rock (requiring blasting) :

This shall include:

i) Any rock or cement concrete for the excavation of which the use of mechanical plant and/or blasting is required.

ii) Reinforced cement concrete (reinforcement cut through but not separated from the concrete) below ground level; and

iii) boulders requiring blasting

d) Hard Rock (blasting prohibited)

This shall comprise:
Hard rock requiring blasting as described under (c) but where blasting is rohibited for any reason and excavation has to be carried out by chiselling, wedging of any other agreed method. e) Marshy Soil

This shall include soils excavated below the original ground level of marshes and swamps and soils excavated from other areas requiring continuous pumping or bailing out of water.

3.2.2 Authority for Classification

The classification of excavation shall be decided by the Engineer and his decision shall be final and binding on the Contractor. Merely the use of explosives in excavation will not be considered as a reason for higher classification unless blasting is clearly necessary in the opinion of the Engineer.

3.3 CONSTRUCTION OPERATIONS

3.3.1 Setting Out:

After the site has been cleared as per Clause 201, the limits of excavation shall be set out true to lines, curves, slopes, grades and sections as shown on the drawings or as directed by the Engineer. The Contractor shall provide all labour, survey instruments and materials such as strings, pegs, nails, bamboos, stones, lime, mortar, concrete, etc., required in connection with the setting out of works and the establishment of bench marks. The Contractor shall be responsible for the maintenance of benchmarks and other marks and stakes as long as in the opinion of the Engineer they are required for the work.

3.3.2 Stripping and Storing Top Soil:

When so directed by the Engineer, the top soil existing over the sites of excavation shall be stripped to specified depths constituting Horizon “A” and Stockpiled at designated locations for re-use in covering embankment slopes, cut slopes, berms and other disturbed areas where re-vegetation is desired. Prior to stripping the topsoil, all trees, shrubs etc. shall be removed along with their roots with approval of the Engineer.

3.3.3 Excavation - General:

All excavations shall be carried out in conformity with the directions laid herein under and in a manner approved by the Engineer. The work shall be so done that the suitable materials available from excavation are satisfactorily utilised as decided upon beforehand.

While planning or executing excavations, the Contractor shall take all-adequate precautions against soil erosion, water pollution etc. Clause 4, and take

appropriate drainage measures to keep the site free of water in accordance with Clause 311.

The excavations shall conform to the lines, grades, side slopes and levels shown on the drawings or directed by the Engineer. The Contractor shall not excavate outside the slopes or below the established grades or loosen any material outside the limits of excavation. Subject to the permitted tolerances, any excess depth excavated below the specified levels on the road shall be made good at the cost of the Contractor with suitable material of similar characteristics to that removed and compacted to the requirements of Clause 4.

All debris and loose material on the slopes of cuttings shall be removed. No backfilling shall be allowed to obtain required slopes excepting that when boulders or soft materials are encountered in cut slopes these shall be excavated to approved depth on instructions of the Engineer and the resulting cavities filled with suitable material and thoroughly compacted in an approved manner. After excavation, the sides of excavated area shall be trimmed and the area contoured to minimise erosion and ponding, allowing for natural drainage to take place. If trees were removed, new trees shall be planted, as directed by the Engineer. The cost of planting new trees shall be deemed to be incidental to the work.

3.3.4 Methods, Tools and Equipment:

Only such methods, tools and equipment as approved by the Engineer shall be adopted/ used in the work. If so desired by the Engineer, the Contractor shall demonstrate the efficacy of the type of equipment to be used before the commencement of work.

3.3.5 Rock Excavation:

Rock, when encountered in road excavation, shall be removed up to the sub-grade top level or as otherwise indicated on the drawings. Where, however, unstable shales or other similar materials are intersected at the sub-grade top level, these shall be excavated to the extent of 500 mm. below the sub-grade top level or as otherwise specified. In all cases, the excavation operations shall be so carried out that at no point on cut formation the rock protrudes above the specified levels/ Tocks and large boulders which are likely to cause differential settlement and also local drainage problems should be removed to the extent of 500 mm. below the formation level in full formation width including drains and cut through the side drains.

Where excavation is done to levels lower than those specified, the excess excavation shall be made good as per Clauses 301.3.3 and 301.6 to the satisfaction of the Engineer. Slopes in rock cutting shall be finished to uniform lines corresponding to slope lines shown on the drawings or as directed by the

Engineer. Notwithstanding the foregoing, all loose pieces of rock on excavated slope surface which move when pierced by a crowbar shall be removed.

Where blasting is to be resorted to, the same shall be carried out and all precautions indicated therein observed.

Where pre-splitting is prescribed to be done for the establishment of a specified slope in rock excavation, the same shall be carried out.

3.3.6 Marsh Excavation:

The excavation of marshes/swamps shall be carried out as per the programme approved by the Engineer.

Excavation of marshes shall begin at one end and proceed in one direction across the entire marsh immediately ahead of back filling. The method and sequence of excavating and back-filling shall be such as to ensure, to the extent practicable, the complete removal or displacement of all muck from within the lateral limits called for on the drawings or as staked by the Engineer, and to the bottom of the marsh, firm support or levels indicated.

3.3.7 Excavation of Road Shoulders/Verge/Median for Widening of Pavement or providing treated shoulders:

In works involving widening of existing pavements or providing treated shoulders, unless otherwise specified, the shoulder/verge/median shall be removed to their full width and to levels shown on drawings or as indicated by the Engineer. While doing so, care shall be taken to see that no portion of the existing pavement designated for retention is loosened or disturbed. If the existing pavement gets disturbed or loosened, it shall be dismantled and cut to a regular shape with sides vertical and the disturbed/loosed portion removed completely and re-laid as directed by the Engineer, at the cost of the Contractor.

3.3.8 <u>Excavation for Surface/Sub-surface Drains</u>

Where the Contract provides for construction of surface/sub-surface drains, excavation for these shall be carried out in proper sequence with other works as approved by the Engineer.

3.3.9 <u>Slides:</u>

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. Adequate precautions shall be taken to ensure that during construction, the slopes are not rendered unstable or given 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 shall conform to its condition at the time of removal and payment made accordingly regardless of its condition earlier.

3.3.10 De-watering:

If water is met with in 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 so discharge the drained water 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.

3.3.11 Disposal of Excavated Materials:

All the excavated materials shall be the property of the Owner. The material obtained from the excavation of roadway, shoulders, verges, drains, cross-drainage works etc., shall be used for filling up of (i) roadway embankment, (ii) the existing pits in the right-of-way and (iii) for landscaping of the road as directed by the Engineer, including levelling and spreading with all leads and lifts.

All hard materials, such as hard murum, rubble, etc. not intended for use as above shall be stacked neatly on specified land as directed by the Engineer with all leads and lifts. Unsuitable and surplus material not intended for use within the lead specified above shall also, if necessary, be transported with all lifts and lead beyond initial 1000 m disposed of or used as directed by the Engineer.

3.3.12 Back-filling:

Back-filling of masonry/ concrete/ hume pipe drain excavation, shall be done with approved material after concrete/masonry hume pipe is fully set and carried out in such a way as not to cause undue thrust on any part of the structure and/or not to cause differential settlement. All space between the drain walls and the side of the excavation shall be refilled to the original surface making due allowance for settlement, in layers generally not exceeding 150 mm. compacted thickness to the required density, using suitable compaction equipment such as mechanical tamper, rammer or plate compactor as directed by the Engineer.

3.4 **PLYING OF CONSTRUCTION TRAFFIC**

Construction traffic shall not use the cut formation and finished sub grade without the prior permission of the Engineer. Any damage arising out of such use shall be made good by the contractor at his own expense.

3.5 **PRESERVATION OF PROPERTY**

The Contractor shall undertake all reasonable precautions for the protection and preservation of any or all existing roadside trees, drains, sewers or other sub-surface drains, pipes, conduits and any other structures under or above ground, which may be affected by construction operations and which in the opinion of the Engineer, shall be continued in use without any change. Safeguards taken by the Contractor in this respect, shall be got approved by him from the Engineer. However, if any of these objects is damaged by reason of the Contractor's negligence, it shall be replaced or restored to the original condition at his expense. If the Contractor fails to do so, within the required time as directed by the Engineer or if, in the opinion of Engineer, the actions initiated by the Contractor to replace/restore the damaged objects are not satisfactory, the Engineer shall arrange the replacement/restoration directly through any other agency at the risk and cost of the Contractor after issuing a prior notice to the effect.

3.6 **PREPARATION OF CUT FORMATION**

The cut formation, which serves as a sub-grade, shall be prepared to receive the sub-base/base course as directed by the Engineer.

Where the material, in the sub-grade (that is within 500 mm of the lowest level of the pavement) has a density less than specific in Table 300-2, the same shall be loosened to a depth of 500 mm. and compacted in 250 mm. thick loose layers in accordance with the requirements of Clause 305. Any unsuitable material encountered in the sub-grade shall be removed to a depth indicated by the Engineer and replaced with suitable material compacted in accordance with clause 4.

Any unsuitable material encountered in the sub-grade level shall be removed as directed by the Engineer and replaced with suitable material compacted in accordance with Clause 4.

In rocky formations, the surface irregularities shall be corrected and the levels brought up to the specified elevation with sub-base or base material as directed by the Engineer, laid and compacted in accordance with the respective specifications for these materials. The unsuitable material shall be disposed of in accordance with Clause 3.3.11. After satisfying the density requirements, the cut formation shall be prepared to receive the sub-base/base-course in accordance with Clause 310 and 311 to receive the sub-base/base course.

3.7 **FINISHING OPERATIONS**

Finishing operations shall include the work of properly shaping and dressing all excavated surfaces.

When completed, no point on the slopes shall vary from the designated slopes by more than 150 mm. measured at right angles to the slope, except where excavation is in rock (hard or soft) where no point shall vary more than 600 mm from the designated slope. In no case shall any portion of the slope encroach on the roadway.

The finished cut formation shall satisfy the surface tolerances. Where directed, the topsoil removed earlier and conserved (Clauses 4.3.1 and 4.3.3) shall be spread over cut slopes, berms and other disturbed areas. Slopes may be roughened and moistened slightly, prior to the application of topsoil, in order to provide satisfactory bond. The depth of topsoil shall be sufficient to sustain plant growth, the usual thickness being from 75 to 150 mm.

3.8 **MEASUREMENTS FOR PAYMENT**

Excavation for roadway shall be measured by taking cross sections at suitable intervals in the original position before the work starts and after its completion and computing the volumes in cubic metres by the method of average end areas. Where it is not feasible to compute volumes by this method because of erratic location of isolated deposits, the volumes shall be computed by other accepted methods.

At the option of the Engineer the Contractor shall leave depth indicators during excavations of such shape and size and in such positions as directed so as to indicate the original ground level as accurately as possible. The Contractor shall see that these remain intact till the final measurements are taken.

For rock excavation, the over burden shall be removed first to that necessary cross sections could be taken for measurement. Where cross sectional measurements could not be taken due to irregular configuration or where the rock is admixed with other classes of materials, the volumes shall be computed on the basis of stacks of excavated rubble after making 40 per cent deductions there from. When volumes are calculated in this manner for excavated material other than rock, deduction made will be the extent of 16 per cent of stacked volumes.

Works involved in the preparation of cut formation shall be measured in units indicated below:

i) Loosening and re-compacting the loosened material at sub-grade … Cubic metre
ii) Loosening and Removal of unsuitable material and replacing with a suitable material and compacting to required density. … Cubic metre
iii) Preparing rocky sub-grade … Square metre
iv) Stripping including storing and re-application of top soil … Cubic metre
v) Disposal of surplus material beyond initial 1000 m lead … Cubic metre

3.9 **RATE**

3.9.1 The contract unit rates for the items of embankment, Sub-grade and Drain excavation shall be payment in full for carrying out the operations required for the individual items including full compensation for:

i) Setting out;

ii) Transporting the excavated materials and depositing the same on sites of embankments spoil banks or stacking as directed within all leads and lifts.

iii) Trimming bottoms and slopes of excavation;

iv) Dewatering

v) Keeping the work free of water. and

vi) all labour, materials, tools, equipment, safeguards and incidentals necessary to complete the work to the specifications Provided, however, where pre-splitting is prescribed to achieve a specified slope in rock excavation, the same shall be paid for vide Clause 3.3.5.

3.9.2 The contract unit rate for loosening and recompacting the loosened material at sub-grade shall include full compensation for loosening to the specified depth, including breaking clods, spreading in layers, watering where necessary and compacting to the requirements.

3.9.3 Clause 3.9 and 4.8 shall apply as regards contract unit rates for items, removal of unsuitable material and replacement with suitable material respectively.

3.9.4 The contract unit rate for preparing rocky sub-grade as per Clause 3.6 shall be full compensation for providing, laying and compacting sub-base or base material, as directed, including all materials, labour and incidentals necessary to complete the work and all leads and lifts.

3.9.5 The contract unit rate for the items of stripping and storing top soil and of re-application of top soil shall include full compensation for all the necessary operations including all leads and lifts.

3.9.6 The contract unit rate for disposal of surplus earth from roadway and drain excavation shall be full compensation for all labour, equipment, tools and incidentals necessary on account of the additional haul or transportation involved beyond the initial lead of 1000 metres.

4. EMBANKMENT CONSTRUCTION

4.1 GENERAL

4.1.1 Description:

These specifications shall apply to the construction of embankments, sub-grades, earthen shoulders and miscellaneous back fills with approved material obtained either from excavation for road construction, borrow pits or other sources. All embankments and sub-grades shall be constructed to accordance with the requirements of these specifications and in conformity with the lines, grades, and cross-sections shown on the drawings or as directed by the Engineer.

4.2 MATERIALS

4.2.1 Physical Requirements:

a) The materials used in embankments, sub-grades, earthen shoulders and miscellaneous backfills shall be murum, gravel, a mixture of these 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/sub-grade.

The following types of material may be considered unsuitable for embankment:

i) Material from swamps, marshes or bogs
ii) Peat, log, stump or perishable material; any soil classifies as OL, OI, OLL or Pt in accordance with IS: 1498.
iii) Material susceptible to spontaneous combustions.
iv) Material in a frozen condition and
v) Clay of liquid limit exceeding 70 and plasticity index exceeding 45; and
vi) Materials with salts resulting in leaching in the embankment.

b) Expansive clay exhibiting marked swell and shrinkage properties ("free swelling index" exceeding 50 per cent 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, sub-grade and top 500mm portion of the embankment just below sub-grade shall be non-expansive in nature.

c) Any fill material with a soluble sulphate content exceeding 1.9 grams of sulphate (expressed as SO3) per litre when tested in accordance with BS: 1377 Test 10, but using a 2:1 water-soil ratio shall not be deposited within 500mm. or other distance described in the Contractor, of concrete, cement bound materials or other cementitious materials forming part of the Paramount Works.

Material with a total sulphate content (expressed as SO3) 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, or metallic items forming part of the Permanent Works.

d) The size of the coarse material in the mixture of earth shall ordinarily not exceed 75 mm. when being placed in the embankment and 60 mm. when placed in the sub-grade. 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-third of the compacted layer thickness.

e) Ordinarily, only the materials satisfying the density requirements given in Table 1 shall be employed for the construction of the embankment and the sub-grade.

TABLE 1
DENSITY REQUIREMENTS OF EMBANKMENT AND SUB-GRADE MATERIALS

Sl.No	**Type of work**	**Maximum laboratory dry density when tested as per IS: 2720 (Part-VIII)**
1.	Embankments up to 3 m. Height not Subjected to extensive flooding.	Not less than 15.2 KN/cu.m
2.	Embankments exceeding 3 metre height or embankments of any height subject to long periods of inundation.	Not less than 16 KN/cu.m
3.	Sub-grade and earthen shoulders / verge/backfill	Not less than 17.5 KN/cu.m

Note:

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 sub-grade should be satisfy design CBR at the dry unit weight applicable as per Table 300.2

4.2.2 General Requirements:

a) 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. The work shall be so planned and executed that the best available materials are saved for the sub-grade and the embankment portion just below the sub-grade.

b) Borrow Materials: Where the materials are to be obtained from approved borrow pits, the location, size and shape of these pits shall be as indicated by the Engineer and the same shall not be opened without his written permission. Where specific borrow area are not designed by the Owner/the Engineer, arrangement for locating the source of supply of material for embankment and sub-grade 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.

Borrow pits along the road shall be discouraged. If permitted by the Engineer, these shall not be dug continuously. Ridges of not less than 8m width should be left at intervals not exceeding 300 m. Small drains shall be cut through the ridges to facilitate drainage. The depth 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.

Haulage of material to embankments or other areas of fill shall proceed only when sufficient spreading and compaction plant is operating at the place of deposition. 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.

Where the excavation reveals a combination of acceptable and un-acceptable 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.

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 sitting of temporary buildings or structures.

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 sub-grade material when compacted to the density requirements as in Table 2 shall yield the design CBR value of the sub-grade.

TABLE: 2

COMPACTION REQUIREMENTS FOR EMBANKMENT AND SUBGRADE

Sl. No	**Type of Work/ Material**	**Relative compaction as percentage of max. aboratory dry density as per IS: 2720 (Part VIII)**
1.	Sub-grade and earthen shoulders	Not less than 97
2.	Embankment	Not less than 95
3.	Expansive clays Sub-grade and	
	500mm. portion just below	Not allowed
	Remaining portion of embankment	Not less than 90

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

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

ii) 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.

iii) The dry density moisture content – CBR relationships for light, intermediate and heavy compactive efforts (light corresponding to IS: 2720 (Part VII), heavy corresponding to IS: 2720 (Part VIII) and intermediate in-between the two) for each of the fill materials he intends to use in the sub-grade.

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

4.3 CONSTRUCTION OPERATIONS

4.3.1 Setting Out:

After the site has been cleared to Clause 201, the work shall be set out to Clause 4.3.1 The limits of embankment/sub-grade shall be marked by fixing batter the earthwork. The embankment/sub-grade shall be built sufficiently wider than the design dimension so that surplus material may be trimmed, ensuring that the remaining material is to the desired density and in position specified and conforms to the specified side slopes.

4.3.2 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 4.4.6 shall apply.

4.3.3 Stripping and Storing Top Soil:

In localities where most of the available embankment materials are no conducive to plant growth, or when so directed by the Engineer the top soil existing over the embankment foundation shall be stripped to specified depths not exceeding 150mm and stored 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.

4.3.4 Compacting Ground Supporting Embankment/Sub-grade

Where necessary, the original ground shall be levelled 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 2.

In a case where the difference between the sub grade level (top of the sub-grade 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 2, the ground shall be loosened up to a level 0.5 m below the sub-grade level, watered and compacted in layers in accordance with Clauses 4.3.5 and 4.3.6 to not less than 97 percent of dry density as given in Table 2.

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.

Embankment or sub-grade work shall not proceed until the foundations for embankment/sub-grade have been inspected by the Engineer for satisfactory condition and approved.

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 an embankment is to be built has any of the material types (a) to (f) in Clause 4.2.1, at least 500 mm of such material must be removed and replaced by acceptable fill material before embankment construction commence.

4.3.5 Spreading material in layers and bringing to appropriate moisture content.

a) The embankment and sub-grade material shall be spread in layers of uniform thickness not exceeding 200mm compacted thickness over the entire width of embankment by mechanical means, finished by a motor grader and compacted as per Clause 4.3.6. 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.2 and got approved by the Engineer. Each compacted layer shall be finished parallel to the final cross-section of the embankment.

b) 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 constructions, 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 surface but without any flooding. The water shall be added uniformly and thoroughly mixed in soil by blading, discing or harrowing until uniform moisture content is obtained throughout the depth of the layer.

   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, work on compaction shall be suspended.

Moisture content of each layer of soil shall be check 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 is in the range of 1 per cent above to 2 per cent 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. After adding the required amount of water, the soil shall be processed by means of harrows, rotary mixers or as otherwise approved by the Engineer until the layer is uniformly wet.

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, being placed in the sub-grade.

c) 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.

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. 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 or 4 horizontal, such faces shall be benched as per Clause 4.4.1 immediately before placing the subsequent fill.

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.

4.3.6 Compaction:

Only the compaction equipment approved by the Engineer shall be employed to compact the different material types encountered during construction. Smooth-wheeled, vibratory, pneumatic, Sheep's 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. 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 tired roller of adequate capacity capable of achieving required compaction.

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.

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.

Each layer of the material shall be thoroughly compacted to the densities specified in Table-2. Subsequent layers shall be placed only after the finalised layer has been tested according to Clause 903 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 identical to that obtained from tests in accordance with IS:2720 (Part 28). The Contractor shall maintain a record of the same.

Where density measurements reveal any soft areas in the embankment/sub-grade earthen shoulder (verge), 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.

4.3.7 Drainage:

The surface of the embankment/sub-grade 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.

4.3.8 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 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.

4.3.9 Finishing Operations:

Finishing operations shall include the work of shaping and dressing the shoulders/verge road bed 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 tolerances described in Clause 901. 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.

The top soil, removed and conserved earlier (Clauses 3.3.2 and 4.3.2) 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 75mm to 150mm.

Where directed, the slopes shall be turfed with sods in accordance. If seeding and mulching of slopes is prescribed, this shall be done to the requirement.

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.

4.4 CONSTRUCTION OF EMBANKMENT AND SUB-GRADE UNDER SPECIAL CONDITIONS

4.4.1 Earthwork for Widening Existing Road Embankment:

When an existing embankment and/or sub-grade is to be widened and its slopes are steeper than 4:1, continuous horizontal benches, each at least 300mm. wide, shall be cut into the old slope for ensuring adequate bond with the fresh embankment /sub-grade material to be added. The material obtained from cutting of benches could be utilised in the widening of the embankment/sub-grade. However, when the existing slope against which the fresh material is to be placed is flatter than 4:1 the slope surface may only be ploughed or scarified instead of resorting to benching.

Where the width of the widened portions is insufficient to permit the use of usual wider rollers, compaction shall be carried out with the help of tandem sheep's foot rollers, mechanical tampers or other approved equipment. 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.

4.4.2 Earthwork for Embankment and Sub-grade to be Placed against Sloping Ground:

Where an embankment/sub-grade is to be placed against sloping ground, the latter shall be appropriately benched or ploughed/scarified as required in Clause 4.4.1, before placing the embankment/sub-grade material. Extra earthwork involved in benching or due to ploughing/scarifying etc. shall be considered incidental to the work.

For wet conditions, benches with slightly inward fall and subsoil drains at the lowest point shall be provided as per the drawings before the fill is placed against sloping ground. Where the contract requires construction of transverse sub-surface drain at the cut-fill interface, work on the same shall be carried out to Clause-309 in proper sequence with the embankment and sub-grade work as approved by the Engineer.

4.4.3 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:

i) If the existing road surface is of granular or bituminous type and lies within 1m of the new sub-grade level, the same shall be scarified to a depth of 50mm. or more if specified, so as to provide ample bond between the old and new material ensuring that at least 500mm.
   Portion below the top of new sub-grade level is compacted to the desired density.
ii) If the existing road surface is of cement concrete type and lies within 1m of the new sub-grade level the same shall be removed completely.
iii) If the level difference between the existing road surface and the new sub-grade level is more than 1m the existing surface shall be permitted to stay in place without any modification.

4.4.4 Embankment and Sub-grade around Structures:

To avoid interference with the construction abutments, wing walls or return walls of culvert/bridge structures, the Contractor shall, at points to be determined by the Engineer suspend work on embankments forming approaches to such structures, until such time as the construction of the letter is sufficiently advanced to permit the completion of approaches without the risk of interference of damage to the structure.

Unless directed otherwise, the filling around culverts, bridges and other structures up to 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 sub-grade shall be brought up simultaneously 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.

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: 78-1983 (Standard Specifications and Code of Practice for Road Bridges-Section VII) in respect of the type of material, the extend of backfill, its laying and compaction etc. The fill material shall be deposited in horizontal layers not exceeding 150mm in loose thickness and compacted thoroughly to the requirements of Table-2.

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.

Where it may be impracticable to use power rollers or other heavy equipment, mechanical tampers shall carry out the compaction or other methods approved by the Engineer. 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.

4.4.5 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 geo-synthetic 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 Contractor 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 4.3.

4.4.6 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 75mm. The material should be non-plastic having uniformity coefficient of not less than 10. The placed in open water shall be deposited by end tipping without compaction.

4.4.7 Earthwork for high embankment

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 reserves the right to accept or reject it.

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.

Where required, the Contractor shall surcharge embankments or other areas of fill 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.

4.4.8 Settlement Period:

Where settlement period is specified in the Contract, the embankment shall remain in place for the required settlement period before excavating for abutment, wing wall, 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.

4.5 **PLYING OF CONSTRUCTION TRAFFIC**

Construction traffic shall not use the prepared surface of the embankment and / or sub-grade 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.

4.6 **SURFACE FINISH AND QUALITY CONTROL OF WORK**

The surface finish of construction of sub-grade shall conform to the requirements. Control on the quality of materials and works shall be exercised.

4.7 SUB-GRADE STRENGTH

4.7.1 It shall be ensured prior to actual execution that the borrow area material to be used in the sub-grade satisfies the requirement of design CBR.

4.7.2 Sub-grade shall be compacted and finished to the design strength consistent with other physical requirements. The actual laboratory CBR values of constructed sub-grade shall be determined on undisturbed samples cut out from the compacted sub-grade in CBR mould fitted with cutting shoe or on remoulded samples, compacted to the field density at the field moisture content.

4.8 **MEASUREMENTS FOR PAYMENT**

Earth Embankment/Sub-grade construction shall be measured by taking cross sections at intervals in the original position before the work starts and after its completion and computing the volumes of earthwork in cubic metres by the method of average end areas. The measurement of fill material from borrow areas shall be the difference between the not quantities of compacted fill and the net quantities of suitable material brought from road and drainage excavation, for this purpose, it shall be assumed that one cubic metre of suitable material brought to site from road and drainage excavation forms one cubic metre of compacted fill and all bulking or shrinkage shall be ignored. Construction of embankment under water shall be measured in Cum. Construction of high embankment with specified material and in specified manner shall be measured in Cum. Stripping including storing and re-application of topsoil shall be measured as volume in Cum.

Works involving loosening and re-compacting of ground supporting embankment/sub-grade foundation and replacement with suitable material shall be measured as individual items in cubic metres.

Removal of unsuitable material at embankment/sub-grade foundation and replacement with suitable material shall be measured in Cum.

Scarifying existing granular/bituminous road surface shall be measured in sq. m. Dismantling and removal of existing cement concrete pavement shall be measured.

Filter medium and backfill material behind abutments, wing walls and other retaining structures shall be measured as finished work in position in Cum.

4.9 **RATE**

4.9.1 The contract unit rates for the items of embankment and sub-grade construction shall be payment in full for carrying out the required operations including full compensation for:

i) Cost of arrangement of land as a source of supply of material of required quantity for construction unless provided otherwise in the contract;
ii) Setting out;
iii) Compacting ground supporting embankment/sub-grade except where removal and replacement of unsuitable material or loosening and re-compacting is involved;
iv) Scarifying or cutting continuous horizontal benches 300mm. wide on side slopes of existing embankment and sub-grade as applicable;
v) Cost of watering or drying of material in borrow areas and/or embankment and sub-grade during construction as required;
vi) Spreading in layers, bringing to appropriate moisture content and Compaction to specification requirements;
vii) Shaping and dressing top and slopes of the embankment and sub-grade including rounding of corners;
viii) Restricted working at sites of structures;
ix) Working on narrow width of embankment and sub-grade;
x) Excavation in all soils from designated borrow areas and transporting the material to embankment and sub-grade site within all leads and lifts.
xi) All labour, materials, tools, equipment and incidentals necessary to complete the work to the specifications;
xii) Dewatering; and
xiii) Keeping the embankment/completed formation free of water.

4.9.2 In case the contract unit rate specified is not inclusive of all leads, the unit rate for transporting material beyond the initial lead, as specified in the contract for construction of embankment and sub-grade shall be inclusive of full compensation for all labour, equipment, tools and incidentals necessary on account of the additional haul or transportation involved beyond the specified initial lead.

4.9.3 Clause 3.9.5 shall apply as regards contract unit rates for items of stripping and storing top soil and of re-application of top soil.

4.9.4 Clause 3.9.2 shall apply as regard contract unit rate for the item of loosening and re-compacting the embankment/sub-grade foundation

4.9.5 Clauses 3.9.1 and 4.8 shall apply as regards contract unit rates for items of removal of unsuitable material and replacement with suitable material respectively.

4.9.6 The contract unit rate for scarifying existing granular/bituminous road surface shall be payment in full for carrying out the required operations

including full compensation for all labour, materials, tools, equipment and incidentals necessary to complete the work. This will also include for handling, salvaging, stacking and disposing of the dismantled materials within all leads and lifts.

4.9.7 Contract unit rate for dismantling and removal of existing cement concrete pavement.

4.9.8 The contract unit rate for providing and laying filter material behind abutments shall be payment in full for carrying out the required operations including all materials, labour, tools, equipment and incidentals to complete the work to the specifications.

4.9.9 Clause 4.4.6 shall be applied as regards Contract unit rate for construction of embankment under water.

4.9.10 Clause 4.4.7 shall apply as regards Contract unit rate for construction of high embankment. It shall include cost of instruments, its monitoring and settlement period, where specified in the Contract or directed by the Engineer.

5. GRANULAR SUB-BASE

5.1 SCOPE

This work shall consist of laying and compacting well-graded material on prepared sub-grade in accordance with the requirements of this specifications. The material shall be laid in one or more layers as sub-base of 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.

5.2 MATERIALS

5.2.1 The material to be used for the work shall be natural sand, murum, gravel, crushed stone, crushed slag, crushed concrete, brick metal, laterite, kankar, etc. or combinations thereof depending upon the grading required. Materials like crushed slag, crushed concrete, brick metal and kankar may be allowed only with the specific approved of the Engineer. The material shall be free from organic or other deleterious constituents and conform to one of the three grading given in Table 1.

While the grading in Table-1 are in respect of close-graded granular sub-base materials, one each for maximum particle size of 75mm, 53mm and 26.5mm, the corresponding grading for the coarse-graded materials for each of the three maximum particle sizes are given at Table-2. The grading to be adopted for a project shall be as specified in the Contract.

5.2.2 Physical Requirement: The material shall have a 10 percent fines 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 uniform air voids content of 5 percent.

ABLE-1

GRADING FOR CLOSE-GRADED GRANULAR SUB-BASE MATEIRALS

IS Sieve Designation	**Percent by weight passing the Sieve**		
	Grading-1	**Grading-2**	**Grading-3**
75.0mm.	100	--	--
53.0 mm.	80-100	100	--
26.5.5mm	55-90	70-100	100
9.50mm.	35-65	50-80	65-95
4.75mm.	25-55	40-65	50-80

IS Sieve Designation	**Percent by weight passing the Sieve**		
	Grading-1	**Grading-2**	**Grading-3**
2.36mm.	20-40	30-50	40-65
0.425mm.	10-25	15-25	20-35
0.075mm.	3-10	3-10	3-10
CBR Value (Minimum)	30	25	20

TABLE-2

GRADING FOR COARSE GRADED GRANULAR SUB-BASE MATEIRALS

IS Sieve Designation	Percent by weight passing the Sieve		
	Grading-1	Grading-2	Grading-3
75.0mm.	100	--	--
53.0 mm.	--	100	--
26.5mm	55-75	50-80	100
9.50mm.	--	--	--
4.75mm.	10-30	15-35	25-45
2.36mm.	--	--	--
0.425mm.	--	--	--

0.075mm.	<10	<10	<10
CBR Value (Minimum)	30	25	20

Note: The material passing 425 micron (0.425mm) sieve for all the three grading when tested according to IS : 2720 (Part V) shall have liquid limit and plasticity index of not more than 25 per cent and 6 percent respectively.

5.3 STRENGTH OF SUB-BASE

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.

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.

5.4 CONSTRUCTION OPERATIONS

5.4.1 Preparation of Sub-grade:

Immediately prior to the laying of sub-base, the sub-grade already finished to section 301 or 305 as applicable shall be prepared by removing all vegetation and other extraneous matter, lightly sprinkled with water if necessary and rolled with two passes 80-100 kN smooth wheeled roller.

5.4.2 Spread and Compacting:

The sub-base material of grading specified in the Contract shall be spread on the prepared sub-grade with the help of a motor grader of adequate capacity, its blade having hydraulic controls suitable for initial adjustment and maintain the required slope and grade during the operation or other means as approved by the Engineer.

When the sub-base material consists of combination of materials mentioned in Clause 5.2.1, mixing shall be done mechanically by the mix-in-place method. Moisture content of the 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 percent above to 2 percent 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 if so directed by the Engineer until the layer is uniformly wet. Immediately thereafter, rolling shall be

started. If the thickness of the compacted layer does not exceed 100mm, a smooth wheeled roller of 80 to 100 KN weight may be used. For a compacted single layer up to 225mm the compaction shall be done with the help of a 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/sq.m 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 cross fall and super elevation and shall commence at the edges and progress towards the centre for portions having cross fall on both sides.

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 cross fall (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.

Rolling shall be continued till the density achieved is at least 100 percent of the maximum dry density for the material determined as per IS: 2720 (Part 8I). 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.

5.5 SURFACE FINISH AND QUALITY CONTROL OF WORK

The surface finish of construction shall conform to the requirements. Control on the quality of materials and works shall be exercised by the Engineers.

5.6 ARRANGEMENT FOR TRAFFIC

During the period of construction arrangement of traffic shall be maintained.

5.7 MEASUREMENTS FOR PAYMENT

Granular sub-base shall be measured as finished work in position in cubic metres. The protection of edges of 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 no extra payment shall be made for the same.

5.8 RATES

The Contract unit rate for granular sub-base shall be payment in full for carrying out the required operations including full compensation for:

i) Making arrangements for traffic to Clause 112 except for initial treatment to verge shoulders and construction of diversions;
ii) Furnishing all materials to be incorporated in the work including all royalties, fees, rents where necessary and all leads and lifts;
iii) All labour, tools, equipment and incidentals to complete the work to the specifications; and
iv) Carrying out the work in part widths of road where directed.
v) Carrying out the required tests for quality control.

6. WET MIX MACADAM SUB-BASE/BASE COURSE

6.1 SCOPE

This work shall consist of laying and compacting clean, crushed, graded aggregate and granular material, premixed with water, to a dense mass on a prepared sub-grade/sub-base/base of 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.

The thickness of a single compacted wet mix layer shall not be more than 100mm when adopted as a sub-base and 75mm 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 200mm upon approval of the Engineer.

6.2 MATERIALS

6.2.1 Aggregate:

a) Physical Requirements – Coarse aggregates shall be crushed stone. If crushed gravel/shingle is used, not less than 90 percent by weight of the gravel/shingle pieces retained on 4.75mm sieve shall have at least two fractured faces. The aggregates shall conform to one of the grading given in Table-10.

TABLE-10
PHYSICAL REQUIREMENTS OF COARSE AGGREGATES FOR

Sr. No.	Test	Test Method		Requirements
1.	*Loss Angeles Abrasion value	IS:2386 (Part-IV)		40 percent (Max.)
2.	Or	IS:2386 (Part-IV)	or	30 percent (Max.)
	*Aggregate Impact value	IS:5640		30 percent (Max.)
	Combined Flakiness and Elongation indices (Total)	IS:2386 (Part-I)		**

*Aggregate may satisfy requirements of either of the two tests.

**To determine this combined proportion, the flaky stone from a representative sample should first be separated out. Flakiness index is weight of flaky stone metal divided by weight of stone sample. Only the elongated particles are separated out from the remaining (non-flaky) stone metal. Elongation index is weight of elongated particles divided by total non-flaky particles. The value of flakiness index and elongation index so foundation is added-up If the water absorption 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).

b) Grading Requirement:
The aggregates shall conform to the grading given in Table-11

TABLE – 11
GRADING REQUIREMENTS OF AGGREGATES FOR WET-MIX-MACADAM

IS Sieve Designation	Percent by weight Passing the IS Sieve
53mm.	100
45mm.	95-100
26.5mm.	--
22.4mm.	60-80
11.2mm.	40-60
4.75mm.	25-40
2.36mm.	15-30
600 micron	8-22
75micron	0-8

Material 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.

6.3 CONSTRUCTION OPERATION

6.3.1 Preparation of Base:
Clause 7 shall apply.

6.3.2 Provision of Lateral Confinement of aggregates:
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 6.

6.3.3 Preparation of Mix:

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 pug mill 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.

Optimum moisture for mixing shall be determined in accordance with IS: 2720 (Part-8) after replacing the aggregate fraction retained on 22.4mm sieve with material of 4.75mm to 22.5mm 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.

6.3.4 Spreading of Mix:

Immediately after mixing, the aggregates shall be spread uniformly and evenly upon the prepared sub-grade/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 not shall their hauling over a partly completed stretch be permitted.

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.

The paver finisher shall be self-propelled, having the following features:

i. Loading hoppers and suitable distribution mechanism;
ii. 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.
iii. The paver shall be equipped with necessary control mechanism so as to ensure that the finished surface is free from surface blemishes.

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.

6.3.5 Compaction:

After the mix has been laid to the required thickness, grade and cross-fall /camber the same shall be uniformly compacted, to the full depth with suitable roller. If the thickness of single compacted layer does not exceed 100mm, a smooth wheel roller of 80 to 100 kN weight may be used. For compacted single layer upto 200mm, 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./hr.

In portions having unidirectional cross fall/super elevation, 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 1m away from any preceding stop. 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.

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. 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.

Rolling should not be done when the sub-grade is soft or yielding or when it causes a wave-like motion in the sub-base/base course or sub-grade. If irregularities develop during rolling which exceed 12mm. when tested with a 3 metre 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 cross fall. In no case should the use of unmixed material be permitted to make up the depressions. Rolling should be continued till the density achieved is at least 100 percent of the maximum dry density for the material as determined by the method outlined in IS: 2720 – Part-VIII.

After completion the surface of any finished layer should 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 should be made good to the full thickness of the layer and re-compacted.

6.3.6 Setting and Drying:

After final compaction of wet-mix macadam course, the road shall be allowed to dry for 24 hours.

6.4 OPENING TO TRAFFIC

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.

6.5 SURFACE FINISH AND QUALITY CONTROL OF WORK

6.5.1 Surface Evenness:

The surface finish of construction shall conform to the requirements of Clause 902.

6.5.2 Quality Control:

Control on the quality of materials and works shall be exercised by the Engineer in accordance with Section 900.

6.6 RECTIFICATION OF SURFACE IRREGULARITY

Where the surface irregularity of the wet-mix macadam course exceeds the permissible tolerances or where the course aggregates, the full thickness of the layer shall be scarified over the affected area, re-shaped with added pre-mixed material or removed and replaced with fresh premixed material as applicable and re-compacted in accordance with Clause 406.3. The area treated in the aforesaid manner shall not be less than 5m long and 2m wide. In no case shall depressions be filled up with unmixed and un-graded material or fines.

6.7 ARRANGEMENT FOR TRAFFIC

During the period of construction, arrangement of Traffic shall be done as per Clause 112.

6.8 MEASUREMENT FOR PAYMENT

Wet mix macadam shall be measured as finished work in position in cubic metres.

6.9 RATES.

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 401.8.

7. PREPARATION OF BASE

7.1 SCOPE

This work shall consist of preparing an existing water bound macadam, wet mix macadam or black-topped surface to specified lines, grades and cross sections in advance of laying a bituminous course. The work shall be performed on such widths and lengths as may be directed by the Engineer and may consist of scarifying and relaying the granular base course. Filling of portholes and/or application of a profile corrective course (levelling course) shall be as necessary.

7.2 MATERIALS

7.2.1 For Scarifying and Re-laying the Granular Base Course:

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 Clause 406 wet mix macadam as the case may be.

7.2.2 For Patching Potholes and Sealing Cracks:

For patching potholes approved material having same specification as that of profile corrective course shall be used. For sealing small cracks finer than 3mm, a fog seal conforming to Section 3000 shall be applied while larger cracks wider than 3mm. shall be treated with an emulsion slurry seal.

7.2.3 For Profile Corrective Course:

A profile corrective course (levelling course) is essentially a pavement base material course for correcting the existing pavement profile which has either lost its shape or has to be given a new shape to meet the requirement of specified lines, grades and cross-sections.

It shall be differentiated from the strengthening course of other type of structural pavement course needed for upgrading as a remedial measure against inherent deficient and/or distressed pavement. It is meant to remove the irregularity in the existing road profile only.

a) Profile Corrective Course Material and their Application:

The type of material for profile corrective course shall be as shown on the drawing. If 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 may be of the same specification as the layer over which it is to be laid or intermediate between underlying layers, as shown on the drawing.

i) Wherever isolated high spots projecting over the pavement surface do exist, the same shall be cut by milling machine or any other approved method, to minimise the profile corrective course requirement. If in the Process, the bottom layer gets disturbed; the local area shall be cut and filled with profile corrective course material.

ii) Where the maximum profile corrective course thickness works out to be not more than 40mm, it shall be done as an integral part of the overlay course. In other cases, the profile corrective course shall be provided, as a separate layer adopting such construction procedures and using such equipment as may be appropriate to the specified type of material and thickness of the course to be provided.

7.3 CONSTRUCTION OPERATIONS

7.3.1 Preparing Existing Granular Surface:

Where the existing bituminous 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. If, however, over the existing granular surface, a profile corrective course of bituminous material is to be laid, the existing granular surface shall be primed as per Clause 12

7.3.2 Scarifying existing bituminous Surface:

Where necessary, 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 removing it, all loose and disintegrated materials of underlying layer which might have been disturbed in the process of removal shall, before laying of the overlay course, be reset properly by spreading/hand rammers/approved mechanical tamper 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 12 to receive a bituminous profile corrective course. Reusable materials shall be stacked as directed by the Engineer with all leads and lifts.

7.3.3 Patching of Pot Holes & Sealing of Cracks

Before providing Profile Corrective Course on the existing pavement, pot holes if any, shall be drained of water, cut to regular shape with sides vertical up to the affected depth and slightly beyond the limits of affected area and dried. All loose and disintegrated materials from it shall be removed.

The pot holes shall then be filled with material as per Clause No. 12.2.2 in layers not exceeding 75mm after painting the sides and bottom with a thin layer of hot straight-run bitumen/emulsion and each layer shall be compacted with approved mechanical tampers/small vibratory roller and the top layer shall be flush with the existing bituminous surface. All loose / or surplus materials on the surface after making good the potholes, shall be removed. The cracks in the

old pavement surface shall be sealed with a fog seal if cracks are small (less than 3mm width); fog seal shall consist of a spray of a bituminous cutback or a slow-setting bitumen emulsion diluted with an equal amount of water, the rate of spray being 0.5 to 1.0 litre/sq.m depending upon the texture and dryness of the existing bituminous

surface. The spray is allowed to set to a firm condition and traffic is allowed only thereafter so as to ensure that the material is not picked up by traffic. For large cracks, the sealing shall be done with emulsion slurry seal as per Clause 516 of these Specifications.

7.3.4 Laying the Profile Corrective Course:

a) After preparing the granular surface as in Clause 501.3.1 and 501.3.2 the Profile Corrective Course with material as per Clause 501.2.3/ 501.2.4 shall be laid compacted to the requirement of particular specification clause. Where a bituminous profile corrective course is to be laid over a primed granular surface, a tack coat conforming to Clause 8 shall be applied prior to laying profile corrective course.

b) An existing bituminous surface shall be prepared as per Clause 7.3.3 and after applying a tack coat conforming to Clause 503, the bituminous profile corrective course shall be laid and compacted to the requirement of particular Specification Clause.

7.3.5 In specific situation of short sags or depressions in the pavement, it may become necessary to provide corrective course in the form of flat wedges. Normally, layers in maximum thickness at any point more than 100mm should not be provided. In placing multiple lifts, the lift of shortest length (at the lowest portion of the sag/depression) should be provided first, with successive lifts extending over and fully covering underneath layer, precluding development of a series of joints on the top surfaces. For camber correction of correction of super-elevation of the existing carriageway, method shall be adopted depending on the profile of the existing carriageway.

7.3.6 Covering the Profile Corrective Course:

Work of Profile Corrective Course shall be so planned that it shall be covered by the designed base/wearing course at the earliest, before opening to regular traffic.

7.4 SURFACE FINISH AND QUALITY CONTROL OF WORK

Relevant Provisions of Section 900 shall be exercised by the Engineer.

7.5 ARRANGEMENT FOR TRAFFIC

During the construction operations, arrangement of traffic shall be done.

7.6 MEASUREMENT FOR PAYMENT

a) The work for filling potholes shall be considered incidental to the construction of Profile Corrective Course /bituminous course for which the existing pavement surface is prepared.

The work of filling cracks by applying fog seal or emulsion slurry seal shall be measured in square metres, and paid separately.

b) Scarifying and relaying the granular base course shall be measured in square metres.

c) Profile Corrective Course type A/B shall be measured as volume compacted in position in cubic metres. The volume shall be worked out by plotting the exact profile of Profile Corrective Course as built-up at site and superimposed on the existing pavement profile.

7.7 RATES

7.7.1 Contract unit rate for scarifying of existing bituminous surface including repairing/resetting disturbed underlying and also removing and stacking reusable/unusable materials shall include cost of all labour, supply of materials needed for repair/resetting, hire charges of tools and plants and transportation of scarified materials with all leads and lifts .

7.7.2 The contract unit rate for Profile Corrective Course shall be payment in full for carrying out the required operations including full compensation for:

i. Making arrangements for traffic to Clause 112 except
ii. Providing all materials to be incorporated in the work including any royalties, fees, rents (where applicable) and all leads and lifts, unless the contract specifically excludes any item of material required for the work or provides for separate payment.
iii. Preparation of the exposed surface/existing surface including filling of pot holes, all cleaning operations and applications of tack coat.
iv. All labour, tools, equipment and incidentals necessary to complete the work to the specifications and
v. Carrying out the work in part widths of road where directed by the Engineer.

7.7.3 The contract unit rate for sealing cracks by applying fog seal shall be inclusive of providing all materials and tools and plant and carrying out the

work. The contract unit rate for sealing cracks by providing emulsion slurry seal shall be as set.

8. TACK COAT

8.1 SCOPE

This work shall consist of application of single coat of low viscosity liquid bituminous material to an existing road surface preparatory to another bituminous construction over it.

8.2 MATERIALS

Binder: The binder used for tack coat shall be bituminous emulsion

8.3 CONSTRUCTION OPERATION

8.3.1 Preparation of Base:

The surface on which the tack coat is to be applied shall be cleaned of dust and any extraneous material before the application of the binder, by using a mechanical broom or any other approved equipment/method as specified by the Engineer.

8.3.2 Application of Binder:

Binder shall be heated to the temperature appropriate to the grade of cutback used and approved by the Engineer and sprayed on the base at the rate specified in Table 500-2. The normal range of spraying temperature for a bituminous emulsion shall be 200C-600C. It shall be the responsibility of the Contractor to carefully handle the inflammable bituminous cutback material so as a safeguard against any fire mishap. The binder shall be applied uniformly with the aid of either self propelled or rowed bitumen pressure sprayer with self heating arrangement and spraying bar with nozzles having constant volume or pressure system, capable of spraying bitumen at specified rates and temperature so as to provide a uniformly unbroken spread of bitumen. Work should be planned so that no more than the necessary tack coat for the day's operation is placed on the surface. After application and prior to succeeding construction allow the tack coat to cure, without being disturbed, until the water/cutter has completely evaporated, as determined by the Engineer.

TABLE-2

RATE OF APPLICATION OF TACK COAT

Type of Surface	**Bitumen Quantity in Kg. Per 10 sq.m area**
Normal Bituminous Surfaces	2.0 to 2.5
Dry and hungry Bituminous Surfaces	2.5 to 3.0

Granular surfaces treated with primer	2.5 to 3.0
Non Bituminous Surfaces:	3.5 to 4.0
Granular base (not primed)	3.0 to 3.5
Cement Concrete Pavement	

Note: There is no need to apply a tack coat on a freshly laid bituminous course if the subsequent bituminous course is overlaid immediately without opening it to traffic

8.4 QUALITY CONTROL OF WORK

Control on the quality of materials and works shall be exercised by the Engineer in accordance with Section 900.

8.5 ARRANGEMENTS FOR TRAFFIC

During the period of construction, the arrangement of traffic shall be done.

8.6 MEASUREMENT FOR PAVEMENT

Tack coat shall be measured in terms of surface area of application in square metres.

8.7 RATES

The contract unit rate for tack coat shall be payment in full for carrying out the required operations including full compensation for all components listed in Clause 5.8 (i) to (iv) and as application to the work specified in these specifications.

9. BITUMINOUS MACADAM

9.1 SCOPE

The work shall consist of construction, in a single course, of 50mm thickness of compacted crushed aggregates premixed with a bituminous binder, to serve as base/binder course, laid immediately after mixing, on a base prepared previously in accordance with the requirement of these specifications and in conformity with the line, grades and cross sections shown on the drawing or as directed by the Engineer.

9.2 MATERIALS

9.2.1 Bitumen:

The bitumen shall be paving bitumen of suitable penetration grade 60/70 as per IS: 73. The actual grade of bitumen to be used shall be decided by the Engineer appropriate to the region, traffic, rainfall and other environmental conditions. Guidelines on selection of the grade of bitumen are given Appendix-4.

9.2.2 Aggregates :

The aggregates shall consist of crushed stone, crushed gravel/shingle or other stones. They shall be clean, strong, durable of fairly cubical shape and free from disintegrated pieces, organic or other deleterious matters and adherent

coating. The aggregates shall preferably be hydrophobic and of low porosity. If hydrophilic aggregates are to be used the bitumen shall preferably be treated with anti stripping agents of approved quality in suitable doses as per Appendix-5. The aggregates shall satisfy the physical requirements set forth in Table-3.

TABLE: 500-3
PHYSICAL REQUIREMENT OF AGGREGATE FOR BITUMINOUS MACADAM

Sl. No	Test	Test method	Requirement
1	Los Angeles Abrasion Value *	IS:2386 (Part 4)	40% Maximum
2	Aggregate Impact Value *	IS:2386 (Part 4)	40% Maximum
3	Flakiness and Elongation Indices (total) **	IS:2386 (Part 1)	30% Maximum
4	Coating and Stripping of Bitumen Aggregate	AASHTO T182	Minimum retained coating 95%.
5	Soundness: Loss with Sodium Sulphate 5 Cycles Loss with Magnesium Sulphate 5 Cycles	IS:2386 (Part-5)	12% max. 18% max.
6	Water absorption	IS:2386 (Part-3)	2% Maximum

*Aggregate may satisfy requirements of either of the two tests

**To determine this combined proportion; the flaky stone from a representative sample should first be separated out. Flakiness index is weight of flaky stone metal divided by weight of stone sample. Only the elongated particles are separated out from the remaining (non-flaky) stone metal. Elongation index is flakiness index and elongation index so found are added up.

Note: If crushed slag is used Clause 404.2.3 shall apply.

a) The aggregate for bituminous macadam shall conform to the one of two grading in Tables-4, depending on the compacted thickness; the actual grading shall be specified in the Contract.

9.2.3 Proportioning of Materials:

The bitumen content for premixing shall be 3 to 3.5 percent by weight of total mix except when otherwise directed by the Engineer.

TABLE:-4

AGGREGATE GRADING FOR BITUMINOUS MACADAM

IS Sieve Designation	**Percent by weight passing the Sieve**	
	Grading-1	Grading-2
45.0mm.	100	--
26.5 mm.	75-100	100
22.4 mm.	60-95	75-100
11.2mm.	30-55	50-85
5.6mm.	15-35	20-40
2.8	5-20	5-20
90 micron	0-5	0-5

The maximum compacted thickness of a layer shall be 100mm.

The quantities of aggregate to be used shall be sufficient to yield the specified thickness after compaction.

9.2.4 Variation in proportioning of Material :

The Contractor shall have the responsibility for ensuring proper proportioning of materials and producing a uniform mix. A variation in binder content +0.3 percent by weight of total mix shall, however, be permissible for individual specimens taken for quality control tests vide Section 900.

9.2.5 Variation in proportioning of Material :

The Contractor shall have the responsibility for ensuring proper proportioning of materials and producing a uniform mix. A variation in binder content +0.3 percent by weight of total mix shall, however, be permissible for individual specimens taken for quality control tests vide Section 900.

9.3 CONSTRUCTION OPERATION

9.3.1 Weather and Seasonal Limitations:

The work of laying shall not be taken up during rainy or foggy weather or when the base course is damp or wet, or during dust storm or when the atmospheric temperature in shade is 100ºC or less.

9.3.2 Preparation of the Base:

The base on which bituminous macadam is to be laid shall be prepared, shaped and conditioned to the specified lines, grades and cross sections in accordance with Clause 7, and a priming coat where needed shall be applied in accordance with clause 12 as directed by the Engineer.

9.3.3 Tack Coat:

A tack coat as per Clause 503 shall be applied over the base.

9.3.4 Preparation and Transport of Mix:

Bituminous macadam mix shall be prepared in a hot mix plant of adequate capacity and capable to yield a mix of proper and uniform quality with thoroughly coated aggregates.

Hot mix plant shall be of suitable capacity preferably of batch mix type. Total system for crushing of stone aggregates and feeding of aggregate fractions in required proportions to achieve the desired mix, deployed by the Contractor must be capable of meeting the overall Specification requirements under stringent quality control. The plant shall have the following essential features:

A. General

a) The plant shall have coordinated set of essential units capable of producing uniform mix as per the job mix formula.

b) Cold aggregate feed system with minimum 4 bins having belt conveyor arrangement for initial proportioning of aggregates from each bin in the required quantities. In order to have free flow of fines from the bin, it is advisable to have vibrator fitted on bin to intermittently shake it.

c) Belt conveyers below each bin should have variable speed drive motors. There should be electronic load sensor on the main conveyer for measuring the flow of aggregates.

d) Dryer unit with burner capable of heating the aggregate to the required temperature without any visible unburnt fuel or carbon residue on the aggregate and reducing the moisture content of the aggregate to the specified minimum.

e) The plant shall be fitted with suitable type of thermometric instruments at appropriate places so to indicate or record/register the temperature of heated aggregate, bitumen and mix.

f) Bitumen supply unit capable of heating, measuring/metering and spraying of bitumen at specified temperature with automatic synchronisation of bitumen and aggregate feed in the required proportion.

g) A filler system suitable to receive bagged or bulk supply of filler materials and its incorporation into mix in the correct quantity, wherever required.

h) A suitably built-in dust control system for the dryer to contain/recycle permissible fines into the mix. It should be capable of preventing the exhaust of fine dust into atmosphere for environmental control wherever so specified by the Engineer.

i) The Plant should have centralised control panel/cabin capable of pre-setting, controlling/synchronising all operations starting from feedinsg of cold aggregates to the discharge of the hot mix to ensure proper quality of mix. It should have indicators for any malfunctioning in the operation.

j) Every hot mix plant should be equipped with siren or horn so that the operator may use the same before starting the plant every time in the interest of safety of staff.

B. For Batch Type Plant

i. Gradation control unit having vibratory screens for accurate sizing of hot aggregate and storing them in separate bins. This unit should be fully covered to reduce the maintenance cost and for better environmental condition.

ii. Proper arrangement for accurate weighing of each size of hot aggregate from the control panel before mixing.

iii. Paddle mixer unit shall be capable of producing a homogeneous mix with uniform coating of all particles of the mineral aggregate with binder.

C. For continuous Type Plant

i. Gradation control unit having vibratory screens for accurate sizing of hot aggregate and storing them in separate bins. This should be fully covered to reduce the maintenance cost and for better environmental condition.

ii. There should be appropriate arrangement for regulating and volumetric control of the flow of hot aggregate from each bin to achieve the required proportioning.

iii. Paddle mixer unit shall be capable of producing a homogeneous mix with uniform coating of all particles of the mineral aggregate with binder.

D. For Drum Mix Plant

i. It is prerequisite that only properly screened and graded materials are fed to the bins. If required a vibratory screening unit should be installed at the plant site to ensure the same. A primary 4-deck vibratory screening unit shall be installed before the multiple bin cold feed system for screening the aggregates and grading the same.

ii. Belt conveyors below each bin should have variable speed drive motors. There should be electronic load sensor on the main conveyor for measuring the flow of aggregate.

iii. There should be arrangement to measure moisture content of the aggregate (s) so that moisture correction may be applied for working out requirement of binder and filter.

The temperature of binder at the time of mixing shall be in the range of 150ºC to 163ºC and that of the aggregate in the range of 155ºC to 163ºC, provided that the difference in temperature between the binder and aggregate at no time exceed 14ºC. Mixing shall be thorough to ensure that a homogeneous mixture is obtained in which

all particles of the aggregate are coated uniformly, and the discharge temperature of mix shall be between 130ºC to 160ºC.

E. The mixture shall be transported from the mixing plant to the point of use in suitable tipper vehicles. The vehicles employed for transport shall be clean and be covered over in transit if so directed by the Engineer. Any tipper causing excessive segregation of materials by its spring suspension or other contributing factors or that which shows undue delay shall be removed from the work until such conditions are corrected.

9.3.5 Spreading :

The mix transferred from the tipper at site to the paver shall be spread immediately by means of self propelled mechanical paver with suitable screeds capable of spreading, tamping and finishing the mix true to the specified lines, grades and cross sections. The paver finisher shall have the following essential features.

i. Loading hoppers and suitable distributing mechanism.
ii. All drives having hydrostatic drive/control.
iii. The machine shall have a hydraulically extendable screed for appropriate width requirement.
iv. 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. It shall have adjustable amplitude and infinitely variable frequency.
v. The paver shall be equipped with necessary control mechanism so as to ensure that the finished surface is free from surface blemishes.
vi. The paver shall be fitted with an electronic sensing device for automatic levelling and profile control within the specified tolerances.
vii. The screed shall have the internal heating arrangement.
viii. The paver shall be capable of laying either 2.5 to 4.0m width or 4.0 to 7.0m width as stipulated in the Contract.
ix. The paver shall be so designed as to eliminate skidding/slippage of the tyres during operation.

However, in restricted locations and in narrow widths where the available plant cannot be operated in the opinion of the Engineer, he may permit manual laying of the mix. The temperature of the mix at the time of laying shall be in the range of 120ºC 160ºC. In multi layer construction the longitudinal joint in one layer shall offset that in the layer below by about 150mm. However, the joint in the top most layers shall be at the centre line of the pavement.

Longitudinal joint and edges shall be constructed true to the delineating line parallel to the central line of the road. All joints shall be cut vertical to the full thickness of the previously laid mix and the surface painted with hot bitumen before placing fresh material. Longitudinal and transverse joints shall be offset by at least 250mm. From those in the lower courses and the joint on the top most layers shall not be allowed to fall within the wheel path. All transverse joints shall be cut vertically to the full thickness of the previously laid mix with asphalt cutter/pavement breaker and surface painted with hot bitumen before placing fresh material. Longitudinal joints shall be preferably hot joints. Cold longitudinal joints shall be properly heated with joint heater to attain a suitable temperature of about 80ºC before laying of adjacent material. 504.3.6 Compaction.

After the spreading of mix, rolling shall be done by 80 to 100 KN rollers or other approved equipment. Rolling should start as soon as possible after the material has been spread deploying a set of rollers as the rolling is to be completed in limited time frame. The rolling move at a speed not more than 5 km/hr. Rolling shall be done with care to keep from unduly roughening the pavement surface.

Rolling of the longitudinal joints shall be done immediately behind the paving operation. After this the rolling shall commence at the edges and progress towards the centre longitudinally except that one super-elevated portions, it shall progress from the lower to the upper edge parallel to the central line of the pavement.

The initial or break down rolling shall be done, with 80 to 100 KN static weight smooth wheel roller (3 wheels or tandem), as soon as it is possible to roll the mix without cracking the surface or having the mix pick up on the roller wheels. The second or intermediate rolling shall follow the break down rolling with vibratory roller of 80 to 100 KN static weight or pneumatic tyred roller of 150 to 250 KN weight, with minimum 7 wheels and minimum tyre pressure of 0.7 MPa as closely as possible to the paver and be done while the paving mix is still at a temperature that will result in maximum density. The final rolling shall be done while material is still workable enough for removal of roller marks with 60 to 80 KN tandem roller. During the initial or break down rolling and final rolling, vibratory system shall be switched off. The joints and edges shall be rolled with a 80 to 100 KN static roller.

When the roller has passed over the whole area once, any high spots or depressions which become apparent shall be corrected by removing or adding mix material. The rolling shall then be continued till the entire surface has been rolled to 95 percent of the average laboratory density (obtained from Marshall Specimens compacted as defined in Table 500-10), there is no

crushing of aggregates and all roller marks have been eliminated. Each pass of the roller shall uniformly overlap not less than one-third of the track made in the preceding pass. The roller wheel shall be kept damp if necessary to avoid bituminous material from sticking to the wheels and being picked up. In no case shall fuel lubricating oil be used for this purpose, nor excessive water to be poured on the wheels.

Rolling operations shall be compacted in every respect before the temperature of the mix falls below 100ºC.

Roller (s) shall not stand on newly laid material while there is a risk that it will be deformed thereby. The edges along and transverse of the bituminous macadam laid and compacted earlier shall be cut to their full depth so as to expose fresh surface which shall be painted with a thin surface coat of appropriate bidder before the new mix is placed against it.

9.4 SURFACE FINISH AND QUALITY CONTROL OF WORK

The surface finish of construction shall conform to the requirements. Control on the quality of materials and works shall be exercised by the Engineer.

9.5 The bituminous macadam shall be covered with either the next pavement course or wearing course, as the case may be, without any delay. If there is to be any delay, the course shall be covered by a seal coat to the requirement of Clause 513 before allowing any traffic over it. The seal coat in such cases shall be considered incidental to the work and shall not be paid for separately.

9.6 ARRANGEMENTS OF TRAFFIC

During the period of Construction, arrangement of traffic shall be done.

9.7 MEASUREMENTS FOR PAYMENT

The work shall be measured as finished work in cubic metres or by weight in metric tonnes as per provided in the Contract.

9.8 RATE

The contract unit rate for the work shall be payment in full for carrying out the required operations including full compensation for:

i. Making arrangements for traffic to Clause 112 except for initial treatment to verge shoulders and construction of diversions.
ii. Preparation of base except for laying of profile corrective course but including filing of pot holes.
iii. Providing all materials to be incorporated in the work including all royalties, fees, rents where necessary and all leads and lifts,

iv. All labour, tools, equipment, plants including installation of hot-mix plant, power supply units and all machineries incidentals to complete the work to the specifications;
v. Carrying out the work in part widths of the road where directed;
vi. Carrying out all tests for control of quality; and
vii. The rate shall cover the provision of bitumen at 3.5 percent of weight of total mix, with the provision that the variation of quantity of bitumen will be assessed and the payment adjusted as per the rate of bitumen quoted.

10. DENSE GRADED BITUMINOUS MACADAM

10.1 Scope

This clause specifies the construction of Dense Graded Bituminous Macadam, (DBM), for use mainly, but not exclusively, in base/binder and profile corrective courses. 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 50 to 100 mm.

10.2 Materials

10.2.1 Bitumen: 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 500-10 for dense bitumen macadam, or this bitumen as modified by one of the methods specified in Clause 521, 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.

10.2.2 Coarse aggregates: The coarse aggregates shall consist of 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 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 the source, the aggregates shall be tested for stripping. The aggregates shall satisfy the physical requirements specified in Table 500-8, for dense bituminous macadam. 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.

10.2.3 Fine aggregates: Fine aggregates consist of crushed or naturally occurring mineral material, or a combination of the two, passing the 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. The fine aggregate shall have a sand equivalent value of not less than 50 when tested in accordance with the requirement of IS: 2720 (Part 37). The plasticity index of the fraction passing the 0.425 mm sieve shall not exceed 4. When tested in accordance with IS: 2720 (Part 5)

TABLE-8. PHYSICAL REQUIREMENTS FOR COURSE AGGREGATE FOR DENSE GRADED BITUMINOUS MACADAM

Property	**Test**	**Specification**
Cleanliness (dust)	**Grain size analysis1**	**Max 5 % passing 0.075 mm sieve**
Particle shape	Flakiness and Elongation Index (Combined)2	Max 30 %
Strength *	Loss Angeles Abrasion Value3	Max 35 %
Aggregate Impact	Value4	Max 27 %
Durability	Soundness:5	Max 12 %
	Sodium Sulphate	Max 18 %
	Magnesium Sulphate	
Water Absorption	Water absorption6	Max 2 %
Stripping		
Water coating	Coating and Stripping of Bitumen	Minimum retained
Sensitivity**	Aggregate Mixtures7 Retained Tensile Strength8	95 % Min 80 %

Notes: 1. IS: 2386 Part 1 5. IS: 2386 Part 5

2. IS: 2386 Part 1 6. IS: 2386 Part 3 (the elongation test to be done only on non-flaky aggregates in the sample)

3. IS: 2386 Part 4* 7. IS: 6241

4. IS: 2386 Part 4* 8. AASHTO T 283**

* Aggregate may satisfy requirements of either of these two tests.

** The water sensitivity test is only required if the minimum retained coating in the stripping test is less than 95 %.

10.2.4. Filler: Filler shall consist of finely divided mineral matter such as rock dust, hydrated lime or cement approved by the Engineer. The filler shall be graded within the limits indicated in Table-9.

TABLE 500-9. 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

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 by 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 the water sensitivity test in Table 500-8, then 2 per cent by total weight of aggregate, of hydrated lime shall be added without additional coat.

10.2.5. Aggregate grading and binder content: 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 the limits shown in Table 500-10, for dense bituminous macadam grading 1 or 2 as specified in the Contract. The type and quality of bitumen, and appropriate thickness, are also indicated for each mixture type.

TABLE-10. COMPOSITION OF DENSE GRADED BITUMINOUS MACADAM PAVEMENT LAYERS

Grading	**1**	**2**
Nominal aggregate size	**40mm**	**25mm**
Layer Thickness	80 – 100 mm	50 – 75 mm
IS Sieve1 (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 mix2	Min 4.0	Min 4.5
Bitumen grade (pen)	65 or 90	65 or 90

Notes:

1. The combined aggregate grading shall not vary from the low limit on one sieve to the high limit on the adjacent sieve.

Determined by the Marshall method.

10.3 Mixture Design

10.3.1 Requirement for the mixture: Apart from conformity with the grading and quality requirements for individual ingredients, the mixture shall meet the requirements set out in Table-11.

TABLE -11. REQUIREMENTS FOR DENSE GRADED BITUMINOUS MACADAM

Minimum stability (kN at 600C)	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
Percent air voids	3 – 6
Percent voids in mineral aggregate (VMA)	See Table 500-12 below.
Per cent voids filled with bitumen (VFB)	65 – 75

The requirements for minimum per cent voids in mineral aggregate (VMA) are set out in Table-12.

TABLE-12. MINIMUM PER CENT VOIDS IN MINERAL AGGREGATE (VMA)

Nominal Maximum Particle Size1 (mm)	**Minimum VMA, Per cent Related to Design Air Voids, Percent2**		
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

Notes:

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.

10.3.2 Binder content:

The binder content shall be optimised to achieve the requirements of the mixture set out in Table 500-11 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 22.4 mm sieve, where approved by the Engineer.

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-11 shall be multiplied by 2.25 and the minimum flow shall be 3 mm.

10.3.3 Job mix formula:

The Contractor shall inform Engineer in writing, at least 20 days before the start of the work, of the job mix formula proposed for be used in the works, and shall give the following details:

(i) Source and location of all materials;
(ii) Proportions of all materials expressed as follows where each is applicable:
(iii) Binder type, and percentage by weight of total mixture;
(iv) Coarse aggregate/Fine aggregate/Mineral filler as percentage by weight of total aggregate including mineral filler;
(v) A single definite percentage passing each sieve for the mixed aggregate;

(vi) The individual gradings of the individual aggregate fractions, and the proportion of each in the combined grading.
(vii) The results of tests enumerated in Table 500-11 as obtained by the Contractor;
(viii) Where the mixer is a batch mixer, the individual weights of each type of aggregate, and binder per batch,
(ix) Test results of physical characteristics of aggregates to be used;
(x) Mixing temperature and compacting temperature.

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.

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.

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.

10.3.4 Plant trials - permissible variation in job mix formula: Over the laboratory job mix formula is approved, the Contractor shall carry out plant trials at the mixer to establish that the plant can be set up to produce a uniform mix conforming to the approved job mix formula. The permissible variations 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 500-13. These variations are intended to apply to individual specimens taken for quality control tests in accordance with Section 900.

TABLE 13. PERMISSIBLE VARIATIONS FROM THE JOB MIX FORMULA

Description	**Permissible variation**	
Base/binder course	**Wearing 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 mm, 0.15 mm	+ 4 %	+ 3 %
Aggregate passing 0.075 mm	+ 2 %	+ 1.5 %

Binder content	+ 0.3 %	+ 0.3 %
Mixing temperature	+ 100ºC	+ 100ºC

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.

10.3.5 Laying Trials:

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. 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 sq. m. 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.

The Contractor shall previously inform the Engineer of the proposed method for 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 layer shall be determined by taking cores, no sooner than 24 hours after laying, or by other approved method.

Once the laying trials 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 required further laying trials.

10.4 Construction Operations

10.4.1 Weather and seasonal limitations:

The provisions of Clause 501.5.1 shall apply.

10.4.2 Preparation of base:

The base on which Dense Graded Bituminous Material is to be laid shall be prepared in accordance with Clauses 501 and 902 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 methods shall be used as directed by the Engineer.

10.4.3 Geosynthetics:

Where Geosynthetics are specified in the Contract this shall be in accordance with the requirements.

10.4.4 Stress absorbing layer:

Where a stress absorbing layer is specified in the Contract, this shall be applied in accordance with the requirements.

10.4.5 Prime coat:

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 502, or as directed by the Engineer.

10.4.6 Tack coat:

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 503, or as directed by the Engineer.

10.4.7 Mixing and transportation of the mixture:

The provisions as specified in Clauses 7.3 and 7.4 shall apply.

10.4.8 Spreading:

The provisions of Clauses 7.5.3 and 7.5.4 shall apply.

10.4.9 Rolling:

The general provisions of Clauses 501.6 and 501.7 shall apply, as modified by the approved laying trails. 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.

10.5 Opening to Traffic

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.

10.6 Surface Finish and Quality Control of Work

The surface finish of the completed construction shall conform to the requirements. All materials and workmanship shall comply with the provisions set out in Section 900 of this Specification.

10.7 Arrangements for Traffic

During the period of construction, arrangements for traffic shall be made in accordance with the provisions.

10.8 Measurement for Payment

Dense Graded Bituminous Materials shall be measured as finished wok either in cubic metres, tons or by the square metre at a specified thickness as detailed on the Contract drawings, or documents, or as directed by the Engineer.

10.9 Rate

The contract unit rate for Dense Graded Bituminous Macadam shall be payment in full for carrying out the all required operations as specified, and shall include, but not necessarily limited to all components listed in Clause 7.8.8.2 (i) to (xi). The rate shall include the provision of bitumen, 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.

11. BITUMINOUS CONCRETE

11.1 SCOPE

This work shall consist of constructing in a single layer, bituminous concrete (asphaltic concrete) of thickness 25 – 100 mm. On previously prepared bituminous courses to the requirements of these specifications.

11.2 MATERIAL

11.2.1 Bitumen

Clause 10.2.1 shall apply.

11.2.2 Course Aggregates:

Clause 507.2.2 shall apply. The Stone Polishing Value as measured by BS: 812 (Part 314) shall not be less than 55. The aggregates shall satisfy the physical requirements as given in Table 500-8 except that the maximum value for the water absorption should be 1 percent.

11.2.3 Fine Aggregates:

Clause 10.2.3 shall apply.

11.2.4 Filler:

Clause 10.2.4 shall apply.

11.2.5 Aggregates Gradation:

The mineral aggregates, including mineral filler shall be so graded or combined as to conform to the grading set forth in Table-23.

TABLE:-23

AGGREGATES GRADATION FOR BITUMINOUS CONCRETE

IS Sieve Designation	Percent by weight passing the Sieve
26.5 mm.	100
19 mm.	90 – 100
9.5 mm.	56 – 80
4.75 mm.	35 – 65
2.36 mm.	23 – 49
300 micron	5 – 19
75 micron	2 – 8

11.3 MIX DESIGN

11.3.1 Requirement of Mix:

Apart from conformity with the grading and quality requirements of individual ingredients, the mix shall meet the requirements set forth in Table-24.

TABLE:-24

REQUIREMENTS OF BITUMINOUS CONCRETE MIX

Sl. No	**Description**	**Requirements**
1.	Marshall stability (ASTM Designation: D-1559) Determined on Marshall specimens compacted By 75 compaction blows on each end.	820 kg. (1800 lb) minimum
2.	Marshall flow (mm.)	2 – 4
3.	Percent air voids in mix	3 – 5
4.	Percent voids in mineral aggregate (VMA)	Minimum 11 – 13 percent
5.	Percent voids in mineral aggregates filled by bitumen (VFB)	65 – 75
6.	Binder content, percent by weight of total mix.	Minimum 4.5

7.	Water Sensitivity (ASTM D1075) Loss of stability on immersion in water at 600C.	Minimum 75% retained strength.
8.	Swell Test (Asphalt Instt. MS-2, No.2)	1.5 percent Max.

11.3.2 Binder Content:

The binder content shall be so fixed as to achieve the requirements of the mix set forth in Table 500-24. Marshall Method for arriving at the binder content shall be adopted.

11.3.3 Job Mix Formula:

Clause 10.3.3 shall apply except that the requirement of Bituminous Concrete mix shall be as per Table-24.

11.3.4 Permissible Variations from the Job Mix Formula:

The Contractor shall have the responsibility of ensuring proper proportioning of materials in accordance with the approved job mix formula and producing a uniform mix. The permissible variations of individual percentages of various ingredients in the actual mix from the job mix formula may be within the limits as specified in Table -11. These variations are intended to apply to individual specimens taken for quality control tests vide Section 900.

11.4 CONSTRUCTION OPERATION

11.4.1 Weather and Seasonal Limitations:

Clause 504.3.1 shall apply.

11.4.2 Preparation of Base:

The base on which bituminous concrete is to be laid shall be prepared, shaped and conditioned to the specified levels, grade and cross-fall (camber) in accordance with Clause 501 or as directed by the Engineer.

The surface shall be thoroughly swept clean free from dust and foreign matter using mechanical broom and dust removed by mechanical means or blown off by compressed air. In portions where mechanical means cannot reach, other approved method shall be used.

11.4.3 Tack Coat:

A tack coat complying with Clause 503 shall be applied over the base.

11.4.4 Preparation of Mix:

Clause 9.4.4 shall apply.

11.4.5 Spreading:

Clause 9.4.5 shall apply.

11.4.6 Rolling:

Clause 9.4.6 shall apply.

11.5 OPENING TO TRAFFIC

Traffic may be allowed immediately after completion of the final rolling when the mix has cooled down to the surrounding temperature.

11.6 SURFACE FINISH AND QUALITY CONTROL OF WORK

The surface finish of construction shall conform to the requirements. Control on the quality of materials and works shall be exercised by the Engineer.

11.7 ARRANGEMENTS FOR TRAFFIC

During the period of construction, arrangement of traffic shall be done to Clause 112.

11.8 MEASUREMENTS FOR PAYMENT

Bituminous concrete shall be measured as finished work in cubic metres or tonnes as provided in the contract.

11.9 RATES

The contract unit rate for bituminous concrete shall be payment in full for carrying out the required operations including full compensation for all components listed in Clause 9.8 (i) to (vi). The rate shall cover the provision of bitumen in the mix at 5.0 percent of the weight of the total mix with the provision that variation of quality of bitumen will be assessed and the payment adjusted as per the rate of bitumen quoted.

12. PRIME COAT OVER GRANULAR BASE

12.1 Scope

This work shall consist of the application of a single coat of low viscosity liquid bituminous material to a porous granular surface preparatory to the superimposition of bituminous treatment or mix.

12.2 Materials

12.2.1 Primer:

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:

(i) Surface of low porosity; such as wet mix macadam and water bound macadam,

(ii) Surface of medium porosity; such as cement stabilized soil base,

(iii) Surface of high porosity; such as a gravel base.

12.2.2 Primer viscosity:

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-1.

TABLE-1. VISOSITY REQUIREMENT AND QUANTITY OF LIQUID BITUMINOUS PRIMER

Type of Bituminous Surface	**Kinematic Viscosity of Primer at 600C (Centistokes)**	**Quantity of Liquid 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

12.2.3 Choice of primer:

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 applications as directed by the Engineer.

12.3 Weather and Seasonal Limitations

Bituminous primer shall not be applied to a wet surface (see 502.4.2) or during a dust storm or when the weather is foggy, rainy or windy or when the temperature in the shade is less than 100ºC. Surfaces which are to receive emulsion primer should be damp, but no free or standing water shall be present.

12.4 Construction

12.4.1 Equipment:

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.

12.4.2 Preparation of road surface:

The surface to be primed shall be prepared in accordance with Clauses 12.8 as 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.

12.4.3 Application of bituminous primer:

The viscosity and rate of application of the primer shall be as specified in the Contract, or as determined by site trials carried out as directed by the Engineer. The bituminous primer shall be sprayed uniformly in accordance with Clause 501. The method for application of the primer will depend on the type of equipment to be used, size of nozzles, 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, within the tolerances specified.

12.4.4 Curing of primer and opening to traffic: 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 volatiles to evaporate before any subsequent surface treatment or mix is laid. Any unabsorbed 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.

12.4.5 Tack coat:

Over the primed surface, a tack coat should be applied in accordance with Clause 503.

12.5 Quality Control of Work

For control on the quality of materials supplied and the works carried out, the relevant provisions of Section 900 shall apply.

12.6 Arrangements for Traffic

During the construction operations, arrangements for traffic shall be made in accordance with the provisions.

12.7 Measurement for Payment

Prime coat shall be measured in terms of surface area of application in square metres.

12.8. Rate

The contract unit rate for prime coat with adjustments as described in Clause 502.7 shall be payment in full for carrying out the required operations including full compensation for all components listed in Clause 401.8 (i) to (v) and as applicable to the work specified in these Specifications. Payment shall be made on the basis of the provision of prime coat at an application rate of 0.6 kg per square metre, with adjustment, plus or minus, for the variation between this amount and the actual amount approved by the Engineer after the preliminary trails referred to in Clause 12.4.3.

B) MISCELLANEOUS WORKS

15 PIPE WORKS

1 General

This section specifies the laying, jointing, testing, repairing and retesting wherever necessary and commissioning of pipelines for wastewater sewers, pressure mains and property connections.

Excavation requirements are covered in Section 1 : Earthworks.

In areas of high ground water table, dewatering arrangements shall be made to ensure the excavations are kept free of water. The Contractor shall take every precaution to prevent infiltration into permanent works.

Pipe ends shall always be plugged or capped immediately the pipe has been laid. The plug shall only be removed for the purposes of making a connection at the pipe end or testing the pipeline. The plug or cap shall be replaced immediately on completion of the test.

Regular inspections will be undertaken on all completed works for signs of infiltration. If infiltration is discovered the Contractor shall measure accurately the rate of seepage and shall carry out rectification in the presence of the Engineer.

2 Handling and Storage of Pipes

Pipes and fittings shall be handled and stored in accordance with the manufacturer's recommendations subject to the approval of the Engineer. Handling operations shall be carried out with care. During transportation loading and unloading of pipes and fittings they shall not be allowed to come into contact with any sharp projections which may cause damage. During transit pipes and fittings shall be well secured and adequately supported along their length. No pipe shall overhang the end of a vehicle during transportation. Pipes shall be stacked to the approval of the Engineer. Spigot and socket pipes shall be stacked so that successive pipe layers have sockets protruding at opposite ends of the stack. Pipes of different sizes and thickness shall be stacked separately. The maximum height of stacked pipes shall not exceed 2 meters, or that recommended by the supplier whichever is less. Pipes and fittings shall be protected in storage to the approval of the Engineer by means of an impermeable membrane which shall cover the pipes and fittings and separate them from the ground on which they are supported. The membrane shall be strong durable in the prevailing climatic conditions.

Each pipe and fitting shall be subject to a visual inspection after off-loading at site and prior to installation. Pipes and fittings damaged during transportation handling and

storage shall be set aside and the damage brought to the attention of the Engineer. Proposals for repair shall be submitted in writing for the Engineer's approval. No attempt shall be made to repair damage without the Engineers approval. If in the Engineer's opinion the nature of any damage is such that the condition of a pipe has been impaired and cannot be repaired the pipe concerned shall not be incorporated in the Works and removed from site.

3 Quality Standards of Pipes

a) Cast Iron Pipes:

Cast iron pipes shall conform to IS: 1536 All pipes and fittings (but excluding valves) shall be coated with an approved bitumen or coal tar paint. Where the external coating of the pipes is damaged, the contractor shall prepare the surface and paint the damaged area with a minimum of three coats of bituminous paint and to the full thickness of original coating. Spigot and socket joints shall be flexible and of an approved `Push'in' type unless otherwise specified. Laying of cast iron pipes shall generally meet the requirements as per IS 3114. Specification for Rubber Gasket use with push joints shall be as per IS 12820.

b) Concrete Pipes:

Concrete pipes shall be reinforced and comply with IS 458. RCC pipes for sewerage system shall be of NP3 class s/s with sulphate resisting cement and lined inside with sulphate resistant cement of minimum thickness 12mm. The pipes shall be manufactured so as to be jointed with Tyton/rubber gaskets. Laying of concrete pipes shall generally meet the requirements as specified in IS 783. PSC pipes shall be s/s for pumping main shall able to withstand test pressure of 8 Kg /cm2, manufactured with sulphate resisting cement and lined inside sulphate resistant cement of minimum thickness 12mm. The pipes shall be manufactured so as to be jointed with Tyton /rubber gaskets.

c) Stone Ware Pipes:

Stone ware pipe shall conform to IS: 651. Laying of stone ware pipes shall generally comply with the requirements as per IS 4127.

IS 1538 -	Cast iron fittings.
IS 7181 -	CI double flanged pipes.
IS 4127 -	Laying of SW pipes
IS 12592 -	Precast RCC M.H Frames & Cover
IS 784 -	Laying of PSC Pipe

4 Laying Pipes - General

Pipes shall be laid generally from down Stream end to Upstream End Pipes and fittings shall be examined for damage and carefully brushed out immediately before laying. The formation of excavations for pipelines shall be firm, dry, even, true to grade, free of stones and other protrusions and compacted to a minimum of 90 per cent Proctor before placing of pipe bedding. Each pipe shall be laid accurately to line gradient so that except where otherwise specified or ordered by the Engineer the finished pipeline shall be in a straight line both in horizontal and vertical planes. The maximum length of pipeline permitted in any individual line shall be limited to the section between two adjacent manholes or chambers as specified by the engineer. Where instructed by the Engineer, the Contractor shall arrange for an approved independent laboratory to carry out tests to determine the insitu density of the pipe bedding material. Cut-off walls or barriers shall be formed in granular bedding and / or surround to pipes to prevent the bedding acting as a sub-soil drain. The barriers shall be provided at suitable locations along the length of a pipeline and at manholes or chambers. The spacing should be a maximum of 50 meters. Concrete barriers shall be M - 10 concrete installed across the full section of the granular bedding and shall be at least 300 mm in length along the axis of the pipelines.

The Contractor shall provide fix and maintain at such points as may be directed by the Engineer properly painted sight rails and boning rods of predetermined measurement for the boning in, of individual pipes to correct alignment. The sight rails shall be situated vertically above the line of pipes or immediately adjacent thereto and there shall at no time be less than three sight rails in position on each length of pipeline under construction to any one gradient. Consideration will be given by the Engineer to any alternative method for controlling alignment such as laser beam instrument.

5 Laying of stoneware pipe:

Laying Stoneware Pipes on Soil: Before laying the pipes, the Contractor shall carefully brush them to remove any soil, stones or other materials which may be therein, even and regular bed having been prepared, and joint pit excavated to form a recess under the socket of each pipe of no greater width and depth than to enable the pipe joining to be properly done, each pipe shall then be carefully lowered and placed singly in the trench and shall rest on the solid ground for a distance of not less than two thirds of its entire length. Each pipe shall be brought into a true line from manhole to manhole. For this purpose, a strong twine line (rat thread) sufficiently long to reach the full length between manholes shall be used. Each shall be set correctly to level, by means of the boning rod and sight rails. The spigot of each pipe shall be carefully wrapped with a ring of spun yarn dipped in cement

grout or tarred gasket sufficient thick to properly fit the socket of the adjoining pipe and to allow true alignment. The pipe shall then be driven fully home into the socket of the adjacent previously laid pipe and yarn to tarred gasket carefully driven home with a caulking tool. The remaining space in the socket shall than be tightly and completely filled with cement mortar composed of one part of Portland cement and one and a half parts sand and shall be neatly beveled off all-round the circumference and finished at an angle of 45 degrees outside the socket of the pipes. A wooden caulking tool shall be used for forcing the mortar into the sockets. A tightly fitting bag of shavings or straw having a rope attached shall be drawn through the pipes as the work proposed to ensure that there is no cement or yarn or other obstruction projecting into the interior. All joints shall be kept moist either by means of wet bags, wet clay or wet earth whichever may be order by the Engineer to protect them from the sun. Such covering shall be removed when the length is tested for water tightness.

6 Laying Stoneware Pipes on Concrete

In trenches where ordinary socket and spigot stone ware pipes are to be laid on concrete, the method to be adopted is as follows: When the earth is taken out to the proper depth and gradient, a concrete bed of suitable thickness and width is to be laid as directed by the Engineer. The top of this concrete bed shall also be to the required gradient. When the concrete has set sufficiently, a series of special concrete invert blocks are to be laid about 60 cm apart and leveled so that their top surface may be exactly the level of the sewer invert less that thickness of the pipes. The correctness of level of the pipes is to be ascertained by working a straight edge from the invert of each pipe to block ahead. The pipe must also be checked at intervals for the proper line and level and the first pipe of any length must be very carefully bedded and levelled into position. The object to be obtained by the method above described is to ensure that the outside of the sockets shall be raised approximately 25mm above the concrete bed in order to allow the joints to be made properly in the under side. In his prices for laying concrete, the Contractor must allow for doing the work in the manner as above described including cost of blocks.

7 Laying of Concrete Pipes

Reasonable care should be exercised in loading, transporting and unloading of concrete pipes. Gradual unloading of pipes by inclined plane or by chain pulley block is recommended.

Broken or defective pipes or connections shall not be used. After laying of any pipe or fitting is found faulty, the contractor shall have to replace the same.

If the sides of the trench are not vertical, the toes of the side slopes shall end at the level of top of the pipe, and practically vertical trench shall be dug from there down to the sub grade / level.

Pipes shall be laid true to line and grade, as specified and the lowering shall be done by a tripod and chain pulley block.

Lying of pipes shall always proceed upgrade of a slope. If the pipes have spigot and socket joints, the socket ends shall face upstream. In places where the natural foundation is inadequate, the pipes shall be laid either in a concrete cradle supported on proper foundations or on any other suitably designed structure as per details given by the Engineer-in-charge. If concrete cradle bedding is used, the depth of concrete below the bottom of the pipe shall be at least one fourth of the internal dia, of the pipe subject to a minimum of 10 cm and a maximum of 30 cm. The concrete shall extend up to the sides of the pipe at least to a distance of one-fourth of the outside dia for pipes 30 cm and over in dia. The pipe shall be laid in this concrete bedding before the concrete has set. The exact details of cradle shall be as directed by the Engineer-in-charge.

When the pipe is laid in a trench in rock, shale or other hard material, the space below the pipes shall be excavated and replaced with an equalizing bed of concrete, sand or compacted murrum. In no place shall the pipe be laid directly on such hard material.

The bedding of murrum, sand or concrete shall be done to the required grade and the alignment is to be checked by sight rails and boning rods as directed by the Engineer-in-Charge.

For bedding of pipes the method employed shall conform to IS 783-1959 and as directed by the Engineer- in charge

Trenches shall be kept free from water until the material in the joints has set.

Walking or working on the completed pipe shall not be permitted until the trench has been backfilled to a height at least 30cm over the pipe.

8 Jointing Pipes

I. Cast Iron and Concrete Pipes

Unless otherwise approved by the Engineer joints on spigot and socket cast iron and concrete pipes shall be flexible and sealed with a rubber ring or flexible gasket which shall be approved by the Engineer and shall withstand the various tests specified herein for pipelines. The physical characteristics of the

rubber ring shall be appropriate to the type of pipe and joint supplied and in accordance with IS 5382 and 12820. Rubber joint rings shall be stored until needed in a cool place free from direct sunlight. Spigot and socket, flexible joints shall have the annular space between the pipe and socket sealed with an approved joint sealant to prevent the ingress of loose material or concrete. The annular space shall be sealed immediately on completion of a satisfactory initial hydraulic test prior to concreting or backfilling but not prior to the test.

II. Stoneware Pipes

Stone Ware Pipes shall be Cement Jointed In each joint, first sufficiently thick spun yarn soaked in neat cement slurry or tarred gasket shall be passed around the joint and inserted in it by means of a caulking tool and well rammed to fit the socket of the adjoining pipe. Yarn or gasket so rammed shall not occupy more than one fourth of the depth of the socket. The remaining space in the socket shall than be filled with slightly moistened cement mortar (1:1) one part of the cement are one part of sand) which shall be carefully inserted by hand. The mortar shall then be caulked into the joint with a caulking tool. More cement mortar shall be added until the space of the joint has been completely filled with tightly caulked mortar. The joint shall then be finished off neatly at an angle of 45 outside the socket of the pipe. The cement mortar joints shall be cured at least for a period of seven days before testing for water tightness.

9 MANHOLES AND CHAMBERS

Manholes and chambers shall be constructed in accordance with the Drawings in the positions indicated thereon or wherever else instructed by the Engineer and such manholes and chambers shall be watertight. Pipes entering and leaving manholes and chambers shall be laid soffit to soffit unless otherwise shown on the Drawings. Details of pipelines entering and leaving manholes and chambers shall be for pipes through structure as per Specifications.

10 CAST IRON RUNGS

Cast iron steps capsulated with PVC shall conform to the Indian Standard Specifications BIS 5455 in terms of the material manufacture, tests and marking and as per the latest amendment of the standard. Only sound C.I. Steps to the stacked at section stores as directed. Broken / cracked /deformed rejected steps should be replaced with sound ones. The C.I. steps should bear ISI certificates / ISI mark. The total weight of 100 pieces shall be 530 Kgs plus or mins tolerance of 2%. If this requirement is not complied with the lot shall be made good with additional pieces of CI steps to make up for the total lot at no extra cost.

11 Bricks

Bricks shall conform to the requirements of IS 1077 and shall be of quality not less than class 50 subclass A with moisture absorption rate not exceeding 15 percent as defined thereon.

12 Manholes

a) Construction

Manholes shall be built in brickwork as per the type design. Manholes shall be rectangular up to 2.40, depth and circular for depth greater than 2.40 m. Manholes shall be excavated true to dimension and levels. The excavation of deep manholes shall be accompanied by safety measures like timbering, staging etc. Manhole shall be built on a bed concrete of 1:4:8 of thickness required to carry safely the weight of the wall, cover, wheel loads and impact of traffic.

b) Brick Work

Brick Work in Masonry Brick work shall be laid with specified Mortar to be prepared in accordance with IS : 2250. It shall be of cement and sharp coarse sand and shall be made in small quantities so as to be used up within 30 minutes. The cement and sand in the required proportion and specification as laid down for concrete work shall be first mixed dry thoroughly on an impression platform and then water added and mixed to a sufficiently thick consistency as required by the Engineer-in-Charge. No left over mortar shall be as mentioned in scope of work and drawings. All other Specifications as given in brick works sub heading

c) Plastering

The walls of manholes shall be plastered with cement mortar 1:3 (1 cement: 3 coarse sand), 20mm thickness inside and 12 mm thickness outside, using sulphate resistant cement, and finished smooth with a coat of neat cement. Where subsoil water condition exists, a richer mix may be used and it shall be water proofed with addition of approved water proofing compound in a quantity as per manufacturer's specifications.

Note: Proper construction should be ensured to prevent moisture penetration. All manholes shall be constructed so as to be water tight under test. A cement concrete collar of 75 mm minimum thickness using 13 mm aggregates and cement concrete of proportion M20 should be provided over the sewer where it passes through manhole walls, and a brick-relieving arch (see IS: 2212-1962) should be turned over the sewer pipe.

d) Channel & Benching

These shall be semi-circular in bottom half and of diameter equal to sewer. Above the horizontal diameter, sides shall be extended vertically 50 mm above the crown of sewer pipe and the top edge shall suitably round off. The branch channels shall also be similarly constructed with respect to the benching but at their junction with main channel, an appropriate, fall, if required suitably rounded off in direction of flow in the main channel an appropriate fall, if required suitably rounded off in direction of flow in the main channel, shall be given. The channels and benching shall be done in concrete M15 and rendered surface shall have a hard impervious finish obtained by using a steel trowel.

e) Covers & Frames

The frames of manhole shall be firmly embedded to concrete alignment and level in plain concrete, on the masonry. After completion of works manhole covers shall be sealed means of thick grease.

f) Rungs

Rungs shall be fixed as shown in drawings, the portion embedded in masonry on cement concrete block being painted with thick cement slurry before fixing.

g) Testing

- Alignment & Grade:

  Uniformity of grade and alignment shall be tested by the contractor when the backfill has reach 300 mm above the pipe. Except for pipes laid curves, the test shall consist of flashing light through the pipe between manholes. I alignment is true and no pipes are misplaced backfilling shall be continued. The contractor at his expense shall make such text and a defects of materials and workmanship shall be rectified by the contractor at his expense.

- Hydraulics Test

  All pipelines between consecutive manholes and the manholes if required shall be subjected to a leakage test under 1.5 times the working pressure rating of the pipe in the case of a force main and 2.5m hydrostatic head for gravity lines. Contractor shall provide all calibrated equipment for measurement of leakage, all bulkheads, pumps and other equipment and all power and labour necessary for the performance of the tests to the satisfaction of the Engineer-in-Charge. Allowable leakage in the case of gravity lines tested at 2.5 m hydrostatic pressure for 10 minutes shall not exceed 0.2 lit per mm dia of pipe per kilometers length per day. Allowable leakage in the case of force mains shall be computed from the following

Formula: q1 = ND P / 115
Where q1 = Allowable leakage in lpcd
N = Number of joints in the length of the pipeline.
D = Diameter in mm.
P = Average test pressure in kg / cm2

13 PVC PIPES

The item includes supplying of PVC pipes with fittings of specified diameter including laying, fixing, cutting, jointing, painting etc. for vent, over flow, waste water pipe line etc.

A. Material: The pipes and fittings shall conform to series IV of IS 4985-1978. PVC pipes and fittings shall be free from cracks, flaws and defects and shall be able to withstand a pressure as mentioned in the schedule.

B. Examining: Before laying the pipe line, it shall be first examined for damages and cracks. No cracked or damaged pipe and fittings shall be used in the work and they shall be removed from the site by the contractor at his own cost and charge.

C. Cleaning: All the pipes and fittings shall be thoroughly cleaned with brush and washed if necessary to remove any accumulated stone, soil or dirt inside and outside, surfaces.

D. Laying: The pipes shall be carefully laid straight to the correct alignment in gradients as indicated in the drawing. The entire pipe shall be used in standard length as far as possible. Cut length may be used only where it is necessary to make up exact length. The entire length of pipe shall be evenly supported on bed of the trench through ~ out. Care shall be taken to prevent any sand, earth or other materials from entering into the pipes during laying. At the end of day's work the open end shall be suitably plugged.

E. Fixing: The pipe line shall be fixed in position as shown in the drawing or as directed by the Engineer-in charge. The pipe shall be fixed with GI clamps not less than 2 mm thick or with suitable diameter

F. PVC clamps. The clamps shall be fixed into the wall with GI nails not less than 40 mm long and wooden gutties.

G. Making joint: The jointing of pipes and fittings generally shall be done with approved make cement solvent including making surface rough. The pipe shall be cut to desired length. Care shall be taken that profile or cut surfaces shall not be changed and the fibrous material shall be removed with scraper or knife.

H. Rungs: Rungs shall be fixed as shown in drawings, the portion embedded in masonry on cement concrete block being painted with thick cement slurry before fixing. Rungs shall be PVC coated. Size of each rung should be 300x150mm.

16 INSERT & BOLTS FOR FAÇADE

Fabricated pipe, plate or moulded, cast or bolts etc. shall be provided in masonry and concrete works as indicated in the drawings. It is imperative that all inserts, bolts, fixtures and fitting shall be provided in their position very accurately. Such inserts and bolts shall be fixed by use of templates. If as a consequence of negligence on the part of the contractor, the inserts, bolts, fixtures, fittings, etc are out of alignment, the contractor shall make arrangements to have the inserts and bolts removed and refixed in their proper position as directed by the Engineer, at no cost to the employer.

17 Cement Penetration Sealant:

All the Shaft and services openings in fire rated walls & floors are to be properly fire stopped with 2 hrs fire rated Insulation. Where the opening is more than 400mm wide and 600mm in length, M.S. flats of 20mm X 4mm is require to install and to hold the Mineral Wool Panel in place. Service Penetrations through walls and floors to be sealed with approved fire stop as tested to BS: 476 Part 20 & AS 1530 part 4 to maintain the required fire rating of 2hrs of the building element. Installation shall be done in accordance with the tested specification. Supply & Installation of System will done by authorized Dealer & Installer. The system will be supported by a valid International Test report of the complete system as per BS 476 part 20

18 Bulkhead System

Systems shall comprise of two layers of 50mm thick, 144 kg/m3 density Mineral wool panels and shall be tightly sealed, and both faces of the fire rated panel seal and a length of 200mm of penetration shall be finish coated with 2 coats of Fire rated Bulkhead Coating. Where the opening is more than 400mm wide and 600mm in length, M.S. flats of 20mm X 4mm is require to install to hold the Mineral Wool Panel in place and approved Bulkhead Coating is require to apply even on the M.S. flats from both the side. All the installation shall be done in accordance with the manufacturers instructions to meet the integrity & insulation performance criteria in acc with BS 476Part 20. The system

will have to be supported by a valid International Test report of the complete system as per BS 476 part 20

19 Fire Pillows

Fire Pillows are made from treated cloth filled with high density, granulated fire seal mineral wool. In case of a fire, pillows will remain in place and form a barrier by charring and creating a solid mass of insulating material. All electrical & service openings in fire rated walls & floors are to be properly fire stopped with 2& 3hrs fire rated FIRE PILLOWS packed tight into openings starting at one edge and working to the center of opening (in case of floors); and at bottom working up (in case of walls). Ensure any possible through gaps (e.g.; near cables) are sealed with approved mastic sealant. All the installation shall be done in accordance with the manufacturer's instructions to meet the Testing / Assessment performance criteria in accordance with the AS:1530 Part 4 and BS 476 Part 20. They can be used in floor and wall situations and have been tested for up to 3hrs with various services penetrating them. Supply & Installation of System should be done by authorized Dealer & Installer. The system will be supported by a valid International Test report of the complete system as per BS 476 part 20

20 Acrylic in tumescent sealants:

Acrylic sealants are acrylic in tumescent based materials of putty consistency with excellent adhesive and fire resistance properties. Sealants are used to prevent the spread of fire and smoke through joints and gaps in fire rated walls and floors and around service penetrations. When exposed to the heat Acrylic Sealant expands forming an insulating char thus preventing the passage of fire and smoke. The choice joint sealant shall be determined by the configuration and the requirement for the degree of movement in substrates. Supply & Installation of System will done by authorized Dealer & Installer The system will be supported by a valid International Test report of the complete system as per BS 476 part 20

21 RUBBER SPEED BREAKERS:

Speed breaker modules shall be made from 100% recycled rubber and a two-part polyurethane binder making the speed breaker impervious to motor fuels, oils, solvents, road salts and outdoor environment. The rubber shall be obtained from recycled truck and tractor tire treads only (which is all rubber as compared to car tires which contain synthetic rubber). The rubber, in fiber form up to 1/2" long, shall contain no rubber dust, granules or fly that will weaken the final product. They shall be compression moulded and have the following properties:

- Shore Hardness: 65 minimum
- Specific Gravity: 1.13

- Skid Resistance: 89 (dry)
- Tensile Strength: 500 p.s.i. minimum
- Deform Rate: None (100% recovery after compression)

All shall be black in color with all markings made of pavement marking tape and moulded into the rubber for long term durability. Markings that are painted on or applied with adhesives shall not be acceptable. Ready made rubber speed breakers of size 380x400x50mm square piece, with necessary nails, epoxy adhesive as per manufacturer's specifications.

22 RUBBER EDGE GUARD FOR COLUMNS:

Rubber Corner guards and column protectors to be best suited for basement parking and inside industries to avoid damage from and to vehicles. Rubber corner guards should be strong and have very high impact resistance followed by high reflectivity at night. They should be used in basement parking, Hotel parking, Shopping mall parking, hospital parking etc. They should beYellow & Black, attractive in the day & night, Embedded with highly reflective all weather resistance reflective material, Manufactured from flexible & high strength rubber, Easy installation and durable product, bright colours effectively catch the drivers attention and Tamper resistant. Rubber corner beads to protect parking area columns made out of rubber of size 100 MM X 100 MM and thickness 8 MM at the corners including tying in position with suitable nails / screws etc., complete and as per manufacturer specification. Rate shall include for preparation of surface, cleaning, curing etc. complete all as directed by the architect / Engineer.

23 Approved List of Materials & Suppliers

All materials to be used in the work shall conform to technical specifications of Volume-II, relevant Indian Standard Specifications and wherever available ISI marked materials will be used. All material procured shall be subjected to relevant tests specified in B.I.S. at the frequency specified therein from any Government recognized laboratory. The list given below is only indicative and not restricted to brand mentioned. Other equivalent brand may be approved at the discretion of the EIC after verifying the quality thereof.

APPROVED LIST OF MAKES / BRANDS

Notes:
No deviations shall be permitted.
All material to be used shall be of first quality unless otherwise specified.
All sizes of materials mentioned shall be finished sizes.
All materials used shall be of I.S.I grade wherever applicable.

Wherever Contractor proposes to use "equivalent" makes (other than the specified makes mentioned in the Bill Of Quantities) , the same shall be done only after taking prior approval from the Architect (who may consult the Client before giving approval), time due to this will be on contractor's account and no claims will be entertained.

Sr. No	Product Categories	Approved brands
1	Ordinary Portland Cement	JK Cement
		JK Sarva Shaktiman
		Aditya Birla Ultratech
		Jaypee OPC
		Birla Plus
		Birla Super
		Aditya Birla Kamal
		ACC Jamul
2	Pozzolano portland cement	JK Super
		Jaypee Buniyad
		Jaypee Buland
		Ultratech (Aditya Birla Group)
		ACC Jamul
3	White Cement	Birla White
		JK White
		JK Camel
4	Ready Mix concrete	ACC
		Birla
5	Structural Steel	Tata
		Ispat
		Salem
		SAIL
		Structural Steel
		Jindal
6	Reinforced Steel	Tata
		SAIL
		VIZAG
7	Shuttering plywood	Century Shuttering plywood
		Anchor densified shuttering ply
8	Advan	Welding Electrodes
9	Concrete admixtures	Pidilite - Dr. Fixit Pidicrete CF 101
		BASF
		Mc Bauchemmie
		Pidilite Dr. Fixit Pidicrete AM
		Dr. Fixit Powder Water-proof
		Fosroc Conplast
		Fosroc Cebex
		Fosroc Structuro
10	Curing compounds	Fosroc Concure
		Pidilite - Dr. Fixit Curing Compound
11	Repair Mortars for damages - surface	Fosroc Renderoc S2

Sr. No	Product Categories	Approved brands
	application	BASF
		Mc Bauchemmie
		Pidilite Dr. Fixit Floor Repair mortar
12	Repair Mortar for damages on underside applications	Fosroc Renderoc HB2
		BASF
13	Repair Mortar for damages on underside applications	Saint Gobain Webertec Refurb
		BASF
14	Plaster additive	Laticrete L3642
		Fosroc CEBEX 112
15	Repair mortars for construction joints	Ardex A45
		Fosroc Nitomortar S
16	Corrosion control systems for structral repairs	Fosroc Galvashield
		Fosroc Norcure
		Fosroc Ebonex
17	Pan fibres reinforced cement for structural repairs	BASF
		repairs Fosroc Renderoc RG
18	Rapid setting three mix pack of polymer modified cement screed	Ardex A37
		Ardex A35
		Fosroc Renderoc RS- xtra
19	Modified mortar with bonding agent	Fosroc Nitobond SBR
		Fosroc Nitobond AR
		Pidilite Dr. Fixit Polymer mortar PX
		Pidilite Dr. Fixit Polymer mortar HB
20	Epoxy based Bonding Agent	Pidilite - Dr. Fixit Epoxy bonding agent
21	Acrylic based Bonding Agent	Pidilite - Pidicrete MPB
22	Rubber Based Bonding Agent	Pidilite - Dr. Fixit Pidicrete UPP
		Saint Gobain Weber SBR
	Preliminary works	
23	Anti-Termite solutions	Pest Control India
		Pecopp Pest Control
		Godrej Fi care Pest Maintenance
	Masonry	
24	Construction Light weight Blocks	Aerocon
		Siporex
		BILT
		Universal
		Con wood
25	DPC compound	Sika
		Fosroc
		MC Bauchemie
		Roffe
	Plaster	
26	PVC fibre mesh	
27	Waterproofing compound for plaster	Fosroc Conplast X421 IC
		Zupa Santulan
		Pidilite Dr. Fixit Pidiproof LW
28	100 % virgin polypropylene fibrillated	Zupa ‘ Mr. Fibre’

Sr. No	Product Categories	Approved brands
	fibres	Harbourite
29	Aluminium Frames , Profiles, Sections	Jindal
		Bhoruka
30	Skim coat plaster	Apurva Buildcare
	Waterproofing	
31	Waterproofing Agencies	(1) Aqua Alliance Pvt. Ltd
		(2) Building Protection Systems (BPS)
		(3) IPWT Corporation
		(4) Likproof India Pvt. Ltd
		(5) NINA Concrete Systems Pvt. Ltd
32	Waterproofing for Roofs :- 100% waterbased Polyurethane Elastomeric Membrane Waterproofing System	(1) ZUPA Aquathon 60 ;
		(2) SIKA lastic 450h
		(3) FOSROC Nukote
		(4) HITCHENS Formak 629
		(5) ANTI-HYDRO INTL. AH Seamless Membrane
		(6) TECH DRY Protekta 500 System]
33	Extruded polyStyrene	Supreme Industries
34	APP membrane waterproofing	(1) FOSROC “Proofex Torch Seal” ;
		(2) VALLI ZABBAN “Zetagum” / “Monogum”;
		(3) TEXSA “Moply FP”;
		(4) POLYBIT “Polyplus”
35	Waterproofing for roofs:- PVC TER POLYMER MEMBRANE	SIKA
36	Flexible-Matrix “Catalytic” In-depth Crystalline Waterproofing System	(1) TAMMS Hey’Di
		(2) ZUPA Intrex ;
		(3) VANDEX Super
		(4) ANTI-HYDRO INTL. AH-Hydrocap
		(5) TECH DRY Protekta]
37	Integral Waterproofing compound	Fosroc Conplast X421 IC
		Zupa Santulan
		Pidilite Dr. Fixit Pidiproof LW
38	Acrylic Polymer Modified Cementitious Coating	(1) ZUPA Hydro-Tight ;
		(2) SIKA Top Seal 107
		(3) FOSROC Brushbond
		(4) HITCHENS Formdex UNI
		(5) ANTI-HYDRO INTL. AH-Hydroseal
39	Water body waterproofing	(1) TAMMS Hey’Di
		(2) ZUPA Intrex ;
		(3) SIKA Top Seal 107
		(4) FOSROC Brushbond TGP
		(5) VANDEX Super
		(6) ANTI-HYDRO INTL. AH-Hydrocap

Sr. No	Product Categories	Approved brands
		(7) TECH DRY Protekta
40	Poly Sulphide Sealant for expansion joints	Fosroc Thioflex 600
		Pidilite Pidiseal PS- 41 G (wall n ceiling joints)
		Pidilite Pidiseal PS- 42 P (floor joints)
		Laticrete Ottoseal S 34
		Dow Corning DC789
		Dow Corning DC790
41	Silicone Sealants for Building Industry	Dow Corning 995
		Dow Corning 789
		Dow Corning DC Glass Sealant
		Dow Corning 991 HP
		Pidilite Dr. Fixit Silicon GPS (Black/Clear)
42	Thermal Expansion Joints	CS Expansion joints
		Robinson
		Vexcolt
43	Seismic Expansion joints	CS Expansion joints
		Robinson
		Vexcolt
44	Expansion joint covers & trims	CS Expansion joints
		Robinson
		Vexcolt
45	Paints/Finishes	
46	Cement Based Wall Putty	Laticrete Latafinish wall putty
		Asian Paint Acrylic wall putty
		JK putty
		Birla Putty
		R.J. London
		DutchBoy
47	Epoxy based Wall Putty	Fosroc Nitoflor VF
48	Metal primer	Asian metal primer
		Nerolac Palm tree Red oxide Primer
		Nerolac Iolite anticorrossive red oxide primer
		Nerolac zinc chromate primer
49	Wood Primer	Asian Woodorite primer
		Nerolac Durolite wood primer (White/pink)
50	cement primers	Asian Decoprime synthetic cement primer ST
		Asian Decoprime synthetic cement primer WT
		Nerolac Primolite Primer
51	Epoxy Primer	Pidilite Dr. Fixit Epoxy Anti - corrosive zinc Primer
52	Distemper	Nerolac oil bound distemper
		Nerolac acrylic distemper
		Nerolac Premium acrylic distemper

Sr. No	Product Categories	Approved brands
		Asian Tractor synthetic washable distemper
		Asian Tractor Acrylic Distemper
		Nerolac Acrylic washable distemper
		Berger Bison distemper
53	Enamel paint	Nerolac synthetic enamel
		Nerolac Goody synthetic enamel
		Nerolac Excel High Performance enamel
		Asian Apcolite Premium Gloss enamel
		ICI Dulux synthetic enamel
		Berger Luxol Synthetic enamel
54	Cement Paint	Nerolac Excel Everlast
		Nerolac Titanium
		Asian Ace Exterior emulsion
	Powder Coatings for the following	
55	for pipes, water, gas valves, steel furniture	Nerolac PolyCoat Epoxy Powder series 6000
56	for aluminium extrusions	Nerolac Pure Polyester Powder series 6100
57	for UV protection	Nerolac PolyEurathane powder series 6300
	Floorings, dado, skirtings	
58	Solvent free Epoxy coating (glossy finish)	Corosid
		Ardex R-35 CE
		Pidipoxy EC-SF epoxy coat
		Fosroc Durafloor FC
		Fosroc Nitoflor FC 150
59	Ceramic tiles	Kajaria
		Somany
		RAK ceramics
		Asian
		Nitco
60	Vitrified tiles	H & R Johnson - marbonite
		Asian
		Euro
		Nitco
61	Artificial stone	Nitco- Crystal white
		Classsic marble Alpha white
62	Composite stones	Classic marble-Rover
63	Epoxy joint fillers for hard floorings	Bal Endura Epoxy Grout
		Ardex WL
		Laticrete Spectra Lock
		Fosroc Nitotile Epoxy grout
64	2-12 mm Epoxy joint fillers for hard floorings for underwater & Anti- fungal applications	BAL Epoxy Grout
		Laticrete SP 100
		Fosroc Condextra EUW

Sr. No	Product Categories	Approved brands
65	2-12 mm Epoxy joint fillers for antifungal, anti- microbial industrial / chemical resistant / refinery / hospital / Laboratory applications	Laticrete L2000
		Fosroc Condextra EP10
66	Paver blocks	Vyara
		Dazzle
		Basant Betons
67	Paver Tiles	Basant Beton
		Pavit
		Ultra
		Eurocon
68	Non metal hardener for IPS	Foscroc
		Sika
69	Pressed cement concrete tiles	
70	Car Park system	Polydeck
71	Polished Concrete floors	Retroplate systems
	Doors and hardware	
72	Fire doors	Shaktimet
		Promat
73	Ball Bearing Butt hinges	Dorma
		Hettich
74	Mortise sash lock	
75	Lever Handle	Union
76	Concealed Tower bolts	Hettich
77	Door closers	Dorma
78	Door Locks	Dorma
		Union
		Assa Abbloy
79	Lever Handles	Dorma
		D-Line
		Union
80	Door knobs	Dorma
		D-Line
81	Pull Handles	Dorma
		D-Line
82	Electro magnetic Locks	Dorma
		Assa Abbloy
83	Panic Hardware	Dorma
84	Swing Door operators	Dorma
85	Fire rated glass for vision panel	Saint Gobain
		Promat
	Miscellaneous	
86	RCC Pipes	Hume
87	PVC pipes & Fittings	Prince
		Supreme
		Finolex
88	Rubber Speed breakers	Nirmal Promiles

Sr. No	Product Categories	Approved brands
89	Rubber Column Edge guards	Nirmal Promiles
90	Fire retardant sealant	Hilti
		3M
91	Heavy Duty Mechanical Anchors for concrete application	Hilti HST
		Hilti HSC, Hilti HSL 3
92	Medium Duty Mechanical Anchors for Ac ducting, Pipe rack fixings, etc.	Hilti HRD
93	Screws	Hilti
		Phillips
		GKW
94	Heavy Duty Chemical Anchors for concrete application	Hilti HVU + HAS-E Rod
		Fischer
		RE 500 + HAS-E Rod
95	Medium Duty Chemical Anchors for concrete application	Hilti HY 150 + HAS-E Rod
96	Medium Duty Chemical Anchors for hollow brick application	Hilti HY 20 + HAS-E Rod
97	Medium Duty Chemical Anchors for solid brick application	Hilti HY 50 + HAS-E Rod
98	Fire Stops	Hilti
		Promat
		3M
99	Entrance MAT systems	CS
		3-M
100	Sink	Nirali
101	Plumbing Accessories	Jaquar
		D-line
		Kimberly clark
102	Marine Ply wood	Century Architect
		Anchor executive
		Anchor 72 marine
103	Commercial Block board	Century MR gradeblockboard
		Anchor M.R. grade blockboard
104	Marine blockboard	Century blockboard (phenol Formaldehyde bonded),
		Anchor Marine treated blockboard (phenol Formaldegyde bonded),
105	Flush doors	Anchor Fire rated flush doors
		Century BWP flush door
106	Commercial Ply	Anchor commercial
		Century Commercial -M.R. grade
107	Laminates	Century Mica
		Formica
		Merino
		GreenLam

Sr. No	Product Categories	Approved brands
		Uro
108	Skim Plaster	Apurva Buildcare
109	Rest Room Cubicles	Bescube
		Merino
110	Rock Anchors	Stresstech Engineers Pvt. Ltd.
		Freyssinate India Pvt Ltd.
		VSL India Pvt Ltd
111	Cast channels	Halfen,
		Jordahl

C) ELECTRICAL

1 PANELS AND DISTRIBUTION BOARDS.

1.1 PANELS

a. STANDARDS

I S 4237- general requirements for switchgear and control gear for voltages not exceeding 1000 volts.

I S 2147- Degrees of protection providing by enclosures for low voltage switchgear and control gear.

I S 375 Marking and arrangement of bus bars.

1.2 CONSTRUCTION

The panel shall be free standing, floor mounting, compartmentalised, cubical type panel with framed structure and bottom channel frame of I S M C 75 M S section.

The frame structure shall be made out of 14 SWG CRCA sheet. All partitions shall be of 16 SWG CRCA sheet.

The terminals of the switchgear shall be modified to provide ample space fastening of cables and to keep sufficient clearance between leads and lugs of different phases.

The panel shall be made dust and vermin proof using neoprene gaskets.

1.3 CLEARANCES

Operating voltage is 415 V. hence

1. Minimum clearances are as follows
2. Phases to phase 35 mm.
3. Phases to neutral 25 mm.
4. Phases to earth 25 mm.
5. Neutral to earth 25 mm.
6. SUPPORTS- The material used for cable lead supports shall be strong enough to take mechanical load of cable leads.

1.4 Cleaning and Painting

i) Fabricated sections shall be thoroughly cleaned by 7 tank process which include
ii) Alkaline degreasing
iii) Cold water rinsing
iv) Acid pickling
v) Water rinsing
vi) Phosphating
vii) Passive
viii) Sections are then painted with 2 coats of corrosion resistant primer and oven dried under controlled temperature.
ix) Then 2 coats of approved quality paint are given.

1.5 Bus Bars:

High conductivity aluminium alloy of grade E9 as per IS 5082 shall be used for bus bars.

i) Bus bar supports shall be suitable for fault level of 50 kA.
ii) Connections shall be done using adequate size of plated hardware with washers and spring washers sets.
iii) The interconnections shall be made with solid bus bars as far as possible.
iv) Colour coded sleeves shall be used on bus bars.
v) Where ever necessary flexible copper cables shall be used for interconnection between bus bars and switches. Cutting, shouldering, sudden tapering of bus links will not be permitted. Proper type of lugs shall be used with cables. The cable links shall be adequately supported using binders.

2 Switches

- All the switches used shall be of approved make.
- All switches shall have door interlocks.

Measuring instruments and instrument transformers

- Direct reading instruments shall be in confirmation with IEC 62053-22 / 21 and of accuracy class 0.5
- Voltmeters and ammeters shall be of moving iron type, backed up by, suitable current transformers, potential transformers, M C B's, selectors switches etc.
- Current transformers shall be wire wound single pole resin cast class 0.5 accuracy for metering and 5.0 for protection. Separate C T 's shall be provided for metering and protection.
- The polarities and coil terminals shall be prominently marked and minimum 2.5 sq. mm. Copper multi-strand wires shall be used for interconnection. Terminal shorting arrangement shall be provided for C T 's.

3 Internal wiring

i) Internal wiring for control circuits shall be made with 1100 V grade single or multistrand copper PVC cable.
ii) Power wiring shall be done either with copper flexible PVC insulated cable of 1100 V grade or with solid copper conductors.
iii) The minimum size of control wiring shall be 2.5 sq. mm. Copper for Current circuits and 1.5 sq. mm. Copper for other circuits.
iv) The wiring shall be terminated I the respective terminal with suitable crimp type lugs.
v) There shall not be more than two wires connected to single terminal.

4 Power cable termination

i) Adequate volume shall be kept for end termination at every terminal.
ii) Front doors and gland plates shall be 2 mm. Thick. Every cable connected to the panel shall have individual gland plate. The provision shall be made for 25 % extra gland

plates to facilitate future alterations. All gland plates shall be interchangeable and hence have standard sizes. The recommended size is 6" X 6" folded plate fitted to panel using ¼" nut bolts covering a cut out of 4" X 4" size. The minimum clear distance 750-mm from gland plate to the incomer terminal shall be maintained to facilitate quality termination.

iii) Labels shall be anodised aluminium with white engraving on black back ground. They shall be properly secured with fasteners or PVC with white engraving on black back ground.

iv) Routine tests shall be conducted on each switch board in accordance with ID 8623 and shall comprises

v) General inspection

vi) 1000 V megger test

vii) HV test 2 kV

viii) Manufacturer's test certificate shall be furnished for all mountings (switches, CT's, Relays, etc,)

ix) Calibration of relays/meters.

x) Secondary injection testing.

xi) Checking of operations of switch gears.

5 Distribution Boards

i) The general specifications will be as per above.

ii) All boards shall have M C B 's as out going feeders.

iii) The container shall be of the same make as of M C B 's, unless otherwise specified. The type of the board is specified in the B O Q.

iv) M C B s shall confirm to IS 8828 and shall have 10 kA breaking capacity.

6 Inspection and testing

i Pre-delivery testing and inspection shall be offered to consultant/Owners/architect.

ii Following tests shall be carried out at manufacturers place and test reports for the same shall be submitted to architects before inspection.

iii Insulation resistance test at 1.5 kV for 1 min. durations. The Insulation resistance shall be 100 m-ohm minimum.

iv High voltage test as per relevant I S.

v Functional tests.

vi Samples of buttons and wires used.

7 Cables

a MATERIAL

i) Power Cables shall be 1100 V grade X L P E insulated multistrand aluminium conductor for sizes more than 10 Sq. mm., Copper conductor for sizes less than & inclusive of 10 Sq. mm., armoured unless otherwise specified.

ii) Control Cables shall be 1100 V grade X L P E insulated multistrand copper conductor armoured unless otherwise specified.
iii) Cables shall confirm I S 1554-1976 with up to date amendments.
iv) Type test certificates from manufacturer shall be provided for particular drums.

b LAYING
i) Cable laying shall not commence without permission of consultant. Such permission will be given after receiving satisfactory response in following manner
ii) Final Cable route drawing
iii) Insulation resistance and continuity test results are satisfactory.
iv) Finalised cable schedule with correct cable lengths.
v) Readiness of Excavation, Hume pipes for road cross, civil work like chambers trenches,
vi) Availability of suitable tools like roller jacks for drums, sufficient manpower.
vii) Low Voltage Cables laid underground shall be 750 mm deep with minimum 50-mm. sand cushioning, bricks for mechanical protection. Refilling shall not be flat but shall have sufficient crown on top.
viii) Minimum bending radius of varies from 6D to 12D as per cable size shall be maintained.
ix) If number of cables are sharing the same trench there shall be minimum clearance of 50 mm. between them.
x) On horizontal run supports shall be at the interval of 450 mm.
xi) On vertical run supports shall be at the interval of 600 mm.
xii) Vertical runs shall be protected up to 1200 mm above ground level using G I pipe or suitable alternative.

c Jointing
i) Skilled manpower shall be employed.
ii) Proper tools shall be used.
iii) Lugs and glands of approved make shall be used.

8 LED Panel wiring(Ranga Bhavan Chowk Plaza)

a Conduits, Accessories and Joints
i) Minimum size of conduits used for wiring, in case of rigid P V C conduits shall be at least 1.5 mm Thick and 25 mm. dia. The accessories shall be of similar quality. The joints shall be made using special adhesives used for pressure pipe joints. Deep junction boxes shall be used wherever necessary in slabs.
ii) Pull boxes shall be provided at suitable locations for easy access and wiring.
iii) Conduits shall be free of burs, sharp edges and shall be cleaned off grease/oil if used.
iv) Using adhesives for joining various accessories is compulsory.
v) Conduits shall be drained and properly ventilated before wiring.

b Surface conduits

i) The surface conduits shall be fixed with help of 20 SWG saddles on spacers at every 600-mm. For vertical run and every 450 mm. For horizontal run. The runs shall be as far as possible straight and sufficient quantity of inspection boxes and inspection bends shall be provided.

c Switch boards

i) Unless specified the switchboard shall be MS fabricated from 16 SWG sheet steel with all sides except top. Cover plate fixing arrangement shall be provided in form of tapped holes on all Four Corners.
ii) At least one earth stud is a must.
iii) Minimum depth 60 mm.
iv) The boxes shall be coated with two coats of red oxide from inside and outside. All exposed surfaces shall be given enamel coats.
v) The switch plates shall be of one side Bakelite laminates of minimum 3 mm. Thickness and fixed with chrome-plated screws and cup washers.

9 Wires

a Multi-stranded copper wire of 1.5 / 2.5 / 4 sq. mm. Copper wire with 650 V graded shall be used. Three core insulated and PVC sheathed FRLS flexible shall be used from junction box to light fitting / fan fitting.

b The wiring shall be done in looping system. The phase conductor shall be looped at the switch box for sub-circuits.

c Coloured insulated wire of respective colour shall be used for phase conductor and black colour insulated wires shall be used for neutral conductor.

10 Earthing

a All non-live metal parts of the electrical system and equipment shall be earth with suitable size of earth conductors. Two distinct earthlings shall be provided for all the equipment.

b The earthing shall confirm to IS 3043 and lightening protection shall be with I S 2309. The earth resistance shall not exceed two-ohm at any time. Earth resistance shall be taken with earth mergers for all earth points. All earth points shall be located 2.0 mtrs. Away from the building and there will be a minimum distance of 5.0 mtrs. Between two earth points.

11 Artificial treatment

a In case of rocky soil, hard murum soil resistance is very high. For getting proper earthing alternate layers of charcoal and salt are to be provided. For entire height of earth electrode with 300 mm. Over all cover. Black cotton soil can be used for refilling the earth points in rocky strata.

12 APPROVED LIST OF MATERIAL

	ACB, MCCB	Siemens, L&T, Legrand, Schneider
	MCB, RCBO, MCB DB	Siemens, L&T, Legrand, Schneider
	LT Cables	Polycab, Finolex, RR Cable, Lap Cable, KEI.
	Glands flange type	Emi, Hmi
	Lugs	Dowell's
	P V C conduit	Diamond, Asian, Precision, Paxton
	Wires F R L S	Polycab, Finolex, RR Cable, Lap Cable, KEI.
	Switches, sockets	Siemens, L&T, Legrand, Schneider
	Lighting fixtures	Wipro, Philips, Bajaj, Havells
	Exhaust fans	Crompton, Havells, Gec, Alstom
	DATA I/O	Siemens, L&T, Legrand, Schneider
	DATA CABLE	D-Link, Finolex, Legrand, Polycab
	LT Meters	Siemens, L&T, Legrand, Schneider
	CT / PT	Amol, Rishabh
	UPS / INVERTOR	Emerson, APC, EATON, Champion
	HT Cable	Polycab, Finolex, Diamond, KEI
	HT Switch	Siemens, Schneider, ABB, C &S, L&T
	HT Cable Joint Kit	M-Seal, Reycham

All the material not listed above shall have consultant's approval.

13 Technical Specifications for Light Fittings

- **LED Street lights**

No	Criteria	Specification for LED street light fitting
1	Luminaire configuration / technical requirement	Side entry type. Shall consist of separate optical and control gear compartment. Driver should be easily replaceable in the field condition
2	Housing / Body of fitting	High pressure die cast Aluminum LM6 housing with corrosion resistant polyester powder coating with manufacturer word mark/name engraved /logo embossed into the housing to allow traceability till the end of life (stickering / printing is not acceptable)
3	Finish	Aesthetically designed housing with Black / Silver Grey color corrosion resistant polyester powder coating
4	Fixture Cover	Heat resistant toughened glass
5	Glare control details	Luminaire light distribution should have zero candela intensity at an angle of 90 degree and more.

No	Criteria	Specification for LED street light fitting
6	Protection – IP	Optical and Control gear compartment-IP 66
7	Impact resistance	Impact resistance greater than or equal to IK 06
8	Optical assembly	Structured LED array for optimized roadway photometric distribution with individual photometric lenses (on single lens plate) designed to optimize application efficiency and minimal glare. The lens plate should be mechanical fixed gluing of lenses is not acceptable.
9	Input Voltage	240 V AC ± 5% (140 to 277 V Range)
10	Frequency	50 Hz
11	Power factor	>= 0.95
12	Fixture designed ambient Temperature	+ 35 degree C
13	Operating temperature	Range 0 to +40 degree C
14	Working Humidity	10% to 90% RH
15	Storage Temperature	0 to 50 degree C
16	Total Current Harmonic distortion	Total Current Harmonic Distortion should be lesser than 20 %
17	Total system wattage and lumens of Fixture including Driver	Nominal value to be printed in the label and within +/- 10% variation from the printed value
18	LED efficacy (lumen/watt)	Efficacy of LED should be greater than 130 lumens / watt.
19	LED Luminaire efficacy	>100 lumen/watt +/- 5%
20	Power efficiency / LED driver efficiency	The efficiency of the electronic driver shall be more than 85 % in all cases at all times during project period.
21	Lumen maintenance	L70 @ 50,000 hours at ambient temp of 35 degree Celsius
22	Correlated Color temperature	Correlated Color Temperature shall be nominal 5700K (with variation limits of ±355K) per ANSI C78.377A CCT standard.
23	CRI	The value of CRI shall be more than 70.
26	Make of LED	Make of LED: CREE / Lumileds / Philips. The LED shall be of Surface Mounted Design
27	Lens	Lens plate should be provided on LED array for sustained correct optics
28	LED Drive Current	Not more than 85% of the rated current carrying capacity of LED
29	Driver Specification	AC universal electronic potted drivers with internal surge protection of 4 kV, having multi-level step dimming facility and should be compatible with automated outdoor street lighting control system

No	Criteria	Specification for LED street light fitting
		through compatible interfacing units. External surge protection of 10KV (DM/CM) within an enclosure inside the luminaire, the driver should be isolated type for protecting the LED Boards from abnormalities
30	Electrical safety as per IEC.	As per IEC safety standards IEC61000, 61547, 61347 / IS 16104 :2012 / IS 15885 (Part 1) 2011 / Part 2/ Sec 13 - 2012
31	Conformation standards of luminaire	The luminaire conform to IEC 60598 / IS 10322 Part 5 Sec 3. Type test certificate should be provided with the technical bid as per IS 10322 Part 5 Sec 3.
32	Reports / certifications	NABL accredited UL/ ERDA / ERTL lab only for luminaire & driver
33	Test reports of luminaire	(a)The luminaire should be tested as per IEC 60598 standards and following test reports should be submitted: Heat Resistance Test, Thermal Test, Ingress Protection Test, Electrical / Insulation Resistance Test, Endurance Test, Humidity Test. The luminaire should be tested for 'Drop test' as per IEC 60068-2-31/IS9000 Part 7 / Sec 3 standards. The luminaire should be tested for 'Vibration test' as per ANSI/IEC 68-2-6 standards. (b) Should comply with IESNA LM-79 (Approved method for the Electrical and Photometric Measurements of Solid-State Lighting Products). The Photometric distribution & electricals parameters should be tested at all dimming wattages (c) The LED' used should comply to LM-80 standards (IESNA: Approved Method for Measuring Lumen Maintenance of LED Light Sources and LED lumen depreciation time to L70 based on LM-80 data) (d)Copy of above test certificates should be submitted with tender. (e) Random samples from supplied lot should be tested at NABL accredited laboratory and report submitted for acceptance.as requested by the department.
34	Serial number	LED street light fitting should be supplied with serial number which should be attached to the fitting. The label should mention: Name of Manufacturer, model name and number, system lumen pack, nominal CCT, Wattage of fitting, Date of Manufacture, and other labeling details as per IS.
35	The photometric distribution of the shall be based on the required lighting parameters mentioned in the tender elsewhere (as per table 1)	Valid LM 79 tested at all dimming wattages for each luminaire from NABL approved UL/ERDA/ERTL laboratory only. Soft copy of the IES file to be submitted along with the tender.

No	Criteria	Specification for LED street light fitting
36	Design Parameters	The luminaire should be able to better A1 category of road lighting parameters (lux levels >= 30 lux & uniformities: min/max > 0.4 & min/avg - >0.6 for a typical road width of 15 m with 1m median & Spacing of28m with mounting height 9 m for central median arrangement with a mf = 0.8, UI > 0.7

- **Lighting Management System**

Lighting Control System should be deployed to manage the entire Street Lighting System under the scope of the project. Web based System should exercise complete control over the streetlights and thus be able to monitor their functions / operations such as Scheduling, Dimming, and Monitoring

Primary requirement of the system is that it should be Simple, Open and Secure. System Infrastructure should be simple providing seamless end to end solution without any complexity, with simple plug and play type of solution for installation not emphasizing of any special expert knowledge. System should be such that it can be easy to use / operative for non IT expert for daily work life. System should be Open and can be easily integrated with other major system. It should use Open standardize network technologies. Lighting data should be secure from any leak. Solution should be scalable and adaptable to future requirements.

A centralized control solution shall be easy to implement that requires less equipment and easier installation and essentially provide following facilities:

- Automatic (with a timer), Remote (with GPRS/GSM) and Manual Switching Options
- Remote Energy Measurement
- Multi Step Dimming functionality through power line communication
- Near real-time monitoring
- Alarms and Report generation.
- Emergency override – locally and remotely.
- Web based User Interface with Integrated Visual maps.
- Data security and secured system access.
- Prevent unauthorized physical access to the street light control box.
- Uninterrupted operation, even during single phasing.
- System integration with third party application software for smart city requirements.

System should be centralized exercising cabinet based control of the street lights such as ON/OFF, Dimming ensures an extremely high up-time and enables fast reaction to fault states.

The hardware modules installed in control cabinets and a full system overview is provided via the Web browser interface. Through a secure connection the system is accessible from any location and provides a fast assessment of the system's status, alarms and other events.

The streetlight automation system shall control and monitor streetlight electrical cabinets remotely via wireless communications such as GPRS as one of the primary communications network to the server

The system shall be easily scalable to include streetlights from a small area to a nationwide system rollout on the same platform.ON/OFF programming shall be enabled remotely and can be changed at any time. The ON/OFF times shall be optimized for the different daylight hours every day for energy optimization. That is, it would be optimized to follow the sunrise and sunset times every day

Electrical cabinet monitoring configurations shall be enabled remotely and can be changed at any time. Electrical meter readings shall be available On Demand and also in configured time intervals. Graphical view of the electrical consumption readings shall be available online for monitoring of the hourly electricity consumption

Power supply voltage and out-going current (from electrical cabinets to streetlights) shall be available ON-Demand. All alarm/fault detection events shall be logged and available for report-out printing for analysis

This system is primarily should be employed for the Important streets. Appropriate scheduling is to be done in consultation with the authorities for Dimming of street lights.

- **LED Post Top**

Construction:

- Post top luminaire should be conical in shape made up of high pressure die cast aluminium with matt polyurethane finish. The diameter of the disc should be 570 mm with tolerance of +/- 2% and height should not be less than 310 mm
- The luminaire canopy and spigot should be made from high pressure die cast aluminium with impact resistant UV stabilized polycarbonate diffuser
- Manufacturer / supplier name should be embossed on the housing to locate traceability.
- The optical compartment should have diffused polycarbonate diffuser boards and the glare of LED`s light source should not be visible from bottom.
- The fixture should have an impact resistance of minimum IK10 and Ingress protection of IP 66 Testing reports from NABL approved laboratory should be provided along with the technical bid document.
- The fixture should be suitable for post top mounting, axial entry for pole outer diameter of 60 mm.

- The fixture should be provided with bayonet whistle connector with integrated M20 Gland for easy installation without opening the luminaire.

Optical

- Input voltage range of 120 -277 V
- The fixture should be provided with high power Led luminaires with nominal lumen output of at least 4000 lumens and wattage not to exceed 48 W.
- The CCT should be 4000 K and CRI > 80
- The fixture should have option of symmetric and medium road distribution in the same shape & size
- Make of LED : CREE / Philips Lumileds / Nichia only
- The driver should be integrated type with internal surge protection of 4 KV. External surge Protection of 10 KV should be provided inside the luminaire. Life of the driver should be more
- The fixture should be suitable for operating temp of -20 degree to 50 degree C.
- Approved makes : Schreder / Philips / Bajaj / GE

Compliance

- The fixture should comply to IEC 60598-1: 2011 & IEC 60598-2-3: 2006 and should have CQC, CE marking approvals. Test reports should be provided in support of these claims.
- The L70 life of the luminaire should be 50000 burning hours at an ambient temp of 35 degrees C.
- There should be no light spill and the ULOR should be zero. IES file should be submitted along with the technical bid document.
- The fixture should be produced under a quality scheme at least in conformity with ISO 9001 or CENELEC permanent documents.
- EN 62493 :2010 / EN 62471: 2010 – Photo biological safety of lamps & lamps system

- **LED Bollard**

Construction:

- LED Bollard luminaire should be cylindrical in shape made up of high pressure die cast aluminium with matt polyurethane finish. The diameter of the disc should be 100mm with tolerance of +/- 2% and height should not be less than 800 mm
- Manufacturer / supplier name should be embossed / Printed on the housing to locate traceability.
- The optical compartment should have diffused polycarbonate diffuser boards and the glare of LED`s light source should not be visible from bottom.
- The fixture should have an impact resistance of minimum IK10 and Ingress protection of IP 65 Testing reports from NABL approved laboratory should be provided along with the technical bid document.

- The fixture should be provided with bayonet whistle connector with integrated M20 Gland for easy installation without opening the luminaire.

Optical

- Input voltage range of 120 -277 V
- The fixture should be provided with high power Led luminaires with nominal lumen output of at least 400 lumens and wattage not to exceed 8 W.
- The CCT should be 4000 K and CRI > 80
- The fixture should have option of symmetric and medium distribution in the same shape & size
- Make of LED : CREE / Philips Lumileds / Nichia only
- The fixture should be suitable for operating temp of -20 degree to 50 degree C.
- Approved makes : Schreder / Philips / Thorn / GE

Compliance

- The fixture should comply to IEC 60598-1: 2011 & IEC 60598-2-3: 2006 and should have CQC, CE marking approvals. Test reports should be provided in support of these claims.
- The L70 life of the luminaire should be 25000 burning hours at an ambient temp of 35 degrees C.
- The fixture should be produced under a quality scheme at least in conformity with ISO 9001 or CENELEC permanent documents.
- EN 62493 :2010 / EN 62471: 2010 – Photo biological safety of lamps & lamps system

- **LED Wall Bracket light**

Construction:

- LED bracket light luminaire should be made up of high pressure die cast aluminium with matt polyurethane finish with polycarbonate diffuser.
- Manufacturer / supplier name should be embossed / Printed on the housing to locate traceability.
- The optical compartment should have diffused polycarbonate diffuser boards and the glare of LED`s light source should not be visible from bottom.
- The fixture should have an impact resistance of minimum IK10 and Ingress protection of IP 65 Testing reports from NABL approved laboratory should be provided along with the technical bid document.

Optical

- Input voltage range of 120 -277 V
- The fixture should be provided with high power Led luminaires with nominal lumen output of at least 500 lumens and wattage not to exceed 9 W.
- The CCT should be 4000 K and CRI > 80
- The fixture should have option of symmetric and medium distribution in the same shape & size
- Make of LED : CREE / Philips Lumileds / Nichia only

- The fixture should be suitable for operating temp of -20 degree to 50 degree C.
- Approved makes : Schreder / Philips / Thorn / GE

Compliance

- The fixture should comply to IEC 60598-1: 2011 & IEC 60598-2-3: 2006 and should have CQC, CE marking approvals. Test reports should be provided in support of these claims.
- The L70 life of the luminaire should be 50000 burning hours at an ambient temp of 35 degrees C.
- The fixture should be produced under a quality scheme at least in conformity with ISO 9001 or CENELEC permanent documents.

- **LED Midbay Luminaire**

Construction:

- luminaire should be made up of high pressure die cast aluminium with toughened glass diffuser
- Manufacturer / supplier name should be embossed / Printed on the housing to locate traceability.
- The optical compartment should have individual lenses
- The fixture should have an impact resistance of minimum IK08 and Ingress protection of IP 65 Testing reports from NABL approved laboratory should be provided along with the technical bid document.

Optical

- Input voltage range of 120 -277 V
- The fixture should be provided with high power Led luminaires with nominal lumen output of at least 10000 lumens and wattage not to exceed 85 W.
- The CCT should be 6500 K and CRI > 80
- The fixture should have option of symmetric and medium distribution in the same shape & size
- Make of LED : CREE / Philips Lumileds / Nichia only
- The fixture should be suitable for operating temp of -20 degree to 50 degree C.
- Approved makes : Schnieder / Philips / Thorn / GE

Compliance

- The fixture should comply to IEC 60598-1: 2011 & IEC 60598-2-3: 2006 and should have CQC, CE marking approvals. Test reports should be provided in support of these claims.
- The L70 life of the luminaire should be 50000 burning hours at an ambient temp of 35 degrees C.
- The fixture should be produced under a quality scheme at least in conformity with ISO 9001 or CENELEC permanent documents.