DISTRICT LEVEL DEVELOPMENT AUTHORITY, RUDRAPUR (UDHAM SINGH NAGAR)

NAME OF WORK : **CONSTRUCTION OF OPEN GYM INFRONT OF L.D BHATT HOSPITAL, KASHIPUR DISTT. UDHAM SINGH NAGAR.**

TENDERED COST (Including G.S.T.) : **Rs. 24.79 lakh**

EARNEST MONEY : **Rs. 0.50 Lakh.**

COMPLETION PERIOD : **03 Months**

DATE OF OPENING OF TECHNICAL BID : **26-05-2025 onwards 2:00 PM**

OFFICE OF THE VICE CHAIRMAN, DISTRICT LEVEL DEVELOPMENT AUTHORITY, RUDRAPUR (UDHAM SINGH NAGAR)

INDEX

Table of Contents	Page No.
SECTION – I : BID REFERENCE	1-4
SECTION – II : INVITATION FOR BIDS (IFB)	5-9
SECTION – III : INSTRUCTIONS TO BIDDERS (I.T.B)	10-39
SECTION – IV : GENERAL CONDITIONS OF CONTRACT (G.C.C.)	40-75
SECTION – V : SPECIFICATIONS	76-301
SECTION – VI : DRAWINGS	302-303
SECTION – VII : CONTRACT DATA	304-310
SECTION – VIII : FORMS REQUIRED WITH BID	311-340
SECTION – IX : SECURITIES AND OTHER FORMS	341-349
SECTION – X : FORM OF BID	350-352
SECTION – XI : SCHEDULES AND BILL OF QUANTITY	353-364

SECTION – I : BID REFERENCE

DISTRICT LEVEL DEVELOPMENT AUTHORITY
RUDRAPUR (UDHAM SINGH NAGAR)

BID REFERENCE

1.	**Tender Notice (IFB)**	**:**	**86 /DDA USN / 2025-26 Date: 30-04-2025**
2.	**Name of Work** **Location of work site** **District** **State**	**:** **:** **:**	CONSTRUCTION OF OPEN GYM INFRONT OF L.D BHATT HOSPITAL, KASHIPUR DISTT. UDHAM SINGH NAGAR INFRONT OF L.D BHATT HOSPITAL, KASHIPUR UDHAM SINGH NAGAR **Uttarakhand**
3.	**Under the Programme**	**:**	**DLDA US NAGAR INFRASTRUCTURE FUND**
4.	**Under the Jurisdiction of**	**:**	VICE CHAIRMAN, DISTRICT LEVEL DEVELOPMENT AUTHORITY, RUDRAPUR **DISTT-UDHAM SINGH NAGAR.**
5	**Time, Date and Place of Pre – Bid Conference**	**:**	**12-05-2025** VICE CHAIRMAN, DISTRICT LEVEL DEVELOPMENT AUTHORITY, RUDRAPUR **DISTT-UDHAM SINGH NAGAR**
6	**Period for offline Submission of Bidding Document**	**:**	**05.05.2025, 11:00 hrs.** **To** **26.05.2025, 14:00 hrs.**
7	**Deadline Date & Time for Offline submission of documents**	**:**	**26.05.2025, 14:00 hrs.**
8	**Time and Date of Opening Bids**	**:**	**26.05.2025, 14:00 hrs onwards**
9	**Place of Opening of Bids**	**:**	VICE CHAIRMAN, DISTRICT LEVEL DEVELOPMENT AUTHORITY, RUDRAPUR **DISTT-UDHAM SINGH NAGAR**
13.	**Officer Inviting Bid**	**:**	VICE CHAIRMAN, DISTRICT LEVEL DEVELOPMENT AUTHORITY, RUDRAPUR **DISTT-UDHAM SINGH NAGAR**

14.	**Cost of tender document** **GST**	**:** **:**	**Rs. 5000.00** **Rs. 900.00**
15	**Earnest money**	**:**	**Rs. 0.50 Lakh.**
16	**Security**		**Contractor shall furnish in department total security deposit (Performance and retention) equal to 10 % of contract value, as and when required, in required shape or format, pledged to** VICE CHAIRMAN, DISTRICT LEVEL DEVELOPMENT AUTHORITY, RUDRAPUR **DISTT-UDHAM SINGH NAGAR.** **Performance Security of 5 % of Contract Value and additional performance security for unbalanced bid shall be furnished and laid with the department till the issuance of completion certificate. The retention money of 5 % of contract value deducted from the running bills as per the rate mentioned in contract data shall be laid with the department till successful completion of Defect Liability Period (DLP) which is liable to be extended automatically if the defects intimated to the contractor are not rectified as per satisfaction of the Engineer incharge. In case of any recovery to be done from contractor, like liquidated damage / penalty / any recovery arises due to any reason or for any defect found during construction and repaired in DLP, the notice will be issued to the contractor indicating amount due, by the concerned Engineer and copy will be sent to Employer. If such amount may not be deducted / recovered from his bills then shall be recovered from security deposit / retention money, by the Engineer. Any amount due to the department from the contractor may be recovered as revenue of the government is recovered. Security deposited will be released as per Conditions set out in General Conditions of Contract.**
17	**Rates**		**Rates agreed upon in the agreement will be final and no price escalation will be paid to contractor in any case. Schedule "G" will always be read with drawings and specifications and rates will remain accordingly always firm and final.**
18	**Address of contractor / firm**		**Address given by contractor at the time of submitting his bid shall be used by department for all correspondence and assumed always correct unless change notified by contractor with his own live signatures.**
19	**Insurance**		**Contractor will insure the work, all the labour, material, T&P, Departmental Staff and nearby properties etc. of worksite at his own cost as per agreement. Contractor will be fully responsible for loss of any type during execution of work at work site.**

20	**Stamp Duty**		**Stamp Duty Rs. 100/- will be borne by the contractor in accordance to G.O. No. 36/XXVII(5)/Stamp/05, Finance Section-5, dated 28-01-2005. If the rate of stamp duty is revised by the Govt. , additional stamp duty due, if any, on account of such revision, will be deposited by the contractor subsequently. In case additional stamp duty is not deposited by the contractor, the same will be recovered from his dues/deposits including penalty if any.**
21	**Details security submitted by contractor (to be filled up at the time of agreement)**		**Shape of security –** **No. of security –** **Dated –** **Valid up to –** **Amount –** **Issuing bank –**
22	**Full address with PIN of contractor**		**Name –** **House no. -** **Sub Street –** **Street –** **Town –** **District –** **State –** **PIN –** **E-mail ID –** **Mobile no. –** **Phone No. -**
23	**Other terms and conditions**		**All terms & conditions, specifications etc. are given in the bid document. Contractor must read and understand these before quoting his rates and signing agreement.**
24	**Reference for obtaining information about bid**		**Other references / information of bid can be seen in or can be obtained from office of THE** VICE CHAIRMAN, DISTRICT LEVEL DEVELOPMENT AUTHORITY, RUDRAPUR **DISTT-UDHAM SINGH NAGAR**, 263153. **Or can be enquired From Phone no. 7906743450.**

SECTION – II : INVITATION FOR BIDS (IFB)

DISTRICT LEVEL DEVELOPMENT AUTHORITY,

UDHAM SINGH NAGAR

NOTICE INVITING TENDER

1. Tenders are hereby invited on behalf of the Vice Chairman District Level Development Authority, U.S Nagar as per details given below

S.NO.	NAME OF WORK	ESTIMATED COST (Rs. IN LAKHS)	EARNEST MONEY (Rs. IN LAKHS)	COST OF TENDER	TIME ALLOWED FOR COMPLETION	CATEGORY
01	CONSTRUCTION OF PLATFORM AND INSTALLATION OF RAJA JAGAT DEV STATUE AT DALPURA, GULARBHOJ DISTT. UDHAM SINGH NAGAR	24.93	0.50	5900.00	03 Months	Registration in civil works with any govt. department/PSU/Nigam in category D or above
02	CONSTRUCTION OF OPEN GYM AT 46 VAHINI P.A.C, T.F RUDRAPUR, U.S NAGAR	24.79	0.50	5900.00	03 Months	Registration in civil works with any govt. department/PSU/Nigam in category D or above
03	CONSTRUCTION OF OPEN GYM INFRONT OF L.D BHATT HOSPITAL, KASHIPUR, U.S NAGAR	24.79	0.50	5900.00	03 Months	Registration in civil works with any govt. department/PSU/Nigam in category D or above

2. Offline Tenders under Single bid System on item rate basic (inclusive of all material but excluding GST) are invited up to 26.05.2025, 2:00 PM. from technically and financially capable bidders registered in any govt. department/PSU/Nigam in category D or above Category. Tender documents and other particulars of the work(s) can be purchased from the office of the Authority between the hours of 11 A.M on all working days till 5 P.M after paying the cost of tender mentioned above.

3. Tender which should be placed in sealed cover will be received by the Executive Engineer, DLDA U.S NAGAR up to 2 P.M. on 26.05.2025 and will be opened by committee on the same day at 3.30 P.M. The Tenderer are expected to be present at the time of opening of tenders. The contractors should quote in figures as well as in words the rate and amount tendered by them.

4 5. Each tender must be accompanied by a deposit of Earnest Money in any of the following forms.

(a) Deposits call receipts of a Scheduled Bank Guaranteed by Reserve Bank of India.

(b) Post Office Saving Bank pass Book/National Saving Certificate/ National Plan Certificates/ National Defence Certificates duly pledged to the Secretary District Level Development Authority, U.S Nagar.

6. The acceptance of a tender, will rest with the Vice Chairman, who does not bind himself to accept the lowest tender and reserves to himself the right of rejecting any or all of the tenders received without assigning a reason or of accepting the whole or part of the tender.

All tenders on which any of the prescribed conditions are not fulfilled or are incomplete in any respect are liable to rejection.

7. Canvassing in connection with tenders is strictly prohibited and the tenders submitted by the contractors who resort to canvassing will be liable for rejection.

8. On acceptance of the tender, the name of the authority representative (s) or the contractor who would be responsible for taking instructions from the Engineer-in-charge shall be communicated to the engineer-in-charge.

9. GST Tax or any other tax on material in respect of this contract shall be payable by the contractor and DLDA U.S NAGAR will not entertain any claim whatsoever in this respect.

10. The contractors must produce Income Tax Clearance Certificate before the tender papers can be sold to him.

11. The Security deposit may be collected by deductions from the running bills of the contractor at the rate of 5%. The Security amount will also be accepted in the Shape of Government Securities Fixed deposit receipt and Guarantee Bonds of Scheduled Banks will also be accepted for This purpose provided confirmatory advises is forth coming from the Reserve Bank of India. Performance securities / additional performance securities shall we applicable as per Uttarakhand procurement rule 2017 and Go no. 6447 dt. 02 January, 2013. Liquidated Damages and bonus shall be applicable as per Uttarakhand Procurement rule 2017 close no. 43 and 44.

12. The contractor shall not be permitted to tender in DLDA U.S NAGAR. if his near relative is employee of (DLDA U.S NAGAR.), He shall also intimate the name of persons who are working with him in any capacity or are subsequently employed by him and who are near relatives of any employee of DLDA U.S NAGAR. Any breach of this condition by the contractor would render him liable to be removed from the approved list of contractors of DLDA U.S NAGAR. NOTE: A near relative will include with, husband, parents and grand children brothers and sisters uncles, aunt and cousins and their corresponding in laws.

13. No employee of DLDA U.S NAGAR. is allowed to work as contractor or as employee of a contractor for a period of two years of his retirement from service without the prior permission of Vice Chaiman, DLDA U.S NAGAR. This contract is liable to be cancelled if other the contractor of any of his employees is found at any time to be such a person who had not obtained the permission of the Vice Chairman, DLDA U.S NAGAR. as aforesaid before submission of the tender or engagement in the contractors service.

Kailash Bangwal

14. The tender for works shall remain open for acceptance for a period of ninety days from the date of opening of tenders. If any tenders withdraws his tender before the said period or makes any modification in the terms and conditions of the tender which are not acceptable to the DLDA U.S NAGAR. then the DLDA U.S NAGAR. shall without prejudice to any other right or remedy, be at liberty to forfeit 100% of the said earnest money absolutely.

15. The contractors exempted from payment of earnest money in individual cases should attach with the tender an attested copy of the letter exempting them from the payment of earnest money and should produce the original whenever called upon to do so.

16. The tender for the work shall not be witnessed by a contractor who himself/themselves may has/have tendered for the same work. Failure to observe this condition would render, tenders of the contractors tendering as well witnessing the tender liable to summary rejection.

17. The contractors shall submit list of works which are in hand (progress) in the following form.

NAME OF WORK	NAME OF DIVISION	AMOUNT OF WORK	PRESENT PROGRESS	REMARK

18. The contractors are advised to see the site of work and be acquainted with the position of materials, condition of contracts, drawing etc. before tendering.

19. If a person, after his tender is accepted does not sign the agreement, his earnest money will be forfeited.

20. The successful bidder shall be required to submit stamp papers of Rs. 100.00 for the execution of agreement due.

Kailash Bangwal

(Secretary)

For and behalf of the Vice Chairman DLDA

U.S Nagar

SECTION – III : INSTRUCTIONS TO BIDDERS (I.T.B)

OFFICE OF THE VICE CHAIRMAN, DISTRICT LEVEL DEVELOPMENT AUTHORITY, RUDRAPUR (UDHAM SINGH NAGAR)

Section III: Instructions to Bidders

Table of Clauses

A.	General	Clause No.	D.	Submission of Bids	Clause No.
1.	Scope of Bid	1	19.	Sealing and Marking of Bids	19
2.	Source of Funds	2	20.	Deadline for Submission of Bids	20
3.	Eligibility Criteria	3	21.	Late Bids	21
4.	Qualification of Bidder	4	22.	Modification &Withdrawal	22
5.	One Bid per Bidder & Cost of Bidding	5	E.	Bid Opening and Evaluation	
6.	Site Visit	6	23	Bid Opening	23
7.	Advance Payment	7	24	Process to be Confidential	24
B.	Bidding Documents		25.	Clarification of Bids	25
8.	Content of Bidding Documents	8	26.	Examination of Bids and Determination of Responsiveness	26
9.	Clarification of BiddingDocuments	9	27.	Financial Evaluation and Comparison of Bids	27
10.	Amendment of Bidding Documents	10	28.	Negotiation with Bidders	28
C.	Preparation of Bids		F.	Award of Contract	
11.	Language of Bid	11	29	Award Criteria	29
12.	Documents Comprising the Bid	12	30.	Employer's Right to Accept any Bid and to Reject any or all Bids and to relax in qualification of contractors	30
13.	Bid Prices	13	31.	Notification of Award and signing agreement	31
14.	Currencies of Bid and Payment	14	32	Performance Security	32
15.	Bid Validity	15	33	Settlement of Disputes	33
16.	Bid Security	16	34	Corrupt or Fraudulent Practices	34
17.	Alternative Proposals by Bidders	17			
18.	Participation in Bid / Format and Signing of Bid	18			

A. General

1 Scope of Bid

1.1 Works detailed in the table given in IFB (Section-II) under the jurisdiction of the DLDA U.S NAGAR specified in Bid Reference (Section-I) and schedule-G, referred to as "The Works" or "work" hereafter. However assessed quantities have been given in BOQ, the quantities can be increased or decreased up to any limit and any extra item necessary for commissioning of the project will have to be executed by the contractor.

1.2 The successful bidder will be expected to complete the works within the intended completion period specified in the IFB (Section-II).

1.3 Throughout these documents, the terms "bid" and "tender" and their derivatives (bidder/ tenderer, bid / tender, bidding / tendering, etc.) are synonymous.

2 Source of Funds

2.1 The Engineer will arrange the funds from the budget of Client Department for the work but time limit for the arrangement of budget is not fixed. The release of fund to the Contractor depends upon the release from Govt. of India / Govt. of Uttarakhand / External Funding Agency under the program specified in Bid Reference (Section-I). No Claim of Contractor in this regard will be entertained.

3 Eligible Bidders

3.1 This Invitation for Bids is open to all eligible bidders meeting the eligibility criteria as defined in Sub Cl. 3.5.

3.2 All bidders shall provide in Section - VIII (Qualification Information, Declaration and other forms) a statement on Rs 100.00 Stamp Paper, duly notarized, that the Bidder is not related / associated, nor has been related / associated in the past, directly or indirectly, with the Employer / Consultant or any other entity (as defined in Section-IV under "Definitions") that has prepared the design, specifications, other documents etc. for this Project / for this Bid and any of the staff engaged in the actual execution of the work. Any bidder found concealing the facts in violation of the above shall automatically be disqualified and all his securities with the department shall stand forfeited.

3.3 Central/State Government owned enterprises /PSUs are not allowed to participate in the bidding.

3.4 The Bidders must not be under a declaration of ineligibility for corrupt and fraudulent practices issued by the owner through any of its authorities / Engineers in accordance with Sub Cl. 34.1.

3.5 Eligibility Criteria

(a) Any Bidder who is presently doing Civil and Ancillary works of similar nature through different contract agreements in DLDA U.S Nagar and registered in required class and category (as per NIT) are eligible to bid. For this purpose, similar nature of work will be defined as below.

(i) Construction of Building work

Experience of only the above category works will be considered in Sub Cl. 3.5 (d) given below.

(b) The bidder is to provide the requisite information in the annexed formats to qualify and determine the eligibility for bidding.

~~**(c) The bidder should have achieved an average annual financial turnover on all type of construction works including those categorized in Sub Cl. 3.5 (a), not less than 30% of work cost put to tender during immediate last three consecutive financial years ending 31st. March 2023**~~ **Not Applicable**

~~**(d) The bidder, as prime contractor, should have satisfactorily completed during last 7 years ending last day of the month previous to the month of calling of tender, at least one similar work of value not less than 80% of the estimated cost put to tender or should have satisfactorily completed at least two similar works of value not less than 60% of the estimated cost put to tender or should have satisfactorily completed at least three similar works of value not less than 40% of the estimated cost put to tender. (Specified in Contract Data)- Section-VII. For qualifying in above criteria the bidder should have satisfactorily completed during last 7 years ending last day of the month previous to the month of calling of tender, Actual value of such similar executed works shall be increased at a simple rate of 7% per annum to bring the same to the current costing level, calculated from the date of current rates which were prevailing at the time of invitation of tender.**~~ **Not Applicable**

The bidder should have experience of successfully completing at least one sculpture work.

~~**(e) The bidder should not have incurred any loss in more than two years during the immediate last five consecutive financial years. Duly certified by Chartered Accountant.**~~ **Not Applicable**

(f) The Bidder, however, must be registered in any public sector undertaking building works category in class "D" or above category its Undertakings as per the bid value Proof of certificate to this effect is required to be given by the Bidder.

(g) The Bidder, if not registered in DLDA U.S NAGAR shall have to give an undertaking on a non-judicial stamp paper of Rs.100.00, in the format prescribed in Sub Cl. 4.2 (y) below, that in case his bid is accepted, he will get himself registered in DLDA U.S NAGARin appropriate category within three Months of acceptance of his bid, failing which the prescribed cost of Registration Form, Registration Fees, late registration fee (if any) and General Security as per departmental Registration Regulations – 2010 or its latest revision, will be deducted from his Running Bill. **Not Applicable**

(h) The bidder should submit solvency certificate worth 40% of tender value issued from any Public Sector (SBI and Nationalized) / Scheduled bank or any other competent authority and not more than 06 months old. **Not Applicable**

(i) Experience of work required in Sub Cl. 3.5 (d) above should be under a Central Govt. Department / any State Govt. Department / Central or State Govt. Undertakings. **Not Applicable**

(j) Experience certificate for the similar works obtained from any private agency / contractor shall not be considered. **Not Applicable**

(k) Availability of necessary equipment and machinery, (owned or leased), as indicated in Contract Data (Section-VII) should be furnished. Work may not be allowed to start at site without availability of necessary equipment, delay thus caused will be attributed to the contractor. If above required documents/ Proof or Affidavit not attached with the bid will not be consider/accepted.

In addition to above the contractor will have to establish a full-fledged Site Lab with all necessary equipment as shown in the contract data and temporary site office with toilet & furniture up to the satisfaction of Engineer in charge prior to start of work. **Not Applicable**

(l) Bidder will have to furnish the availability of technical staff required for this work, as detailed in Contract Data (Section-VII), with minimum experience specified in implementation / construction of similar works and other key personnel with adequate experience. **Not Applicable**

(m) Bidder will have to furnish the availability of Credit Limit equivalent to 3 Months Cash Flow for this tender from any Public Sector (SBI and Nationalized) / Scheduled bank of value not less than the amount as indicated in Contract Data (Section-VII). The Credit Limit Certificate issued by the bank should not be more than 3 months old. Its Format is attached in Section-VIII.

~~In addition to above the net working capital (current assets – Current liability) must be positive.~~ **Not Applicable**

~~(n) Bidders who meet the minimum qualification criteria will be qualified only if their Available Bid Capacity is more than the total bid value. The Available Bid Capacity will be calculated as under:-~~

~~Assessed 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 five years (updated to the price level of the current financial year) taking into account the completed as well as works in progress.~~

~~N = Number of years prescribed for completion of the works for which bids are invited.~~

~~B = Value of existing commitments and ongoing works to be completed during the next years.~~

~~Note: - The statements showing the value of existing commitments and on-going works as well as the stipulated period of completion remaining for each work listed in the statement should be countersigned by the Engineer in charge, not below the rank of an Executive Engineer or equivalent. In the absence of counter signature of the Engineer in charge, a notarized affidavit may regarding trueness of the data has to be submitted.~~

~~Escalation factors (to update to the price level of the current financial year) will be as follows:-~~

~~Year~~	~~Multiplying factor~~
~~One~~	~~1.07~~
~~Two~~	~~1.14~~
~~Three~~	~~1.21~~
~~Four~~	~~1.28~~
~~Five~~	~~1.35~~

(o) Even though the bidders meet the above qualifying criteria on the basis of information furnished by them in the bid documents, they will be treated as disqualified if they have:- Not Applicable

Furnished misleading or false information in the prescribed forms, statements and attachments submitted in proof of the qualification requirements; and/or

(ii) Record of poor performance such as leaving the works uncompleted, improper completion of contracted works, inordinate delays in completion of works, litigation history, or financial failures etc. and / or

(iii) Participated in the previous bidding for the same work and had been found guilty of provisions of Sub Cl. 3.5 (o) (i) & (ii) above.

Note: - If required the Contractor shall have to produce extract copy of the agreements, certificates for the satisfactory execution of the similar type of works in progress and those completed, in support of experience required under Cl. 3.5 (d) from a competent employer not less than the rank of the Executive Engineer or equivalent. The year wise detail of quantities of different item of works executed and their value as per their agreements should also be furnished in support of the experience certificate.

However employer has full right to relax in qualification to any bidder, whom he thinks capable to execute work successfully. Tender inviting authority reserves right to cancel one or all or any bid / to relax in qualification to any bidder, without assigning any reason and bidder will have no right to claim any way in such cases. Only those bidders who accept this condition should submit their bid and Submission of bid by Bidder shall be acceptance of this condition.

(p) **For electrical works, the bidder should be registered in electrical works category in class "D" or above in DLDA U.S NAGAR and is experienced to execute such work. If not registered himself, can execute joint venture (form no.-I, in Section VIII) with qualified, registered and experienced electrical contractors. In support of the eligibility of the proposed associated electrical contractor, copy of their registration documents, Valid license for Electrical works from the competent authority, good and service Tax (GST) documents, experience Certificate duly attested by the applicants shall be submitted with the bid. If above required documents/ Proof not attached with the bid will not be consider/accepted. Not Applicable**

~~(q) For specialized works like Antitermite etc.(if any) included in the Tender the Bidder should submit the MOU with any manufacturer /authorized dealers/registered agency preferred brands as mentioned in the bid document for its execution. The manufacturer /authorized dealers/ registered agency should have at least five year experience proof and will submit all the eligibility documents and experience certificates (Format of MOU in form-XII of Section VIII).~~ **Not Applicable**

~~If above required documents/ Proof not attached with the bid will not be consider/accepted.~~ **Not Applicable**

(r) The bidder have to submit "NO Dues Certificate" of GST and proof of filling of GST statement and returns for qualification in bid. The GST registration should be in Active condition for bidder qualification.

(s) The bidder should have experience of successfully completing at least one sculpture work.

~~4 Qualification of Bidders~~

~~4.1 All the Bidders shall provide a brief profile of themselves and their partners, if any / the profile of bidding Company along with its Articles of Association / Joint Venture Agreement along with the profile of each participating Firm. They shall also provide a preliminary description of proposed work methods and schedule including necessary drawings and charts, along with other documents required in the formats detailed below.~~ **Not Applicable**

4.2 Documents required to be submitted for Qualification

The bidder shall include the following documents and information preferably in same order and same format with their bids on requisite formats and other details given in Qualification Information Declaration & Other forms (Section-VIII).

(a) Proof of valid and updated Registration Certificate (class and type, Building works as per NIT) in DLDA U.S NAGAR. ~~In case of Joint Venture all the partners will present registration certificate, copies of original documents defining the constitutional or legal status in JV, copy of Memorandum of Articles of participating firms.~~

~~(b) Written Power of Attorney (if required)of the authorized signatory of participating firm / lead partner of JV on a non-judicial stamp paper of Rs 100.00 duly notarized by a Public Notary.~~ **Not Applicable**

(c) Bid Security (Earnest Money) mentioned in Tender Notice (IFB) in the form of FDR / NSC as required in condition 2 of IFB (Section-II).

(d) Cost of bidding document in the form of Demand Draft as mentioned in condition 1 of IFB (Section-II).

~~(e) Joint Venture only for electrical work Agreement on Form-I given in Section-VIII on non-judicial stamp paper of Rs 100.00 duly notarized in case of bidder being a JV.~~ Not Applicable

(f) Affidavit of Bid Validity for 120 days beyond the date of bid opening in Form-II given in Section-VIII on Rs 100.00 Stamp Paper duly notarized.

~~(g) Public Sector (SBI &Nationalized) / Scheduled Bank's Credit Limit Certificate of requisite amount as mentioned in Contract Data (Section-VII)on Form-II I , given in Section-VIII. The relevant certificate should not be more than three months old.~~ Not Applicable

(h) Undertaking on Rs 100.00 Stamp Paper in Form-IV given in Section-VIII, duly notarized, that the decision of the Departmental Tender Committee regarding the acceptance of the bids shall be final and binding on the bidder.

(i) Affidavit on Rs 100.00 Stamp Paper on the Form-V given in Section-VIII, duly notarized, regarding no relation with persons responsible for technical design & execution of the project / works.

(j) Affidavit on Rs 100.00 Stamp Paper on the Form-VI given in Section-VIII, duly notarized, regarding no dues or recoveries of IT, CST, State Trade Tax / GST or any other Government taxes & duties pending in connection with works done under any previous employer.

(k) General Information of bidder in the Form-VII given in S ection- VIII.

(l) Affidavit on Rs 100.00 Stamp Paper on the Form-VIII given in Section-VIII, Information regarding any litigation pending currently or occurred during the last five years regarding the works done under the previous employers, involving the Bidder, other parties concerned, cause of dispute and the amount involved etc. on Form-VIII given in Section-VIII.

~~(m) Details of Financial Assets on Form-IX given in Section-VIII.~~ Not Applicable

~~(n) Details of Annual Turnover of last 5 (Five) years on the Form-X duly verified by Chartered Accountant, given in Section-VIII.~~ Not Applicable

~~(o) Experience of work as per C.L. 3.5d with work wise details, completed during last 7 years including details of subletting done, if any, on the Form-XI given in Section-VIII, and proof of satisfactory completion of works within the designated time as per the contract agreement and the value of the work~~

~~done within the time frame substantiated by the certificates issued by employers not below the rank of Executive Engineer.~~ **Not Applicable**

~~(p) Affidavit on non-judicial stamp paper of Rs. 100.00 duly notarized by a Public Notary, on the Form-XII given in Section-VIII that the bidder will get the specialized civil / electrical works executed through registered, qualified and experienced agencies after approval from the department.~~ **Not Applicable**

~~(q) Summary of current contract commitments / works in progress, for which a letter of intent or acceptance has been received by the bidder and also for the contracts under execution/ approaching completion, specifying stages of each on Form-XIII given in Section-VIII, along with addresses and contact nos. of the corresponding employers who may be contacted for further information regarding these contracts.~~ **Not Applicable**

~~(R) Proposal for subcontracting the components of the works included in this tender which the bidder intends to sublet, if any, on Form-XIV given in Section-VIII, the aggregate sum of which should not be more than 20 percent of the total Bid Value (*The bidder shall furnish and annex the qualifications and experience of each identified sub-contractor for similar work done during the last 5 years).* No vertical splitting of work for sub-contracting is acceptable.~~ **Not Applicable**

(s) Bidder's banker detail on Form- XV (Section-VIII).

~~(t) Construction Equipment proposed to be deployed for the project, purchased or leased on Form- XVI (Section-VIII).~~ **Not Applicable**

~~(u) Key personnel available and proposed to be engaged for management, and supervision of the Project, their qualification and experience on Form-XVII (Section-VIII).~~ **Not Applicable**

~~(v) Proposed Site Organization Chart on Form-XVIII (Section-VIII).~~ **Not Applicable**

~~(w) The proposed methodology and programme of construction, backed with equipment planning and deployment, duly supported with broad calculations and quality control procedures proposed to be adopted, justifying their capability of execution and completion of the work as per requisite specifications on Form-XIX (Section-VIII).~~ **Not Applicable**

(x) Declaration-cum-Request regarding customs / excise duty exemption for materials / construction equipment bought for the work on Form-XX (Section-VIII).

~~(y) An undertaking on a non-judicial stamp paper of Rs 100.00 on Form-XXI (Section-VIII)to get himself registered in DLDA U.S NAGAR(if not already registered) in appropriate category within three months of acceptance of his bid, in case his bid is accepted.~~ **Not Applicable**

(z) Affidavit on Rs 100.00 Stamp Paper on the Form-XXII given in Section-VIII, duly notarized, regarding correctness of information furnished with bid.

~~(a') Audited Profit & Loss Statement, Balance Sheet and Income Tax Return of last 5 years.~~ **Not Applicable**

~~(b') Solvency certificate issued from any Public Sector (SBI and Nationalized) / Scheduled bank or any other competent authority, on the Form-XXIII not more than 06 months old from the date of final uploading of the tender.~~ **Not Applicable**

(c') The bidder have to submit "NO Dues Certificate" of GST and proof of filling of GST statement and returns for qualification in bid. The GST registration should be in Active condition for bidder qualification.

(d') The bidder should have experience of successfully completing at least one sculpture work.

However, the tender Committee has full right to relax in qualification/eligible criteria to any bidder.

4.3 Not Applicable ~~Joint Venture (Joint venture will be acceptable only for electrical work)~~

~~Bids from Joint Ventures only for electrical works are acceptable. Bids submitted by a Joint Venture (JV) of not more than two firms / contractors as partners shall comply with the following requirements:~~

~~a) There shall be a Joint Venture Agreement (refer Form-I in Section-VIII) specific for this contract package between the constituent firms, indicating clearly, amongst other things, the proposed distribution of responsibilities, both financial as well as technical, amongst them for execution of the work. For the purpose of this clause, the most experienced and financially capable partner will be defined as the Lead Partner. A copy of the notarized Joint Venture agreement in accordance with requirements mentioned in the said Form-I, duly signed by the legally authorized signatories of all the partners of the Joint Venture, shall be submitted in original with the tender.~~

~~b) The bid, and in the case of successful bidder, the Form of Agreement etc. of Contract Bond, shall be signed by the Lead~~

~~Partner /authorized signatory and shall be deemed to be legally binding on all the partners in respect of all operative parts of the ensuing Contract inclusive of Agreement of Arbitration, etc.~~

~~c) Lead partner shall be nominated as being the partner-in-charge, and this authorization shall be evidenced by submitting a Power of Attorney signed by the legally authorized signatories of all the partners.~~

~~d) The partner-in-charge shall be authorized to incur liabilities and to receive instructions for and on behalf of all the partners of the Joint Venture, whether jointly or severally. Entire execution of the Contract (including payments) shall be carried out exclusively through the partner-in-charge. A copy of the said authorization shall be furnished with this bid.~~

~~e) All partners of the Joint Venture shall be liable jointly and individually for the execution of the Contract in accordance with the Contract terms & conditions, and a relevant statement to this effect shall be included in the authorization mentioned under sub clause (c) above as well as in the Form of Tender and the Form of Agreement (in case of a successful bidder).~~

~~f) In the event of default by any partner, in the execution of his part of the Contract, the Engineer shall be so notified within 30 days by the partner-in-charge, or in the case of the partner-in-charge being the defaulter, by the remaining partner(s) of the Joint Venture. Engineer will recommend necessary action and inform to employer. In case of the defaulter being a partner other than the partner-in-charge, the partner-in-charge shall, within 30 days of the said notice, assign the work of the defaulting partner to any other equally competent party acceptable to the Employer to ensure the execution of that part of the Contract, as envisaged at the time of bid. Failure to comply with the above provisions will make the Contractor liable for action by the Employer under the Conditions of Contract. But if the Most Experienced Lead Partner, defined as partner-in-charge defaults, then it shall be construed as default of the Contractor and shall be treated as Breach of Contract under the Conditions of Contract.~~

~~g) Notwithstanding the permission to assigning the responsibilities of the defaulting partner to any other equally competent party acceptable to the Employer as mentioned in Sub Cl. (f) above, all the partners of the Joint Venture will retain the full and undivided responsibility for the performance of their obligations under the Contract and / or for satisfactory completion of the Works.~~

~~h) The bid submitted shall include all the relevant information as required under the provisions of Sub Cl. 4.2 of ITB and furnished separately for each partner.~~

4.4 If bidder is a Joint Venture, the partners would be limited to maximum three (including lead partner). Joint Venture firm shall jointly and individually responsible for completion of the project. Joint Venture must fulfill the following minimum qualification requirement:- Not Applicable

(i) The lead partner shall meet not less than 50% of qualification criteria given in Cl. 3.5 (c), (d) & (e) of ITB above and must comply with the provisions of Cl. 3.5 (f) & (g).

(ii) All the partners jointly shall meet 100% of all qualification criteria given in Cl. 3.5 (a) to (o) of ITB above.

(iii) In the event the Employer finds the bidder guilty under Cl. 3.5 (o) of ITB above, all of the Joint Venture partners will automatically stand disqualified.

(iv) Joint venture partners shall also provide a certified copy of the Mutual Agreement arrived amongst them regarding distribution of work and roles & responsibilities, undertaking joint and individual liabilities, for the performance of ensuing Contract against this bid.

(v) The available bid capacity of the JV as required under Cl. 3.5 (n) of ITB above will be applied for all the partners jointly. The total bid capacity available shall be more than estimated contract value.

Note 1 - The bidder / contractor shall submit the proof of all the contract agreements (e.g. copy of acceptance letter, extract copy of the agreements, letter of date of start, certificate of completion etc.), in support of details given in Form-XI, particularly for the work through which he fulfills the eligibility requirements. It is mandatory that the bidder should not have incurred any loss in more than two years during the immediate last 5 years. Not Applicable

Note 2 - In Sub Cl. 3.5 (d) above, similar work means agreements completed for similar work as defined in this document during the last 7 (seven) years of value indicated as above. The contractors shall have to produce the list of running works of similar nature, in progress, their up to date progress and execution of the work satisfactorily, certified by the employer not less than the rank of the Executive Engineer. In the absence of certification by employer, affidavit in regard of trueness of the data must be attached.

Note 3-Date of start, stipulated date of completion, actual date of completion and quality of similar completed works should also be mentioned in the experience certificate.

Note 4 - Contractor has to satisfy the eligibility criteria for technical capability competence as well as for financial capacity and organizational resources.

Note 5 - The experience certificate from any private contractor or private organization and as a sub-contractor to prime contractor shall not be considered while evaluating the bid in compliance to the qualifying criteria.

Note 6 - The Experience of any bidder, who got the awarded work executed by subletting the same in whole or piece to other contractor, shall not be considered for the technical qualification.

Note 7 - The bidder showing T.D.S. deduction in their balance sheet, income tax return shall have to submit details of T.D.S., date of deposition with I.T.D. and copy of challans, thus, submitted, reasons for deduction of T.D.S.

Note 8- The bidder shall have to submit copies of the income tax return filed and clearance receipts for the last five years. The bidder shall also give an undertaking that the bidding firm or any of its directors or partners have no dues / recovery pending with any government departments that is IT, CST, GST, state trade tax or any other Government dept. taxes and the bidder shall have to submit an affidavit of same on Rs 100/- (One Hundred only) stamp paper duly notarized for the same.

5 One Bid per Bidder & Cost of Bidding

5.1 Each Bidder shall submit only one Bid for a work. In case, a bidder who submits more than one Bid for a work or if a Joint Venture partner is found to have participated in more than one JVs for the same work, it will cause the bids of all such JVs / Bidder disqualified.

5.2 The Bidder shall bear all costs associated with the preparation and submission of his Bid. The Employer will, in no case, be responsible or liable for any such costs.

6. Site Visit

6.1 The Bidder, at the Bidder's own responsibility, risks and cost, is encouraged to visit and examine the Site of Works and its surroundings and obtain all information that may be necessary for preparing and quoting rates in the Bid and entering into a Contract for construction of the Works. The costs of visiting the Site shall be at the Bidder's own expense.

7. Advance Payment:

7.1 As per contract data

8 Content of Bidding Document

8.1 The set of bidding document comprises the documents listed below and addendum issued in accordance with Cl. 10:

Section	Particulars
I	Bid Reference
II	Invitation for Bids (IFB)
III	Instruction to Bidders (ITB)
IV	General Conditions of Contract (GCC)
V	Specifications
VI	Drawings(tentative)
VII	Contract Data
VIII	Qualification Information, Declaration and Other Forms
IX	Securities and Other Forms
X	Form of Bid
XI	Bill of Quantities

8.2 The bid documents shall be published online on the e-Govt. Procurement System (e-GPS) portal http://www.uktenders. gov.in on the date and time as mentioned in the Notice Inviting Tender. The bidding document published by the Tender Inviting Officer in the website will appear in the "Latest Active Tenders" tab. The Bidder / Guest User can download the bid document only after the due date & time for sale. The publication of the tender will be for specific period of time till the last date of submission of bids as mentioned in the "Notice Inviting Tender" after which the same will be removed from the list of Latest Active Tenders.

8.3 The bidder is expected to examine carefully all instructions, terms and conditions of contract, contract data, forms, specifications, bill of quantities, certificates, annexure and drawings etc. in the Bid Document. Failure to comply with the requirements of Bid Documents shall be at the bidder's own risk. Pursuant to Cl. 26 hereof, bids which are not substantially responsive to the requirements of the Bid Documents, shall be rejected.

9 Clarification of Bidding Documents and Pre-bid Meeting

9.1 The bidder may ask questions personally /by e-mail or by phone from VICE CHAIRMAN, DISTRICT LEVEL DEVELOPMENT AUTHORITY, RUDRAPUR (UDHAM SINGH NAGAR) 263153**, to clarify queries related to tender and work. Bidders are advised to attend pre-bid meeting to get better answers of their queries. If any genuine point is raised, tender document may be modified accordingly.**

9.2 Pre-bid meeting

9.2.1 The bidder or his official representative is invited to attend a pre-bid meeting, which will take place as per time and date as mentioned in Bid Reference.

9.2.2 The purpose of the pre-bid meeting will be to clarify issues and to answer questions on any matter that may be raised by a prospective bidder or his representative at that stage.

9.2.3 The bidder is requested to submit any questions in writing so as to reach the Employer preferably one day before the pre-bid meeting either by email or any other means. Question and queries received after pre-bid meeting may not be replied / admitted for any modification in bid / bidding process.

9.2.4 Minutes of the meeting, including the text of the questions rose (without identifying the source of the enquiry) and the responses given (if any) will be uploaded on the website. Any modifications of the bidding documents listed in Sub Cl. 8.1, which may become necessary as a result of the pre-bid meeting, shall be made by the Officer Inviting Tender exclusively through the issue of an Addendum pursuant to Cl. 10 and not through the minutes of the pre-bid meeting.

9.2.5 Non-attendance at the pre-bid meeting will not be a cause for disqualification of a bidder.

10 Amendment of Bidding Documents

10.1 Before the deadline for submission of bids, the Officer Inviting Tender may modify / cancel the bidding documents by issuing addenda /cancellation notice on line. Interested bidders/contractors are requested to check on-line notifications /addendums regularly.

10.2 Officer Inviting Tender shall publish any addendum / corrigendum / cancellation of tender in the website and shall also display it on office notice board. The notice thus issued shall be part of the bidding documents. The bidders who have already uploaded their tenders before the publication date of such notice, these bidders, if they wish, can modify their tender and upload it again on the website, and only last submitted bid will be considered.

10.3 To give prospective bidders reasonable time in which to take an addendum into account in preparing their bids, the Employer may at his discretion, extend, as necessary the deadline for submission of bids or any schedule key dates, in accordance with Sub Cl. 20.2 below.

C. Preparation of Bids

11 Language of Bid

11.1 All documents relating to the Bid shall be in the English language.

12 Documents Comprising the Bid

12.1 The Bid submitted by the Bidder shall comprise the following: -

i. **Cost of bidding document in the form as specified in Notice Inviting Tender.**
ii. **Bid Security in the form as specified in Cl. 16 of these instructions.**
iii. **Entire set of Bidding Document in token of acceptance of all instructions and terms & conditions of the Bid Document. However, if not submitted it will be understood that all the terms and conditions of this tender document are accepted to contractor/bidder.**
iv. **All documents pursuant to Sub Cl. 4.2 of these instructions with supporting information and certificates required.**
v. **Bill of Quantities with bidder's name & address filled on top and Rates filled against each item for Item Rate Tender & Percentage above or below for Percentage Rate Tender.**

12.2 The documents listed at Sub Cl. 12.1 i, ii & iv above are required to be submitted both online as well as offline while the documents at iii & v have to be submitted online only.

13 Bid Prices

13.1 The Contract shall be for the whole Works, as described in Sub Cl. 1. 1 based on the priced Bill of Quantities submitted by the Bidder.

13.2 The contractor shall fill-in his offered item wise rates for all items of works described in the Bill of Quantities (B.O.Q) for Item Rate Tender and shall fill percentage above or below for Percentage Rate Tender. Items for which no rates are entered by the bidder will not be paid-for by the Employer when executed and shall be deemed to be covered by the other item rates and prices in the B.O.Q.

13.3 excluding GST , All duties, taxes, including customs and excise duty and other levies payable by the contractor under the contract, or for any other cause, shall be deemed to be included in the rates, prices and total bid-price submitted by the Bidder. In case, at the time of execution of works, exemption from a customs / excise duty is sought, it will be debited from the bid price submitted by the Bidder.

13.4 The rates and prices quoted by the Bidder shall be fixed for the entire duration of the contract and shall not be subject to revision, increase or adjustment on any account.

14 Currencies of Bid and Payment.

14.1 The unit rates and the prices shall be quoted by the bidder entirely in Indian Rupees. All payments shall be made in Indian Rupees.

15 Bid Validity

15.1 Bids shall remain valid for acceptance for a period not less than 120 Days after the deadline date for bid submission as specified in Cl. 20. A bid submitted with a shorter validity period shall be rejected as non-responsive. In case of discrepancy in bid validity period between that given by the undertaking (affidavit on Rs. 100.00 stamp paper) pursuant to Cl. 4.2 (f) and Form of Bid submitted by the bidder, the later shall be deemed to stand corrected in accordance with the former.

15.2 In exceptional circumstances, prior to expiry of the original time limit, the Engineer / Employer may request that the bidders may extend the period of validity for a specified additional period. The request and the bidder's responses shall be made in writing or by cable / fax / e-mail. A bidder may refuse the request without getting his bid security forfeited. A bidder agreeing to the request will not be required or permitted to modify his bid rates & prices, but will be required to extend the validity of his bid security for a period of the extended validity, and in compliance with Cl. 16 in all respects.

16 Bid Security

16.1 The bidder shall furnish, as part of his Bid Security, the amount in the prescribed form mentioned under Notice Inviting Tender or this document. The bidder shall scan all the written / printed pages of the Bid Security and upload the same in portable document format (PDF) to the system in the designated place of the technical bid. Furnishing scanned copy of such document is mandatory otherwise his / her bid shall be declared as non-responsive and liable to rejection. The Bidder shall furnish the original Bid Security in separate envelope marked as 'BID SECURITY' in accordance with details given in IFB. It shall be either physically submitted in the office of VICE CHAIRMAN, DISTRICT LEVEL DEVELOPMENT AUTHORITY, RUDRAPUR (UDHAM SINGH NAGAR) **or delivered through Registered Post in the same office before the specific date mentioned in the Notice Inviting Tender. Officer Inviting Tender shall not be responsible for any postal delay and / or non-receipt of the original copy of the bid security on or before the specified date and time. Non submission of original bid security within the designated period shall debar the bidder from participating in the online bidding system and such bid will be rejected. Combined bid security for more than one work is not acceptable.**

16.2 Any online bid not accompanied by an acceptable Bid Security and not submitted as indicated in Sub Cl. 16.1 above shall be rejected as non-responsive.

16.3 The Bid Security of unsuccessful bidders will be returned after opening of financial bid on the request of the bidder

16.4 The Bid Security of the successful Bidder will be discharged when the Bidder has signed the Agreement / Contract Bond and furnished the required Performance Security.

16.5 The Bid Security may be forfeited, if:-

a) the Bidder withdraws or modifies the Bid after bid opening during the period of bid validity; or

b) in the case of a successful Bidder, he fails within the specified time limit to-

i. sign the Agreement / Contract Bond; or

ii. Furnish the required Performance Security and any other relevant documents.

17 Alternative Proposals by Bidders

17.1 Bidders may submit offers that comply with the requirements of the bidding documents, including the conditions of contract, basic technical design as indicated in the drawings and specifications. Conditional offer or alternative offers will not be considered in the process of tender evaluation.

18 Participation in Bid

18.1 Getting Digital Signature Certificate (DSC): The bidder is required to obtain Digital Signature Certificate (DSC) from one of the authorized Certifying Authorities (CA). Digital signature is mandatory to participate in the e-tendering. More information on how to obtain a DSC and also its use is available under the link "Information about DSC" on the e-GPS portal i.e. http://www.uktenders.gov.in. Bidders already possessing the digital signature issued from authorized CAs can use the same in these tenders.

18.2 Portal Registration: The contractor / bidder intending to participate in the bid is required to register in the portal using his / her active personal / official e-mail ID as his / her Login ID and attach his / her valid Digital Signature Certificate (DSC) to his / her unique login ID. He / She will enter relevant information as asked for about the firm / contractor.

This is a one-time activity for registering in the portal.

i) **Bidders participating through Joint Venture shall declare the authorized signatory through JV Agreement. It is mandatory that the DSC issued in the name of the authorized signatory is used in the portal.**

ii) **Any third party / company / person under a service contract for operation of e-procurement system in the Uttarakhand State or his / her subsidiaries or their parent companies shall be ineligible to participate in the procurement processes that are undertaken through the e-procurement system irrespective of who operates the system.**

18.3 Logging to the Portal: The contactor / bidder is required to type his / her login ID and password. The system will again ask to select the DSC and confirm it with the password of DSC as a second stage authentication. For each login, a user's DSC will be validated against its date of validity and also against the Certification Revocation List (CRL) of respective CA stored in system database. The system checks the unique Login ID, password & DSC combination and authenticates the login process for use of the portal.

18.4 Downloading of Bid: The bidder can download the tender of his choice and save it in his system to undertake necessary preparatory work off-line and upload the completed tender at his convenience before the closing date and time of submission.

D. Submission of Bids

19 Sealing and Marking of Bids / Submission of Bids

19.1 The bidder shall carefully go through the tender and prepare the required documents. The bid shall have a Technical Bid and a Financial Bid. The Technical Bid generally consists of cost of bid document, Bid Security & all the Supporting Documents in support of qualification. The Financial Bid consists of Bill of Quantities (BOQ) and any other price related information / undertaking including rebates.

19.2 The protected Bill of Quantities (BOQ) uploaded by the Officer Inviting Tender for the bid is authentic BOQ. Any alteration / deletion / manipulation in BOQ shall lead to cancellation of bid.

19.3 The bidder shall upload the scanned copy / copies of document in support of eligibility criteria and qualification information in prescribed format in PDF to the portal in the designated locations of Technical Bid.

19.4 The bidder shall write his name in the space provided in the specified location in the protected Bill of Quantities (BOQ) published by the Officer inviting Tender. The bidder shall type rates in figure only in rate column in case of item rate tender and type percentage excess or less up to one decimal place only in case of percentage rate tender.

19.5 The bidder shall log on to the portal with his / her DSC and move to the desired tender for uploading the documents in appropriate place one by one simultaneously checking the documents.

19.6 The bidder shall ensure the following before final submission of his bid:-

- **i. The bids once submitted cannot be viewed, retrieved or corrected. The bidder should ensure the correctness of the bid prior to uploading and take printout of the system generated summary of submission to confirm successful uploading of bid. The bids cannot be opened by the Officer Inviting Tende r before the due date & time of opening.**
- **ii. Each process in th ee-procurement is tim e stamped and the system can detect the time of login of each user including the bidder.**
- **iii. The Bidder should ensure clarity / legibility of the document uploaded by him to the portal.**
- **iv. The system shall require all mandatory forms and fields filled up by the contractor during the process of submission of the bid / tender.**
- **v. The bidder should check the system generated confirmation statement on the status of the submission.**
- **vi. The bidder should upload his bid sufficiently ahead of the bid closure time to avoid traffic rush and failure in the network.**
- **vii. The Officer Inviting Tender is not responsible for any failure, malfunction or breakdown of the electronic system used during the e-procurement process.**
- **viii. The bidder is required to upload documents related to his eligibility criteria and qualification information and Bill of Quantities duly filled in. It is not necessary on the part of the bidder to upload the drawings and other bid documents (after signing) while uploading his bid. It is assumed that the bidder has referred all the drawings and documents uploaded by the Officer Inviting Tender.**
- **ix. Seeking any revision of rates or backing out of the bid, claiming for not having referred to any or all the documents provided in the Bid uploaded by the Officer**

Inviting Tender, will be constructed as plea to disrupt the bidding process and in such cases, the bid security shall be forfeited.

x. The bidder will not be able to submit his bid after expiry of the date & time of submission of Bid (server time).

19.7 The bidders are also required to submit cost of bidding document, bid security & all the documents listed in Sub Cl. 4.2 of Section-III I.T.B. in original, either by registered post or by hand, in the office of the concerned Division up to the date and time as mentioned in Notice Inviting Tender.

19.8 Security of Bid Submission: The bids submitted by the bidder are fully secured as:-

i. All bids uploaded by the bidder to the portal will be encrypted.

ii. The encrypted bid can only be decrypted / opened by the authorized openers on or after the due date and time.

20 Deadline for Submission of Bids

20.1 Complete bids must be submitted before the scheduled date and time as specified in Notice Inviting Tender. In case of E-Tender The date & time of Bid Submission shall remain unaltered even if the specified date of submission of bids is declared as a holiday . But the date & time of Bid opening , shall be next working day if date specified for opening in tender declared office holiday. But in case of off-line/manual tender the date & time of Bid Submission and opening shall be next working day if date specified in tender declared office holiday. However, Employer/tender inviting authority has full right to alter any tender schedule key date including bid submission end date.

20.2 The Officer Inviting Tender may extend the deadline for submission of bids by issuing an amendment in accordance with Cl. 10, in which case all rights and obligations of the Officer Inviting Tender and the bidders previously subject to the original deadline will then be subject to the new deadline.

21 Late Bids

21.1 Bids cannot be submitted after the deadline date and time as specified in Notice Inviting Tender. Documents required offline must reach either by registered post or by hand, in the office of VICE CHAIRMAN, DISTRICT LEVEL DEVELOPMENT AUTHORITY, RUDRAPUR (UDHAM SINGH NAGAR) **upto the date and time as mentioned in tender time schedule (Key Dates) otherwise the bid will be rejected.**

22 Modification and Withdrawal of Bids

22.1 Resubmission of bid by the bidders for any number of times before the final date and time of submission is allowed.

22.2 Resubmission of bid shall require uploading of all documents including price bid afresh.

22.3 If the bidder fails to submit his modified bids within the predefined time of receipt, the system shall consider only the last bid submitted.

22.4 The bidder can withdraw his bid before the closure date and time of receipt of the bid by uploading scanned copy of a letter addressing to the Officer Inviting Tender citing reasons for withdrawal. The system shall not allow any withdrawal after expiry of the closure time of the bid.

E. Bid Opening and Evaluation

23 Bid Opening

23.1 Bids cannot be opened before the specified date and time. All bid openers have to log on to the portal to decrypt the bid submitted by the bidders. On the due date and appointed time & place, the Bid Openers will open the Bid in the presence of the Bidders or their representatives who choose to attend at the time, date and place specified. The bidders and guest users can view the summary of opening of bids from any system. Contractors are not required to be present during the bid opening at the opening location if they so desire. If the specified date of Bid opening is declared a holiday in the Officer Inviting Tender's Office, then the Bids will be opened at the specified time and location on the next working day. In case bids are invited for more than one package, the order for opening of the "Bid" shall be that in which they appear in the "Notice Inviting Tender".

23.2 During bid opening, the covers containing original financial instruments towards cost of bid and bid security in the form specified in the "Notice Inviting Tender" & valid for the period stated in the bid, received before due date & time shall be opened and declared. The Bid Openers shall continue opening of other documents if they are satisfied about the appropriateness of the cost of bid and bid security. The bid prices, item wise rates, total amount of each item in case of item rate tender and percentage above or less in case of percentage rate tenders will then be announced.

23.3 All the opened bids shall be downloaded and printed for taking up evaluation. The Bid Openers shall sign on each page of the BOQ as well as Comparative Statement and furnish a certificate that the documents as available in the portal for the tender have been downloaded.

23.4 Not Applicable ~~(i) Subject to confirmation of the Bid Security by the issuing Bank / Post Office, the bids accompanied with valid Bid Security shall be taken-up for evaluation. If any bid contains any deviation from the bid documents and / or deviation of the Bid Security, then the Bid will be rejected and the bidder will be informed accordingly.~~

~~(ii) The Bids will be evaluated technically by Departmental Tender Committee on the basis of criteria as mentioned below:-~~

~~Attributes~~		~~Evaluation~~	~~Marks Obtained~~
~~A)~~	~~Financial strength-20 marks (i) Average annual turnover -16 marks (ii) Solvency Certificate -4 marks~~	~~(i) 60% marks for minimum eligibility criteria (ii) 100% marks for twice the minimum eligibility criteria or more In between (i) & (ii) – on pro-rate basis~~	
~~(B)~~	~~Experience in similar works - 20 marks~~	~~(i) 60% marks for minimum eligibility criteria (ii) 100% marks for twice the minimum eligibility criteria or more In between (i) & (ii) – on pro-rate basis~~	
~~(C)~~	~~Performance of works (Time over run)-20 marks~~		

~~Parameter~~	~~Criteria for points~~	~~Score~~	~~Maximum marks~~	
~~Timely Completion of Works Assessed by Time Over Run (TOR)~~ ~~(a) Without levy of compensation~~ ~~(b) With levy of compensation~~ ~~(c) Levy of compensation not decided~~ ~~TOR=AT/ST, Where AT= Actual Time; ST= Stipulated Time~~	~~If TOR up to~~	~~1.0 2.00 3.00 > 3.00~~ ~~(a) 20 15 10 0~~ ~~(b) 20 05 0 -5~~ ~~(c) 20 10 0 0~~	~~20~~	

Note: Marks for value in between the stages indicated above is to be determined by straight line variation basis.					
(D). Quality of Works- 15 marks		**(i) Very Good** **(ii) Good / Satisfactory** **(iii) Fair** **(iv) Poor**	**15** **10** **5** **0**	**Max 15 marks**	
(E)	**Personnel and Establishment - 10 marks**	**Key Personnel & Supervisory Staff per Cl.3.5 (l) above (details given in Contract Data, i.e. Section-VII)**	**(i)80% for minimum Eligibility Criteria** **(ii)100% for 1.5 times of minimum Eligibility Criteria** **In between (i) & (ii) – on pro-rate basis**	**Max. 10 marks**	
(F)	**Plant & Equipment - 15 marks**	**Equipments & Machinery as per Cl.3.5 (k) above (details given in Contract Data, i.e. Section-VII)**	**(i) 80% for minimum Eligibility Criteria** **(ii) 100% for 1.5 times of minimum Eligibility Criteria** **In between (i) & (ii) – on pro-rate basis**	**Max. 15 marks**	
	Total-100 Marks	**Minimum Qualifying Marks**	**60 marks overall (Subject to minimum 50% qualifying marks in individual item also)**	**Max. Marks – 100**	

(iv) Technical evaluation of all bids shall be carried out as per information furnished by the bidders. But evaluation of bids does not exonerate bidders from checking their documents at later date. If the bidder is found to have misled the evaluation through wrong information, action as per Cl. 34 of ITB shall be taken against the bidder / contractor.

24 Process to be Confidential

24.1 Information relating to the examination, clarification, evaluation, and comparison of bids and recommendations for the award of a contract shall not be disclosed to the bidders or any other persons not officially involved with such process until the award of the Bid to the successful Bidder has been announced. Any effort by a Bidder to influence (in any manner whatsoever) the process, right from bid submission to the final bid award decision, may result in the rejection of his Bid.

25 Clarification of Bids

25.1 After receipt of confirmation of the bid security, the bidder may be asked in writing to clarify on the documents provided in the Technical Bid, if necessary, with respect to any doubts or illegible documents. The Officer inviting Tender may ask for any other document of historical nature during technical evaluation of the tender. Provided in all such cases, furnishing of any document in no way alters the Bidder's price bid. Non submission of legible documents may render the bid non-responsive.

25.2 The bidders will respond in not more than seven days of issue of the clarification letter, failing which the bid of the bidder will be evaluated on its own merit.

25.3 Subject to Sub Cl. 25.1, no Bidder shall contact the Officer Inviting Tender or any of his authorities on any matter relating to the Bids from the time of bid opening to the time of award of contract. If the Bidder wishes to bring additional information to the notice of the Departmental Authorities, he should do so in writing.

26 Examination of Bids and Determination of Responsiveness

26.1 Prior to detailed evaluation of Bids, the Departmental Tender Committee will determine whether each Bid-

(a) meets the eligibility criteria defined in this Bid Document.

(b) has been properly signed by the bidder or authorized signatory holding Power of Attorney in his favour.

(c) is accompanied by the required securities and

(d) is substantially responsive to the requirements of the bidding documents.

26.2 A substantially responsive Bid is one which conforms to all the terms, conditions, and specifications of the Bidding documents without material deviation or reservation. A material deviations or reservation is one :-

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

(b) which limits in any substantial way the Employer's rights or the Bidder's obligations under the Contract; or

(c) whose rectification would affect unfairly the competitive position of other Bidders presenting substantially responsive Bids.

26.3 If a Bid is not substantially responsive, it will be rejected by the Departmental Tender Committee or higher authorities, and may not subsequently be made responsive by correction or withdrawal of the non-conforming deviation or reservation.

26.4 Employer / tender committee reserve's right to relax in qualification to any or all bidders without any notification or assigning reason.

27 Financial Evaluation and Comparison of Bids

27.1 The Departmental Tender Committee will evaluate and compare only the bids determined to be substantially responsive in accordance with Cl. 26.

Tender with 0.00 (zero) charges or total cost nil, will not be accepted.

27.2 In evaluating the bids, the Departmental Tender Committee will determine for each Bid the evaluated Bid Price by adjusting the Bid price as follows:

(a) Making an appropriate adjustments for any other acceptable modifications, variations and deviations; and / or

(b) Making appropriate adjustments to reflect discounts or other price modifications offered before the deadline for submission of the bid.

27.3 The Departmental Tender Committee reserves the right to accept or reject any variation or deviation. Variations and deviations and other factors, which are beyond the provisions, requirements and scope of the Bidding documents, shall not be taken into account in Bid evaluation.

27.4 If the Bid of the successful Bidder is seriously unbalanced in relation to the Employer's estimate of the cost of work to be performed under the contract, the Employer may require the Bidder to produce detailed price analysis for any or all items of the Bill of Quantities, to demonstrate the internal consistency of those prices with the implementation /construction methods and schedule proposed. After evaluation of the price analysis, the employer may require that the amount of the performance security set forth in Cl. 32 be increased at the expense of the successful bidder to a level sufficient to protect the Employer against financial loss in the event of default of the successful bidder under the contract.

Additional performance security over performance security, from successful bidder before executing agreement, shall be charged as under:-

Up to 5% below estimated cost – Nill

From 5% below to 15% below estimated rate of item – 0.5% of estimated cost of item for every 1% below estimated rate.

More than 15% below estimated rate of item – 1% of estimated cost of item for every 1% below estimated rate.

27.5 A bid which contains several items in the Bill of Quantities which are unrealistically priced low and which cannot be substantiated satisfactorily by the bidder may be rejected as non-responsive.

27.6 Conditional Bids are liable to be rejected.

28. Negotiation with Bidders

Negotiation with Bidders after bid opening shall not normally be done. However, in exceptional circumstances where price negotiations is considered necessary due to some unavoidable circumstances, the same may be resorted to only with the lowest evaluated responsive bidder.

F. Award of Contract

29 Award Criteria

29.1 The designated competent authority of the department will ordinarily award the Contract on recommendation of the Departmental Tender Committee to the Bidder whose Bid has been determined to be substantially responsive to the Bidding documents and who has offered the lowest evaluated Bid Price, provided that such Bidder has been determined to be (a) eligible in accordance with the provisions of Cl. 3 and (b) qualified in accordance with the provisions of Cl. 4. The summary of Award of Contract will be displayed on the website and also on office notice board.

30 Employer's Right to accept any Bid and to reject any or all Bids and Providing relaxation in any bidders qualification

30.1 Notwithstanding Cl. 29, the Employer reserves the right to accept or reject any Bid, and to cancel the bidding process and reject all bids, at any time prior to the award of Contract, without thereby

incurring any liability to the affected Bidder or bidders or any obligation to inform the affected Bidder or bidders of the grounds for the Employer's action.

Employer reserves the right to provide relaxation to any bidder in qualification / experience / bid capacity etc.

31 Notification of Award and Signing of Agreement

31.1 The bidde r whose Bid has been accepted will be notified of the award by the Engineer / Employer prior to expiration of the Bid validity period by cable, telex, facsimile, or registered letter. This letter (hereinafter and in the *Conditions of Contract* called the "Letter of Acceptance") will state the sum that the Employer will pay to the Contractor in consideration of the execution, completion and maintenance of the Works by the Contractor as prescribed by the Contract (hereinafter and in the Contract called the "Contract Price"). The issue of the Letter of Acceptance shall be treated as closure of the bid process and commencement of the contract.

31.2 The notification of award will constitute the formation of the Contract, subject only to the furnishing of a performance security in accordance with the provisions of Cl. 32.

31.3 The Agreement will incorporate all correspondence between the Engineer / Employer and the successful Bidder. It will be signed by the contractor and authorized Engineer within specified time. This time limit may very as per satisfaction of Employer. Within specified time (This time limit may very as per satisfaction of Employer) of receipt of letter of award, the successful Bidder will furnish performance security, stamp papers of requisite amount as per the current Stamp Act. Notice to proceed with the work shall be issued by the Engineer In charge with copy thereof to the Officer Inviting Tender. The Officer Inviting Tender shall upload the summary of award of work and declare the bidding process as complete.

31.4 Upon the furnishing by the successful Bidder of the Performance Security, the Engineer will promptly notify the other Bidders that their Bids have been unsuccessful and accordingly release their Bid security.

32. Performance Security

32.1 Within specified time, the successful Bidder shall deliver to the Engineer a Performance Security in any of forms given below for an amount equivalent to 5% of contract price or as per prevailing government orders plus additional security for unbalanced bids in accordance with Cl. 27.4 of ITB and Cl. 52 of GCC:-

(a) Fixed Deposit Receipt/Bank Guarantee from any Public Sector (SBI & Nationalized) / Scheduled Bank located in India.

(b) National Savings Certificate issued by any Indian Post Office duly endorsed by the competent postal authority in India.

32.2 Failure of the successful bidder to comply with the requirements of Sub Cl. 32.1 shall constitute a breach of contract, cause for annulment of the award, forfeiture of the bid security and any such other action, the Employer may deem fit under the contract and the Employer may resort to awarding the contract to the next ranked responsive bidder.

33 Settlement of Disputes

33.1 Disputes between Contractor and Engineer / Employer shall be resolved as per the provisions of Cl. 24 & 25 of General Condition of Contract (Section IV).

34 Corrupt or Fraudulent Practices

34.1 The Employer requires the Bidders / Suppliers / Contractors under this contract to observe the highest standard of ethics during the procurement and execution of this contract. In pursuance of this policy: -

(i) "Corrupt practice" means the offering, giving, receiving or soliciting of anything of valu e or significance to influence the action o fa public official in the procurement process or in Contract execution, and

(ii) "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 and includes collusive practices among Bidders (prior to or after bid submission) designed to establish bid prices at artificial non-competitive levels and to deprive the Employer of the benefits of free and open competition.

34.2 The Employer will reject a proposal for award of work if he determines that the Bidder recommended for award has been engaged in corrupt or fraudulent practices in competing for the contract in question and will declare a Bidder ineligible either indefinitely or for a stated period of time, to be awarded a contract / contracts if he, at any time determines that the bidder has been engaged in corrupt or fraudulent practices in competing for, or in executing the contract.

34.3 After the award of work & signing the Contract Bond, sub-letting any work or part thereof to any other contractor, except as submitted with the bid documents under Sub Cl.4.2 (r), by the Bidder / Lead Partner of a JV is strictly prohibited. If at any stage, it is found that the contractor has indulged in subletting the work or part thereof to any other contractor in contravention of the above, it shall be considered a serious violation of the conditions of the Contract and this act shall also be treated as corrupt & fraudulent practice and in that case the contract bond is likely to be rescind with forfeiture of the full Performance Security deposit.

SECTION – IV : GENERAL CONDITIONS OF CONTRACT (G.C.C.)

OFFICE OF THE VICE CHAIRMAN, DISTRICT LEVEL DEVELOPMENT AUTHORITY, RUDRAPUR (UDHAM SINGH NAGAR)

General Conditions of Contract

Table of Contents

Sl. No.	Clause	Clause No.		Sl. No.	Clause	Clause No.
A.	General			C.	Quality Control	
1	Definitions	1		32	Identifying Defect	32
2	Interpretation	2		33	Tests	33
3	Language and Law	3		34	Completion and Commissioning of Work	34
4	Engineer's Decisions	4		35	Correction of Defects	35
5	Delegation and execution of bond	5		36	Uncorrected Defects	36
6	Communications	6		D.	Cost Control	
7	Subcontracting	7		37	Bill of Quantities	37
8	Other Contractors	8		38	Changes in the Quantities	38
9	Personnel	9		39	Variations	39
10	Employer's & Contractor's Risks	10		40	Payments for Variations	40
11	Employer's Risks	11		41	Cash Flow Forecasts	41
12	Contractor's Risks	12		42	Payment Certificates	42
13	Insurance	13		43	Payments	43
14	Site Investigation Reports	14		44	Compensation Events	44
15	Queries about the Contract Data	15		45	Tax	45
16	Contractor to Construct the Works	16		46	Currencies	46
17	The Works to Be Completed by the Intended Completion Date	17		47	Appreciation	47
18	Approval by the Engineer	18		48	Retention	48
19	Safety	19		49	Liquidated Damages	49
20	Discoveries	2o		50	Penalty	50
21	Possession of the Site	21		51	Advance Payment	51

22	Access to the Site	22		52	Securities	52
23	Instructions	23		53	Cost of Repairs	53
24	Disputes	24		E.	Finishing the Contract	
25	Procedure for settlement of Disputes	25		54	Completion	54
26	Replacement of Adjudicator	26		55	Taking Over	55
B.	Time Control			56	Final Account	56
27	Program	27		57	Drawing / Manuals	57
28	Extension of the Intended Completion Date	28		58	Termination	58
29	Delays Ordered by the Engineer	29		59	Payment upon Termination	59
30	Management Meetings	30		60	Property	60
31	Early Warning	31		61	Release from Performance	61
				62	Fraud and Corruption	62
				F.	Special Conditions of Contract	63

A. General

1. Definitions

1.1 Terms which are defined in the Contract Data (Section-VII) other than those defined hereunder shall keep their respective meanings as defined therein. Capital initials are used to identify the defined terms.

The Adjudicator (synonymous with the Dispute Review Expert) is the person appointed jointly by the Employer and the Contractor to resolve disputes in the first instance, as provided for in Cl. 24 and 25 hereunder.

Bill of Quantities means the priced and completed Bill of Quantities forming part of the Bid.

Vice Chairman means the Vice Chairman of District Level Development Authority, U.S Nagar .

Compensation Events are those defined in Cl. 44 hereunder.

The Completion Date is the actual date of completion of the Works as certified by the Engineer in accordance with Sub Cl. 54.1.

The Contract is the agreement in the form of a Contract Bond between the Employer and the Contractor to execute & complete the works in a specified time and thereafter to maintain them during the defect liability period specified therein. It consists of the documents listed in Sub Cl. 2.3 below.

The Contract Data defines the documents and other information which comprise the Contract.

The Contractor is a person or a corporate body (which may be a Firm, a Company or a Joint Venture) whose bid has been accepted by the Employer to carry out the Works.

The Contractor's Bid is the duly completed Bidding Document submitted by the Contractor to the Employer including complete tender document uploaded on e-portal / tender document purchased by bidder including rates quoted by bidder.

The Contract Price is the price stated in the Letter of Acceptance and thereafter as adjusted in accordance with the provisions of the Contract.

Days are calendar days; months are calendar months and years are calendar years.

A Defect is any part of the Works not completed in accordance with the Contract or does not remain in accordance with the contract after completion.

The Defects Liability Period is the period specified in the Contract Data and calculated from the Completion Date.

The Employer is the authority named in the Contract Data who will employ the Contractor to carry out the Works by means of Contract Bond.

The Engineer is the person named in the Contract Data (or any other competent authority working under him, authorized and notified to the contractor, to act in replacement of the Engineer) who is responsible for supervising the execution of the works and administering the Contract. Engineer is responsible for performing all duties and responsibilities of the contract bond. He is also responsible for proper execution of work.

The Engineer's Representatives are the persons named in the Contract Data who are responsible for supervising the execution of the works on behalf of the Engineer.

Equipment is the Contractor's machinery (including Tools & Plants) and vehicles brought temporarily to the site for proper execution of works.

The Initial Contract Price is the Contract Price listed in the Engineer's / Employer's Letter of Acceptance.

The Intended Completion Date is the date on which it is intended that the Contractor shall complete the works. The Intended Completion Date is specified in the Contract Data. The Intended Completion Date may be revised/ extended only by the competent authority by issuing an extension of time.

Materials are all supplies, including consumables, intended to be used and brought to site / site store, including their quantity actually consumed, by the Contractor in the Works.

Managing Director is the authority in which the powers of Vice Chairman of DLDA U.S Nagar are vested.

Owner is DLDA U.S Nagar through its Vice Chairman.

Plant is any integral part of the Works which is to have a mechanical, electrical, electronic or chemical or biological function.

The Site is the project area as defined in the Contract Data.

Site Investigation Reports are those which are either included in the Bidding documents, or required to be submitted by the Contractor therein after conducting the specified site investigations, and are factual interpretative reports about the surface and sub-surface conditions at the site.

Specifications mean the Specifications of the Works included in the Contract an dany modification sor addition slater o nmade /approve dby th eEmploye rfor proper execution and completion of works.

The Start Date is given in the Contract Data. It is the date when the Contractor is required to commence the execution of contracted works. It does not necessarily coincide with any of the Site Possession Dates.

A Subcontractor is a person or corporate body (which may be a Firm or a Company) who has a Sub-Contract with the Contractor, in conformity of provisions contained in Cl. 7 below, to carry out a part of the work in the Contract which includes work on the Site.

Temporary Works are the works which are designed, constructed and installed by the Contractor, needed for proper construction or execution of the Works and are to be removed or removed thereafter.

A Variation is the difference in quantities of works resultant to any instruction s duly given by the Enginee r/ Employe r/ Higher Authorities either in writing or verbally which varies the Works. Any such verbal instructions shall immediately, within 7 days, be confirmed by the contractor in writing to the Employer duly acknowledged by his office. **The Works** are all that which the Contract requires the Contractor to construct, install, maintain during the defect liability period and handover to the designated authority, as defined in the Contract Data.

2. Interpretation

2.1 In interpreting these General Conditions of Contract, singular also means plural, male also means female or neuter, and the other way around. Headings have no significance. Words have their normal meaning under the languag e of the Contract unless specifically defined. The Engineer will provide instructions clarifying queries about the Conditions of Contract.

2.2 If sectional completion is specified in the Contract Data, references in the Conditions of Contract to the Works, the Completion Date, and the Intended Completion Date apply to any Section of the Works (other than references to the Completion Date and Intended Completion date for the whole of the Works).

2.3 The documents forming the Contract shall be in the following order:

(1) Agreement
(2) Copies of Performance Security Documents
(3) Letter of Acceptance
(4) Section VII (Contract Data)
(5) Section X (Form of Bid)
(6) Section XI of Contractor's Bid (Bill of Quantities)
(7) Section IV (General Conditions of Contract including Special Conditions of Contract)
(8) Section V (Specifications)
(9) Section VI (Drawings)
(10) Remaining Sections I, II, III,
(11) Supporting documents of Section VIII & IX of Contractor's Bid
(12) Any other document required for forming the Contract.

Any document mentioned above, whether annexed or not with agreement, or not annexed in proper order, shall assumed / deemed / remain part of agreement and will be binding on both parties.

3. Language and Law

3.1 The language of the Contract and the law governing the Contract are stated in the Contract Data and Section-F of this GCC (Special Conditions of Contract).

4. Engineer's Decisions

4.1 Except where otherwise specifically stated, the Engineer, in the role representing the Employer, will decide all

routine contractual matters between the Employer and the Contractor.

5. Delegation and execution of bond

5.1 All the responsibilities and duties of Employer are delegated to the Engineer. The Employer may cancel any of his duties and responsibilities delegated to the Engineer any time. From the side of the department, Engineer will be always responsible for the planning, progress, quality control and proper execution of bond and work. The contractor will have always to take directions from Engineer and work as per directions of Engineer. Engineer will report to the Employer about progress etc. of work every month and recommend any action / punishment if required or award like E.O.T. extra item etc. in time. But after delegation of powers to his representative too, Engineer will be responsible for execution of bond and work properly. The responsibilities and duties of Employer, which are delegated to Engineer, may not be further delegated by him and he will be fully responsible for exercise of the responsibilities and duties of Employer.

6. Communications

6.1 Communications between parties which are referred to in the conditions shall be effective only when made in writing or by e-mail at Contractor's ID. A notice shall be effective only when it is delivered or deemed to be delivered as per law / in terms of Indian Contract Act.

7. Subcontracting

7.1 Normally, Subcontracting of works is not allowed in case of Joint Venture. However, the contractor can employ sub-contractors only for specialized works details of which shall be given by the bidder, at the time of bidding, in the Form-XIV as per Cl.4.2 (r) of ITB (Section-III). Subcontracting does not alter the Contractor's obligations in any manner.

8. Other Contractors

8.1 The Contractor shall cooperate and share the Site with other contractors, the Employer / Engineer / their representatives, public authorities, utility services etc, as required according to their schedule of various activities during the currency of the Contract including defect liability period. The Contractor shall also provide all necessary facilities and services for them. The Employer / Engineer may modify the schedule of other contractors and shall notify the contractor of any such modification.

9. Personnel

9.1 The Contractor shall employ the key personnel named in the Schedule of Key Personnel as referred to in the Contract Data to carry out their functions for proper execution and completion of works stated in the Schedule. The Employer / Engineer may ask the Contractor for replacement of any key personnel listed in the Schedule with the personnel having equivalent or better qualifications, abilities, and relevant work experience and will, accordingly, approve the revised list of key personnel. Non employment of required personnel will lead to recovery from the contractor at the rate specified in the contract data.

9.2 If the Engineer / Employer / any Higher Authority ask the Contractor to remove a person who is a member of the Contractor's staff or his work-force stating the reasons, the Contractor shall ensure that the person leaves the Site within three days and has no further connection with the work in the Contract. If any such person is declared undesirable, then he will have to leave the site immediately.

10. Employer's and Contractor's Risks

10.1 The Engineer / Employer carries the risks which this Contract states are Employer's risks, and the Contractor carries the risks which this Contract states are Contractor's risks.

11. Engineer's / Employer's Risks

11.1 The Engineer is responsible for the excepted risks which are- (a) the risks of war, hostilities, invasion, act of foreign enemies, rebellion, revolution, insurgency, military coup or usurp of power, civil war, riot, commotion or disorder (if not restricted to the Contractor's employees), and contamination from any nuclear fuel or nuclear waste or radioactive toxic explosive and any such other happening in the Employer's country, in so far as they directly affect the execution of the Works, or (b) a cause due, solely, to the design of the works, other than the Contractor's design, or (c) dispute by villagers on land / source / pipeline alignment etc., or (d) delay in forest land acquisition, or (e) non availability of funds for more than 6 months, or (e) delay due to natural calamities like landslide, flood, earthquake, cloud burst etc.

12. Contractor's Risks

12.1 All risks of loss of, or damage to, physical property (either pertaining to the Contracted Works or to the Engineer /

Employer or any Third Party) and of personal injury and death (of Contractor's staff / member of work-force or the Employer's staff or any Third Party) which arise during and in consequence of the performance of the Contract, other than the excepted risks, are the responsibility of the Contractor.

13. Insurance

13.1 The Contractor, at his own cost shall provide, in the joint names of the Engineer and the Contractor, insurance cover from the Start Date to the end of the Defects Liability Period, in the amounts stated in the Contract Data for the following events which are due to the Engineer's / Employer's risks and Contractor's risks as well:

(a) Loss of or damage to the Works, Plant and Materials;

(b) Loss of or damage to Equipment;

(c) Loss of or damage of property (except the Works, Plant, Materials and Equipment) in connection with the Contract; and

(d) Personal injury to all concerned with the project or death.

13.2 Policies and certificates for insurance shall be delivered by the Contractor to the Engineer for his approval before the Start Date. All such insurance shall provide for compensation to be payable in the types and proportions of currencies required to completely rectify / compensate the loss or damage incurred.

13.3 If the Contractor does not provide the required policies and insurance certificates within stipulated time, the Engineer may affect the insurance which the Contractor should have provided and recover the premium which the Engineer has paid, from payments otherwise due to the Contractor or, if no payment is due, the payment of the premium shall be a debt due. If the insurance could not be done anyhow, ultimate responsibility of insurance will be of contractor.

13.4 Both parties, the Contractor and the Engineer, shall comply with all conditions of the insurance policies.

13.5 However, any alterations to the terms of insurance shall not be made, either by the Contractor or by the Insurance Company, without prior approval of the Employer.

14.Site Investigation Reports

14.1 The Contractor, in preparing the Bid, shall rely on any site Investigation Reports referred to in the Contract Data, supplemented by any other information available to the Bidder.

15. Queries about the Contract Data

15.1 The VICE CHAIRMAN, DLDA, UDHAM SINGH NAGAR will clarify queries on the Contract Data.

16. Contractor to Construct the Works

16.1 The Contractor shall make necessary arrangements, at his own cost, for detailed survey to verify the actual availability and levels of suitable site locations for different components of works as well as alignments of pipeline, and shall intimate his findings to the Engineer in writing. If any significant change from the sanctioned project proposal is found, then the Contractor shall get the designs and drawings modified accordingly, at his own cost, in compliance of Engineer's / Employer's written directions for the same and shall get such modified deigns and drawing approved by competent technical authority, through the Engineer, before procurement of material for works and actually starting the execution of works. The contractor shall construct and install all the Works in accordance with the approved Specifications of works and as per the approved Designs and Drawings, and also ensuring the compliance of the Engineer's / his Representatives' / Employer's / Higher Authority's instructions. The Contractor shall be solely responsible for proper workmanship, timely completion and due performance of all the works.

16.2 Protection of Environment:

The contractor shall take all reasonable steps to protect the environment on and off the Site and to avoid damage or nuisance to persons or to property of the public or others resulting from pollution, noise or other undesirable causes arising as a consequence of his methods of operation. During continuance of the contract, the contractor and his sub-contractors shall abide at all times by all existing enactments on environmental protection and rules made there under, regulations, notifications and bye-laws of the State or Central Government, or local authorities and any other law, bye-law, regulations that may be passed or notification that may be issued in this respect in future by the State or Central Government or the local authority.

17. The Works to Be Completed by the Intended Completion Date

17.1 The Contractor shall make all efforts to commence the execution of the Works on the Start Date and shall carry out the Works in accordance with the program submitted by the Contractor and duly approved by the Engineer / Employer and modified / updated by Competent Authority, if necessary. This program shall invariably be within the framework of the mile-stones prescribed in Contract Data (Section-VII), in order that all the works are completed in all respect by the Intended Completion Date.

18. Approval by the Engineer

18.1 The Contractor shall submit, and get approved by the Engineer, all the Specifications, Designs, Drawings & Site Plan showing locations of all the proposed Temporary Works, required to execute the Contract.

18.2 The Contractor shall solely be responsible for safe design of Temporary Works and safety of all materials / machinery / equipments etc. stored / placed in them and all residing / handling personnel.

18.3 The Engineer's approval shall not relive the Contractor of his responsibility of proper design and safety of the Temporary Works.

18.4 The Contractor shall obtain approval of third parties deployed by the owner / Govt. on the design and layout of the Temporary Works where required.

19. Safety

19.1 The Contractor shall be responsible for the safety of all activities, structures and lives on the Site.

20. Discoveries

20.1 Anything of historical or other interest or of significant value, discovered on the Site, shall be the property of the Employer. The Contractor is to notify the Engineer of such discoveries and strictly carry out the Engineer's instructions for dealing with them.

21. Possession of the Site

21.1 The Engineer shall give possession of all parts of the Site to the Contractor. If possession of any part is not given by the date stated in the Contract Data, the Engineer is deemed to have delayed the start of the relevant activities and the completion date may accordingly be extended

22. Access to the Site

22.1 The Contractor shall allow the Engineer / Employer / Higher Authorities, and any person authorized by them, access to the Site or to any place where work in connection with the Contract is being carried out or is intended to be carried out and to any place where materials or plant are being installed / manufactured / fabricated / assembled / stored for the works.

23. Instructions

23.1 The Contractor shall carry out all instructions of the Engineer / Employer / Higher Authorities / their Authorized Representatives which comply with the provisions of the Contract as well as with the laws / bye-laws applicable to the area where the Site is located.

23.2 The Contractor shall permit the Engineer / Employer to inspect the Contractor's accounts and records relating to the performance of the Contractor and to have them audited by auditors appointed by the Employer, if so required by the Employer.

24. Disputes

i. **24.1** Excepting the decisions taken by the Vice Chairman of DLDA US NAGAR, all disputes or differences whatsoever arising between the parties out of or relating to the construction, meaning and operation or effect of this contract or the breach thereof shall be settled by arbitration by a reference to the sole arbitrator or the person appointed by the Vice Chairman and the award made in pursuance thereof shall be binding on the parties. Such arbitration shall be governed by the Indian Arbitration and Conciliation Act, 1996.

ii. It is also the term of this agreement that consultant shall have no objection whatsoever, in the appointment of an officer of the DLDA US NAGAR as the sole Arbitrator by the Vice Chairman.

B. Time Control

25. Program

25.1 Within the time stated in the Contract Data and the milestones specified therein, the Contractor shall submit to the Engineer for approval a Program for execution of the Works including Environmental Management Plan showing the general methods, arrangements, sequence and timing for all the activities necessary for the Works along with monthly cash flow forecast. This Program shall necessarily include PERT Chart as well as Bar Chart of all the activities.

25.2 An update of the Program shall be a program showing the actual progress achieved on each activity and the effect of the progress achieved on the timing of the remaining works including any changes to the sequence of the activities required for timely completion of works within the Intended Completion Period.

25.3 The Contractor shall submit to the Engineer, for approval, an updated Program at intervals no longer than the period stated in the Contract Data. If the Contractor does not submit an updated Program within this period, the Engineer may withhold the amount stated in the Contract Data from the next payment certificate and continue to withhold this amount until the next payment up to the date on which the overdue Program has been submitted.

25.4 The Engineer's / Employer's approval of the Program shall not alter the Contractor's obligations of timely completion of works within the Intended Completion Period. The Contractor may revise the Program and submit it to the Engineer again at any time. A revised Program is to show the effect of Variations and Compensation Events also.

28. Extension of the Intended Completion Date

28.1 The Engineer / Employer / Higher (Competent Authority) may extend the Intended Completion Date, if a Compensation Event occurs or a Variation is necessitated which makes it impossible for Completion to be achieved by the Intended Completion Date without taking additional steps to accelerate the remaining work and which would cause the Contractor to incur additional costs. Intended Completion Date may be extended by Competent Authority at his own discretion or satisfaction without assigning any reason, even when the contractor does not apply for extension of time in order to keep the contract alive.

28.2 The Engineer / Employer / Higher Competent Authority shall decide whether to extend and by how much to extend the Intended Completion Date, within 30 days of the Contractor asking the Engineer for a decision, upon the effect of a Compensation Event or Variation by submitting full supporting information. If the Contractor fails to give early warning of a possible delay in writing to the Engineer or fails to notify the Engineer about the hindrances causing unavoidable and justifiable delay, which is beyond his control, within a week of commencement of such delay / hindrance or fails to deal with the hindrances responsible for any avoidable delays, such delays shall not be considered in assessing the new Intended

Completion date. Employer's decision regarding the Contractor's failure to deal with avoidable delays due to any reason shall be final and binding. The delay in procurement of material for whatsoever reason, except due to natural calamities, shall also not be considered for extension of Intended Completion Date. Contractor shall submit his application on format prescribed by department for extension of time with application stating details to Engineer in original. Photo copy or scanned copy of such application will not be entertained. After receiving original application on prescribed format, Engineer will either reject it or forward to Employer with clear reasons and recommendations for necessary action. Intended Completion Date may or may not be extended, by Competent Authority at his own discretion or satisfaction without assigning any reason.

29. Delays Ordered by the Engineer / Employer

29.1 The Engineer / Employer may instruct the Contractor to delay the start or progress of any activity within the Works, at any time during the currency of the Contract, if he considers it proper in the interest of works or for safety of works / staff / material / third party. The Contractor shall not be entitled to any compensation for such delays, but the Engineer / Employer / Higher Authorities may consider the same for extension of Intended Completion Date.

30. Management Meetings

30.1 Either the Engineer or the Employer may require the Contractor to attend a Management Meeting at any time during progress of work. The objective of a Management Meeting shall be to review the plans for the remaining works and to deal with matters raised in accordance with the early warning procedure. Such meetings shall be called by Engineer, whenever he feels it necessary after taking approval from Employer.

30.2 The Engineer shall record the minutes of Management Meetings and shall provide copies of the same to all those attending the meeting and to the Employer as well. The responsibility of the parties for actions to be taken is to be decided by the Engineer / Employer either during the Management Meeting or after the Management Meeting and shall inform about it in writing to all concerned.

31. Early Warning

31.1 It shall be the duty of the Contractor to give an early warning, in writing, to the Engineer at the earliest regarding specific likely future events or circumstances that may adversely

affect the progress of work or quality of the work or delay the execution of works or likely to increase the Contract Price.

31.2 The Contractor shall cooperate with the Engineer in considering any proposals and in carrying out, by anyone involved in the work, any resulting instructions of the Engineer to minimize or avoid the effect of any such events or circumstances on the works.

C. Quality Control

32. Identifying Defects & Shortcomings

32.1 The Engineer / Employer / Higher Authorities shall check the Contractor's work, but such checking shall not relieve the Contractor / Engineer of his responsibilities regarding correctness, quality and quantity of works in any manner. The Engineer / Employer / Higher Authorities shall notify the Contractor of any defects or shortcomings that are found and instruct the Contractor to search for a defect or shortcoming and to uncover and test any work which may have a defect or shortcoming in their opinion.

32.2 The contractor shall permit the Engineer's / Employer's / Owner's authorized representative or any Technical Auditor / Third Party designated by Owner / State / Central Govt. to check the contractor's work and to notify the Contractor of any defects or shortcomings that are noticed during inspections. Such a check shall neither relieve the Contractor's responsibilities regarding specifications as defined in the Contract Agreement nor shall relieve him from any responsibilities regarding proper performance of works.

33. Tests

33.1 All the civil construction and materials & fittings supplied (other than the materials provided by DLDA U.S NAGAR, if any) shall be got tested, prior to installation, through IIT, Roorkee / Sri Ram Institute of Industrial Research, Delhi or any other Institution of repute designated by the Engineer / Employer, by the contractor at his own expense. If the test report doesn't conform to relevant Specifications / IS Standards, the contractor will replace such defected materials from site within a week of receipt of the report, at his own cost. The materials or fittings required to be tested prior to installation shall not be installed until the Engineer has approved the test results. The number of samples to be tested will be decided as per the directions of Engineer. All the samples shall be drawn and sealed jointly by the Contractor / his Authorized Representative and the Engineer /

his Authorized Representative. All Cost of testing shall be borne by the contractor.

33.1 The contractor will arrange for the testing of other materials at manufacturer works as per Schedule-E / Technical Specifications. Department will depute its representative to witness the test and the final test of other material shall be conducted at site. All Cost of testing shall be borne by the contractor.

33.2 Concrete cubes shall have to be casted by the contractor during construction of all RCC / PCC works and got them tested through IIT, Roorkee / Sri Ram Institute of Industrial Research, Delhi or any other Institution of repute designated by the Engineer / Employer. All Cost of testing shall be borne by the contractor. Similarly, the Contractor may be required to get cement mortar or any such component of finished works tested. A proper record o fal ltests shall b emaintained by the Contractor in a Testing Register, which may be required to be produced to the Engineer any time or as many time, as required. In addition, the Contractor shall submit to the Engineer all test reports in original as soon as they are received, copies of which may be retained by the Contractor for his own record. If any of the test reports doesn't conform to relevant Specifications / IS Standards, the contractor will demolish and reconstruct such defected works within shortest possible time, entirely at his own risk and cost. Th enumber of samples t obe tested will b edecided as per the directions of Engineer. All the samples drawn from work shall be taken and sealed jointly by the Contractor / his Authorized Representative and the Engineer / his Authorized Representative.

33.3 All the water retaining structures and pipelines / sewer lines laid along with their appurtenant works shall have to be hydraulically tested by the contractor for detection of any seepage / leakages and their due performance under the required test conditions, in isolated sections to be determined by the Engineer, during progress of the works or after their completion. Such hydraulic testing shall be performed by the Contractor in presence of the Engineer or his Authorized Representative in the required manner and as per the specifications set out in the Specifications of Works including all necessary arrangements and supply of required equipments, at his own cost. Hydraulic testing shall be deemed to be satisfactorily accomplished, only when it is duly signed / countersigned by the Engineer. A proper record of all tests shall be maintained by the Contractor in a Testing Register, which may be required to be produced to the Engineer at any time or as many time, as required. In addition, the Contractor shall

submit to the Engineer all test reports in original as soon as they are received, copies of which may be retained by the Contractor for his own record. If any of the test reports doesn't conform to relevant Specifications / IS Standards, the contractor will demolish and reconstruct such defected works within shortest possible time, entirely at his own risk and cost.

33.4 Execution of any water retaining structure or pipeline work with appurtenant structures shall be deemed to be completed only after their satisfactory completion, followed by their hydraulic testing as per the provisions of Sub Cl. 33.3 above. Such works shall not be treated as actually completed unless the certificate of hydraulic testing has been furnished by the Contractor and duly signed / countersigned by the Engineer and a mention to this effect has been recorded on the measurement book after recording measurements of the concerned works.

33.5 Water required for construction, curing, testing etc., if not available through the executed works, shall have to be arranged by the Contractor from his own sources and at his own cost. No responsibility in this regard shall lie on the Engineer / Employer / Owner.

33.6 If the Engineer instructs the Contractor to carry out any test not specified in the Specifications to check any component of work, equipment, machinery etc. for its due performance or a possible defect / shortcoming and the test shows that it doesn't conform to the desired specifications / performance or found to have a defect / shortcoming, then the Contractor shall pay all expenditure incurred in connection with such tests and shall rectify the defect / shortcoming immediately, and if it is not possible then shall dismantle / demolish / remove such works, equipment, machinery etc. from the site of works at the earliest and entirely at his own risks and costs.

33.7 The contractor has to establish a full-fledged site lab for routine testing of construction materials and concrete cubes prior to start of work as per the contract data

34. Completion and Commissioning of Work

34.1 The Contractor shall ensure to complete and commission the work up to date of Intended Completion date as defined in Contract Data. One month before the end of completion period, the Contractor shall request the Engineer to issue a certificate of completion of the works and the Engineer will do so after inspecting the works by himself / Higher Authorities / Govt. Technical Audit / Third Party Quality Control team and certify

that the work has been completed as per the specifications within the completion period as defined in the Contract Data.

Note: ***Where in certain cases, the technical specifications provide for acceptance of works within specified tolerance limits at reduced rates, Engineer will certify payments to Contractor accordingly.***

35. Correction of Defects

35.1 The Engineer shall give notice to the Contractor of any Defects noticed during the Defects Liability Period (DLP), which begins after the date of successful Completion and issuance of completion certificate and is defined in the Contract Data.

35.2 Every time notice of a Defect is given, the Contractor shall correct the notified Defect within the length of time specified in the Engineer's notice. Non rectification of notified defects within time will lead to automatic extension of DLP.

36. Uncorrected Defects

36.1 If the Contractor has not corrected a Defect within the time specified in the Engineer's notice, the Engineer will get the Defects corrected at the Contractor's cost and the cost so incurred will be debitable from pending bills due to the Contractor and the retention money.

D. Cost Control

37. Bill of Quantities

37.1 The Bill of Quantities shall contain items for the construction, installation, testing, commissioning, maintenance & handing over of work to be done by the contractor as defined in Section-XI (Bill of Quantities). Quantity of any item can be increased or decreased up to any limit and execution of any extra item necessary for commissioning of project will be binding on contractor.

37.2 The Bill of Quantities is used to calculate the Contract Price. The Contractor is paid for the quantity of the work done at the rate in the Bill of Quantities for each item. For Lump Sum contracts / items, the payment shall be made as per the payment schedule. Quantities given in the Schedule G are approximate and may vary (+/-) to any extent and some items may be deleted altogether. No claim in regard of change of scope of work will be acceptable.

38. Changes in the Quantities

38.1 The quantities mentioned in the BOQ of the contract bond may vary up to any limit. If the quantity of the work to be executed differs from the quantity in the Bill of Quantities for the particular item, it should be brought to the notice of the Engineer by the contractor prior to execution of work. After verification, he will approve or seek the approval of the competent authority for such variations in quantities of the contract.

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

39. Variations

39.1 All Variations shall be included in updated Programs produced by the Contractor.

40. Payments for Variations

40.1 The Engineer shall assess the quotation, which shall be given within seven days of the request or within any longer period stated by the Engineer and before the Variation is ordered.

40.2 If the work in the Variation corresponds with an item description in the Bill of Quantities and if, in the opinion of the Engineer, the quantity of work is above the limit stated in Sub Cl. 37.1, the rate in the bill of Quantities shall be used to calculate the value of the Variation.

40.3 The Contractor shall provide the Engineer with a quotation (with breakdown of unit rates) for carrying out the Variation.

40.4 If the Contractor's quotation is unreasonable (or if the contractor fails to provide the Engineer with a quotation within a reasonable time specified by the engineer in accordance with Sub Cl. 40.1), the Engineer may order the Variation and make a change to the Contract Price which shall be based on the prevent schedule of rates.

41. Cash flow forecasts

41.1 When the Program is updated, the contractor is to provide the Engineer with an updated cash flow forecast.

42. Payment Certificates

42.1 The Contractor shall submit to the Engineer monthly statements of the estimated value of the work completed less the cumulative amount certified previously

along with details of measurement of the quantity of works executed in a tabulated form as approved by the Engineer.

42.2 The Engineer shall check the details given in the Contractor's monthly statement and certify the amounts to be paid to the Contractor after taking into account any credit or debit for the month in question in respect of materials for the works in the relevant amounts and under conditions set forth in Sub Cl. 51.4 of G.C.C. and Contract Data (Secured Advance).

42.3 The value of work executed shall be determined by the Engineer after due check measurement of the quantities claimed as executed by the contractor.

42.4 The value of work executed shall comprise the value of the quantities of the items in the Bill of Quantities completed.

42.5 The value of work executed shall include the valuation of Variations and Compensation Events.

42.6 The Engineer may exclude any item certified and paid earlier in a previous certificate or reduce the proportion of any item previously certified if it comes to his knowledge later on to do so.

43. Payments

43.1 Payments shall be adjusted for deductions of advance payments, retention, other recoveries in terms of the contract and taxes, at source, as applicable under the law. The Employer shall pay the Contractor, the amounts certified by the Engineer as early as possible. excluding GST, which is included in rates of contractor.

43.2 Payment schedule will be as per Sub Cl. 42.1 except for items covering lump sum items which will be paid only after proper completion.

44. Compensation Events

44.1 The following are Compensation Events unless they are caused by the Contractor:

(a) The Engineer does not give access to a part of the Site by the Site Possession Date stated in the Contract Data.

(b) The Engineer / Employer modify the schedule of other contractors in a way which affects the work of the contractor under the contract. In case it relates with the work under the contract.

(c) **The Engineer orders a delay or does not issue drawings, specifications or instructions required for execution of works in time.**

44.2 If a Compensation Event would prevent the work being completed before the Intended Completion Date, the Intended Completion Date is extended. The Engineer shall decide whether and by how much the Intended Completion Date shall be extended and send his recommendation on original application for E.O.T. of contractor on prescribed format. Competent authority will take final decision about E.O.T. at his own satisfaction.

44.3 The Contractor shall not be entitled to compensation for E.O.T. to the extent that the Employer's interests are adversely affected by the Contractor not having given early warning or not having cooperated with the Engineer.

45. Tax

45.1 The rates quoted by the Contractor shall be deemed to be inclusive of the all other taxes etc, excluding GST. That the Contractor will have to pay for the performance of this Contract. The Engineer will perform such duties in regard to the deduction of such taxes at source as per applicable law.

46. Currencies

46.1 All payments shall be made in Indian Rupees.

47. Appreciation

47.1 If the Contractor achieves completion of the Works prior to the time prescribed in Contract Data, the Employer shall issue an appreciation letter to the Contractor / Bidder.

48. Retention

48.1 The Engineer shall retain from each payment due to the Contractor the proportion stated in the Contract Data until Completion of the whole of the Works.

48.2 The total amount retained will be paid to the Contractor when the Defects Liability Period is passed and the Engineer has certified that all Defects notified by the Engineer to the Contractor before the end of this period have been corrected. The release of retention money after completion of work solely depends upon the Discretion of Secretary. If the Secretary decides to release the retention money, it can be released against the F.D.R. of same amount duly pledged in favor Secretary.

49. Liquidated Damages

49.1 The Contractor shall pay liquidated damages to the Engineer / Employer at the rate per day stated in th e Contract Data for each day that the Completion Date is later than the Intended Completion Date (for the whole of the works or the milestone as stated in the contract data). The total amount of liquidated damages shall not exceed the amount defined in the Contract Data. The Engineer may deduct liquidated damages from payments due to the Contractor in any of his work / payment. Time is the essence of the contract and payment or deduction of liquidated damages shall not relieve the contractor from his obligation to complete the work as per agreed construction program and milestones or from any other of the contractor's obligations and liabilities under the contract.

49.2 If the Intended Completion Date is extended after liquidated damages have been paid, the Engineer shall correct any over payment of liquidated damages by the Contractor by adjusting the next payment certificate.

50. Penalty

50.1* ~~5% value of pump for each and every one tenth of B.O.T. above guaranteed figures shall be levied by as a penalty. However no damages shall be claimed if the consumption is less than 0.05 B.O.T. above guaranteed figures otherwise pro rata reduction shall be made. The pumping plant will be accepted up to the allowable limit of +\- 4% discharge without imposing any penalty. If discharge found less than 5% to 14% pro rata reduction at the rate of 1% of the cost of pumps and motors for less percentage of discharge will be made. If the discharge is found less by 15%, the pumping plant will be rejected and cost of it will be recovered from the contractor.~~

**** For tenders of Electrical & Mechanical Works only***

51. Advance Payment

51.1 The Engineer shall make advance payment to the Contractor of the amounts stated in the Contract Data by the date stated in the Contract Data, against provision by the Contractor of an Unconditional Bank Guarantee in a form and by a bank acceptable to the Employer in amounts and currencies equal to the advance payment. The guarantee shall remain effective until the advance payment has been repaid, but the amount of the guarantee shall be progressively reduced by the amounts repaid by the Contractor. Interest may be charged on the advance

payment as stated in the Contract Data and no interest will be charged if nothing is stated about this in contract data.

51.2 The Contractor is to use the advance payment only to pay for Equipment, Plant and Mobilization expenses required specifically for execution of the Works. The Contractor shall demonstrate that advance payment has been used in this way by supplying copies of invoices or other documents to the Engineer.

51.3 The advance payment shall be repaid by deducting proportionate amounts from payments otherwise due to the Contractor, following the schedule of completed percentages of the Works on a payment basis.

51.4 Secured Advance:

The Engineer shall make advance payment in respect of certain specified materials intended for but not yet incorporated in the Works in accordance with conditions stipulated in the Contract Data.

52. Securities

52.1 The Performance Security shall be provided to the Engineer not later than the date specified in the Letter of Acceptance and shall be issued in an amount and form and by a bank or surety acceptable to the Engineer / Employer, and denominated in Indian Rupees. The Performance Security shall be valid until a date 60 days from the date of issue of the completion certificate and the additional security for unbalanced bids shall be valid until a date from the date of issue of the completion certificate

53. Cost of Repairs

53.1 Loss or damage to the Works or Materials to be incorporated in the Works between the Start Date and the end of the Defects Correction periods shall be remedied by the Contractor at the Contractor's cost if the loss or damage arises from the Contractor's acts or omissions.

E. Finishing the Contract

54. Completion

54.1 The Contractor shall request the Engineer to issue a Certificate of Completion of the Works and the Engineer will do so upon deciding that the Work is completed in accordance with Cl. 34.

55. Taking Over

55.1 The Engineer or his authorized person shall take over the Site and the Works after the Engineer issuing a Certificate of Completion. The contractor will have to submit guarantee and warrantee certificates provided by the manufacturer for all type of machinery and equipment to the Engineer incharge.

56. Final Account

56.1 The Contractor shall supply to the Engineer a detailed account of the total amount that the Contractor considers payable under the Contract before the end of the Defects Liability Period. The Engineer shall issue a Defect Liability Certificate stating that the all the defects have been rectified and certify any final payment that is due to the Contractor within 60 days of receiving the Contractor's account if it is correct and complete. If it is not, the Engineer shall issue within 60 days a schedule that states the scope of the corrections or additions that are necessary. If the Final Account is still unsatisfactory after it has been resubmitted, the Engineer shall decide on the amount payable to the Contractor and issue a payment certificate, within 60 days of receiving the Contractor's revised account.

57. Drawing / Manuals

57.1 If the drawing and design is to be provided by Contractor and he does not supply the Drawings and / or manuals by the dates stated in the Contract Data, or they do not receive the Engineer's approval, the Engineer shall withhold the amount stated in the Contract Data from payments due to the Contractor.

58. Termination

58.1 The Employer may terminate the Contract if the contractor / party cause a fundamental breach of the Contract, or any other reason thereof.

58.2 Fundamental breaches of Contract include, but shall not be limited to the following:

(a) The Contractor stops work for 28 days when no stoppage of work is shown on the current program and the stoppage has not been authorized by the Engineer.

(b) The Contractor is made bankrupt or goes into liquidation other than for a reconstruction or amalgamation.

(c) The Engineer gives Notice to correct a particular Defect and the Contractor fails to correct it within the specified period of time determined by the Engineer.

(d) The Contractor does not maintain a security of the works executed or in progress.

(e) The Contractor has delayed the completion of works by the number of days for which the maximum amount of liquidated damages can be paid as defined in the Contract data.

(f) If the Contractor, in the judgment of the Purchaser has engaged in fraud and corruption, as defined in GCC Cl. 62, in competing for or in executing the Contract, and

(g) If the contractor is Joint Venture and the lead partner becomes defaulter in the execution of works under contract,

(h) The Contractor has contravened Cl. 7 of GCC read with SCC and Cl. 9 of GCC

(i) The contractor does not adhere to the agreed construction program (Cl. 27 of GCC) and also fails to take satisfactory remedial action as per agreements reached in the management meetings (Cl. 30) for a period of 60 days.

(j) The contractor fails to carry out the instructions of Engineer within the specified time determined by the Engineer in accordance with GCC Sub Cl. 16.1 and 23.1.

58.3 Notwithstanding the above, the Employer may terminate the Contract for convenience.

58.4 If the Contract is terminated the Contractor shall stop work immediately, handover the site along with the work executed and materials available at the site up to the date of termination, to Engineer. The Engineer shall immediately takeover the site along with the materials on 'As is where is basis' and make it safe and scare.

58.5 Fundamental breach of contract by the contractor may result into following consequences, as decided by the Engineer / Employer:-

i. Performance security submitted by the contractor can be forfeited.

ii. Rescind the contract (of which recession notice in writing to the contractor under the hand of the Engineer shall be conclusive evidence) and in which case the security deposit of the contractor together with such sum or sums due to him under

the contract shall stand forfeited and be absolutely at the disposal of the Engineer.

iii. **Determine the contract and call in other contractor, or employ daily labour to dismantle bad work if necessary (the bad work to be certified by the Engineer whose decision shall be final) and to renew and complete the said works and pay the cost of such contractor for daily labour and price of materials required for such dismantling, renewing and completion out of the said security deposit or such sum or sums as may be due to the contractor under this contract, and if such sum or sums due to the contractor under this contract, and if such cost be more than the amount made up the security money and the sum or sums due to the contractor under this contract the difference between it and the sum made up by the security money and the balance due to the contractor as aforesaid shall be a debt due from the said contractor.**

iv. **Take legal action against the contractor if the breach of the contract is related to Fraud and Corruption as per Sub Cl. 58.2 (f).**

v. **Blacklist the Contractor and debar him fo r awarding of an y contract in DLDA U.S NAGAR.**

In the event of either of the above courses being adopted by the Engineer, the contractor shall have no claim for compensation for any loss sustained by him by reason of his having purchased or procured any materials, or entered into any agreement, or made any advance on account of, or with a view to the execution of the work or the performance of the contract. And in case the contract shall be rescinded under the provision aforesaid, the contractor shall not be entitled to recover or be paid any sum for any work therefore actually performed under this contract, unless and until the Engineer certifies in writing the performance of such work and the value payable in respect thereof.

59. Payment upon Termination

59.1 If the Contract is terminated because of a fundamental breach of Contract by the Contractor, the Engineer shall issue a certificate for the value of the work done less advance payments received up to the date of the issue of the certificate, less other recoveries due in terms of the contract, less tax due to be deducted at source as per applicable law and less the penalty to be imposed as per the rates as indicated in the Contract Data. Additional Liquidated Damages shall not apply. If the total amount due to the Employer exceeds any payment due to the Contractor the difference shall be a debt payable to the Employer.

The percentage to apply to the value of the work not completed by the contractor, representing the Employer's Additional cost for completing the Works, shall be 20.00%. In addition to the liquidated damage contractor will pay to the employer / engineer 20% of cost of work not completed as additional cost for completing the work.

60. Property

60.1 All materials on the Site, Plant, Equipment, Temporary Works and Works are deemed to be the property of the Employer, if the Contract is terminated because of a Contractor's default. The Engineer will assess the cost of utilizable materials lying at site, which will be final and binding to the contractor and will be deemed to be the property of the department. The Engineer will be free to use the materials for the past under project or any other project.

61. Release from Performance

61.1 If the Contract is frustrated by the outbreak of war or by any other event entirely outside the control of either the Employer or the Contractor the Engineer shall certify that the Contract has been frustrated. The Contractor shall make the Site safe and stop work as quickly as possible after receiving this certificate and shall be paid for all work carried out before receiving it and for any work carried out afterwards to which commitment was made.

62. Fraud and Corruption

62.1 The Employer requires that Bidders, Suppliers, Contractors, and Consultants under this contract, observe the highest standard of ethics during the procurement and execution of such contracts. In pursuit of this policy, the Employer:

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

(i) "corrupt practice" means the offering, giving, receiving, or soliciting, directly or indirectly, of anything of value to influence the action of a public official in the procurement process or in contract execution;

(ii) "fraudulent practice" means a misrepresentation or omission of facts in order to influence a procurement process or the execution of a contract;

(iii) "collusive practice" means a scheme or arrangement between two or more Bidders, with or without the

knowledge of the borrower, designed to establish bid prices at artificial, non-competitive levels; and

(iv) "coercive practice" means harming or threatening to harm, directly or indirectly, persons or their property to influence their participation in the procurement process or affect the execution of a contract;

(b) will sanction a firm or individual, including declaring them ineligible, either indefinitely or for a stated period of time, to be awarded a contract by DLDA U.S NAGAR if it at any time determines that they have, directly or through an agent, engaged, in corrupt, fraudulent, collusive or coercive practices in competing for, or in executing, a contract by DLDA U.S NAGAR; and

(c) will have the right to require that Contractors to permit the Employer to inspect their accounts and records and other documents relating to the bid submission and contract performance and to have them audited by auditors appointed by the Employer.

63. F. Special Conditions of Contract 63.1. 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 of wages, housing and transport

The Contractor shall, if required by the Engineer, provide the details of worker men employed by the Contractor on the Site.

During the Construction of work, the contractor shall give preference to local labour.

63.2. COMPLIANCE WITH LABOUR REGULATIONS :

During continuance of the contract, the Contractor and his sub contractors shall abide at all times by all existing labour enactments and rules made thereunder, regulations, notifications and bye laws of the State or Central Government or local authority and any other labour law (including rules), regulations, bye laws that may be passed or notification that may be issued under any labour law in future either by the State or the Central Government or the local authority. Salient features of some of the major labour laws that are applicable to construction industry are given below. The Contractor shall keep the Employer indemnified in case any action is taken against the Employer by the competent authority on account of contravention of any of the provisions of any Act or rules made thereunder, regulations or notifications including amendments. If the Employer is caused to pay or reimburse, such amounts as may be necessary to cause or

observe, or for non-observance of the provisions stipulated in the notifications/bye laws/Acts/Rules/regulations including amendments, if any, on the part of the Contractor, the Engineer/Employer shall have the right to deduct any money due to the Contractor including his amount of performance security. The Employer/Engineer shall also have right to recover from the Contractor any sum required or estimated to be required for making good the loss or damage suffered by the Employer.

The employees of the Contractor and the Sub-Contractor in no case shall be treated as the employees of the Employer at any point of time.

SALIENT FEATURES OF SOME MAJOR LABOUR LAWS APPLICABLE TO ESTABLISHMENTS ENGAGED IN BUILDING AND OTHER CONSTRUCTION WORK
(The law as current or on the date of bid opening will apply)

a) Workmen Compensation Act 1923: The Act provides for compensation in case of injury by accident arising out of and during the course of employment.

b) Payment of Gratuity Act 1972: Gratuity is payable to an employee under the Act on satisfaction of certain conditions on separation if an employee has completed 5 years service or more or on death the rate of 15 days wages for every completed year of service. The Act is applicable to all establishments employing 10 or more employees.

c) Employees P.F. and Miscellaneous Provision Act 1952 *(since amended)*: The Act Provides for monthly contributions by the employer plus workers @ 10% or 8.33%. The benefits payable under the Act are :

(i) Pension or family pension on retirement or death, as the case may be.

(ii) Deposit linked insurance on the deat hin harness of the worker.

(iii) payment of P.F. accumulation on retirement/death etc.

d) Maternity Benefit Act 1951: The Act provides for leave and some other benefits to women employees in case of confinement or miscarriage etc.

e) Contract Labour (Regulation & Abolition) Act 1970: The Act provides for certain welfare measures to be provided by the Contractor to contract labour and in case the Contractor fails to provide, the same are required to be provided, by the Principal Employer by Law. The Principal Employer is required to take Certificate of Registration and the Contractor is required to take license from the designated Officer.

The Act is applicable to the establishments or Contractor of Principal Employer if they employ 20 or more contract labour.

f) Minimum Wages Act 1948: The Employer of the workers (contractor) is supposed to pay not less than the Minimum Wages fixed by appropriate Government as per provisions of the Act if the employment is a scheduled employment. Construction of Buildings, Roads, Runways are scheduled employments.

g) Payment of Wages Act 1936: It lays down as to by what date the wages are to be paid, when it will be paid and what deductions can be made from the wages of the workers.

h) Equal Remuneration Act 1979: The Act provides for payment of equal wages for work of equal nature to Male and Female workers and for not making discrimination against Female employees in the matters of transfers, training and promotions etc.

i) Payment of Bonus Act 1965: The Act is applicable to all establishments employing 20 or more employees. The Act provides for payments of annual bonus subject to a minimum of 8.33% of wages and maximum of 20% of wages to employees drawing Rs.3500/-per month or less. The bonus to be paid to employees getting Rs.2500/-per month or above upto Rs.3500/- per month shall be worked out by taking wages as Rs.2500/-per month only. The Act does not apply to certain establishments. The newly set-up establishments are exempted for five years in certain circumstances. Some of the State Governments have reduced the employment size from 20 to 10 for the purpose of applicability of this Act. Latest amendments of the act will always prevail and will be applicable.

j) Industrial Disputes Act 1947: The Act lays down the machinery and procedure for resolution of Industrial disputes, in what situations a strike or lock-out becomes illegal and what are the requirements for laying off or retrenching the employees or closing down the establishment.

k) Industrial Employment (Standing Orders) Act 1946: It is applicable to all establishments employing 100 or more workmen (employment size reduced by some of the States and Central Government to 50). The Act provides for laying down rules governing the conditions of employment by the Employer on matters provided in the Act and get the same certified by the designated Authority.

l) Trade Unions Act 1926: The Act lays down the procedure for registration of trade unions of workmen and employers. The Trade Unions registered under the Act have been given certain immunities from civil and criminal liabilities.

m) Child Labour (Prohibition & Regulation) Act 1986: The Act prohibits employment of children below 14 years of age in certain occupations

and processes and provides for regulation of employment of children in all other occupations and processes. Employment of Child Labour is prohibited in Building and Construction Industry.

n) Inter-State Migrant workmen's (Regulation of Employment & Conditions of Service) Act 1979: The Act is applicable to an establishment which employs 5 or more inter-state migrant workmen through an intermediary (who has recruited workmen in one state for employment in the establishment situated in another state). The Inter-State migrant workmen, in an establishment to which this Act becomes applicable, are required to be provided certain facilities such as housing, medical aid, traveling expenses from home upto the establishment and back, etc.

o) The Building and Other Construction workers (Regulation of Employment and Conditions of Service) Act 1996 and the Cess Act of 1996: All the establishments who carry on any building or other construction work and employs 10 or more workers are covered under this Act. All such establishments are required to pay cess at the rate not exceeding 2% of the cost of construction as may be modified by the Government. The Employer of the establishment is required to provide safety measures at the Building or construction work and other welfare measures, such as Canteens, First-Aid facilities, Ambulance, Housing accommodations for workers near the work place etc. The Employer to whom the Act applies has to obtain a registration certificate from the Registering Officer appointed by the Government.

p) Factories Act 1948: The Act lays down the procedure for approval at plans before setting up a factory, health and safety provisions, welfare provisions, working hours, annual earned leave and rendering information regarding accidents or dangerous occurrences to designated authorities. It is applicable to premises employing 10 persons or more with aid of power or 20 or more persons without the aid of power engaged in manufacturing process.

Salient features of some of the major laws that are applicable are given below :

The Water (Prevention and Control of Pollution) Act, 1974, This provides for the prevention and control of water pollution and the maintaining and restoring of wholesomeness of water. 'Pollution' means such contamination of water or such alteration of the physical, chemical or biological properties of water or such discharge of any sewage or trade effluent or of any other liquid, gaseous or solid substance into water (whether directly or indirectly) as may, or is likely to, create a nuisance or render such water harmful or injurious to public health or safety, or to domestic, commercial, industrial, agricultural or other legitimate uses, or to the life and health of animals or plants or of aquatic organisms. The Air (Prevention and Control of Pollution) Act, 1981, This provides for prevention, control

and abatement of air pollution. 'Air Pollution' means the presence in the atmosphere of any 'air pollutant', which means any solid, liquid or gaseous substance (including noise) present in the atmosphere in such concentration as may be or tend to be injurious to human beings or other living creatures or plants or property or environment.

The Environment (Protection) Act, 1986, This provides for the protection and improvement of environment and for matters connected therewith, and the prevention of hazards to human beings, other living creatures, plants and property. 'Environment' includes water, air and land and the inter-relationship which exists among and between water, air and land, and human beings, other living creatures, plants, micro-organism and property.

The Public Liability Insurance Act, 1991, This provides for public liability insurance for the purpose of providing immediate relief to the persons affected by accident occurring while handling hazardous substances and for matters connected herewith or incidental thereto. Hazardous substance means any substance or preparation which is defined as hazardous substance under the Environment (Protection) Act 1986, and exceeding such quantity as may be specified by notification by the Central Government.

Latest amendments of all the above act / acts will always prevail and will be applicable.

SECTION – V : SPECIFICATIONS

OFFICE OF THE VICE CHAIRMAN, DISTRICT LEVEL DEVELOPMENT AUTHORITY, RUDRAPUR (UDHAM SINGH NAGAR)

SPECIFICATIONS

INDEX

Table of Contents	Page No.
PREAMBLE	
General	77-289
SPECIFICATIONS & DRAWINGS	
MATERIALS	
STANDARDS	
LIST OF IMPORTANT INDIAN STANDARDS	
GENERAL SPECIFICATIONS	
EARTHWORK AND EXCAVATION	
RELEVANT IS CODES	
EXCAVATION	
DEFINITIONS	
SITE CLEARANCE	
GENERAL EXCAVATION	
LEAD	
EXCAVATION IN HARD ROCK	
EXCESS EXCAVATION TO BE MADE GOOD	
STRIPPING TOP SOIL	
SUPPORTING EXCAVATIONS	
TRIMMING EXCAVATIONS	
INSPECTION BY THE ENGINEER-IN-CHARGE	
DISPOSING EXCAVATED MATERIAL	
BACK-FILLING GENERAL SITE GRADING AND SAND FILLING	
FILL DENSITY	
LOCAL RULES AND REGULATIONS	
DEWATERING	
TIMBER SHORING	
RAIN WATER DISCHARGE	
ANTI TERMITE TREATMENT	
DELIVERY, STORAGE AND HANDLING	
SAFETY REQUIREMENTS	
WARRANTY	
QUALITY ASSURANCE	
APPLICATION REPORT	
PRODUCTS	
PESTICIDES	
EXECUTION	
APPLICATION	
RATES AND METHODS OF APPLICATION	
CONCRETE AND ALLIED WORKS	

GENERAL
APPLICABLE CODES
MATERIALS FOR STANDARD CONCRETE
FINE AGGREGATE
COARSE AGGREGATE
WATER
STEEL AND ALUMINUM ENCASED IN CONCRETE
ANCHOR BOLTS, ANCHORS, SLEEVES, INSERTS, /CONDUITS/PIPE AND OTHER MISC. EMBEDDED FIXTURES
CONTROLLED CONCRETE
MIX DESIGN
GENERAL
PRELIMINARY TESTS
MIXING OF CONCRETE
GRADE OF CONCRETE
WORKMANSHIP
SAMPLING AND TESTING CONCRETE IN THE FIELD
CONCRETE TESTS
LOAD TEST ON MEMBERS OR ANY OTHER TESTS
UNSATISFACTORY TESTS
ADMIXTURES
GENERAL
AIR ENTRAINING AGENTS
WATER REDUCING ADMIXTURES
RETARDING ADMIXTURES
WATER PROOFING AGENT
OTHER ADMIXTURES
PREPARATION PRIOR TO CONCRETE PLACEMENT, INSPECTION AND APPROVAL
TRANSPORTATION
GENERAL
RETEMPERED OR CONTAMINATED CONCRETE
AVOIDING SEGREGATION
PLACING BY MANUAL LABOUR
PLACING BY MECHANICAL EQUIPMENT
PLACEMENT OF RESTRICTED FORMS
CHUTING
PLACING BY PUMPING/PNEUMATIC PLACERS
CONCRETE IN LAYERS
COVER BLOCKS
BEDDING OF LAYERS
COMPACTION
PLACEMENT INTERVAL
SPECIAL PROVISION IN PLACING
PLACING CONCRETE THROUGH REINFORCING STEEL
BLEEDING
APPLICATION OF ARALDITE FOR BONDING OF NEW AND OLD CONCRETE
GENERAL
FORMULATION
APPLICATION
HANDLING PRECAUTIONS
CONSTRUCTION JOINTS

MOVEMENT JOINTS
WATER STOPS AND JOINT FILLERS
WATER STOPS
JOINTING FILLERS
SEALING COMPOUNDS
TOLERANCES IN CONCRETE SURFACES
CURING, PROTECTING, REPAIRING AND FINISHING
CURING
CURING WITH WATER
CONTINUOUS SPRAYING
ALTERNATE CURING METHODS
CURING COMPOUND
CURING EQUIPMENT
PROTECTING FRESH CONCRETE
REPAIR AND REPLACEMENT OF UNSATISFACTORY CONCRETE
FINISHING
HOT WEATHER REQUIREMENT
PLACING CONCRETE UNDERWATER
PRECAST CONCRETE
GENERAL
STRIKING FORMS
PRECAST UNITS
CURING
SLOTS, OPENINGS, ETC.
GENERAL
GROUTING
INSPECTION
CLEAN-UP
RECORDS OF CONCRETING
FOUNDATION BEDDING, BONDING AND JOINTING
PREPARATION OF ROCK STRATA OF FOUNDATIONS
FORMWORK
FORMWORK, FIXING AND GENERAL
REMOVAL OF FORMWORK
FORMED SURFACES - CLASSES OF FINISH
DEFECTS IN FORMED SURFACES
HOLES TO BE FILLED
TOLERANCES
BRACING, STRUTS AND PROPS
REINFORCEMENT
RELEVANT IS CODES
GENERAL
STORAGE
QUALITY
LAPS
BENDING
FIXING
COVER
INSPECTION
WELDING OF REINFORCEMENT
SUPPLY OF REINFORCING BARS
STRUCTURAL STEEL WORK

RELEVANT IS CODES
GENERAL
MATERIALS
FABRICATION AND ERECTION
PAINTING
GENERAL
IRONWORK AND UN GALVANIZED STEELWORK
BRICK WORK AND STONE MASONRY
RELEVANT IS CODES
MATERIALS
BRICKS
MORTAR
CONSTRUCTION
CURING
SCAFFOLDING
STONE MASONRY FOR RETAINING WALLS
UNCOURSED STONE MASONRY
POINTING OF UNCOURSED MASONRY
STONE PITCHING
RUBBLE PACKING
CONCRETE BLOCK MASONRY
MATERIALS
WORKMANSHIP
DAMP-PROOF COURSE MATERIALS AND WORKMANSHIP
PLASTERING
RELEVANT IS CODES
PLASTERING
NEERU
MATERIAL
WORKMANSHIP
FLOORING
RELEVANT IS CODES
GENERAL CEMENT CONCRETE FLOORING
GENERAL
FILLING
BASE COARSE
FLOOR FINISH PLAIN CEMENT FINISH
CURING
GRANOLITHIC (IPS) FLOORING
FINISHED LAYERS
CURING
TERRAZZO (MOSAIC) TILE
TOLERANCES
MANUFACTURE
LAYING
CURING, POLISHING AND FINISHING
TERRAZZO (MOSAIC) IN-SITU FLOORING
MATERIAL
PREPARATION AND LAYING OVER BASE CONCRETE

CURING, POLISHING AND FINISHING
GLAZED TILE FLOORING
WHITE GLAZED TILES
SIZE AND TOLERANCE
COLOURED TILES
DECORATIVE TILES
PREPARATION OF SURFACE AND LAYING
POINTING AND FINISHING
KOTA STONE FLOORING
TOLERANCES
DRESSING
SURFACE PREPARATION AND LAYING
POLISHING AND FINISHING
MOSAIC FINISHED DADO OR SKIRTING
HARDONITE FLOORING
WORKMANSHIP
PREPARATION OF SURFACE
DISTEMPERING AND PAINTING
GENERAL
CONCRETE, BRICKWORK AND PLASTER
IRONWORK AND UNGALVANISED STEELWORK
GALVANIZED STEELWORK
BITUMINOUS SURFACES
ALUMINUM SURFACES
WOODWORK
WATERPROOF CEMENT PAINT
SURFACE PREPARATION
MIXING THE PAINT
METHOD OF APPLICATION
CURING
SILICON PAINT
PREPARATION
APPLICATION
SPRAYING EQUIPMENT
SAFETY
RELEVANT IS CODES
DISTEMPERING
TYPE
MATERIAL
PREPARATION OF SURFACE AND PRIMING COAT
APPLICATION
DECORATIVE FINISH CEMENT PAINT
SURFACE PREPARATION
PREPARATION OF MIX AND APPLICATION
PAINTING
PAINTING GENERAL
COMMENCING THE WORK
WORKMANSHIP
PREPARATION OF SURFACE

APPLICATION
PAINTING WITH SYNTHETIC ENAMEL/ENAMEL PAINT MATERIAL
PREPARATION OF SURFACE
APPLICATION
EXPANSION JOINTS AND CONSTRUCTION JOINTS
GENERAL
MATERIAL
JOINTS IN FLOOR
JOINTS IN WALLS
EXPANSION JOINT
CONSTRUCTION JOINT
COMPLETE CONSTRUCTION JOINTS
EPOXY COATING AND BITUMINOUS PAINTING
EPOXY COATING
GENERAL
MATERIALS
SUBSURFACE PREPARATION
CURING
BITUMINOUS PAINTING MATERIAL
APPLICATION
DOOR, WINDOWS, GRILLS, SHUTTERS, ETC.
RELEVANT IS CODES
GENERAL
WOODWORK IN DOORS, WINDOWS, PARTITIONS, ETC.
STEEL DOORS, WINDOWS AND FITTINGS
ROLLING SHUTTERS
HAND RAILING
GRATINGS
DESIGN DRAWINGS
WATER SUPPLY AND SANITARY WORKS
ROAD SIDE DRAIN
SPECIFICATION FOR ELECTRICAL WORKS

List of Tables

Table 1: List of IS
Table 2: Foreign Material Limitations in Fine Aggregate
Table 3: Grading of Sand for Fine Aggregate
Table 4 : Foreign Material Limitations in Coarse Aggregate
Table 5: Grade of Concrete
Table 6: Compressive Strengths at 28 days
Table 7: Minimum Cement Content in Concrete
Table 8: Limits of Consistency
Table 9 : Types of Water Stops
Table 10 : Proportions for Standard Grout
Table 11 : Proportions for Non-Shrinking Grout
Table 12 : Period for Formwork
Table 13 : Sizes of Terrazzo Tiles

PREAMBLE

The "Specifications" are to be read for the purpose of pricing in conjunction with "Conditions of Contract" of the Tender Documents containing instructions to Bidder and General Conditions of Contract; and "Financial Bid" of this tender.

The prices quoted in the Financial Bid shall be all inclusive of value for the work described including all costs and expenses which may be required in and for the execution of the work described together with all general risks, liabilities and obligations set forth or implied in the document on which the tender is based.

All works shall be carried out strictly as per detailed specifications (as specified or CPWD) whether actually specified or not.If not specified work shall be carried out as per directions of Owner / Engineer.

The total amount entered in the Financial Bid shall be written in ink and shall be entered both in figures and words.

Specifications of items of work described in BOQ for each item shall read this in conjunction with other technical specifications and specific technical requirements and quote accordingly.

No separate payment whatsoever shall be made for dewatering if required to be done during excavation, laying of PCC and RCC laying and jointing of pipes, construction of manholes, testing and backfilling etc. and hence Contractor should quote accordingly.

If the bidder needs any clarification, they shall obtain the same in writing from Owner / Engineer. No notice will be taken of any verbal discussions in such matters.

Abbreviations used in this Specifications document have the meanings shown below:

mm	**Millimetre**	**CI**	**Cast Iron**
Cm	**Centimetre**	**GI**	**Galvanized Iron**
M	**Metre**	**GSW**	**Glazed Stone Ware**
km	**Kilometre**	**BBCC**	**Burnt Brick Cement Concrete**
sq.m	**Square Metre**	**RCC**	**Reinforced Cement Concrete**
cum.	**Cubic Metre**	**PCC**	**Plain Cement concrete**
M.T.	**Metric Ton**	**wt**	**Weight**
SWG	**Standard Wire Gauge**	**kg**	**Kilogram**
R.M.	**Running Metre**	**I.D.**	**Internal Diameter**
nos.	**Numbers**	**C.M.**	**Cement Mortar**
MS	**Mild Steel**	**IS**	**Indian Standards**
M.D	**Metre Depth of Manhole**	**SS**	**Stainless Steel**

OFFICE OF THE VICE CHAIRMAN, DISTRICT LEVEL DEVELOPMENT AUTHORITY, RUDRAPUR (UDHAM SINGH NAGAR)

General

Specifications & Drawings

The drawings of the proposed work(s)/plant(s) are incorporated in tender documents. These drawings are made for Tenderer's guidance only.

The Contractor will work as per detailed design as well as General Arrangement drawings and structural drawings provided Engineer–in-Charge and immediately start the construction, erection and commissioning of civil, electrical and mechanical components of the structures and other appurtenant works.

Work shall be carried out by Contractor exactly in accordance with the Drawings marked as RELEASED FOR CONSTRUCTION and provided by Engineer-in-Charge and as per the instructions of the Engineer-in-Charge in writing.

Materials

The term "Materials" shall mean all materials, goods and articles of every kind whether raw, processed or manufactured and equipment and plant of every kind to be supplied by the Contractor for incorporation in the works.

Except as may be otherwise specified for particular parts of the Works the provision of clauses in "materials and workmanship" shall apply to materials and workmanship for any part of the works.

All materials shall be new and of the kinds and qualities described in the Contract and shall be approved by the Engineer in- charge.

Materials shall be transported, handled and stored in such a manner as to prevent deterioration, damage or contamination, failing which such damaged materials will be rejected and shall not be used on any part of the Works under this contract.

Standards

The special attention of the Contractor is drawn to the relevant sections and clauses of the National Building Code of India 2016, CPWD specifications and latest BIS Codes (Latest editions along with Amendments) and should follow them strictly in addition to the specifications & conditions stipulated in this volume. Materials and workmanship shall comply with the relevant Indian Standards (with amendments), unless a more recent amendment is specified hereinafter, or with the requirements of any other authoritative standard approved by the Engineer-in-Charge which shall be no less exacting in the opinion of the Engineer-in-Charge than the corresponding standard quoted here in. The specifications, standards and codes listed below are made a part of this specification. All standards, tentative specifications, specifications, codes of practice referred to herein shall be the latest editions including all applicable official amendments and revisions.

If no standard is indicated, the relevant Indian Standard, if any, shall apply. Indian standards are published by BIS.
Hand Book (1990) shall be followed, wherever not specified in this "Volume II: Technical Specifications", IS specifications shall be applicable. In case of discrepancy Engineer-in-Charge's decision will be final & binding. All structures must be constructed as per standards of earthquake safety. All the standards make / guidelines given for safety against earthquake for construction of structures in IS Codes must be followed.

List of Important Indian Standards

The following list includes various Indian Standards which are IMPORTANT and are referred to in the general specifications and used in construction works. These standards are to be strictly adhered to unless otherwise is applicable in the relevant context. These standards are to be followed both in respect of materials and construction of civil engineering works included in the tenders. Though the list of Indian Standards includes the year of Publication of the standard, it may not in all cases be the latest. It is obligatory that only the latest edition of the standard is referred to and followed, along with all amendments and revisions issued with respect to the standard under consideration. This list is not exhaustive but contains only the standards that are very frequently used on the construction works. If a standard exists for a particular item of material or equipment or code of practice the same shall be followed whether the same is included in this list, specifications, other parts of the tender documents or not. Some Indian Standards are referred to in the specifications/ drawings/ other parts of the tender documents and they are supplementing this list if they do not find a place in the list.

Table 1: List of IS

S.No.	IS Code No. / Year	Title
1	2062-1984	Specification for Structural Steel (Fusion Welding Quality)
2	269-1976	Ordinary and low heat Portland cement
3	383-1970	Coarse and fine aggregates from natural sources for concrete
4	432(part1)-1982	Mild steel and medium tensile steel bars
	455-1976	Portland slag cement
6	456- 2000	Code of practice for plain and reinforced cement concrete
7	516-1959	Methods of test for strength of concrete
8	800-1984	Code of practice for general construction in steel
9	816-1969	Code of practice for use of metal arc welding for general construction in mild steel
10	1038-1983	Steel-doors, windows and ventilators
11	1077-1986	Common burnt clay building bricks
12	1199-1959	Methods of sampling and analysis of concrete

13	1200 (part1-26)	Method of measurement of building and civil engineering works
14	1477 (part 1-2)	Code of practice for painting of ferrous metals in buildings
15	1542-1977	Sand of plaster
16	1726 (part 1,2 & 4)	Cast iron manhole covers and frames
17	1786-1985	High strength deformed steel bars and wires for concrete reinforcement
18	2116-1980	Sand for masonry mortars
19	2212-1962	Code of practice for brickwork
20	2250-1981	Code of practice for preparation and use of masonry mortars
21	2386 (part I-VIII)	Methods of tests for aggregate for concrete
22	2502-1963	Code of practice for bending and fixing of bars for reinforced concrete
23	2720 (part IV,VIII)	Methods of test for soil
24	3370 (part I-IV)	Code of practice for concrete structures for the storage of liquids
25	3696	Safety code for scaffolds and ladders
26	3764-1966 (part 1-2)	Safety code for excavation work
27	4082-1977	Recommendations on stacking and storage of construction materials at site
28	6248-1979	Metal rolling shutters and rolling grills
29	7293-1974	Safety code for working with construction machinery
30	7969-1975	Safety code for handling and storage of building materials
31	Code	National Building Code of India
32	4014	Code of practice for steel tubular scaffolding.
33	5121	Code of practice for deep foundation
34	3764	Safety code for excavation work
35	4082	Recommendations on stocking & storage material at site.
36	7293	Safety code of working with construction machinery.
37	7364	Plastic pipe work for potable water supply (part I-III)
38	IS 3589-1981	ERW Pipes
39	1239 Part 1	GI Pipes

Indian Standards
Institution Manak Bhavan
9, Bahadur Shah Zafar Marg
New Delhi - 110002.

General Specifications

The contract shall be deemed to be completed when all the works described in the specifications and set out in schedules have been successfully completed, tested and maintenance period of one year from the date of completion and handling over to the department is over.

The Engineer will establish the necessary bench marks and levels but the contractor must set out the works and he will responsible for its correctness and it shall be incumbent him to dismantle, remove and rebuild at his own expenses work not correctly set out.

Further before ordering any materials, the contractor shall make his own conclusions as to the actual amount of materials as the payment will only be made on 'Net' measurement of the work actually completed.

The contractor shall provide all pegs, plates, pillars, required for setting out the work and shall give such as may be required by the Engineer or his authorized representative in fixing bench marks, giving levels and carrying works before, during & after execution of work.

As materials are collected and the construction of each section of the work is completed, it will be checked by the Engineer or his authorized representative. The representative of contractor shall ascertain from the Engineer's representative from time to time as to what part or portions he wishes to check over and passes but such approval shall in no way relieve the contractor from any of his responsibility which shall not end until the contract has been completed.

During the progress of the work and the period of maintenance the contractor shall carry out such tests as in the opinion of the Engineer or his authorized representatives are necessary. The rates in BOQ shall include cost of such tests.

As the work proceeds the contractor shall submit Samples of materials for approval as may be required by the Engineer and all deliveries at the site shall not be below the standard of the samples. The contractor must tender in general in accordance with the requirements of these specification.

The contractor must fill in ink the rates and amount etc. in English in BOQ. He must write in words as well as in figure the rates and total cost of each item in the columns provided in BOQ. BOQ must also be signed by the contractor firms or a duly authorized agent acting on his behalf.

The contractor must carefully go through the conditions, specifications and items of contract and study the drawing before tendering. In cases of any absurdity he should apply to the Engineer-in-charge for its rectification as no excuse for want of knowledge for non-compliance of any part or portion of these specifications or terms of contract shall be considered. Octroi charges on all materials supplied by the contractor for the work from outside the Municipal limits shall be paid by him to the Municipal Board in accordance with the Municipal Schedule of rates in force at the time the materials cross the Municipal barrier. The contractor shall consult the Municipal Schedule of rates and make an allowance for the claim in his rates as no extra claim on account of it shall be entertained.

In item wise contract, firm prices in rupees and paisa shall be quoted for each item in the BOQ and in a manner as indicated in the tender, tender shall remain good and open for acceptance for a period of 1.5 month (calendar months) from the date they are opened.

The contractor shall, before tendering, consider the all aspect of work and shall also arrange for supply of drinking water to his own employee and labour. All such facilities as are required to be provided for the labours under the labour welfare Rules in force shall be provided by the contractor at his own cost.

The contractor shall be responsible for fencing off in a good and sufficient manner all excavating works and materials at site so as to prevent accidents by night as well as during day time. He shall also be responsible for lighting up in a proper and sufficient manner at night for the portion of the work which is open or under construction. He shall appoint sufficient number of watchmen on duty when his workers are not actually working, to safeguard work and the materials. He should make his rates sufficiently comprehensive to allow for these duties. In case of accidents caused by the neglect of such precautions contractor shall be fully responsible.

Notice boards / caution boards shall be supplied and fixed in suitable positions where the road or other through fares have been opened out for the construction work, and the traffic has to be diverted or cautioned. Such board shall display in large letters in black and white or in red and white such warnings as road-closed, drive slow, work ahead etc.

Note: - All Caution Boards considered necessary or directed by the Engineer in charge shall be provided by the contractor at his own cost as and when required and in case it is observed by the Engineer that due care in display of board not taken by the contractor. The Engineer reserves the right to set another board fixed, chargeable to the contractor.

The contractor will provide for partiers at each of portion of the road under repair and red flag shall be placed at each barrier by day and Red Light by night. The contractor must include in his rates necessary charges direr sum required for diversion of traffic. And all such diversions shall be maintained neat and clean, well rammed and watered.

The contractor shall provide at his own expense a tip for surplus earth and shall include in his rates a sufficient sum to cover the cartage and disposal charges in this connection.

The contractor shall include in his rates a sufficient amount to cover the cost of all temporary bridges and channel across trenches or excavations at the places considered necessary by the Engineer. He shall also provide for temporary diversion and reinstatement of all drains open or covered, or water mains that may be met with during the execution of the work.

All measurements connected with the work shall be taken geometrically or net and the dimensions given in BOQ shall be held to mean the finished size of the respective items of work.

The rates should be complete and including all labour material T&P testing etc complete. The rates of supply, laying and joining o fvarious pipe line e.g. G.I., M.S., C.I., A.C. & P.V.C., includes supply lowering laying, jointing, carting, testing & maintenance of all type of specials also e.g.

G.I., M.S., C.I., A.C. & P.V.C. DIF & plane ended specials for which no extra payment in any manner shall be made to the contractor, however to account for above measurements for the pipe line work, for all types of pipes i.e. e.g. G.I., M.S., C.I., A.C. & P.V.C. and all class of pipes i.e. light, medium & heavy (suitable for different pressure) for the purpose of payments will be made from end to end without making any deductions for the length (s) occupied by such specials and fitting. In case of plain ended of D/F fittings, the rates of lowering, laying, jointing, testing and maintenance shall be treated included in pipe line laying, jointing works and for there no separates payment for these shall be made but the length (s) occupied by these shall be measured as explained above. No carting and fixing shall be paid. No separate payment on any account for above shall be entertained, as the rate of these are treated included in laying & joining of pipe line work, of respective included in laying & jointing of pipe line work, of respective item.

The quantities given in the BOQ are approximate and may vary. The payment will be made on actual "Net" measurements taken during construction and after completion of the works as per attached schedule. It is therefore, important that the contractor should order the exact quantity of materials required after working out his own quantities as he will not be paid for any materials ordered & procured but not used on work.

The work shall he paid for in manner set out in the general conditions here to annexed and at the rates stated deleted in BOQ.

MATERIALS (RAW & MANUFACTURED)

The contractor shall procure, provide and supply and include in his rates for all labour, materials, tools and plants required temporarily or permanently on the works that may become proper or necessary to complete the execution of the work in all respects.

The sand used on the "Works" for cement mortar, lime mortar, cement concrete and other purpose shall comply in every respect with public works department detailed specification No. 7 Part-I Section-DA (Buildings) of public works department.

These materials shall comply in every respect with the respective clauses of the P.W.D. detailed specification, Part-I Section-'A' (Buildings) which shall be deemed to be incorporated in this contract. Contractor shall be responsible for the safe cartage, storage and use of these materials.

All the joining materials used for laying jointing of C.I. S&S pipes and D/S pipe specials and fitting and also for G.I., M.S., A.C. & P.V.C. pipes & specials shall be arranged by the contractor. These will be subject to the approval of the Engineer. The load used shall be of the best quality B.M. refined soft pig virgin lead and shall be obtained from an approved stockiest or manufacturer. The spun-yern shall be of best machine made quality. The rubber insertions for flanged joints shall be 3 mm. thick. The bolts and nuts of approved make and sizes shall also be supplied by the contractor for making the flanged joints.

All steel required such as M.S. rounds. Angle Iron etc. will be arranged by the contractor himself. The steel used on works shall be of tested quality.

Certain other materials not particularly mentioned or described herein may be required for the works and these if not specifically mentioned shall comply with the description sate out in P.W.D. Detailed specification or Indian or British standard specifications for the respective materials. The specification in so far as they are applicable, shall be deemed to be incorporated in the contract, in a manner as given in schedule-E.

WORK & WORKMANSHIP

The tenderer are advised to inspect the sites at which the work is to be carried out so that they may form their own idea regarding the difficulties in transportation of materials and execution of work.

They are also advised to make their own investigations regarding the conditions of underground sub-soil conditions & strata, availability of materials and water required for construction and tests so that they may quote their rates after accounting for all the difficulties and making provisions for the complete items of works. I tmay b enoted by the tenderer that the various items of works included in BOQ required to be executed for construction of water retaining structures have to be executed with all due care so that the water retaining structures remain completely water tight. The contractor shall be responsible for the complete water tightness of the pipe line joints, and reservoirs and other similar water tight structures and he will be required to give a water tightness test for the same at his own cost, in a manner as described at appropriate places, to the satisfactions of the Engineer in charge.

The alignment of various mains to be laid has been clearly shown on the plans which can be seen in the office. The Executive Engineer reserves the right to alter the alignments and to affect similar changes without any compensation what so over.

The excavation for foundations of buildings and trenches for pipe line shall be carried out in accordance with the P.W.D. detailed specification No. 3 of Part-I section 'A' and L.S.G.E.D./U.P. Jal Nigam, detailed specifications No. 2 & 3. The rate shall include for sheeting, shuttering, timbering, pumping out of water where ever necessary all complete and also sorting out of serviceable materials if any. The contractor shall be responsible for any damage done to adjoining property or to any of the works in progress or partially competed due to any slips, subsidence's etc. He shall make good all damages on this account at his own cost to the satisfaction of Engineer.

The trenches shall be made of sufficien twidth to provide proper and enough working space. However, he should note that the width of the trenches that shall be payable will be up to a maximum of 0.6 meters plus pipe inner dia. If the contractor excavates a width lesser than this, the actual width excavated will be paid.

The bed of the trenches for laying o fpipe line shall be mad eperfectly level without any projections of stones, boulders etc.

The contractor shall provide gangways for the convenience of pedestrians and occupants of the adjoining property. The closure of roads or diversions of traffic shall not be slowed unless obligatory in the opinion of the Engineer.

Pipes shall be truly laid to the depth and gradient with the aid of rails and boning rod or as may be directed by the Engineer.

Care shall be given to see that all pipes and specials are carefully cleaned before joining is commenced and precautions must be taken to prevent any rubbish or foreign matter finding its way into the pipes whiles they are being laid. These of all the mains that are laid by him and if called up to do so, shall test each section before it is covered up under pressure equal to a head of 60 meters of water and should any leakage or obstruction found in the pipe before or during the maintenance period he will be required to trace the cause and remove and rectify the same at his own cost.

No damaged pipes and specials shall be lowered in the trenches. Rates will also include the cost of testing of pipe lines. The work shall not be considered as complete till the pipe lines are tested as specified.

The rates for service valve chamber shall be for the complete chamber as per type design. Rate shall include for supply and fixing of R.C.C. pipe. Valves fire hydrants, all are supplied by the contractor. The rates shall include for the supply of all jointing materials e.g. for the supply of rubber insertions, packing, bolts, nuts, washers etc. This item shall also include the laying and jointing of tail pieces with lead and spun yarn. Fixing of sluice valves shall be paid extra over the length of pipe line.

It may be necessary to open these water supply fittings, oil and grease, replace the gland packing etc. The rate shall include for all such works.

When shingles are used in concrete work, then a deduction equal to 7 (seven) percent shall be accounted to work out actual consumption of cement. In case when shingles are used consumes more cement, then after accounting above deduction, then recovery for the extra consumption shall be effected at double rates for the wasteful consumption, as per condition of schedule-I. The contractor should make himself familiar with the actual cement consumption figures for different mixes before carrying any particular work. The theoretical consumption figures, as workout during the progress of work should tally with the consumption figures, of course after accounting the deductions as mentioned above for shingle.

Leaving aside the case when specific written orders exits, the contractor in no case should use extra cement than the norms fixed for particular work which can be had from the Project Manager, Construction Unit, DLDA U.S Nagar on written request. In case if the contractor does consume extra cement then treating it as a wasteful expenditure no payment will be made to contractor for said wasteful expenditure. The contractor's rate shall include for carting the material to site of work and embedding the same in PCC as shown in the drawings. All other chambers shall be constructed as per type design and the item of works involved in construction of the same shall be as per relevant P.W.D. & Jal Nigam detailed specifications.

The cement concrete work shall be carried out as per P.W.D. detailed specifications. No. 30 and 31 of Part-I section 'A' (Buildings). The coarse aggregate shall consisting of approved shingle aggregate or hard stone ballast of 40mm. gauge for P.C.C. 1:4:8 and 20mm. gauge for P.C.C. 1:2:4. The face stones shall be laid in alternate headers and stretchers. The stones shall break joints on the faces for at least ½ the height of the coarse. The walls and pillars shall be carried up truly plumb and all

courses shall be laid truly horizontal. Each stone shall be laid with both bed & vertical joints quite full of mortar. Simple lapping at the edges shall not be permitted. No face joint shall be thicker than 10 mm. The mortar used shall consist of one part of cement and 4 parts of approved of local sand. The joints shall be struck finished at the time of laying. The rate shall include for supply of all materials, scaffoldings, labour, tools and plants, etc. required for proper completion of the work.

The work shall be carried out in accordance with P.W.D. detailed specifications No. 35 of Part-I section 'A' (Buildings) in general. The rate shall include for rendering smooth of all exposed surface after removal forms and centering which shall be neat and properly smooth ended planks. No extra payment for the rendering plastering of surface of RCC shall be made.

The moulds and centering of concrete shall be substantially and rigidly constructed true to shape and dimensions shown in drawings. The rate shall include for cleaning of mild steel bars of all rust, dust etc., their fixing in position, and binding the same, with 24 BMG wire.

For all R.C.C. works, Jwalapur stone grit 10 mm. to 12 mm. gauge or as specified in the BOQ and clean coarse, Saung River sand will be used. The mix shall be in the proportion as given in the description of items or drawings.

The work shall be carried out in accordance with PWD detailed specifications No. 35 & 89 of Part-I section 'A' (Buildings). The rate of M.S. for R.C.C. work shall include for cleaning of mild steel bars of grease, dust etc., cutting to the same and fabrication to required shape and size. The reinforcement shall be measured for end to end and no extra payment shall be made for hook, band, over lapping and wastage. The bars shall be bent cold. The over lapping shall be to a length not less than 45 times the diameters of the bars and all bars shall be hooked at each end.

All steel used in the different works shall be of tested quality and will be arranged by the contractor himself. The contractor shall furnish the test certification of the steel brought by him to the site in demand and will also bear the charges for the testing of steel brought to the site if desired by the Engineer. It shall be free from pitting, loose, rust or mild scales, oil or grease, adhering earth or other materials that may adhere the bond between the concrete and the steel.

The work shall be carried out as per P.W.D. detailed specifications Part-I section 'A' (Buildings) end as per conditions given in reference books/booklets under schedule. Only first class bricks confirming various specified test (s) should be used.

The rate shall include for the supply of C.I. fittings and appurtenances of approved quality and make at site of work and fixing the same as per direction of the Engineer-in-charge all complete, as per conditions of the contracts.

There may be certain other items of work which though not specifically mentioned or described here in above may be required to be executed for the due completion of the work under this contract. All such works shall be carried out as per relevant Jal Nigam or P.W.D. detailed specifications of Part-I and II and these specifications shall be deemed to have incorporated in this contract, read along with other clauses applicable under this contractor.

Best quality paint or varnish for each class of work shall be used and the work shall be carried out according to P.W.D. detailed specification No. 69 & 70 part-I section 'A' (Buildings). The color and make shall be approved by Engineer-in-charge.

The contractor is advised quote their rates after working out their own quantities of work required to be done and quote their rates accordingly. The rates shall include for the supply and fixing of G.I. pipes specials of approved quality as per BIS specification. The rate shall also include for painting the exposed pipe.

Maxfalt will be filled in mid between R.C.C. roof mixed with coarse sand and saw dust after making the expansion joints by cutting the edges of slabs. The work shall comply with P.W.D. detailed specifications. White washing or color washing shall comply with P.W.D. detailed specification no. 74 Part-I Schedule 'A' (Buildings) and as described in BOQ. The color shall be getting approved first from Engineer-in-charge.

This work shall be complying with Jal Nigam and P.W.D. detailed specifications and specified in BOQ to the satisfaction of Engineer I/C.

Semicircular P.C.C. drain shall be constructed as per type design. All the item of work in valued in construction shall be carried out as per P.W.D. detailed specification. The interior of drain shall be perfectly smooth with neat cement and shall be truly semicircular.

Earthwork and Excavation

RELEVANT IS CODES

IS: 1200	**:**	**Method of Measurement for Building Works**
IS: 3764		**Safety code for Excavation of Work**
IS: 3385	**:**	**Code of practice for measurement of civil engineering works**
IS: 2720	**:**	**Part II - Determination of Moisture Content**
	:	**Part VII - Determination of Moisture content dry density relation using light compaction**
	:	**Part VIII -Determination of Moisture Content Dry Density using heavy compaction**
	:	**Part XXVIII - Determination of Dry Density of soils, in place, by the sand replacement method**
	:	**Part XXIX - Determination of Dry Density of soils, in place, by the core cutter method.**

EXCAVATION

Definitions

The following terms shall have the meanings hereby assigned to them:

Top Soil means any surface material, including turf, suitable for use in soiling areas to be grassed or cultivated.

Excavation means excavation in open cut (excluding trench excavation) down to levels required as per approved Drawings or otherwise as being the general levels after completion of excavation.

Site Clearance

All area of the Site, marked in the Specification / Drawings shall be cleared to the extent required by the Engineer-in-Charge of all buildings, walls, gates, fence and other structure and obstructions of all bushes, hedges, trees, stumps, roots and other vegetation except for trees marked for preservation. Material so cleared shall so far as suitable be preserved and stacked will be the property instructed by the Engineer-in-Charge.

Before starting the work the site shall be cleared of all shrubs, grass, and other vegetation including large and small bushes, all stumps, removal of roots, cutting and disposal of small trees up to 300 mm girth etc.
All the tress having girth above 300 mm. (the girth shall be measured at a height of 1.5 m above the ground level) by felling, logging, fashioning of timber and billeting of all branches, trunks etc. include removal of all roots etc. complete as directed. All serviceable reclaimed material shall be stacked separately at the site shown by the Engineer in Charge near the site of excavation and/or transported as directed by Engineer In Charge
After the tree is cut and roots taken out, the potholes formed shall be filled with good earth in 250mm layers and consolidated unless directed by the Engineer in Charge otherwise. The trees shall be cut in suitable piece as instructed by the Engineer In Charge

General Excavation

General excavation means excavation required for structures and from borrows areas, and shall not include trench excavation. General excavation may also include miscellaneous isolated lengths of trenches beneath or adjacent to other structures, trial pits along the structural layout or otherwise.
The ground shall be excavated by such methods and to such dimensions and depths as shall allow for the proper construction of the works and safety of personnel and equipment used on excavation. Slopes required for stable formation of sides shall be provided.
The excavation in earth, murum, boulders, soft and hard rock shall be carried out to the correct levels required and specified and no tolerance, plus or minus, shall be permitted. However, if any depressions/Loose

pockets are formed due to removal of boulders, they shall be made good by filling with 1:5:10 concrete up to the bottom layer of the footing/raft.

Payment for all types of excavation shall be made by detailed measurement supported by ground levels recorded prior to and after completion of excavation, subject to the limit for payment indicated by the slopes of excavation indicated in the specification drawing. Any additional excavation will be at the contractor's expense, unless specifically approved by the Engineer-in-Charge. Measurement for excavation shall be done all as per dimensions of P.C.C. given in design drawings & specifications. For concrete foundations same shall be paid on least dimensions at bottom and contractor shall cover any extra excavation required for workspace, supports etc while quoting.

As far as possible, excavation should be done by means of mechanical equipment. The bidder should quote accordingly and nothing extra will be paid for mechanical excavation and deployment of extra staff.

It will be the responsibility of the contractor to obtain prior permissions from the competent authority to use blasting device, if at all to be resorted to and the license are to be obtained for the same.

The chance of blasting required shall be well decided with the expert, to avoid any damage to the surrounding property. However for any such damage to the surrounding property or public or additional excavation shall be the contractor's responsibility and the risks what so ever arising from the same will have to be borne by the contractor.

Lead

Lead for deposition of the excavated materials should be at appropriate places. For the purpose of measurement of lead, the area to be excavated or filled or area in which excavated material is to be deposited /disposed off shall be divided into suitable blocks and for each of the blocks, the distance between centerlines shall be taken as the lead which shall be measured by the shortest straight line route on plan and not the actual route taken by contractor. No extra compensation is admissible on the grounds that the lead including that for borrowed material had to be transported over marshy or kaccha land route.

Excavation in Hard Rock

Excavation in hard rock may be done either by blasting or chiseling depending upon the site conditions. When excavation has reached within 300 mm of the required formation level, further excavation shall be carried out carefully either by blasting (if as directed by the Engineer-in-Charge) or chiseling. Where blasting is resorted to, small charges shall be used to minimize occurrence of heavy over-cuts. The Contractor shall make every effort to carry out the excavation to correct formation level as far as practicable. In order to minimize the over break and loosening of materials at the finished surfaces, final cutting for the last 450 mm to 600 mm in rock shall be carried out by controlled blasting and trimming with the help of pneumatic or other power tools. Unless otherwise specified, the over break shall not exceed 75 mm. The over breakage of 75 mm shall not be measured for payment and therefore the Contractor while quoting his rates for rock excavation has to take this into account. Deduction of 40% or higher percentage as may be decided by the engineer-in-Charge shall

be made to allow for the voids. Stacks shall not be of width greater than 1.5 m wide or of height less than one meter

Blasting shall be carried out by the licensed person The contractor shall provide a method statement and shall comply fully with the requirements of this clause, or any direction, order, requirement or instruction given by the police department or any other relevant authorities as required by the law.
Contractor shall submit Blasting plan to the ENGINEER-IN-CHARGE and take approval for the same on daily basis
Contractor shall plan the blasting activities in well advance and convey same to the Engineer In-charge so as to co-ordinate with all the work groups at site.

This includes rock, which is easily excavated by blasting, but due to close proximity of structures or any other reason that the Engineer-in-Charge may consider, will have to be excavated by chiseling.

It should be noted that this clause does not override the contractor's obligation to satisfy the requirement of the relevant authorities but sets out the extent to which the Engineer in charge will exercise his control in approving the contractor's use of explosive to ensure that explosive are always used in a safe manner. It is the contractor's sole responsibility to ensure that his method of blasting is safe, that all statutory and imposed limitation are adhered to, and to obtain a permit to use explosive from the relevant authorities and to comply with the condition of issue of the permit.

The contractor shall be solely responsible for obtaining the necessary licenses for the procurement, possession, transport, storage and handling of explosive and for ensuring the validity of such licenses at all times. Before starting work, the contractor shall satisfy the Engineer that all the requirement permits are in order and that this category of work is adequately covered in the policies of insurance.

Explosives shall be used in the quantities and manner recommended by the manufacturers.

All necessary precautions shall be taken to preserve the materials below in the soundest possible condition and also beyond the lines of all excavations. Blasting by means of drill holes, tunnels or any other similar method shall be the responsibility of the contractor.

The contractor shall take all necessary precautions during blasting operations to ensure that no injure is caused to persons or damage to property or to the finished works. Shots shall be properly loaded and capped and only appropriate charges shall be used in each hole.

Storage and Transport

Proper building or magazine, with separate compartment for detonators in suitable positions for the storage of explosive in the manner and quantities to be approved, shall be provided. Separate vehicles or vessels for detonators shall also be used for the transportation of explosives. The prevention of any unauthorized issue or improper use of any explosive brought on to the site shall be the responsibility of the contractor and only experienced licensed short firers shall be employed to handle the explosive for the purpose of the work the relevant security regulations dealing with the storage, handling and transport of explosives shall be complied with.

Safety

The Contractor shall provide an approved system of warning and preparing the general public and all site personnel of an impending blast by both audible & visual means and shall ensure that the blasting area is cleared of all personnel immediately prior to blasting. This system shall comply with all statutory requirements. The contractor's attention I drawn to the need to devise adequate system for warning and clearing the public from specified areas during blasting operations and to prevent persons entering the blasting area.

When blasting is near to the proximity of existing public and private thoroughfares, traffic is to be stopped just prior to firing. The operation is to be carried out I close cooperation with the police department and in such a way as to cause minimum traffic delay.

All operations involving explosives shall be suspended on the approach of a thunderstorm and shall not be resumed until the storm has clearly passed.

Blasting screens shall be erected to conform with the permit conditions. Public roads, private roads and property adjacent to the site and services within the site area shall be protected by rock fall fences which will be subjected to the engineer's approval.

The contractor shall take all necessary precautions to avoid damage to permanent and temporary works already completed. In all cases, delay blasting techniques will be mandatory with the quantity of explosives restricted to ensure that the peak particle velocity generated does not exceed the peak particle velocity of each component of the safe limits of the nearest structure subject to vibration damage. All operations shall stop when these limits are exceeded until reports are made available to the engineer that no damage has occurred and will not occur or corrective action has been taken to lower the vibration. The sound level limit in areas where site personnel or public can access during blasting operation must not exceed 110 dB.

The contractor may not be permitted to use explosives in areas of the site immediately adjacent to pylon positions. Particular limitations may apply in such areas depending on the contractor's proposed method of working and a detailed method statement will therefore be required from the contractor. The method statement shall cover the methods of excavation

and protection systems proposed, all of which shall be subjected to the approval of the relevant authorities and the Engineer.

In all such cases particular attention should be paid to the requirements stated above and effects on these structures and installations shall be closely monitored and the quantities of explosives limited accordingly.

Drilling rigs for shot hole shall be of the hydraulic type fitted with efficient silencers and with means of dust separation. The Contractor may report to any of the following methods to excavate rock by chiseling:
Wedging by means of crowbars, pick axes or pneumatic drills
Heating and quenching
Controlled blasting with a small charge just sufficient to make a crack in rock which will be subsequently removed by wedging

No extra payment shall be made for removal of rock by chiseling and controlled blasting.

Excess excavation to be made good

The contractor, at his own expense, shall, if directed, remove from the Site all excess material resulting from excess excavation and shall make good the same with such kind of fill material or in such class of concrete as may be reasonably required by the Engineer-in-Charge having regard to the circumstances.

Stripping Top Soil

Where ordered by the Engineer-in-Charge, top soil shall be stripped to such depths and over such areas as he may direct, as a separate operation prior to any further excavation, which may be required.

Supporting Excavations

The Contractor shall properly support the sides and ends of all excavations to prevent any fall or run from any portion of the ground outside the excavation and to prevent settlement or damage to structures adjacent to the excavation. Any excavation necessary to provide space for such support or other working space shall be carried out. If, for any reason, any portion of the bottoms, sides or ends of any excavations shall give way, the contractor shall at his own expense take all necessary remedial measures including the extra necessary excavation and removal of excess material.
Where the Contractor proposes and is permitted by the Enineer-In-Charge to perform excavations with sloping faces (other than sloping excavations shown on the Drawings or required as permanent features of the Works) and without shoring, the excavated faces shall be to stable slopes and heights.

Trimming Excavations

When excavating to specified or required levels for the foundation of any structure or to specified or required limits for the face of any structure required to abut undisturbed ground, the Contractor shall not excavate the last 150 mm until immediately before commencing the constructional work, except where the Engineer-in-Charge shall permit otherwise. After getting the permission for the commencement of the construction, if the contractor delays on any account & the formation level gets damaged he

will have to do further excavation upto 150mm or as per Engineer-in-charge's instructions at his own account.
Before commencement of any constructional work all shattered and loose materials shall be removed from the excavations by hand so as to ensure that the work rests on a solid and perfectly clean foundation or abuts against solid ground.

Inspection by the Engineer-in-Charge

When the specified levels or limits of excavation are reached the Engineer-in-Charge will inspect the ground exposed, and if he considers that any part of the ground is by its nature unsuitable he may direct th eContractor to excavate further. Such further excavation shall be refilled to the specified levels or limits with concrete, selected excavated material or selected imported material as directed by the Engineer-in-Charge.
Should the material forming the bottom of any excavation, while acceptable to the Engineer-in-charge at the time of his inspection, subsequently become unacceptable to him due to exposure to weather conditions or due to flooding or have puddles, soft or loss during the progress of the works, the Contractor shall remove such damaged, softened or loosened material and excavate without any extra cost.

Disposing Excavated Material

All excavated material shall remain the property of the Employer. The Contractor shall ensure that no excavated material which is suitable for and is required for re-use in the Works is transported unless so ordered by the Engineer-in-Charge.

Back-Filling General Site Grading And Sand Filling

Fill Material

All fill material whether such material is brought from outside borrow areas or excavation within the site, will be subject to Engineer-in-Charge's approval after carrying required tests at Contractor's Soil testing laboratory. Notwithstanding any approval given to the fill material or borrow areas from which fill material is proposed to be brought, the Engineer-in-Charge reserves the right to reject such material which does not meet the specification requirements or unsuitable for the purpose for which it is intended.

Backfilling

Excavated material used as back filling to excavations or completed structures shall be free from rubbish, vegetation, clods and lumps and shall be approved by the Engineer-in-charge. The approved materials shall be placed in layers, not exceeding 150 mm in depth before compaction and shall be compacted with watering, consolidating and ramming. The maximum boulder size shall be of 150 mm for filling material
Soft material shall not be used as back filling around structures in rock. The Contractor shall backfill such excess excavation with concrete; rubble, stone or rock fills as directed by the Engineer-in-Charge. Filling other than concrete shall be placed in layers not exceeding 150 mm in

thickness, shall be thoroughly compacted and have adequate fined content to fill the voids.

Should the material being placed as back filling, while acceptable at time of selection, become unacceptable to the Engineer-in-Charge due to exposure to weather conditions or due to flooding or have become puddles, soft or segregated during the progress of the works, the Contractor shall remove such damaged, softened or segregated material and replace it with fresh approved material at his expense.

The Contractor shall while placing the back filling make due allowance for any settlement that may occur before the end of the Defects Liability Period, remove any excess material or make up any deficiency by back filling to the specified levels. As a rule material to be back filled shall be stacked temporarily at a suitable place.

General Site Grading: Site grading shall be carried out as directed by the Engineer-in-Charge. Excavation shall be carried out as specified in the specification. Filling and compaction shall be carried out as specified under (6) of this Clause unless otherwise indicated below.

The approved material shall be placed in layers not exceeding 150 mm in depth before compaction and shall be compacted to 90% of Proctor Density with water contain at OMC.

The Contractor shall protect the earth fill from being washed away by rain or damaged in any other way. Should any slip occur, the Contractor shall remove the affected materials and make good the slip without any extra cost

The fill shall be carried out to such dimensions and levels as directed by the Engineer-in-charge, after the compaction.

Sand filling below Plinth and other places

Back filling shall be carried out with sand at places as directed by the Engineer-in-Charge. The sand used shall be clean, medium grained and free from impurities. The filled-in-sand shall be kept flooded with water for 24 hours to ensure maximum consolidation. Any temporary work required to contain sand under flooded conditions shall be to the Contractor's account. The surface of the consolidated sand shall be dressed to the required level or slope. Construction of floors or other structures on sand fill shall not be started until the Engineer-in-Charge has inspected and approved the fill.

Where specified in the schedule of works, compaction of the plinth fill shall be carried out by means of 12 tone rollers smooth wheeled, sheep foot or wobbly wheeled rollers. A smaller weight roller may be used only if permitted by Engineer-in-Charge. As rolling proceeds water sprinkling shall be done to assist consolidation. Water shall not be sprinkled in case of sandy fill.

The thickness of each unconsolidated fill layer can in this case up to 300 mm. Engineer-in-Charge will determine the thickness of layers in which fill has to be consolidated depending on the fill material and equipment used.

Rolling shall commence from outer edge and progress towards the centre and continue until compaction is to the satisfaction of the Engineer-in-charge, but in no case less than 10 passes of the roller will be accepted for each layer.

The compacted surface shall be properly shaped, trimmed and consolidated to an even and uniform gradient. All soft spots shall be excavated and filled and consolidated.

At some locations / areas it may not be possible to use rollers because of space restrictions etc. Contractor shall then be permitted to use pneumatic tampers; rammers etc and he shall ensure proper compaction.

Fill Density

The compaction, only where so called for, in the schedule of quantities /items shall comply with the specified (proctor/modified proctor) density at moisture content differing not more than 4 percent from optimum moisture content. Contractor shall demonstrate adequately at his cost, by field and laboratory tests that the specified density had been obtained.

Local Rules And Regulations

The Contractor shall familiarize himself with the local rules and regulations governing the excavation, quarrying operations, etc. and the work shall be carried out strictly in accordance with rules and regulations, if any. Whenever a quarry is required to be opened in connection with the execution of work covered under this Contract, the Contractor shall investigate that it shall yield stones and other materials such as sand, murum, soil etc. of approved quality and shall satisfy himself as to the availability in desired quantity. He shall supply necessary quantity of sand, stone, metal aggregate etc. to the Engineer-in-Charge for carrying out tests as desired by the Engineer-in-Charge and well in advance of its use so as to carry out tests and to get approval. The cost of opening and operating the quarry & royalties and ant other charges shall be borne entirely by the Contractor.
The Contractor shall obtain necessary permission from the concerned authorities before opening the quarry. In case of quarries in private land on payment of whatever charges as may be due to the owner.

DEWATERING

All excavations shall be kept free of water. Grading in the vicinity of excavations shall be controlled to prevent surface water running into excavated areas. The Contractor shall remove by pumping or other means approved by Engineer-in-Charge any water inclusive of rain water and sub-soil water accumulated in excavation and keep all excavations de-watered until the foundation work is completed and back filled. Sumps made for dewatering must be kept clear of the excavations/trenches required for further work. Method of pumping shall be approved by Engineer-in-Charge; but in any case, the pumping arrangement shall be such that there shall be no movement of sub-soil or blowing in due to

differential head of water during pumping. Pumping arrangements shall be adequate to ensure no delays in construction.
When there is a continuous inflow of water and quantum of water to be handled is considered in the opinion of Engineer-in-Charge, as large, well point system: Single-stage or Multi-stage shall be adopted. Contractor shall submit to the Engineer-in-Charge his scheme of well pointing system including stages, the spacing, number and diameter of well points, headers etc. and the number, capacity and location of pumps for approval. The rates for excavation are inclusive of dewatering by any means and no extra payment is allowed for excavation in wet condition.

TIMBER SHORING

The Timber Shoring shall be as per 3764-1966 safety code for excavation work.

Close timbering shall be done by completely covering the sides of the trenches and pits generally with short, upright members called 'polling boards'. The boards shall generally be placed in position vertically side by side without any gap on each side of the Excavation and shall be secured by horizontal walings of strong wood at maximum 1.2 m spacing and suitably strutted. If the soil is very soft and loose, the boards shall be placed horizontally against each side of the excavation and supported by vertical walings, which in turn shall be suitably strutted. The lowest boards supporting the sides shall be taken into the ground and no portion of the vertical side of the trench or pit shall remain exposed, so as to render the earth liable to slip out.
The shoring material shall not be sizes less than those specified below unless steel sheet piling is used or unless otherwise approved by the Engineer-in-charge in writing:

Planks	**-**	**5 cm x 25 cm**
Waling pieces	**-**	**10 cm x 20 cm**
Struts	**-**	**15 cm x 20 cm**

Timber shoring shall be 'close' or 'open' type, depending on the nature of soil and the depth of pit or trench. The type of timbering shall be as approved by Engineer-in-charge. It shall be the responsibility of the Contractor to take all necessary steps to prevent the sides of excavations, trenches, pits, etc., from collapsing. Timber shoring may be required to keep the sides of excavations vertical to ensure safety of adjoining structures or to limit the slope of excavations, or due to space restrictions or for other reasons. Such shoring shall be carried out, except in an emergency, only under instructions from the Engineer-in-Charge.

The withdrawal of the timber shall be done very carefully to prevent the collapse of the pit or trench. It shall be started at one end and proceeded systematically to the other end. Concrete or masonry shall not be damaged during the removal of the timber. No claim shall be entertained for any timber, which can not be retrieved.

In the case of open timbering, the entire surface of the side of trench or pit is not required to be covered. The vertical boards of minimum 25 cm X 5 cm sections shall be spaced sufficiently apart to leave unsupported strips of maximum 50 cm average width. The detailed arrangement, sizes of the timber and the spacing shall be subject to the approval of the Engineer-in-Charge. In all other respects, the specification for close timbering shall apply to open timbering.

In case of large pits and open excavations, where shoring is required for securing safety of adjoining structures or for any other reasons and where the planking across sides of excavations/pits cannot be strutted against, suitable inclined struts supported on the excavated bed shall be provided. Load from such struts shall be suitably distributed on the bed to ensure no yielding of the strut.

RAIN WATER

DISCHARGE Scope

The scope covers the drainage of the rainwater in excavated areas.

Grading in the vicinity of excavation shall be such as to exclude rain/surface water draining into excavated areas. Excavation shall be kept clean of rain and such water as the Contractor may be using for his work by suitably pumping out the same at no extra cost to the Owner. The scheme for pumping and discharge of such water shall be approved by the Engineer-in-Charge.

Anti Termite Treatment

IS: 6313 – 1981	**:**	**Code of Practice for Anti Termite Measure in Buildings**
IS: 6313 (Part I) – 1981:		**Construction Measures**
IS: 6313 (Part II) – 1981:		**Pre-Construction Chemical Treatment Measures**
IS: 6313 (PartIII) – 1981:		**Treatment for existing Buildings**

Delivery, Storage and Handling

Deliver pesticides to the project site in sealed and labeled containers in good condition as supplied by the manufacturer or formulator. Store, handle, and use pesticides in accordance with manufacturer's labels. Labels shall bear evidence of registration as per the IS or appropriate regulations.

Safety Requirements

Formulate, treat, and dispose of termiticides and their containers in accordance with label directions. Draw water for formulating only from sites designated by the Contracting Officer, and fit the filling hose with a backflow preventer meeting local plumbing codes or standards. The filling operation shall be under the direct and continuous observation of a contractor's representative to prevent overflow. Secure pesticides and related materials under lock and key when unattended. Ensure that proper protective clothing and equipment are worn and used during all phases of termiticide application. Dispose of used pesticide containers off Government property

Warranty

Furnish a 21 written warranty against infestations or reinfestations by subterranean termites of the buildings or building additions constructed under this contract. Perform annual inspections of the building(s) or building addition(s). If live subterranean termite infestation of subterranean termite damage is discovered during the warranty period, and the soil and building conditions have not been altered in the interim, the Engineer-in-charge:
Retreat the soil and perform other treatment as may be necessary for elimination of subterranean termite infestation;
Repair damage caused by termite infestation; and
Reinspect the building approximately 180 days after the pretreatment.

Quality Assurance

<u>Application Report</u>

Upon completion of this work, submit Pest Management Report, Identifying target pest, type of operation, brand name and manufacturer of pesticide, formulation, concentration or rate of application used. Maintain daily records using Pest Management Maintenance Record, and submit copies of records when requested by the Engineer-in-Charge.

PRODUCTS <u>Pesticides</u>

Termiticides bearing current registration or approved for such use by the appropriate agency of the host country. The Contractor shall comply with the requirements on contractor's licensing, certification, and record keeping.

Execution

Verification of Conditions

At the time of application, the soil shall have sufficiently low moisture content to allow uniform distribution of the treatment solution throughout the soil. Do not make applications during or immediately following heavy rains or when conditions may cause runoff and create an environmental hazard.

Application Treatment Area

Apply termiticide to soil material which will be covered by or lie immediately adjacent to the buildings and structures so as to provide a protective barrier against subterranean termites.

Treatment Application

Apply termiticide as a coarse spray and in such matter as to provide uniform distribution onto the soil surface. Apply treatment prior to placement of a vapor barrier or waterproof membrane and prior to concrete pouring. Where treated soil or fill material is not to be covered with a vapor barrier or waterproof membrane, exercise adequate precautions to prevent its disturbance. If soil or fill material has been disturbed after treatment, retreat as specified above before placement of slabs or other covering structures. Coordinate treatment of the soil on the exterior sides of foundation walls, grade beams, and similar structures with final grading and planting operations so as to avoid disturbance of the treated barriers by such operations.

Observe manufacturer's warnings and precautions in the handling and use of such materials. Exercise precaution that these chemicals do not enter water supply systems or potable water supplies or aquifers, and that they do not endanger plants and animals as well. Notify the Contracting Officer at least 48 hours prior to beginning of treatment and perform formulating, mixing, and application in the presence of the Employer's representative.

Rates and Methods of Application

Apply in accordance with the pesticide label. Provide maximum application or dosage rates. Resolve conflict between this specification and label direction in favor of the label.

Concrete And Allied Works

GENERAL

The quality of materials and method and control of manufacture and transportation of all concrete work irrespective of mix, whether reinforced or otherwise shall conform to the applicable portions of this specification. The Engineer-in-Charge shall have the right to inspect the source/s of material/s, the layout and operation of procurement and storage of materials, the concrete batching and mixing equipment, and the quality control system. Such an inspection shall be arranged and Engineer-in-Charge's approval obtained, prior to starting of concrete work. However, this shall not relieve the contractor with any of his responsibilities and all the materials, which do not conform to the specifications, will be rejected.
The minimum wall thickness for all RCC wall shall be 225 mm thick.
The liquid retaining structures will be in M30 grade.
The Contractor will maintain all registers and formats for quantity qualitative and quantitative measures of all concrete works on daily basis of steel consumed and concreting done updated on daily basis.

APPLICABLE CODES

The following specifications, standards and codes, including all official amendments/revisions and other specifications & codes referred to therein to therein, should be considered a part of this specification. In all cases the latest issue/edition/revision shall apply. In case of discrepancy between this specification and those referred to herein this bid document, this specification shall govern.

<u>MATERIALS</u>

IS:29 -Specification for 33 grade ordinary Portland cement IS:455 -Specification for Portland slag cement.
IS:148 -Specification for Portland-pozzolana cement.
IS: 811 -Specification for 43-grade ordinary Portland cement.
IS: 123 -Specification for sulphate resisting Portland cement.
IS: 383 -Specification for coarse and fine aggregates from natural sources for concrete.
IS: 432 - Specification for mild steel and medium tensile steel (Parts-I & II) bars and hard-drawn steel wires for concrete reinforcement.
IS: 1786- Specification for high strength deformed steel bars and wires for concrete reinforcement.
IS: 1566- Specification for hard-drawn steel wire fabric for (Part-I) concrete reinforcement.
IS: 9103- Specification for admixtures for concrete.
IS: 2645- Specification for integral cement waterproofing compounds.

IS: 4990- Specification for plywood for concrete shuttering work.

MATERIAL TESTING

IS: 4021	**-Methods of physical tests for hydraulic cement. (Parts-1 to 13)**
IS: 4032	**-Method of chemical analysis of hydraulic cement.**
IS: 650	**-Specification for standard sand for testing of cement.**
IS: 2430	**-Methods for sampling of aggregates for concrete.**
IS: 2386	**-Methods of test for aggregates for concrete. (parts-I to VIII)**
IS: 3025	**-Methods of sampling and test (physical and chemical) water used in industry.**
IS: 6925	**-Methods of test for determination of water-soluble chlorides in concrete admixtures.**

MATERIALS STORAGE

IS: 4082	**-Recommendations on stacking and storing of construction materials at site.**

CONCRETE MIX DESIGN

IS: 10262 - Recommended guidelines for concrete mix design. SP: 23 - Handbook on Concrete Mixes. (S & T)

CONCRETE TESTING

IS: 1199	**-Method of sampling and analysis of concrete.**
IS:516	**-Method of test for strength of concrete**
IS: 9013	**-Method of making, curing and determining compressive strength of accelerated cured concrete test specimens.**
IS: 8142	**-Method of test for determining setting time of concrete by penetration resistance.**
IS: 9284	**-Method of test for abrasion resistance of concrete.**
IS: 2770	**-Methods of testing bond in reinforced concrete.**

EQUIPMENT

IS: 1791	**-Specification for batch type concrete**
mixers. IS: 2438	**-Specification for roller pan mixer.**
IS: 4925	**-Specification for concrete batching and mixing plant.**
IS: 5892	**-Specification for concrete transit mixer and agitator.**
IS: 7242	**-Specification for concrete spreaders.**

IS: 2505	**-General Requirements for concrete vibrators: Immersion type.**
IS: 2506	**-General Requirements for screed board concrete vibrators.**
IS: 2514	**-Specification for concrete vibrating tables.**
IS: 3366	**-Specification for pan vibrators.**
IS: 4656	**-Specification for form vibrators for concrete.**
IS: 11993	**-Code of practice for use of screed board concrete vibrators.**
IS: 7251	**-Specification for concrete finishers.**
IS: 2722	**-Specification for portable swing weigh batchers for concrete (single and double bucket type).**
IS: 2750	**-Specification for steel scaffoldings.**

CODES OF PRACTICE

IS: 456	**-Code of practice for plain and reinforced concrete.**
IS: 457	**-Code of practice for general construction of plain and reinforcedconcrete for dams and other massive structures.**
IS:3370	**-Code of practice for concrete structures for storage of liquids.(parts-I to IV)**
IS: 3935	**-Code of practice for composite construction.**
IS: 2204	**-Code of practice for construction of reinforced concrete shell roof.**
IS: 2210	**-Criteria for the design of reinforced concrete shell structures and folded plates.**
IS: 2502	**-Code of practice for bending and fixing of bars for concrete reinforcement.**
IS: 5525	**-Recommendation for detailing of reinforcement in reinforced concrete works.**

IS: 2751 -Code of practice for welding of mild steel plain and deformed bars used for reinforced concrete construction.

IS: 9417 -Specification for welding cold worked bars for reinforced concrete construction.

IS: 3558 -Code of practice for use of immersion vibrators for consolidating concrete.

IS: 3414 -Code of practice for design and installation of joints in building.

IS: 4326 -Code of practice for earthquake resistant construction of building.

IS:4014 -Code of practice for steel tubular scaffolding.(parts-I & II)

IS: 2571 -Code of practice for laying in-situ cement concrete flooring.

IS: 7861 -Code of practice for extreme weather concreting.

Part-I: Recommended practice for hot weather concreting.

Part-II: Recommended practice for cold weather concreting.

IS: 13920-Ductile Detailing of Reinforced Concrete Structure subjected to1993 seismic forces.

SP-16 -Design Aids for Reinforcement Concrete to IS:456-1978 (S&T) - 1980

SP-24 -Explanatory Handbook on IS: 456-1978

SP-34 -Handbook on Concrete Reinforcement and Detailing(S&T) - 1987

CONSTRUCTION SAFETY

IS:3696 - Safety code for scaffolds and ladders.(Parts-I & II)

IS:7969 - Safety code for handling and storage of building materials

IS: 8989 - Safety code for erection of concrete framed structures.

MEASUREMENT

IS: 1200 - Method of measurement of building and engineering works.

IS: 3385 - Code of practice for measurement of civil engineering works.

MATERIALS FOR STANDARD CONCRETE

The ingredients to be used in the manufacture of concrete shall consist solely of Ordinary Portland Cement or Sulphate Resistant Cement clean sand, natural course aggregate, clean water, and admixtures.

The contractor will have to make own arrangements for procuring cement and steel. Cement remaining in bulk storage at the mill, prior to shipment for more than 6 months or cement in bags in local storage in

the hands of vendor for more than 3 months after completion of tests may be retested before use and may be rejected if it fails to conform to any of the requirement of IS 269-1976.

The Contractor will have to make his own arrangements for transport from supplier godown and storage of adequate quantity of cement. Contractor will construct cement godown. in batches of 10x10, which will provide complete protection from dampness, contamination and minimize caking and false set. Cement bags shall be stored in a dry enclosed shed (storage under tarpaulins will not be permitted), well away from the outer walls and insulated from the floor to avoid contact with moisture from the ground and so arranged as to provide ready access. Damaged or reclaimed or partly set cement will not be permitted to be used and shall be removed from the site. The storage bins and storage arrangement shall be approved by the Engineer-in-Charge. Consignments of cement shall be stored as received and shall be consumed in the order of their delivery. Stacking of cement shall be done as per IS and in such a way that first come cement shall be used first.

Cement held in storage for a period of ninety (90) days or longer shall be tested. Should at any time the Engineer-in-Charge have reasons to consider that any cement is defective, then irrespective of its origin, date of manufacture and or manufacturer's test certificate, such cement shall be tested immediately at the Contractor's cost at an approved laboratory and until the results of such tests are found satisfactory, it shall not be used in any work. Testing certificates for each batch of cement should be submitted by the contractor to the Engineer-in-Charge, before starting the concreting work. The Contractor shall not be entitled to any claim of any nature on this account.

Aggregats

i) General

"Aggregate" in general designates both fine and coarse inert materials used in the manufacture of concrete (Vide BIS 456 & BIS 383) and confirming to tests as per BIS 2386 (Part I to VI)

"Coarse Aggregate" is aggregate most of which is retained when passed through on 4.75 mm BIS sieve.

Aggregates shall consist of natural sands, stone (crushed or uncrushed) and gravel from a source known to produce satisfactory aggregate for concrete and shall be chemically inert, non-flaky, strong, hard, durable against weathering, of limited porosity and free from deleterious materials that may cause corrosion of the reinforcement or may impair the strength and or durability of concrete. The grading of aggregates shall be such as to produce a dense concrete of specified strength and consistency that will work readily into position without segregation and shall be based on the "mix design" and preliminary tests on concrete specified later.

ii) Storage of aggregates

All coarse and fine aggregates shall be stacked separately in stock piles in the material yard near the work site in bins properly constructed to avoid inter mixing of different aggregates. Contamination with foreign material and earth during storage and while heaping the materials shall be avoided. The aggregates must be of specified quality not only at the time of receiving at site but more so at the time of loading into mixer. Rakers shall be piled in layers not exceeding 1.20 m in height to prevent coning or segregation. Each layer shall cover the entire area of stockpile before succeeding layers are started. Aggregates that have become segregated shall be rejected.

iii) Specific Gravity

Aggregates having a specific gravity below 2.4 (saturated surface dry basis) shall not be used.

FINE AGGREGATE

Fine aggregate shall consist of natural or crushed sand conforming to BIS 383 confirming to tests as per BIS 2386 part I to VI. The sand shall be clean, sharp, hard, strong and durable and shall be free from dust, vegetable substances, adherent coating, clay, alkali, organic matter, mica, salt, or other deleterious substances, which can be injurious to the setting qualities/strength/durability of concrete.

Screening and Washing: Sand shall be prepared for use by such screening or washing, or both, as necessary, to remove all objectionable foreign matter while separating the sand grains to the required size fraction.

Foreign Material limitations: The percentage deleterious substances in sand delivered to the mixer shall not exceed the following:

Table 2: Foreign Material Limitations in Fine Aggregate

Sr. No.	Foreign material	Percentage by weight	
		Uncrushed	Crushed
1	Material finer than 75 micron BIS sieve	3.0	15.0
2	Shale	1.0	-
3	Coal & Lignite	1.0	1.0
4	Clay Lumps	-	1.0
	Total	5.0	17.0

d) Gradation: Unless otherwise directed or approved by the Engineer-in-Charge, the grading of sand shall be within the limits indicated hereunder:

Table 3: Grading of Sand for Fine Aggregate

BIS :Sieve Designation	Grading Zone I	Grading Zone II	Grading Zone III	Grading Zone IV
10 mm	100	100	100	100
4.75 mm	99-100	90-100	90-100	95-100
2.36 mm	60-95	75-100	85-100	95-100
1.18 mm	30-70	55-90	75-100	90-100
600 microns	15-34	35-59	60-79	80-100
300 microns	5-20	8-30	12-40	15-50
150 microns	0-10	0-10	0-10	0-15

Where the grading falls outside the limits of any particular grading zone of sieves, other than 600 microns IS sieve, by total amount not exceeding 5%, it shall be regarded as falling within that grading zone. This tolerance shall not be applied to percentage passing the 600 micron IS sieve or to percentage passing any other sieve on the coarser limit of grading zone I or the finer limit of grading zone IV. Fine aggregates conforming to grading zone IV shall be used. Mix designs and preliminary tests shall show its suitability for producing concrete of specified strength and workability.

e) Fineness Modulus

The sand shall have a fineness modulus of not less than 2.0 or more than 3.5. The fineness modulus is determined by adding the cumulative percentages retained on the following IS sieve sizes (4.75 mm, 2.36 mm, 1.18 mm, 600 microns and 150 microns) and dividing the sum by 100.

COARSE AGGREGATE

Coarse aggregate for concrete, except as noted above, shall conform to IS 383 & IS 2386. This shall consist of crushed stone and shall be clean and free from elongated, flaky or laminated pieces, adhering coatings, clay lumps, coal residue, clinkers, slag, alkali, mica, organic matter or other deleterious matter. Screening and Washing: Crushed rock shall be screened and/ or washed for the removal of dirt or dust coating, if so requested by the Engineer-in-Charge.

Grading

i) Coarse aggregate shall be either in single size or graded, in both cases the grading shall be within the following limits:

BIS Sieve Size (mm)	Percentage passing for single sized aggregate of normal size					Percentage Passing For Graded Aggregate Of Normal Size			
	40 mm	20 mm	16 mm	12.5mm	10mm	40 mm	20 mm	16 mm	12.5mm
63	100	-	-	-	-	100	-	-	-
40	85-100	100	-	-	-	95-100	-	-	-
20	0-20	85-100	100	-	-	30-70	95-100	100	-
16	-	-	85-100	100	-	-	-	90-100	-
12.5	-	-	-	85-100	100	-	-	-	90-100
10	0-5	0-20	0-30	0-45	85-100	10-35	25-35	30-70	40-85
4.75	-	0-5	0-5	0-10	0-20	0-5	0-10	0-10	0-10
2.36	-	-	-	-	0-5	-	-	-	-

ii) The pieces shall be angular in shape and shall have granular or crystalline surfaces. Friable, flaky and laminated pieces, mica and shale, if present, shall be only within tolerance limits which will not affect adversely the strength and or durability of concrete. The maximum size of coarse aggregate shall be 40 mm for M-7.5 and M-10 and 20mm for M-15 to M-30 concrete, or as directed by the Engineer-in-charge or specified. The maximum size of coarse aggregate shall be the maximum size specified above but in no case greater than 1/4th of the minimum thickness of the member, provided that the concrete can be placed without difficulty so as to surround all reinforcement thoroughly and fill the corners of the form. For plain concrete the maximum size of aggregate shall be of 40 mm. For heavily reinforced concrete members, the nominal maximum size of the aggregate shall be 5 mm less than the minimum clear distance between the reinforcing main bars or 5 mm less than the minimum cover to reinforcement whichever is smaller.

Foreign material limitations

The percentage of deleterious materials in the aggregate delivered to the mixer shall not exceed the following:

Table 4 : Foreign Material Limitations in Coarse Aggregate

Sr. No.	Foreign Material	Percentage by Weight	
		Uncrushed	Crushed
1	Material finer than 75 micron BIS Sieve	3.0	3.0
2	Coal and lignite	1.0	1.0
3	Clay Lumps	1.0	1.0
4	Soft Fragments	3.0	-
	Total	8.0	5.0

Water

Water used for washing, mixing and curing shall be free from injurious amounts of deleterious materials. Potable water is generally satisfactory for mixing and curing concrete. Physical and chemical analysis of the water should be submitted to the Engineer-in-charge, before starting the work.

In case of doubt, the suitability of water for making concrete shall be ascertained by the compressive strength and initial setting time test specified in BIS 456. The sample of water taken for testing shall be typical of the water proposed to be used for concreting, due account being paid to seasonal variation. The sample shall not receive any treatment before testing other than that envisaged in the regular supply of water proposed for use in concrete. The sample shall be stored in a clean container previously rinsed out with similar water.

Average 28 days compressive strength of at least three 15 cm concrete cubes prepared with water proposed to be used shall not be less than 90% of the average strength of three similar concrete cubes prepared with distilled water. The cubes shall be prepared, cured and tested in accordance with the requirements of BIS 516.

The initial setting time of test block must be made with the appropriate test cement and the water proposed to be used. It shall not be less than 30 minutes and shall not differ by more than +/-30 minutes from the initial setting time of control test block prepared with the appropriate test cement and distilled water. The test block shall be prepared and tested in accordance with the requirements of BIS 4031.

Where water can be shown to contain an excess of acid, alkali, sugar or salt, Engineer-in-charge may refuse to permit its use. As a guide, the following concentrations represent the maximum permissible values.

To neutralize 200 ml sample of water, using phenolphthalein as indicator, it should not require more than 2 ml of 0.1 normal NaOH. The details of test shall be as given in BIS 3025.

To neutralize 200 ml sample of water, using methyl orange a san indicator, it should not require more than 10 ml of 0.1 Normal HCl. The details of test shall be as given in BIS 3025.

Percentage of solids, when tested in accordance with the method indicated below shall not exceed the following:

Solids	Percent	Method of test
Ref. to col. no in IS:3025) Organic		
(organic solid = total solids minus ignited residue)	0.02	10 and 11
Inorganic	0.03	11(ignited residue)
Sulphates (as So_4)	0.05	20
Alkali Chlorides (as Cl)	0.20	24
Suspended matter	0.20	12
The pH value of water shall not generally be less than 6.		

Steel and Aluminum Members Encased in Concrete

Structural steel and aluminum ladders etc. to be encased in concrete shall be without paint. Primer should be used for encasing purpose. The encasing shall be done in concrete with 10 mm, maximum size aggregate and works cube strength not less than 150 kg/sq.cm. at 28 days unless otherwise specified. The member shall be wrapped with galvanized aluminum wire mesh of adequate size. The galvanized aluminum wire mesh shall be kept 20 mm from the edge or surface of the member and shall be held in position securely. The member will have a minimum cover of 50 mm unless otherwise indicated in the drawings. Where the clear cover is more than 75 mm, concrete with 20 mm coarse aggregate can be used.

Anchor Bolts, Anchors, Sleeves, Inserts, Hangers/Conduits/Pipe and Other Misc. Embedded Fixtures

The contractor shall build in to concrete work all the items mentioned in Drawings or Engineer In Charge and shall embed them partly or fully as directed and secure the same as ma ybe required. Th ematerials if required to be supplied by the contractor, shall be as specified and be of best quality available according to relevant Indian standards of approved manufacture and to the satisfaction of the engineer. Exposed surface of embedded materials is to be painted with one coat of approved anti-corrosive paint and/ or bituminous paint without any extra cost to the owner. If welding is to be done subsequently on the exposed surface of embedded material the paint shall be cleaned off the member to a minimum length of 50 mm beyond each side of the weld line.

Necessary templates, jigs, fixtures, supports etc. shall be used as may be required or directed by the Engineer In Charge.

Controlled Concrete

All concrete in the works shall be "Controlled Concrete" as defined in IS: 456 except for M-7.5 and M-10 for which normal mix concrete shall be used. Whether reinforced or otherwise, all concrete works to be carried out under this specification shall be divided into the following classifications:

Minimum Compressive Strength of 15 cm cubes at 7 days and 28 days after mixing, conducted in accordance with IS: 516.

Any operation of concrete done at atmospheric temperature above 40 degree C or where the temperature of concrete at the time of placement is expected to be beyond 40 degree C may be categorize as hot weather concreting and should be confined to the requirement of IS 7861(Part-I) 1975 and SP-23 (S&T)-1982.

Class	Preliminary Test N/mm²		Works Test N/mm²		Max. Size Of Aggregate mm	Locations For Use
	At 7 Days	At 28 days	At 7 days	At 28 days		
M40	33.5	50.0	27.0	40.0	20	As indicated in the specifications or as required
M35	30.0	44.0	23.5	35.0	20	
M30	25.0	38.0	20.0	30.0	40 or 20	
M25	22.0	32.0	17.0	25.0	40 or 20	
M20	17.5	26.0	13.5	20.0	40 or 20	

Class	Preliminary Test N/mm²		Works Test N/mm²		Max. Size Of Aggregate mm	Locations For Use
	At 7 Days	At 28 days	At 7 days	At 28 days		
M15	13.5	20.0	10.0	15.0	40 or 20	

Note: It shall be very clearly understood that whenever the grade of concrete such as M-20, etc. is specified it shall be contractor's responsibility to ensure the minimum crushing strength stipulated for the respective grade of concrete is obtained at works.

Mix

Design General

This is essential for investigating the grading of aggregates, water-cement ratio, workability and the quality of cement required to give preliminary and works cubes of the minimum strength specified. The proportions of the mix shall be determined by weight. Adjustment of aggregate proportions due to moisture present in the aggregate shall be made.

Determination of mix proportions shall be carried out according to "Recommended guidelines for Concrete Mix Design" conforming to IS: 10262.
Whenever there is a change either in required strength of concrete, or water-cement ratio or workability or the source of aggregates and/or cement, preliminary tests shall be repeated to determine the revised proportions of the mix to suit the altered conditions. While designing proportions, over-wet mixes shall always be avoided.
While fixing the value for water/cement ratio for preliminary mixes, assistance may be derived from the graph (Appendix A, BIS 456 showing the relationship between the 28 day compressive strengths of concrete mixes with different water/cement ratios and the 7-day compressive strength of cement tested in accordance with IS: 269.

Preliminary Tests

Test specimens shall be prepared with at-least two different water/cement ratios for each class of concrete, consistent with work ability required for the nature of the work. The materials and proportions used in making preliminary tests shall be similar in all respects to those to be actually employed in the works as the object of these tests is to determine the properties of cement, aggregates and water necessary to produce concrete of required consistency and to give the specified strength, it will be contractor's sole responsibility to carry out these tests and he shall therefore furnish to Engineer-in-Charge a statement of proportions proposed to be used for the various concrete mixes. For preliminary tests, the following procedure shall be followed.

Materials shall be brought to the room temperature and all materials shall be in a dry condition. The quantities of water cement and aggregates for each batch shall be determined by weight to an accuracy of 1 part in 100 parts.

Mixing concrete shall be done by hand (for small quantities, as directed by Engineer-in-Charge) or in a small batch mixer as per IS: 516 in such a manner as to avoid loss of water. The cement and fine aggregate shall first be mixed dry until the mixture is uniform in color. The coarse aggregate shall then be added, mixed and water added and the whole batch mixed thoroughly for a period of not less than two minutes until the resulting concrete is uniform in appearance. Each batch of concrete shall be such a size as to leave about 10% excess concrete, after moulding the desired number of test specimens.

The consistency of each batch of concrete shall be measured immediately after mixing, by the slump test in accordance with IS: 1199. If in the slump test, care is taken to ensure that no water or other material is lost, the material used for the slump test may be re-mixed with the remainder of the concrete for making the specimen test cubes. The period of re-mixing shall be as short as possible yet sufficient to produce a homogeneous mass.

The samples for compression tests of concrete shall be made as per IS: 516 on 15 cm cubes. Each mould shall be provided with a metal base plate having a plate surface so as to support the mould during filling without leakage. The base plate shall be preferably attached to the mould by springs or screws. The parts of the mould when assembled shall be positively and rigidly held together. Before placing concrete, the mould and base plate shall be cleaned and oiled. The dimensions and internal faces of the mould shall be accurate within the following limits. Height and distance between the opposite faces of the mould shall be of specified size +0.2 mm. The angle between the adjacent internal faces and between internal faces and top and bottom faces of mould shall be 90-degree +0.5 degree. The interior faces of the mould shall be plane surfaces with a permissible variation of 0.03 mm.

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

Curing shall be as specified in IS 516. The cubes shall be kept in moist air of at least 90% relative humidity at a temperature of 27 degree C + 2 degree C for 24 hours +2 hours from the time of adding water to the dry ingredients. Thereafter they shall be removed from the moulds and kept immersed in clean, fresh water and kept at 27 degree C +2 degree C temperature until required for test. Curing water shall be renewed every seven days. A record of maximum and minimum temperatures at the place of storage of the cubes shall be maintained during the period they remain in storage.

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

The determination of the water cement ratio and proportion of aggregates to obtain the required strength shall be made from preliminary tests by designing the concrete mix. Controlled concrete shall be used on all concrete work complying with all the requirements of IS: 456. Cube tests shall be carried out by the contractor on the trial mixes before the actual concreting operation starts. Based on the strength of the concrete mix sanction for the use has to be obtained from Engineer-in-Charge.

If during the execution of the works it is found necessary to revise the mix because of the cube tests showing lower strengths than the required one due to inconsistency of quality of material or otherwise, The Engineer-in-

Charge shall ask for fresh trial mixes to be made by the contractor. No claim to alter the rates of concrete work shall be entertained due to such change in mix variations, as it is the contractor's responsibility to produce the concrete of the required grade.

Great care shall be exercised when mixing the actual works concrete using the proportions of the selected trial mix. The final concrete mix shall have the same proportions and same source of cement, fine and coarse aggregates and water as that of the approved selected mix.

A reasonable number of bags should be weighed separately to check the Net weight, where the weight of cement is determined by accepting the manufacturer's weight per bag at the site. Proper control of mixing water is deemed to be of paramount importance. If mixers with automatic addition of water are used, water should be either measured by volume in calibrated buckets, tins or weighed. All measuring equipment shall be maintained in a clean serviceable condition and their accuracy periodically checked and certified and the Engineer-in-Charge's approval obtained.

The Engineer-in-Charge may require the contractor to carry out moisture content tests in both fine and coarse aggregates. The amount of the added water shall then be adjusted to compensate for any observed variations in the moisture contents. BIS: 2386 shall be referred to for determination of moisture content.

No substitution in material, used on the work or alteration in the established proportions shall be made without additional tests to show that the quality and strength of concrete are satisfactory. No alterations shall be permitted without the prior sanction of the Engineer-in-Charge.

Mixing of Concrete

The mixing of concrete shall be strictly carried out in an approved type of mechanical Concrete mixer. The mixing equipment shall be capable of combining the aggregates. Cement and water within the specified time into a thoroughly mixed and uniform mass, and of discharging the mixture without segregation. The entire batch shall be discharged before recharging. Mixing periods shall be measured from the time when all of the solid materials are in the mixing drum, provided that all of the mixing water shall be introduced before one fourth of the mixin gtime has elapsed. The mixing time in no case shall be less than two minutes. The mixer speed shall not be less than 14 nor more than 20 revolutions per minute.

Mixing shall be continued until there is a uniform distribution of the materials and the mass is uniform in color and consistency. Hand mixing of concrete shall not be permitted at all.

For quantities less than 1 cum of concrete, hand mixing may be permitted at the discretion of the Engineer-in-Charge with 10% excess cement quantity.

Grade of Concrete

The different grades of concrete specified shall conform to the strengths as required by IS: 456-1987.Standard deviation shall be calculated as stated in 14.5 of IS: 456-1978. The acceptable criteria for concrete shall be as stated in clause 15 of IS: 456 -1978.The assumed standard deviations as given in table 6 of IS: 456-1978 has to be followed and are given here under. However, the minimum cement content shall be as per *Table no. 7: Minimum Cement Content in Concrete* in this tender document.

Table 5: Grade of Concrete

Grade of Concrete M 10	Assumed Standard Deviation N/sq.mm2.3
Grade of Concrete	**Assumed Standard Deviation N/sq.mm**
M 15	**3.5**
M 20	**4.6**
M 25	**5.3**

In order to get a quick idea of quality of concrete the optional tests are conducted as stipulated in 14.1.1 of IS: 456-1978 and the results are analyzed according to table 5 on page 41 of IS: 456-1978.

Controlled Concrete

Controlled concrete shall be used on all concreting works except where specified otherwise the mix proportions for all grades of concrete shall be designed to obtain strengths corresponding to the values specified in table below for respective grades of concrete.

Table 6: Compressive Strengths at 28 days

Grade	Specified Characteristic Compressive Strength at 28 days (N/sq.mm)
M15	**15**
M20	**20**
M25	**25**
M30	**30**

The maximum Water : Cement ratio for all controlled concrete works shall be as specified in IS: 456-1978 as Preliminary tests as specified in the BIS code and required by the Engineer-in-charge shall be carried out sufficiently ahead of the actual commencement of the work with different grades of concrete made from representative samples of aggregates and cement expected to be used on the job to ascertain the ratios by weight of cement of total quantity of fine and coarse aggregates and the water

cement ratio required to produce a concrete of specified strength and desired workability.

The minimum cement content for each grade of concrete shall be as per table below.

Table 7: Minimum Cement Content in Concrete

Grade of Concrete	Minimum Cement Content in Concrete (kg/cum of finished Concrete)
M 15	300
M 20	330
M 25	360
M 30	400

At least 4 (four) trial batches are to be made and 7 test cubes should be taken for each batch noting the slump on each mix. These cubes shall then be properly cured and two cubes from each mix shall be tested in a testing laboratory approved by the Engineer-in-Charge at 7 days and others at 28 days for obtaining the ultimate compressive strength. The test reports shall be submitted to the Engineer in charge. The cost of mix design and testing shall be borne by the contractor. On the basis of the preliminary test reports for trial mix, a proportion of mix by weight and water cement ratio will be approved by the Engineer-in-Charge, which will be expected to give the required strength . Consistency and workability and the proportions so decided for different grades of concrete shall be adhered to during all concreting operations. If however at any time the Engineer-in-Charge feels that the quality of material, being used has been changed from those used for preliminary mix design, the contractor shall have to run similar trial mixes to ascertain the mix proportions and consistency.

The mix once approved must not be varied without prior approval of the Engineer-in-Charge. However should the contractor anticipate any change in the quality of future supply of materials than that used for preliminary mix design, he shall inform the same to the Engineer-in-Charge and bring fresh samples sufficiently ahead to carry out fresh trial mixes. The Engineer-in-Charge shall have access to all places and laboratory where design mix is prepared. Design mix will indicate by means of graphs and curves etc. the extent of variation in the grading of aggregates which can be allowed.

In designing the mix proportions of concrete, the quantity of both cement and aggregate shall be determined by weight. All measuring equipment shall be maintained in clean and serviceable condition and their accuracy periodically checked.

To keep the water cement ratio to the designed value, allowance shall be made for the moisture contents in both fine and course aggregates and determination of the same shall be made as frequently as directed by the Engineer-in-Charge. The determination of moisture contents shall be according to IS: 2386 (Part III). Absorption of water by dry aggregates shall not be more than 5%.

Strength Requirements

Where ordinary Portland cement conforming to IS: 269 or Portland blast furnace slag cement conforming to IS: 455 is used the compressive strength requirements for various grades of concrete shall be as shown in table below. Where rapid hardening Portland cement is used the 28 days compressive strength requirements specified in Table- hereunder shall be met in 7 days. The strength requirements specified in table shall apply to both controlled concrete and ordinary concrete.

Strength Requirements of Concrete

Grade of Concrete	Minimum Compressive Strength Concrete in Accordance with IS: 516 (In kg/cm)

As per IS: 456-1978
For 15 cm cube specimens

Grade of concrete	at 7 days Work Test	Preliminary Work Test	at 28 days
M 15	100	200	150
M 20	135	260	200
M 25	170	320	250
M 30	200	380	300

Other requirements of concrete strength as may be desired by the Engineer-in-Charge shall be in accordance with Indian Standard IS: 456 (latest revision). The acceptance of strength of concrete shall be as per clause 5.4 "Sample size and Acceptance Criteria" of IS: 456 (latest revision) subject to stipulation and/or modifications stated elsewhere in this specification if any.

Concrete work found unacceptable shall have to be dismantled and replaced to the satisfaction of the Engineer-in-Charge by the Contractor free of cost to the Owner. No payment will be made for the dismantled concrete, the relevant formwork and reinforcement, embedded mixtures etc. wasted in the dismantled portion shall be made. In the course of dismantling if any damage is done to the embedded items or adjacent structures, the same shall also be made good free of charge by the contractor to the satisfaction of the Engineer in charge. If the water quantity has to be increased in special cases, cement also has to be increased proportionately to keep the ratio of water to cement same as adopted in trial mix design for each grade of concrete.

Workability

The workability of concrete shall be checked at frequent intervals by slump test. Where facilities exist and if required by the Engineer-in-Charge, alternatively the compacting factor test in accordance with IS: 1199 shall be carried out. The degree of workability necessary to allow the concrete to be well consolidated and to be worked into the corners of form work and round the reinforcement to give the required surface finish shall depend on the type and nature of the structure and shall be based on experience and tests. The limits of consistency for structures are as specified in the table below:

Table 8: Limits of Consistency

Placing Conditions	Degree of Workability	Values of Workability
Concreting of shallow Sections with vibration	Very low	20-10 seconds Veebee time or 0.75-0.80 compacting factor
Concreting of lightly Reinforced sections With vibration	Low	10-5 seconds or 0.80-0.85 compacting factor

Concreting of lightly Reinforced sections Without Vibration or Heavily reinforced Section with Vibration	**Medium**	**5-2 seconds Veebee time or 0.85-0.92 compacting factor or 25-75mm slump for 20 mm Aggregate**
Concreting of heavily Reinforced sections compacting Without vibration factor	**High**	**Above 0.92 compacting factor or 75-125 mm slumps for 20 mm aggregate**

Workmanship

All workmanship shall be according to the latest relevant standards. Before starting a pour the contractor shall obtain the approval of the Engineer-in-Charge and all other concerned department including safety dept, in a "Pour Card" maintained for this purpose. He shall obtain complete instructions about the material and proportion to be used, slump, workability of water per unit of cement, number of test cubes to be taken, finishing to be done and any admixture to be added etc.

SAMPLING AND TESTING CONCRETE IN THE FIELD

Sampling and Testing of Concrete shall conform to IS: 456 2000.

a) **Facilities required for sampling materials and concrete including whether proof buildings to house the facilities in the field, shall be provided by the contractor at no extra cost. The following equipment with operator shall be made available in serviceable conditions.**

No concrete of any kind may be placed until the field concrete testing laboratory as specified is provided to the satisfaction of the Engineer. The contractor shall notify the Engineer in advance of all concrete and concrete material testing as provided in the clause to provide the Engineer/his representative with an opportunity to witness all prescribed tests.

At least 6 test cubes of each class of concrete shall be made of every 50cum concrete or part thereof or from different batches as directed by Engineer-in-Charge. Such samples shall be drawn on each day for each type of concrete. Of each set of 6 cubes, three shall be tested at 7 days age and three at 28 days age. The cubes must be casted from various batches to arrive at an average strength. The laboratory test results shall be tabulated and furnished to the Engineer. The Engineer will pass the concrete if average strength of the specimens tested is not less than the strength specified, subject to the condition that only one out of three consecutive tests may give a value less than the specified strength but this shall not be less than 90% of the specified strength.

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

CONCRETE TESTS

The Engineer-in-Charge, may order tests to be carried out on cement, sand, coarse aggregate, water in accordance with the relevant Indian standards.

Tests on Cement shall include: Fineness test
Test for normal consistency
Test for setting time
Test for soundness
Test for tensile strength
Test for compressive strength
Test for heat of hydration (by experiment and by calculations) in accordance with BIS 269

Tests on Sand shall include:
Sieve test
Test for organic impurities
Decantation test for determining clay and silt content
Specific gravity test
Test for unit weight and bulk age factor
Test for sieve analysis and fineness modulus

Tests on Coarse Aggregate shall include: Sieve analysis
Specific gravity and unit weight of dry, loose and rodded aggregate
Soundness and alkali aggregate reactivity
Petrography examination
Deleterious materials and organic impurities
Test for aggregate crushing value

Any or all these tests would normally be ordered to be carried out only if the Engineer feels the materials are not obtained and shall be performed by the contractor at a test laboratory approved by Engineer-in charge. The contractor shall bear the charges of these optional tests.
Concrete not made to the requirements of specification in all respects may be rejected by the Engineer-in-Charge in which case it shall be removed and reconstructed entirely at the expense of the contractor.

Load Test on Members or Any Other Tests

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

The test load shall be 125% of the maximum superimposed load for which the structure was designed. Such test load shall not be applied before 56 days after the effective hardening of concrete. During the test, struts strong enough to take the whole load shall be placed in position leaving a gap under the members. The test load shall be maintained for 24 hours before removal.

If within 24 hours of the removal of the load, the structure does not show a recovery of at least 75% of the maximum deflection shown during the 24 hours under load, the test loading shall be repeated after a lapse of at least 72 hours. The structure shall be considered to have failed to pass the test if the recovery after the second test is not at least 75% of the maximum deflection shown during the second test. If the structure is certified as failed by the Engineer-in-Charge, the cost of all the new construction and the load tests shall be borne by the contractor.

Any other tests, e.g. taking out in an approved manner concrete cores, examination and tests on such cores removed from such parts of the structure as directed by the Engineer-in-Charge, sonic testing etc. shall be carried out by the contractor, if so directed, at no extra cost.

Unsatisfactory tests

Should the results of any test prove unsatisfactory, or the structure shows signs of weakness, undue deflection or faulty construction, the contractor shall remove and rebuild the member or members involved or carry out such other remedial measures as may be required by the Engineer-in-Charge.

Admixture

s General

Admixtures may be used in concrete where required, only with the approval of the Engineer-in-Charge. How ever it should be seen that, with the passage of time, neither the compressive strength nor its durability is reduced. Calcium chloride shall not be used for accelerating set of the cement for any concrete containing reinforcement or embedded steel parts. When calcium chloride is permitted to be used, such as in mass concrete works, it shall be dissolved in water and added to the mixing water in an amount not to exceed 1.5% of the weight of the cement in each batch of concrete. When admixtures are used, the designed concrete mix shall be corrected accordingly. Admixtures shall be used as per manufacturer's instruction and in the manner and with the control specified by the Engineer-in-Charge.

Air Entraining Agents

Neutralized Vinson resin or other approved air in the concrete mix agents shall conform to the requirements of ASTM standard 6.260; Air Entraining Admixtures for Concrete. The recommended total air content of the concrete is 4% + 1%. The method of measuring air content shall be as per IS: 1199.

Water Reducing Admixtures

Water reducing lignosulfonate admixture may be added in quantities approved by the Engineer-in-Charge. The admixtures shall be added in the form of a solution.

Retarding Admixtures

Retarding agents may be added to the concrete mix in quantities approved by the Engineer-in-Charge.

Water Proofing Agent

Water proofing agents shall conform to IS: 2645.

Other Admixtures

The Engineer-in-Charge may at his discretion allow the contractor to use any other admixture in the concrete.

Preparation Prior to Concrete Placement, Final Inspection and Approval

Before the concrete is actually placed in position, the insides of the formwork shall be inspected to see that they have been cleaned and oiled. Temporary openings shall be provided to facilitate inspection, especially at bottoms of columns and wall forms, to permit removal of sawdust, wood shavings, binding wire, dirt etc. Openings shall be placed or holes drilled so that these materials and water can be removed easily. Such openings/holes shall be suitably plugged later.

The various agencies shall be permitted ample time to install drainage and plumbing lines, floor and trench drains, conduits, hangers, anchors, inserts, sleeves, bolts, frames and other miscellaneous embedment to be cast in the concrete as specified or required or as is necessary for the proper execution of the work as specified in the drawings.

All embedded parts, inserts, etc. supplied by the contractor shall be correctly positioned and securely held in the forms to prevent displacement during depositing and vibrating of concrete.

All anchor bolts shall be positioned and kept in place with the help of properly manufactured templates unless specifically waived in writing by the Engineer-in-Charge.

Slots, openings, holes, pockets etc. shall be provided in the concrete work in the position specified in drawing or required or as directed by the Engineer-in-Charge.

Reinforcement and other items to be cast in concrete shall have clean surfaces that will not impair bond.

Prior to concrete placement, all work shall be inspected and approved by the Engineer-in-Charge and if found unsatisfactory, concrete shall not be poured until after all defects have been corrected.

Approval by the Engineer-in-Charge of any and all materials and work as required herein shall not relieve the contractor from his obligation to produce finished concrete in accordance with the requirements of the specifications.

Rain or wash water

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

Bonding Mortar

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

The corrosive matters on the reinforcement should be removed by means of wire brush.

Laitance should be removed by means of chiseling from top concrete layer which was earlier concreted

Transportation

General

All buckets, containers or conveyors used for transporting concrete shall be mortar-tight, leak proof irrespective of the method of transportation adopted, concrete shall be delivered with the required consistency and plasticity without segregation or loss of slump. However, chutes shall not be used for transport of concrete without the written permission of the Engineer-in-Charge and concrete shall not be re-handled before placing.

Retempered or Contaminated Concrete

Concrete must be placed in its final position before it becomes too stiff to work. On no account, water shall be added after the initial mixing. Concrete, which has become stiff or has been contaminated with foreign materials shall be rejected and disposed off as directed by the Engineer-in-Charge.

Avoiding Segregation

Concrete shall, in all cases, be deposited as nearly as practicable directly, in its final position and shall not be re-handled to flow in a manner which will cause segregation, loss of materials, displacement of reinforcement, shuttering or embedded insets, or impai rits strength. Fo rlocations where direct placement is not possible, and in narrow forms, the Contractor shall provide suitable drop and "Elephant Trunks" to confine the movement of concrete. Special care shall be taken when concrete is dropped from a height, especially if reinforcement is in the way, particularly in column and the walls.

Placing by Manual Labour

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

Placing by Mechanical Equipment

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

Types of Buckets

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

Operation of Bucket

In placing concrete in large open areas, the bucket shall be spotted directly over the position designated and then lowered for dumping. The open bucket shall clear the concrete already in place and the height of drop shall not exceed 1.0 m. The bucket shall be opened slowly to avoid high vertical bounce. Dumping of buckets on the swing or in any manner, which results in separation of ingredients or disturbance of previously placed concrete, will not be permitted.

Placement of Restricted Forms

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

Chuting

Where it is necessar yto use transfe rchutes, specific approval of Engineer-in-Charge must be obtained to type, length slopes, baffles, vertical terminals and timing of operations. These shall be so arranged that an almost continuous flow of concrete is obtained at the discharge and without segregation. Concrete should flo wsmoothly in th echute and there should not be any obstruction to the flow. To allow for the loss of mortar against the sides of the chutes, the first mixes shall have less coarse aggregate. During cleaning of chutes, the wastewater shall be kept clear of the forms. Concrete shall not be permitted to fall from the end of the chutes by more than 1.0 m. Chutes, when approved for use shall have slopes not flatter than 1 vertical, 3 horizontal and not steeper than 1 vertical, 2 horizontal. Chutes shall be of metal or metal lines end of rounded cross section. The slopes of all chute sections shall be approximately the same. The slopes of all chute sections shall be approximately the same. The discharge end of the chutes shall be maintained above the surface of the concrete in the forms.

Placing by Pumping/Pneumatic Placers

Concrete may be conveyed and placed by mechanically operated equipment e.g., pumps or pneumatic placers only with the written permission of the Engineer-in-Charge at no extra cost. The slump shall be held to the minimum necessary for conveying concrete by this method.

When pumping is adopted, before pumping of concrete is started, the pipeline shall be lubricated with one or two batches of mortar composed of one part cement and two parts sand. Care shall be taken to avoid stoppages in work once pumping has started.
When a pneumatic placer is used, the manufacturer's advice on layout of the pipeline shall be followed to avoid blockages and excessive wear. Restraint shall be provided at the discharge box to cater for the reaction at this end. Manufacturer's recommendations shall be followed regarding concrete quality and all other related matters when pumping/ pneumatic placing equipment is used. It should be noted that no extra payment is made for these items, if required and directed by Engineer-in-Charge.

Concrete in Layers

Concreting, once started, shall be continuous until the pour is completed. Concrete shall be placed in successive horizontal layers of uniform thickness ranging from 15 cm to 45 cm directed by Engineer-in-Charge. These shall be placed as rapidly practicable to prevent the formation of cold joints or planes of weakness between each succeeding layer within the pour. The thickness of each layer shall be such that it can be deposited before the previous layer has stiffened. The bucket loads or other units of deposit shall be spotted progressively along the face of the layer with such overlap as will facilitate spreading the layer to uniform depth and texture with a minimum shoveling. Any tendency to segregation shall be corrected by shoveling stones into mortar rather than mortar on to stones. Such a condition shall be corrected by redesign of mix or other means, as directed by the Engineer-in-Charge.

Cover Blocks

Cover blocks of required size depending on the cover of the reinforcement as mentioned in the drawings shall be prepared in 1:3 cement mortar with fine aggregates and minimum compressive strength of 300 kg/sq.cm.

Bedding of Layers

The top surface of each pour and bedding planes shall be approximately horizontal unless otherwise instructed. Top layer should be rough and with key for further extension of work.

Compaction

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

Type of Vibrators

Vibrators shall conform to BIS specifications. Type of vibrator to be used shall depend on the structures where concrete is to be placed. Shutter vibrators to be effective, shall be firmly secured to the formwork which must be sufficiently rigid to transmit the vibration and strong enough not to be damaged by it. Immersion vibrators in sufficient numbers and each of adequate size shall be used to properly consolidate all concrete. Tapping or external vibrating of forms by hand tools or immersion vibrators will not be permitted.

Use of Vibrators

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

Melding Successive Batches

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

Penetration of Vibrators

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

Vibrating against Reinforcement/Formwork

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

Use of Form Attached Vibrators

Form attached vibrators shall be used only with specific authorization of the Engineer-in-charge.

Use of Surface Vibrators

The use of surface vibrators will not be permitted under normal conditions. However, for thin slabs, surface vibrating by specially designed vibrators may be permitted, upon approval of Engineer-in-Charge.

Stone Pockets and Mortar Pond ages

The formation of stone pockets and mortar pond ages in corners and against faces of forms shall not be permitted. Should these occur, they shall be dug out, reformed and refilled to sufficient depth and shape for thorough bonding, as directed by the Engineer-in-Charge.

Placement Interval

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 and before the start of a subsequent placement.

Special Provision in Placing

When placing concrete in walls with openings, in floors of integral slabs and beam construction and other similar conditions, the placing shall stop when the concrete reaches the top of the opening in walls or bottom horizontal surface of the slab, as the case may be.

Placing shall be resumed before the concrete in place takes initial set, but not until it has had time to settle as determined by the Engineer-in-Charge.

Placing Concrete Through Reinforcing Steel

When placing concrete through reinforcing steel, care shall be taken to prevent segregation of the coarse aggregate. Where the congestion of steel makes placing difficult, it may be necessary to obtain Engineer in-Charge's permission for temporarily moving the top steel aside for proper placement & for restoring reinforcement as per drawing.

Bleeding

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

Application of Araldite for Bonding of New and Old Concrete

General

Araldite epoxy resins will be used to bond fresh concrete to concrete that is fully cured, to give a monolithic bond capable of transmitting high stresses when traditional bonding agents such as cement slurry cannot always be relied upon to provide good adhesion which is particularly the case when large areas are involved.

The Araldite based formulation shall be applied to a suitably prepared concrete sub-strata and the fresh concrete poured as soon as possible, but always during the 'open time' of the adhesive.
Materials used shall be of best quality like CIBA, FOSROC or ROFF and approved by the Engineer-in-Charge.
Manufacturer's instructions shall be followed in all respects.
No separate payment shall be paid for this item of work.

Formulation

ARALDITE	**GY250**	**100**	**Parts by weight**
Hardener	**HY825**	**20**	**Parts by weight**
Hardener	**HY830**	**20**	**Parts by weight**
Hardener	**HY850**	**20**	**Parts by weight**
Silica Flour			

Application

The application of the adhesives shall be as per manufacturer standards.

Preparation of the Substrata

To obtain good adhesion, it is necessary to have clean and sound substrata. Preparation can be carried out using a variety of techniques including chemical treatment and mechanical methods such as grinding, milling, and abrading, planning and sand blasting. Dust and loose particles resulting from the pretreatment should be removed by vacuum cleaning or oil-free or blast.

Mixing

The resin and hardener should be thoroughly mixed in the dry filler. The mixed, ready to use adhesive should not contain lumps of unwetted filler and should be of uniform color. For a total weight of 1 kg or less hand mixing should be sufficient. For quantities in excess of 1 kg, the use of a mechanical mixer is recommended.

Pot life and 'Open time'

The pot life is the period during which the ready to use ARALDITE based formulation must be applied. After this period, the mix can no longer be worked and will have begun to set in its container. The table below indicates the pot life at different temperatures:

Mix Temperature	Pot life in minutes
25° C	90 Minutes
30° C	60 Minutes
35° C	45 Minutes

(The figures in this table are for batches less than 1 kilogram).

The 'Open time' is the maximum period of time allowable between application of the ARALDITE adhesive and pouring the fresh concrete. Exceeding the 'Open time' would result in considerably reduced adhesion. The adhesive should be applied to the pre-treated substrata as soon as the components have been mixed and fresh concrete poured immediately afterwards.

Accurate knowledge of the 'Open time' is essential in case the work is interrupted.
Table gives the 'Open time' of ARALDITE based formulations as a function of substrata temperature. In all cases, the adhesives shall be applied immediately after mixing. Any delay between mixing and application will reduce the 'Open time'. Fresh concrete must be poured before the adhesive begins to gel. New to old concrete bonding is not recommended

at temperatures below 5-Degree Centigrade, as curing cannot be assured under these circumstances.

Methods of Application

The shape and size of the concrete structure will determine the method of application used. The ARALDITE based adhesive may be applied by hand using brushed, brooms or any other suitable applicator.

Suitability of Fresh Concrete

Best results are obtained when the water/ cement ratio of the new concrete is low as is practicable.

Coverage

One kilogram of the mixed ARALDITE adhesive including hardeners and filler covers an area of 2 to 3 sqm. When applied with a stiff nylon bristle brush. However, the coverage is very much dependent on the finish in the concrete.

Handling Precautions

Epoxy resins can cause irritation of the skin in sensitive person if incorrectly handled. Certain safety precautions must therefore be observed and those handling the resins and hardeners should be given suitable instructions. Those working with epoxy resins should, above all, be instructed that personal cleanliness at the place of work is essential. The resin and hardener should not be allowed to come into direct contact with the skin. The most effective protection is achieved by wearing rubber or polythene gloves, the latter having the advantage that they can be replaced when dirty. They are more pleasant to wear if cotton gloves are worn underneath. Parts of the skins, which have come into contact with the resin or hardener, should be washed with lukewarm water and a mild soap. Special cleaning creams may be used as they have proved to be highly suitable.

Construction Joints

A construction joint is defined as a joint in the concrete introduced for convenience in construction at which special measures are taken to achieve subsequent continuity without provision for further relative movement.

No concreting shall be started until the Engineer-in-Charge has approved the method of placing the positions and form of the construction joints and lifts. The construction joints shall be so located as not to impair the strength of the structure. Water stops shall be inserted as per clause 3.20 Concrete placed to form the face of a construction joint shall have all Laitance removed and the aggregate exposed prior to the placing of fresh concrete. The Laitance shall wherever practicable be removed by spraying the concrete where it is still green. The whole of the concrete surface forming part of the joint shall be hacked to expose the aggregate to the 1/3rd size of maximum size of aggregate. Where aggregate is damaged during hacking, it shall be removed from the concrete face by further

hacking. All loose matter shall be removed and the exposed surface thoroughly cleaned by wire brushing, air blasting or washing, leaving the surface clean and damp. Immediately before fresh concrete is placed, a 12 mm thick layer of sand/cement mortar mixed in the same proportions as in the concrete shall be spread in the horizontal face of the construction joint. A drier mix shall be used for the top lift of horizontal face of the construction joint. A drier mix shall be used for the top lift of horizontal pours to avoid Laitance. The new concrete shall be well worked against the prepared face before the mortar sets. Special care shall be taken to obtain thorough compaction and to avoid segregation of the concrete along the joint plane.

Movement Joints

Movement joints are defined as all joints intended to accommodate relative movement between adjoining parts of a structure, special provision being made where necessary for maintaining the water tightness of the joint. The contractor shall comply with the instructions of manufacturers of proprietary jointing materials and shall, if required by the Engineer-in-Charge, demonstrate that the jointing materials can be applied satisfactorily.
The surface of set concrete in a movement joint shall, as shown on the drawings, be painted with two coats of bituminous paint and new concrete shall be placed against it only when the paint is dry. Expansion joints shall be formed by a separating strip of approved preformed joint filler.
Caulking grooves shall be provided. At all joints where a caulking groove is formed, immediately prior to caulking, the groove shall be wire brushed and loose material removed and blown out by compressed air. After the groove has dried, it shall be primed and caulked with approved sealing compound applied in accordance with the manufacturer's instructions. At all caulked joints, the face of the caulking strip and a width of concrete on either side shall be painted with two coats of paint having the same base as the sealing compound.

Water Stops and Joint Fillers

Water stops

At all construction, contraction and expansion joints in the water retaining structures and wherever specified or directed by the Engineer-in-charge, water stops shall be provided. The water stops shall be PVC type or of any other equivalent material as approved by the Engineer-in-charge. PVC water stops shall have a tensile strength of not less than 14 MN/m^2 and elongation at break of not less than 300%. Water stops shall not be exposed to direct sunlight for long periods. Before being concreted in water stops shall be cleaned of all foreign materials. Wherever provided, water stops shall be placed in such a manner that they are embedded in the adjacent sections of the panels for equal width.

As far as possible, jointing on site shall be confined to the making of butt joints in straight runs of water stops and all the joints should be monolithic. Where it is agreed with the Engineer-in-Charge that it is necessary to make an intersection or change of direction of any joint, other than a butt joint in a straight run on site, a preliminary joint, intersection or change of direction piece shall be made and submitted to such tests as the Engineer-in-Charge may require.

Flexible water stops shall be fully supported in the form work, free of nails and clear of reinforcement and other fixtures. Damaged water stops shall be replaced and during concreting care shall be taken to place the concrete so that water stops do not bend or distort or displace.

The different types of water stops to be used in liquid retaining structures will be as follows:

Table 9 : Types of Water Stops

Sr.	Type of Joint	Type of water stops
1.	Partial/complete Contraction joint in walls and slabs	230 mm wide, ribbed with hollow centre bulb & 6 mm minimum thickness
2.	Expansion joints in walls and slabs	230 mm wide, ribbed with hollow centre bulb & 9 mm minimum thickness
3.	Construction joint in raft	230 mm wide, ribbed with hollow centre bulb & 9 mm minimum thickness
4.	Construction joint in wall	230 mm wide, ribbed with hollow centre bulb & 6 mm minimum thickness
5.	Expansion joint raft	230 mm wide, ribbed with hollow centre bulb & 9 mm minimum thickness
6.	Partial/complete Contraction joint in raft	230 mm wide, ribbed with hollow centre bulb & 9 mm minimum thickness

Jointing fillers

Joint fillers shall be of durable, compressible and non-extruding material. Details of jointing material required here. Type of joint, size or width of joint and joint filler material to be used with preferred brands if any.

Sealing Compounds

Horizontal joints shall, where used in water-retaining structures be sealed with a cold pouring polysulphide rubber sealing compound of quality equal to, or better than serviced "Paraseal". Horizontal joints in roofs, floors and other non-water retaining structures shall be sealed with an approved sealant with properties equal to or better than serviced "Paraplastic 41". Vertical joints and joints in the soffits of slabs in both

water retaining as well as non-water retaining structures shall be sealed with a trowel or gun applied polysulphide rubber sealing compound such as serviced "Vertiseal" or equivalent. Sealing compounds shall be fully cured before water is permitted to come in contact. At 40 C, the curing time would be approximately 7 weeks for polysulphide compounds like CIBA, FOSROC or ROFF as approved by Engineer-in-charge.

Tolerances in Concrete Surfaces

Concrete surfaces for the various classes of unformed and formed finishes specified in various clauses shall comply with the tolerances shown in Table hereunder, except where different tolerances are expressly required by the specification.
In the table 'line an dlevel' and 'dimension' shall mean the lines, levels and cross-sectional dimensions as specified and required.
Surface irregularities shall be classified as 'abrupt' or 'gradual'. Abrupt irregularities include by shall not be limited to offsets and fins caused by displaced or misplaced formwork, loose knots and other defects in formwork materials, and shall be tested by direct measurement. Gradual irregularities shall be tested by means of a straight template for plane surfaces and 1.5 m long formed surfaces.

Class of finish	Maximum tolerance (mm) in:			
	Line & level	Abrupt irregularit	Gradual irregularit	Dimensio n
U 1	12	6	6	-
U 2	6	3	3	-
U 3	6	3	3	-
F 1	12	6	6	+12-6
F 2	6	6	6	+12-6
F 3	3	3	3	+6-

Curing, Protecting, Repairing and Finishing

Curing

All concrete shall be kept continuously in a damp or wet condition by ponding or by covering with a layer of sacking, canvas, hessian or similar materials and kept constantly wet for at least seven days from the date of placing concrete in case of OPC and 10 days in case of mineral admixture or blended cements are used. The period of curing

shall be not less than 10 days for concrete exposed to dry and hot weather condition

Curing with Water

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

Continuous Spraying

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

Alternate Curing Methods

Whenever in the judgment of the Engineer-in-Charge, it is necessary to omit the continuous spray method, a covering of clean sand or other approved means such as wet gunny bags, which will prevent loss of moisture from the concrete, may be used. No type of covering will be approved which would stain or damage the concrete during or after the curing period. Covering shall be kept continuously wet during curing period. For curing of concrete in sidewalks, floors, flat roofs of other level surfaces, the ponding method of curing is preferred. The method of containing the ponded water shall be approved by the Engineer-in-Charge. Special attention shall be given to edges and corners of the slabs to ensure proper protection to these areas. The ponded areas shall be kept continuously filled with water during the curing period.

Curing Compound

Surface coating type-curing compounds shall be used only by special permission of Engineer-in-Charge. Curing compounds shall be liquid type white pigmented, conforming to US Bureau of Reclamation specification. No curing compound shall be used on surfaces where future blending with concrete, water of acid proof membrane or painting is specified. Curing compound shall be used only after getting sufficient/satisfactory test results at site.

Curing Equipment

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

Protecting Fresh Concrete

Fresh concrete shall be protected from defacements and damage due to construction operations by leaving forms in place for an ample period as specified in section D3 of this specification. Newly placed concrete shall be protected by approved means such as tarpaulins from rain, sun and winds. Steps as approved by the Engineer-in-Charge shall also be taken to protect immature concrete from damage by debris, excessive lading, vibration, abrasion or contact with other materials, etc. that may impair the strength and/or durability of the concrete. Workmen shall be warned against and prevented from disturbing green concrete during its setting period. If it is necessary that the workmen enter the area of freshly placed concrete, the Engineer-in-Charge may require that bridges be placed over the area.

Repair and Replacement of Unsatisfactory Concrete

General

Immediately after the shuttering is removed, the surface of concrete shall be very carefully gone over and all defective areas called to the attention of the Engineer-in-Charge who may permit patching of the defective areas or also reject the concrete unit either partially or in its entirety. Rejected concrete shall be removed and replaced by the contractor. Holes shall be filled with mortar composed of one part of cement to one and half parts of sand passing 2.36 mm I.S sieve after removing any loose stones adhering to the concrete. Concrete surfaces shall be finished as described in specifications or as directed by the Engineer-in-Charge. Superficial honey combed surfaces and rough patches shall be similarly made good immediately after removal of shuttering, in the presence of the Engineer-in-charge and superficial water and air holes shall be filled in. The mortar shall be well worked into the surface with a wooden float. Excess water shall be avoided. Unless instructed otherwise by the Engineer-in-Charge, the surface of the exposed concrete placed against shuttering shall be rubbed down immediately on removal of shuttering to remove fine or other irregularities, care being taken to avoid damaging the surface. Surface irregularities shall be removed by grinding. If reinforcement is exposed or the honeycombing occurs at vulnerable positions e.g. ends of beams or columns, it may be necessary to cut out the member completely or in part and reconstruct. The decision of the Engineer-in-Charge shall be final in this regard. If only patching is necessary, the edges being cut perpendicular to the affected surface or with a small undercut if possible. Anchors, tees or dovetail slots shall be provided whenever necessary to attach the new concrete securely in place. An area extending several centimeters beyond the edges and the surfaces of the prepared voids shall be saturated with water for 24 hours immediately before the patching material is placed.

For small repairs concerned Engineering-Charge shall permit to repair the same and shall be repaired at his directions. For major repairs contractor

shall submit the method of statement and on approval of same shall carry such repairs with strict compliance to the method of statement.

Use of Epoxy

The use of epoxy for bonding fresh concrete used for repairs will be permitted upon written approval of the Engineer-in-Charge. Epoxies shall be applied in strict accordance with the instructions of the manufacturer.

Method of Repair

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

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

Curing of Patched Work

The patched area shall be covered immediately with an approved non-staining, water-saturated material such as gunny bags which shall be kept continuously wet and protected against sun and wind for a period of 24 hours. Thereafter, the patched area shall be kept wet continuously by a fine spray, or sprinkling for not less than 10 days. All fillings shall be tightly bounded to the concrete and shall be sound, free from shrinkage cracks after the fillings have been cured and dried.

Approval by the Engineer-in-Charge

All materials, procedures and operations used in the repair work shall be subject to the approval of the Engineer-in-Charge.

Finishing

General

The type of finish for formed concrete surfaces shall be as follows, unless varied by the design/architectural drawings and specifications.
When the structure is in service all the surfaces shall receive no special finish, except repair of damaged or defective concrete, removal of fine and abrupt irregularities, filling defective concrete, filling of holes left by form ties and rods and clean up of loose or adhering debris. Surfaces which will be exposed to the weather and which would normally be level, shall be sloped for drainage. Unless a horizontal surface or the slope required is specified, the tops of narrow surfaces such as stair treads, walls, curbs and parapets shall be sloped across the width approximately 1 in 30. Broader surfaces such as walkways and platforms shall be sloped about 1 in 50. Surfaces that will be covered by backfill or concrete, subfloors to be covered with concrete topping, terrazzo or quarry tiles and similar surfaces shall be smooth ascended and leveled to produce even surfaces. Surface irregularities shall not exceed 6 mm. Surfaces which will not be covered by backfill, concrete or tile toppings such as outside decks, floors of galleries and sumps, parapets, gutters, side-walks, floors and slabs, shall be consolidated, screened and floated. Excess water and laitance shall be removed before final finishing. Floating may be done with hand or power tools and started as soon as the screened surface has attained a stiffness to permit finishing operations and these shall be the minimum required to produce a surface uniform in texture and free from screened marks or other imperfections. Joints and edges shall be tooled as specified or as directed by the Engineer-in-Charge.

Standard Finish for Exposed Concrete

Exposed concrete shall mean any concrete, other than floors or slabs, exposed to view upon completion of the works. Unless otherwise specified, the standard finish for exposed concrete shall be a smooth finish. A smooth finish shall be obtained with the use of lined or plywood forms having smooth and even surfaces and edges. Panels of forms shall be of uniform size and be as large as practicable and installed with closed joints. Upon removal of forms the joint marks shall be smoothed off and all blemishes, protections etc., removed leaving the surfaces smooth.

Integral Cement Concrete Finish

When specified, integral cement concrete finish of specified thickness for floors and slabs shall be applied either monolithic or bonded, as specified or directed by the Engineer-in-charge. The surface shall be tested with a straight edge and any high and low spots eliminated. Floating or trowelling of the finish shall be permitted only after all surface water has evaporated. Dry cement or a mixture of dry cement and sand shall not be sprinkled directly on the surface of the cement finish to absorb moisture or to stiffen the mix.

Rubbed Finish

A rubbed finish shall be provided only on exposed concrete surfaces. Upon removal of forms, all fins and other projections on the surfaces shall be carefully removed, offsets leveled and voids and/or damaged sections immediately saturated with water and repaired by filling with a concrete or mortar of the same composition as was used in the surface. The surfaces shall then be thoroughly wetted and rubbed with carborundun or other abrasive. Cement mortar may be used in the rubbing, but the finished surfaces shall not be brush coated with either cement or grout after rubbing. The finished surfaces shall present a uniform and smooth appearance.

Protection

All concrete shall be protected against damage until final acceptance by the Engineer-in-Charge.

Hot Weather Requirement

All concrete work performed in hot weather shall be in accordance with IS: 456, except as herein modified. Admixtures may be used only when approved by the Engineer-in-Charge. Adequate provisions shall be made to lower give limit concrete temperatures by cool ingredients, eliminating excessive mixing, preventing exposure of mixers and conveyors to direct sunlight and the use of reflective paint on mixers, etc. The temperature of the freshly placed concrete shall not be permitted to exceed 38 degrees centigrade. Consideration shall be given to shading aggregate stockpiles from direct rays of the sun and spraying stockpiles with water, use of col dwater when available, and burying, insulating, shading and/or painting white the pipelines and water storage tanks and conveyance.

In order to reduce loss of mixing water, the aggregate, wooden forms, sub grade, adjacent concrete and other moisture absorbing surfaces shall be well wetted prior to concreting, placement and finishing shall be done as quickly as possible.

Extra precautions shall be taken for the protection and curing of concrete. Consideration shall be given to continuous water curing and protection against high temperatures and drying hot winds for a period of at least 7 days immediately after concrete has set and after which normal curing procedures may be resumed.

Placing Concrete Underwater

a) Under all ordinary conditions, all foundations shall be completely dewatered and concrete placed in the dry. However, when concrete placement under water is necessary, all work shall conform to IS: 456 and the procedure shall be as follows: Method of Placement Concrete shall be deposited underwater by means of tremises, or drop bottom buckets of approved type. Direction, Inspection and Approval All work requiring placement of concrete underwater shall be designed, directed and inspected with due regard to local circumstances and purposes. All underwater concrete shall

be placed according to specifications approved by the Engineer-in-Charge.

b) Special precautions shall be taken for prevention of lifting of concrete due to uplift pressure of subsoil water.

Precast Concrete General

Precast concrete units, whether manufactured on or off site, shall comply in every way with the provisions of the contract for in situ concrete. Wherever possible, precast units shall be hydraulically pressed. When ready for incorporation in the works, precast units shall be responsible for the accuracy of the level, shape of the bed or platform. A suitable serial number and the date of casting shall be impressed or painted on each unit.

Striking Forms

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

Precast Units

The lifting and removal of precast units shall be undertaken without causing shock, vibration or undue bending stresses to or in the units. Before lifting and removal takes place, contractor shall satisfy the Engineer-in-Charge or his representative that the methods he proposes to adopt for these operations will not over-stress or otherwise effect seriously the strength of the precast units. The reinforced side of the units shall be distinctly marked.

Curing

All precast work shall be protected from the direct rays of the sun for at least 7 days after casting and during that period each unit shall be kept constantly watered or preferably be completely immersed in water if the size of the unit so permits.

Slots, Openings, Etc. General

Slots, openings or holes, pockets, etc., shall be provided in the concrete work in the approved positions as per design drawings and as directed by Engineer-in-Charge and extra reinforcement should be provided as per design requirement. Short pipes with puddle collar shall be fixed in the side wall of suction pipes. They shall be supplied at the appropriate time during construction. Any deviation from the approved drawings shall be made good by contractor at his own expense, without damaging any other work. Sleeves, bolts, inserts etc., shall also be provided in concrete work where so required.

Grouting

Standard Grout

The proportions of grout shall be such as to produce a flowable mixture consistent with minimum water content and shrinkage. The grout proportions shall be limited as follows:

Table 10 : Proportions for Standard Grout

Sr.	Use	Grout thickness	Mix proportions	W/c ratio (max.)
1.	Fluid	Under 25 mm	One part Portland cement to one part sand	0.44
2.	General	25mm & over but less than 50mm	One part Portland cement To 2 parts of sand	0.53
3.	Stiff Mix	50mm & over	One part Portland cement	0.53

Sr.	Use	Grout thickness	Mix proportions	W/c ratio (max.)
			to 3 parts of sand	

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

Passing BIS 2.36 mm sieve 95 to 100%
Passing BIS 1.18 mm sieve 65 to 95%
Passing BIS 300 micron sieve 10 to 30%
Passing BIS 150 micron sieve 3 to 10%

Sand for fluid grouts shall have the fine material passing the 300 and 150 micron sieves at the upper limits specified above. Sand, for still grouts, shall meet the usual grading specifications for concrete laitance. Anchor bolts, anchor bolt holes and the bottoms of equipment and column base plates shall be cleaned of all oil, grease, dirt and loose material. The use of hot, strong caustic solution for this purpose will be permitted. Prior to grouting, the hardened concrete surfaces to be grouted shall be saturated with water. Water in anchor bolt holes shall be removed before grouting is started. Forms around base plates shall be reasonably tight to prevent leakage of the grout. Adequate clearance shall be provided between forms and base plate to permit grout to be worked properly into place. Grouting, once started, shall be done quickly and continuously to prevent segregation, bleeding and breakdown of initial set. Grout shall be worked from one side of one end to the other to prevent entrapment of air. To distribute the grout and to ensure more complete contact between base plate and foundation and to help release trapped air, link chains can be used to work the grout into place. Grout throughout holes in base plates shall be by pressure grouting. Variations in grout mixes and procedures shall be permitted if approved by the Engineer-in-Charge.

Non-Shrinking Grout for Equipment Foundation

Non-shrinking grout shall be used for grouting of machine base plates, anchor bolts, other anchoring devices and at locations where ordinary grouts are ineffective due to shrinkage. It shall be composed of a type of expansive hydraulic sheeting binder and select-graded aggregates. It shall have properties as mentioned below:

Table 11 : Proportions for Non-Shrinking Grout

Sr.	Properties	Values
1	Maximum grain size	6 mm
2	Water % (for 80% flow)	15.17
3	Density of hardened grout	2.27 - 2.30 gm/m1
4	Compressive strength	
	Minimum 3 days	23
	7 days	34
	28 days	45
5	Expansion %	
	Free	0.10 - 0.20
	Restrained	0.08 - 0.12
	Restrained	0.08 - 0.12

Mixing, batching, cleaning, preparation of surface and curing of non-shrinking grout shall be done as per manufacturer's instructions. Brands like FOSROC or BUILDMASTER etc. shall be used as per manufacturer specifications.

Inspection

All materials, workmanship and finished construction shall be subject to continuous inspection and approval of the Engineer-in-Charge.
All materials supplied by the Contractor and all work or construction performed by the Contractor which is rejected as not being in conformity

with the specifications and requirements, shall be immediately replaced.
All concrete shall be protected against damage until final acceptance by the Engineer-in-Charge.

Clean-Up

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

Records of Concreting

An accurate and up to date record showing times, dates, weather and temperature conditions when various positions of all the concrete structures forming the works were concreted will be kept by the contractor and shall be countersigned by the Engineer-in-Charge. If the Contractor fails to sign the Engineer-in-Charge's record, it shall nevertheless be regarded as correct and binding on the Contractor.

The Contractor has to submit concrete pour card in duplicate duly to be signed to the Engineer-in-Charge for each type of concreting work. Contractor shall keep copy of it, after Engineer-in-Charge has checked and signed the pour card.

Foundation Bedding, Bonding and Jointing

In no case foundation shall rest on any loose strata or loose pockets etc. even though it has reached level shown on design drawings and referred back to design engineer / Engineer-in-Charge
All surfaces upon or against which concrete will be place dshal lbe suitably prepared by thoroughly cleaning, washing and dewatering, as specified or as the Engineer-in-Charge may direct, to meet the various situations encountered in the work.
Soft or spongy areas shall be cleaned out and backfilled with lean concrete or clean sand fill compacted.
Prior to construction of formwork for any item where soil will act as bottom form, approval shall be obtained from the Engineer-in-Charge for the suitability of the soil.

Preparation of Rock Strata of Foundations

To provide tight bond with rock foundations, the rock surface shall be prepared and the following general requirements shall be observed.
Concrete shall not be deposited on large sloping rock surfaces. Where required by the Engineer-in-Charge, the rock shall be cut to form rough steps or benches to provide roughness or a more suitable bearing surface.
Rock foundation stratum shall be prepared by picking, barring, wedging and similar methods which will leave the rock in an entirely sound and unshattered condition.

Shortly before concrete is placed, the rock surface shall be cleaned with high pressure water and air jet even though it may have been previously cleaned in that manner.
Prior to placing concrete, the rock surface shall be kept wet for a period of 2 to 4 hours unless otherwise directed by the Engineer-in-Charge.
Before placing concrete on rock surfaces all water shall be removed from depressions to permit thorough inspection and proper bonding of the concrete to the rock.

Formwork, Fixing and General

All formwork shall be constructed of waterproof plywood or preferably sheet metal. Plywood used for form work shall be conforming to BIS: 4990 i.e. Specification for plywood for concrete shuttering works. The materials for formwork shall get approved by the Engineer-in-Charge before starting the work. Formwork shall be firmly supported, adequately strutted, braced and tied to withstand the placing and vibrating of concrete and the effects of weather. The tolerance on line and level shall not exceed 3 mm and the soffits of beams other than pre-stressed beams shall in the absence of any specified camber, be erected with an upward camber of 6 mm for each 3 meters of span.
The Contractor shall be responsible for the calculations and designs for the formwork, and if required, shall submit them to the Engineer-in-Charge for approval before construction. On form work to external faces, which will be permanently, exposed, all horizontal and vertical formwork joints shall be so arranged that joint lines will form a uniform pattern on the face of the concrete. Where the Contractor proposes to make up the form work for standard sized manufactured form work panels, the size of such panels shall be approved by the Engineer-in-Charge before they are used in the construction of the Works. The finished appearance of the entire elevation of the structure and adjoining structures shall be considered when planning the pattern of joint lines caused by form work and by construction joint to ensure continuity of horizontal and vertical lines.
Faces of form work in contact with concrete shall be free from adhering foreign matter, projecting nails and the like, splits or other defects, and all form work shall be clean and free from standing water, dirt, shavings, chippings or other foreign matter. Joints shall be sufficiently watertight to prevent the escape of mortar or the formation of fins or other blemishes on the face of the concrete and no bleeding should be allowed through the joints.

Form work shall be provided for the top surfaces of sloping work where the slope exceeds fifteen degrees from the horizontal (except where such top surface is specified as spaded finish) and shall be anchored to enable the concrete to be properly compacted and to prevent flotation, care being taken to prevent air being trapped.

Openings for inspection of the inside of the form work and for the removal of water used for washing down shall be provided and so formed as to be easily closed before placing concrete. Before placing concrete, all bolts,

pipes or conduits or other fixtures which are to be built in shall be fixed in their correct positions, and cores and other devices for forming holes shall be held fast by fixing to the formwork or otherwise. Holes shall not be cut in any concrete without approval of the Engineer-in-Charge.

All exterior angles on the finished concrete of 90 degree or less shall be given 20 mm x 20 mm chamfers unless otherwise ordered by the Engineer-in-Charge.

No ties or bolts or other device shall be built into the concrete for the purpose of supporting formwork without the prior approval of the Engineer-in-charge. The whole or part of any such supports shall be capable of removal so that no part remaining embedded in the concrete shall be nearer than 50 mm from the surface in the case of reinforced concrete and 150 mm in the case of un-reinforced concrete. Holes left after removal of such supports shall be neatly filled with well rammed dry-pack mortar.

Formwork in contact with the concrete shall be treated with suitable non-staining mould oil to prevent adherence of the concrete except where the surface is subsequently to be rendered. Care shall be taken to prevent the oil from coming in contact with reinforcement or with concrete at construction joints. Surface retarding agents shall be used only where ordered by the Engineer-in-Charge.

No formwork shall be started or placed unless the requirement work is fully completed and checked by Engineer-in-Charge.

Necessary cover blocks shall be provided before starting connection.

Removal of Formwork

Formwork shall be so designed as to permit any removal without resorting to hammering or levering against the surface of the concrete.
The periods of time elapsing between the placing of the concrete and the striking of the loads likely to be imposed on the concrete and shall in any case be not less than the periods shown in Table below. Where soffit formwork is constructed in a manner during and after such removal of a sufficient number of adequate supporting props in an undisturbed condition, the Contractor may, with the agreement of the Engineer-in-Charge, remove the formwork at the earlier times listed below provided that the props are left in position.

Table 12 : Period for Formwork

Position of formwork	Days for striking
Walls	1
Sides of beams and columns	2
Slabs (Props left under)	3
Props to slabs (span not exceeding 4.5m)	7
Props to slabs (span exceeding 4.5 m)	14

Beams soffits (props left under)	**7**
Props to beams (span not exceeding 6 m)	**14**
Props to beams (span exceeding 6 m)	**21**
Circular structures, domes, cantilever portions etc.	**21**

Notwithstanding the foregoing, the Contractor shall be held responsible for any damage arising from removal of formwork before the structure is capable of carrying its own weight and any incidental loading.

Striking shall be done slowly with utmost care to avoid damage to projections and without shock or vibration, by gently easing the wedges. If after removing the formwork it is found that timber has been embedded in the concrete. It shall be removed and made good as specified earlier.

Reinforced temporary openings shall be provided, as directed by the Engineer-in-Charge, to facilitate removal of formwork which otherwise may be inaccessible.

The rods, clamps, form bolts, etc. which must be entirely removed from walls or similar structures shall be loosened not sooner than 24 hours not later than 40 hours after the concrete has been deposited. Ties, except those required to hold forms in place, may be removed at the same time. Ties, withdrawn from walls and grade beams shall be pulled toward the inside face. Cutting ties back from the faces of the walls and grade beams will not be permitted.

For liquid retaining structures, no sleeves for through bolts shall be used nor shall through bolts be removed as indicated above. The bolts, in this case, shall be cut at 25 mm depth or more from the surface and then the hole shall be made good by cement sand mortar of the same proportions as the concrete just after striking the form work.

Formed Surfaces - Classes of Finish

Finishes to formed surfaces of concrete shall be classified as F1, F2, or F3, or such other special finish as may be particularly specified. Where the class of finish is not specified the concrete shall be finished to Class F1.

Form work for Class F3 finish shall be lined with as large panels as possible of non-staining material with a smooth unblemished surface such as sanded plywood or hard compressed fiber board, arranged in a uniform approved pattern and fixed to back form work by oval nails. Unfaced wrought boarding or standard steel panels shall not be permitted.

Form work for Class F2 finish shall be faced with wrought tongued and grooved boards or plywood or metal panels arranged in a uniform approved pattern free from defects likely to detract from the appearance of the surface.

Form work for Class F1 finish shall be constructed in sheet metal. Surfaces subsequently to be rendered, plastered or tiled shall be adequately scrabbled or hacked as soon as the form work is removed to reduce the irregularities to not more than half the thickness of such rendering, plastering or bedding for tiles and to provide a satisfactory key.

Defects in Formed Surfaces

Workmanship in formwork and concreting shall be such that concrete shall normally require no making good, surfaces being perfectly compacted and smooth.

If any blemishes are revealed after removal of formwork, the Engineer-in-Charge's decisions concerning remedial measures shall be obtained immediately. These measures may include, but shall not be limited to the following:

Fins, pinhole bubbles, surface discoloration and minor defects may be rubbed down with sacking immediately after the formwork is removed. Abrupt and gradual irregularities may be rubbed down with carborundun and water after the concrete has been fully cured. These and any other defects shall be remedied by methods approved by the Engineer-in-Charge which may include using a suitable epoxy resin or, where necessary, cutting out to a regular dovetails shape at least 75 mm deep and refilling with concrete over steel mesh reinforcement sprung into the dovetail.

The form work shall be checked by the Engineer-in-Charge before the form work starts
and form found defective shall be rejected and the same can be used after rectifying the
defects and with due approval of the Engineer-in-Charge

Holes to be filled

Holes formed in concrete surfaces by form work supports or the like shall be filled with dry-pack mortar made from one part by weight of ordinary Portland cement and one part fine aggregate passing BIS sieve 1.18 mm. The mortar shall be mixed with only sufficient water to make the materials stick together when being molded in the hands.
The contractor shall thoroughly clean any hole that is to be filled with dry-pack mortar and where the surface has been damaged, the contractor shall break out any loose, broken or cracked concrete or aggregate. The concrete surrounding the hole shall then be thoroughly soaked after which the surface shall be dried so as to leave a small amount of free water on the surface. The surface shall then be dusted lightly with ordinary Portland cement by means of a small dry brush until the whole surface that will come into contact with the dry-pack mortar has been covered and darkened by absorption of the free water on the surface. The surface shall then be dusted lightly with ordinary Portland cement by means of a small dry brush until the whole surface that will come into contact with the dry-pack mortar has been covered and darkened by absorption of the free water by the cement. Any dry cement in the hole shall be removed.

The dry-pack material shall then be placed and packed in layers having a compacted thickness not greater then 15 mm. The compaction shall be carried out by use of a hardwood stick and a hammer and shall extend over the full area of the layer, particular care being taken to compact the dry-pack against the sides of the hole. After compaction, the surface of each layer shall be scratched the dry-pack fill and striking the block several times. Steel finishing tools shall not be used and water shall not be added to facilitate finishing.

Tolerances

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

Tolerances for RCC Structures

i. Variation from the plumb **In the lines and surfaces of columns, piers, walls 5 mm per 2.5 m or 25 mm, whichever is less.** **For exposed corner columns and other conspicuous lines In any bay or 5 m maximum 5 mm** **In 10 m or more 10 mm**
ii. Variation from the level or from the grades indicated on the approved drawings In slab soffits, ceilings, beam soffit, and in arises **In 2.5 m** **5 mm In any bay or 5 m maximum** **10 mm In 10 m or more** **15 mm** **For exposed lintels, sills, parapets, horizontal grooves and other**
iii. Variation of the linear building lines from established position in plan and related position of columns, wall and partitions **In any bay or 5 m maximum** **10 mm In 10 m or more** **20 mm**
iv. Variation in the sizes and locations of sleeves, openings in walls and floors excep ti nthe case of and for 5mm anchor bolts
v. Variation in cross sectional dimensions of columns and beams and in the thickness of slabs and walls **Minus** **5 mm Plus** **10 mm**
vi. Footings Variation in dimension in plan **Minus** **5 mm Plus** **10 mm**

vii.	**Misplacement or eccentricity 2% of footing width in the direction of misplacement but not more than 50 mm Reduction in thickness: Minus 5% of specified thickness subject to a maximum of 50 mm**
viii.	**Variation in steps In a flight of stairs** **Rise 3 mm Tread 5 mm In consecutive steps** **Rise 1.5 mm Tread** **3 mm Tolerances in other Concrete Structures**
ix.	**All structures** **Variation of the constructed linear outlines from established position in plan In 5 m 10 mm** **In 10 m or more 15 mm** **Variations of dimensions to individual structural features from established positions In 20 m or more 25 mm** **In buried construction 50 mm** **Variation from plumb, from specified batter or from curved surfaces of all structures In 2.5 m 10 mm** **In 5 m** **15 mm In 10 m or more** **25 mm** **In buried construction twice the above amounts** **Variation from level or grade indicated on approved drawings in slab, beams, soffits, horizontal grooves and visible arises** **In 2.5 m 5 mm In 7.5 m or more 10 mm** **In buried construction Twice the above amounts Variation in cross-sectional dimensions of columns, beams, buttresses, piers and similar members** **Minus 5 mm Plus 10 mm**
x.	**Footings for columns, piers, walls, buttresses and similar members** **Variation of dimensions in plan** **Minus 10 mm Plus 50 mm Misplacement 2% of footing width in the direction of misplacement but not more than 50 mm. Reduction in thickness** **5% of specified thickness subject to a maximum of 50 mm**
xi.	**Tolerance in other types of structures shall generally conform to those given in Clause 2.4 of Recommended Practice for Concrete Formwork (American Concrete Institute Act 347).**
xii.	**Tolerance in fixing anchor bolts shall be as follows: Anchor bolts without sleeves + 5 mm** **Anchor bolts with sleeves + 5 mm for bolts up to 20 mm dia 3 mm for bolts above 32 mm dia** **Embedded parts + 5 mm in all directions**

Bracing, Struts and Props

Form work shall be braced, strutted, propped and so supported that it shall not deform under weight and pressure of the concrete and also due to the movement of men and other materials. Bamboo shall not be used as props or cross bearers.

The formwork for beams and slabs shall be so erected that the formwork on the sides of the beams and under the soffit of slabs can be removed without disturbing the beam bottoms. Repropping of beams shall not be done except when props have to be reinstated to take care of construction loads anticipated to be in excess of the design load. Vertical props shall be supported on wedges or other measures shall be taken whereby the props can be gently lowered vertically while striking the formwork.

If the formwork for a column is erected for the full height of the column, one side shall be left open and built up in sections as placing of the concrete proceeds, or windows may be left for pouring concrete from the sides to limit the drop of concrete to 1.0 m as directed by the Engineer-in-Charge.

Contractor shall submit the detailed design and methodology with applicable drawings if any of Formwork system for different members for approval of Engineer-in-Charge.

Reinforcement

Relevant IS Codes

IS: 432	**:**	**Mild steel and medium tensile steel bars & hard for**
IS: 1786	**:**	**drawn steel wire concrete reinforcement**
IS: 2502 (1963):		**Cold twisted steel bars for concrete reinforcement Code**
IS: 55225(1969):		**concrete of practice for bending and fixing of bars for reinforcement works**
IS: 2751	**:**	**Recommendations for detailing of reinforcement in RCC**
IS: 9417	**:**	**C.P. for welding of MS bars used for RCC**
IS: 10790	**:**	**Recommendations for welding cold worked steel bars Methods of sampling of reinforced steel**

General

Reinforcement shall be high strength deformed corrosion resistant (CRS) bars as per IS: 1786 – Fe415. Wire mesh or fabric shall be in accordance with IS: 456. Substitution of reinforcement will not be permitted except upon written approval from the Engineer-in-Charge.

Storage

The reinforcement shall not be kept in direct contact with the ground but stacked on top of an arrangement of timber sleepers or the like.
If the reinforcing rods have to be stored for a long duration, they shall be coated with cement wash before stacking and/or be kept under cover or stored as directed by the Engineer-in-Charge.
Fabricated reinforcement shall be carefully stored to prevent damage, distortion, corrosion and deterioration.
It should be seen that the reinforcement will not be exposed to direct sunlight and preventive measures should be taken for the same.

Quality

All reinforcements shall be clean, free from grease, oil paint, dirt, loose mill scale, loose rust, dust bituminous material or any other substances that will destroy or reduce the bond. All rods shall be thoroughly cleaned before being fabricated. Pitted and defective rods shall not be used. No welding of rods to obtain continuity shall be allowed unless approved by the Engineer-in-Charge. If welding is approved, the work shall be carried out as per IS: 1786 – Fe415 according to the best modern practices and as directed by the Engineer-in-Charge. In all cases of important connections, tests shall be made to prove that the joints are of full strength of bars welded. Special precautions, as specified by the Engineer-in-Charge, shall be taken in the welding of cold worked reinforcing bars and bars other than mild steel.

Laps

Laps and splices for reinforcement shall be as per IS: 456-2000. Splices in adjacent bars shall be staggered as mentioned in structural drawings and locations of all splices shall be approved by the Engineer-in-Charge.

Also contractor shall submit the Bar bending schedule for approval of Engineer-in-Charge and shall follow same unless and until changed by any design changes.

Bending

Reinforcement bars supplied bent or in coils, shall be straightened before they are cut to size. Straightening of bars shall be done cold and without damaging the bars.
All bars shall be accurately bent according to the sizes and shapes shown on the approved detailed working drawings/bar bending schedules. They shall be bent gradually by machine or other approved means. Reinforcing bars shall not be straightened and re-bent in a manner that will injure the material; bars containing cracks/splits shall be rejected. They shall be bent cold, except bars of over 25 mm in diameter, which may be bent hot

if specifically, approved by the Engineer-in-Charge. Bars, which depend for their strength of cold working, shall not be bent hot. Bars bent hot shall not be treated beyond cherry red colour (nor exceeding 845 C) and after bending shall be allowed to cool slowly without quenching. Bars incorrectly bent shall be used only if the means used for straightening and re-bending be such as shall not, in the opinion of the Engineer-in-Charge, injure the material. No reinforcement shall be bent when in position in the work without approval, whether or not it is partially embedded in hardened concrete. Bars having kinks or bends other than those required by design shall not be used.

Fixing

Reinforcement shall be accurately fixed by any approved means and maintained in the correct position shown in the approved Drawings by the use of blocks, spacers and chairs, as per IS:2502 to prevent displacement during placing and compaction of concrete. Bars intended to be in contact at crossing points shall be securely bound together at all such points with number 16 gauge GI wire. The vertical distances required between successive layers of bars in beams o rsimilar members shall be maintained by the provision of mild steel spacer bars at such intervals that the main bars do not perceptibly sag between adjacent spacer bars. No binding wire shall protrude in cover area and shall bent inside.

Cover

Unless indicated otherwise, clear concrete cover for reinforcement (exclusive of plaster or other decorative finish) shall be as follows:
At each end of a reinforcement bar, not less than 25 mm nor less than twice the diameter of the bar whichever is greater.
For a longitudinal reinforcing bar in a column not less than 40 mm nor less than the diameter of the bar.
For longitudinal reinforcing bars in a beam, not less than 40 mm nor less than the diameter of the bar, whichever is greater.
For tensile, compressive, shear or other reinforcement in a slab, or wall, not less than, 20 mm, nor less than the diameter of such reinforcement.
For any other reinforcement, not less than 20 mm, nor less than the diameter of such reinforcement.
For footing and other principal structural members in which the concrete is poured on a layer of lean concrete, the bottom cover shall be reduced to 60 mm.
For concrete surfaces exposed to the weather or the ground after removal of forms, such as retaining walls, grade beams, footing sides and tops, etc. not less than 40 mm for bars larger than 16 mm diameter and not less than 30 mm for bars 16 mm diameter or smaller.
For liquid retaining structures, the minimum cover to all steel shall be 40 mm or the diameter of the main bar, whichever is greater.
The correct cover shall be maintained by cement mortar cubes or other approved means. Reinforcement for footings, grade beams and slabs on subgrade shall be supported on precast concrete blocks as approved by the Engineer-in-Charge. The use of pebbles or stones shall not be permitted.

The 28 day crushing strength of cement mortar cubes/precast concrete cover blocks shall be at least equal to the specified strength of concrete in which these cubes/blocks are embedded.
The minimum clear distance between reinforcing bars shall be in accordance with IS: 456

Inspection

After final erection of reinforcement, it shall be intimated to Engineer-in-Charge in writing or through pour cards. Erected and secured reinforcement shall be inspected and approved by the Engineer-in-Charge prior to placement of concrete.

Welding OF Reinforcement

Reinforcement which is specified to be welded shall be welded by any process which conforms with the requirements of IS:2751 and which the Contractor can demonstrate by bend and tensile tests will ensure that the strength of the parent metal is not reduced and that the weld possesses a strength not less than that of the parent metal. The welding procedure established by successful test welds shall be maintained and no deviation from this procedure shall be permitted. Welds in positions other than those shown on the approved Drawings shall not be permitted. Tack welding to lightly secure reinforcement in place will be permitted subject to approval of the Engineer-in-Charge.

Supply of Reinforcing Bars

Steel reinforcement, such as MS bars HYSD bars etc. required for the works shall be procured by contractor from primary manufacturers only. Bidder shall consider use of any of the following Steel bar reinforcements required for civil works and associated works:
Steel bar reinforcement (Grade Fe 415, Fe 500, Fe 550): or High strength Rebar (Thermo-mechanically treated bar) ISI marked from SAIL, Tata Steel, RINL, Jindal Steel and Power Ltd. and JSW Steel Ltd. or any other primary producer, as approved by MD/CGM, who are using iron ore as the basic raw material and having crude steel capacity of 2.0 million tons per annum or more.

The contractor shall arrange for transport, loading, unloading and storage at the work sites. The contractor should plan the procurement of steel in such a way that at least required quantity of steel of specified sizes is available at site for 3 months period.

Steel brought on site shall be stored in proper manner as approved by Engineer In Charge so as to avoid distortion, deterioration and corrosion. The contractor shall maintain proper register for the steel account, showing the steel received at site, steel used, and the balance stock on site, to the entire satisfaction of the Engineer-in-Charge.

Structural Steel Work

Relevant IS Codes

IS: 2062 : Specification for Structural Steel (Fusion Welding Quality)
IS: 800 : C.P. for general construction in steel
IS: 808 : R.S. beam, channel and angel sections
IS: 814 : Covered electrodes for metal arc welding of structural steel
IS: 1148 : Hot rolled steel rivet bars for structural purpose
IS: 1363 : Black hexagon bolts, nuts, and lock nuts (dia 6 to 39mm) & black hexagon screws (dia 6 to 24mm)
IS: 2062 : Structural steel (fusion welding quality)
IS: 3954 : Hot rolled steel channel sections for general engineering purposes
SP-6 (I – VII) : ISI Handbook for Structural Engineers
SP-40 : Handbook on structures with steel portal frames (without cranes)

General

Structural steel fabrication work shall include all types of steel structural work required for installation of platform for operation and installation of equipment where rolled steel sections are joined together either by bolting or riveting or welding as specified in the drawings/bill of quantities/directed by the Engineer. It shall also include fabrication and installation of air vessels/pressure vessels etc. Covers for ducts for electrical panels along with their seating arrangements are also classified under this heading unless they are provided separately under a different heading. Reaction tanks or storage vessels are also classified under this heading.

Materials

The MS structural members such as MS angles, channels, flats, I sections etc. shall conform IS 2062. Structural steel that is used for fabrication shall be conforming to any of the following grades of steel as specified to each of the works:
IS: 2062 : Specification for Structural Steel (Fusion Welding Quality)
IS: 1977-1975 : Structural steel (ordinary quality)
IS: 2062-1980 : Weld able Structural steel (fusion quality)

Whenever the contractor supplies steel, he shall on demand the test certificates from the manufacturer. The welding rods used for fabrication hall conform to IS: 814-1974 (parts I and II). The fasteners like bolts, nuts etc., shall conform to IS: 1367.

Rivets shall conform to IS: 1184-1982. Plain washers shall conform to IS: 2016-1967. Spring washers shall conform to IS: 3063-1972.

MS rivets shall conform to IS: 1148 and IS: 1929-1967 bolts and nuts shall conform to IS: 1363 - 1967.

If metal arc welding is to be done as per design or as ordered by the Engineer-in-charge the electrodes used for strength welds shall conform to IS: 814 and shall be of such shape and size approved by the Engineer-in-Charge and shall be prevented from oxidation and shall be kept in clean condition.

Paints used shall be of approved manufacture and shade and shall conform to the ISI standards.

Fabrication and Erection

All the shop drawings shall be prepared by the contractor and submitted in advance of at least 15 days to the Engineer for his approval. The drawings shall be submitted in triplicate. The fabrication work shall not be taken in hand until the shop drawings are approved by the Engineer. Approval of the shop drawings however shall not relieve the contractor of his responsibility of correct conformation to the designs and fabrications of the structure to meet the requirements of the contract. One copy of the approval drawings shall be given to the contractor for going ahead with the fabrication work.

In the shop drawings to be submitted by the contractor, standard symbols as described in the IS: 813-1961 shall be followed.

Fabrication work shall be carried out as laid down in IS: 800-1984 Code of practice for general construction in steel.

Welding shall be carried out in accordance with the following specifications as applicable:

IS: 803 - 1976 : Code of practice for design fabrication and erection of vertical mild steel cylindrical welded oil storage tanks.

IS: 816 - 1969 : Code of practice for use of metal and welding for general construction in mild steel

IS: 822 - 1970 : Code of practice for manual and welding of mild steel

IS:9595 - 1980 : Recommendations for metal are welding of carbon Radiographic tests are required to be carried out as directed by the Engineer in case of pressure vessels.

IS: 818 - 1968 : Code of practice for safety and health requirements in electric and gas welding and cutting operations

IS: 3016-1982 : Code of practice for fire precautions in welding and cutting operations

IS: 7205 – 1973 : Safety code for erection of structural steel work

The sections shall be fixed absolutely vertical or to the specified angle as shown in the drawings/as desired/directed by the Engineer.

All connections like angle brackets, cleats, gusset plates, anchor bolts, bearing plates shall all be fixed as shown in the drawings or as directed by the Engineer.
The items of work shall include supply of materials, fabrication and erection in position on site as shown in the drawings. This shall also include all labour consist, materials and equipment required for all fabrication, hoisting, erection, and satisfactory completion of the item of work.

The supply of materials includes all structural members like rolled sections, plates, brackets, rivets, bolts and nuts and welds.

The steelwork shall be painted as specified in the drawings, described in the bill of quantities or as directed by the Engineer. Unless otherwise provided for in th ebill of quantities separately, the rate quote dfor the item is inclusive of all costs for painting like cost of paint, cost of labour, scaffolding etc. Welding work shall be done generally using electric arcs welding. Where public electricity is not available, generators shall be arranged by the contractor shall be arranged by the contractor himself.

Gas welding shall not be allowed to be resorted to for welding. Under special circumstances if in the opinion of the Engineer it cannot be avoided, gas welding can be done with the prior permission of the Engineer. However gas welding shall not be used where structural strength is the criteria for consideration.

All arrangements shall be made by the contractors for access for inspection by the Engineer or his representative to the workshop where the welding work is being carried out and necessary equipment like gauges, measuring instruments etc., shall be made available to the inspecting personnel.

Painting work shall not be started without the express approval of the Engineer and the painting shall be started only after his inspection and approval of the works after carrying out surface preparations.

All holes shall be carefully marked. Holes shall have their axis perpendicular to the surfaces bored through. Holes being made through two or more members shall be truly concentric. Holes shall not be formed cutting process.

All the temporary connections of parts during assembly shall be done in the following ways. For welded structures. Tack welding fixtures.

After welding is over, the surface on the joint should be ground and made smooth and even. The welding should be so perfect so as to give required strength as taken for designed purpose at joints in particular. The

contractor will make necessary arrangements for testing of joints as required by Engineer in Charge.
Welded joints shall be free from defects that would impair the service performance of the construction. All the welds shall be free from incomplete penetration, incomplete fusion, slag inclusion, burns, un-welded creators undercuts and cracks in the welded metal, porosity etc. All the defects shall be rectified as directed by the Engineer. Defective portions shall be removed to the sound metal and re-welded. Rectification of the welds by caulking shall not be permitted.

All welds shall be cleaned of stag and other deposits after completion.

Painting

Painting shall generally comply with IS subject to addition and alterations as may be prescribed in the special provisions for any particular item. It shall also comply with the requirements of the manufacture's specifications. One priming coat of red lead shall be applied immediately after fabrication. Two coats of oil paint of approved shade shall be applied after complete erection. The structural steel to be embedded in concrete shall not be painted.

Inspection and testing shall be carried out in conformity with IS: 800.

Riveting, welding and bolting shall not be started until such time as the Engineer has personally satisfied himself that the alignment is correct, in the vertical plumb, the camber correct with camber packs, screwed tight, all joints and cover plates fixed tightened with service bolts and field rivet holes coinciding. While assembling holes in different components shall be made concentric with the use of drills before service bolts are fixed.

Welding if required shall be done a sper standard practice and as approved by the Engineer-in-Charge.

All permanent machine fitted nuts and bolts must be perfectly tight and shall be burred o rotherwise checked to prevent nuts from becoming loose. No unfitted rivet or bolt holes are to be left in any of the structure.

Structural Steel
All structural steel shall conform to IS: 2062-1984. The steel shall be free the defects mentioned in IS given above and shall have a smooth finish. The material shall be free from loose mild scale, rust pits or other defects affecting the strength and directly.

General

Engineer's approval shall be obtained before commencing the painting work. All paints and preserves shall be of approved make and colour and their application shall conform to the manufacture's instructions. Where more than one undercoat is specified it shall be applied in coats of

distinctive tints. Workmanship shall conform to the requirement of IS: 2395

Unless the manufacturer's instructions state otherwise48 hours drying time shall elapse between successive applications of any primer and 24 hours between applications of all subsequent coats. The surface of bituminous paints shall be left at least 3 days before further handling.
No paints in any coats shall be applied until the engineer is satisfied that the surface is clean and dry. And that any previous coat is satisfactory and has hardened adequately. When a surface has been approved, it must be painted immediately.

Paint work shall be rubbed down with a glass paper between coats. No paint shall be applied to a surface, which is damp, dirty or otherwise inadequately prepared.

Ironwork and Un Galvanized Steelwork

Structural steelwork shall be shot blasted to a "white metal" finish, and grease and oil removed prior to painting. Priming shall immediately follow blast cleaning and no cleaned surface shall be left unprimed for more than four hours. Only primers that chemically inhibit corrosion shall be used. Where the iron or steelwork is not in contact with raw or treated water, the primer shall be red lead complying with IS: 57. Where there is a possibility that the steel or ironwork may come in contact with water, the priming treatment shall be non toxic, zinc chromate or equivalent. Where it is anticipated tha tfurther welding will be required. An approved welding primer shall be applied to the areas to be welded and re primed with the main primer when welding has been completed. Primer coats shall not be less than 0.05 mm each.

After erection, all damaged areas shall be made good, and re primed where the original coat has spread under the primer, the affected surface shall be cleaned down to bare metal to the satisfaction of the Engineer and then re primed.

Repainting shall be carried out as soon as possible after erection. If it is to he exposed to weather or condensation, it shall receive one further coal of primer.

Metalwork in intermittent or permanent contact with raw or treated water shall have two finishing coats of an approved coal tar pitch epoxy paint such as "Epilux 5" by Berger Paints, or equivalent. The total coating shall be minimum of 0.125 mm thick.

After the second coat of primer is hard dry, the entire surface shall be wet rubbed cutting down to a smooth uniform surface. When the surface becomes dry, be undercoat of synthetic enamel paint conforming-to IS:2932 of optimum thickness shall be applied by brushing with minimum of brush marks. The coat shall be allowed to hard dry. The under coat shall then be wet rubbed cutting down to a smooth finish, taking adequate

care to ensure that at no place the undercoat is completely removed. The surface shall then be allowed to dry.

The first finishing coat of paint shall be applied by brushing and allowed to hard dry. The gloss from the entire surface shall then be gently removed and the surface dusted off. The second finishing coat shall then be applied by brushing.

At least 24 hours shall elapse between the applications of successive coats. Each coat shall very slightly in shade and this shall be got approved by the Engineer.

Brick Work and Stone Masonry

These specifications deal with all types of brickwork required for buildings, manholes, drains, retaining walls or any construction made out of bricks.

Relevant IS Codes

IS: 1077	**:**	**Common burnt clay building bricks**
IS: 2180	**:**	**Heavy duty burnt clay-building bricks**
IS: 2212	**:**	**C.P. for brickwork**
IS: 3495 (I – IV)	**:**	**Method of test for clay building bricks**
IS: 5454	**:**	**Method of sampling of clay building bricks**

Material

s Bricks

Bricks used for the construction of brick masonry shall be sound, hard, rectangular in shape and size and well burnt of uniform deep red, cherry or copper colour and shall conform to IS:1077-1986.

The bricks shall be brought from approved brick kilns. The bricks shall be free from cracks, chippings flaws, stones or lumps of any kind. The bricks shall not show any signs o feffloresccence and shall b ehomogeneous in texture.

They should emit a clear metallic sound on being struck and shall have a minimum compressive strength of 75 kg/sq.cm. They shall not absorb water more than specified in the Indian Standard Specifications, of its dry weight when soaked in cold water for 24 hours.

Mortar

The proportion of the cement mortar used for the masonry work shall be as specified on the various drawings for different places/types of construction, bills of quantities, specifications for each part of the work.

Mortar should be prepared by volume using boxes of appropriate sizes on clean platform or this sheet to avoid mixing of foreign material and maintain consistency of mortar.

Sharp coarse sand is mixed with the required quantity of cement for the preparation of the mortar. Mortar shall be prepared in accordance with IS:2250-1981. The sand used for the masonry mortar shall meet the requirements as specified in IS:2116-1980. Sand for masonry mortars. Sand and cement of required proportions are mixed in small quantities in a dry state first and then water is added to make the mortar of required the consistency suitable for the type of work it is required as directed by the Engineer-in-charge. No left over mortar shall be used and therefore only that much quantity of mortar that can be consumed within 30 minutes shall be mixed in batches.

Construction

The brick masonry shall be constructed as per the Indian Standard Code of Practice for Brick Work - IS: 2212-1962. The thickness of the joints shall not be thicker than those specified in of the above Code of Practice.

The bricks shall be thoroughly soaked in water before using them on the work for at least six hours and all the air bubbles shall come out during soaking process. The soaked bricks shall be stacked on wooden planks/platforms so as to avoid sticking of the earth and other materials on to the surfaces of bricks. Bricks required for construction in mud mortar or lime mortar shall not be soaked. Brickwork shall be laid in English Bond unless otherwise specified. Half bricks shall not be used except when need to complete the bond. Each course shall be perfectly

straight and horizontal. The masonry shall be true to plumb in case of vertical walls and in case of battered construction the batter or slope shall be truly maintained. The level of the courses completed shall be checked at every meter interval or less as required.

The bricks shall be laid frogs upwards. While laying the bricks they shall be thoroughly bedded and flushed in mortar and well trapped into position with wooden mallets and superfluous mortar shall be removed.

No part of the structure shall be raised more than one meter above than the rest of the work. In case it is unavoidable the brickwork shall be raked back at an angle of not more than 45 degrees so as to maintain a uniform and effectual bond, but raking shall not start within 60 cms from a corner.

In cases of construction of buttresses, counter forts, returns they are built course by course carefully bound into the main walls. At all junctions of walls the bricks at alternate courses, shall be carried into each of the respective walls so as to thoroughly unite both the walls together. The brickwork shall not be raised more than 14 courses per day.

All the beds and joints shall be normal to the pressures applied upon them i.e. horizontal in vertical walls, radial in arches and at right angles to the face in battered retaining walls.

Vertical joints in alternate courses shall come directly one over the other and shall be truly vertical. Care shall be taken to ensure that all the joints are fully filled up with mortar, well flushed up where no pointing is proposed, neatly struck as the work proceeds. The joints in faces, which are plastered or painted, shall be squarely raked out to a depth not less than 12 mm while the mortar is still green. The raked joints shall be well brushed to remove the loose particles and the surfaces shall be cleaned with a wire brush so as to remove any splashes of mortar sticking to the surfaces during the construction.

All iron fixtures, pipes, bolts, conduits, sleeves, holdfasts etc., which are required to built into the walls shall be embedded in cement mortar or cement concrete as shown in the drawings/indicated in the specifications directed during the execution by the Engineer-in-charge as the work proceeds and no holes be left for fixing them at a later date unless authorized by the Engineer-in-Charge.

Curing

Fresh work shall be protected from rain by covering the work suitably. Masonry work as it progresses shall be thoroughly kept wet by watering on all the faces for atleast 7 (Seven) days after completion of the parts of the work. Proper watering cans, flexible pipes, nozzles shall be used for the purpose. The top of the masonry work shall be kept flooded at the close of the day's work by constructing fillets of mortar 40 mm high all around the edges of the top course. In case of fat lime mortar curing shall start two days after construction of masonry and shall continue for seven

days. No additional payment is admissible for curing and the rates quoted are deemed to be inclusive of the cost of curing.

Scaffolding

Double scaffolding sufficiently strong so as to withstand all loads that are likely to come upon it and having two sets of vertical supports shall be provided. Where two sets of vertical supports are not possible the inner end of the horizontal supporting pole shall rest in a hole provided in a header course only. Only one header for each pole shall be left cut. Such holes, however shall not be permitted in pillars under one meter in width or immediately near the skewbacks of arches. Such holes shall be filled up immediately after removal of the scaffoldings. Safety Code for Scaffolds and Ladders, IS: 3696-1987 (Parts I and II) shall be followed. The cost of scaffolding is deemed to be included in the rates quoted for brick masonry and no separate costs are payable.

Stone Masonry for Retaining Walls

Stone masonry in general is to be used for retaining walls as per engineer in-charge's instructions and as per drawings, which will be supplied during course of construction to suit site conditions.

Following Indian Standards shall be applicable:

IS:1122-1974	**Methods of determination of specific gravity and porosity of natural building stones**
IS:1200	**Method of measurement of stone masonry.**
IS:1597	**Code of practice of construction of rubble stone masonry.**
IS:1805	**Glossary of terms relating to stone quarrying and dressing**
IS:4101	**Stone facing**
IS:1121	**Determination of strength, properties of natural building stones**

Uncoursed Stone Masonry

Uncoursed stone masonry shall be built in layers not exceeding 450 mm in height. No stone shall be less in breadth than 14 times its height and less in length than twice its height. Every stone whether large or small, shall be laid in its natural bed and set flush in mortar, and the small stones used for wedging or filling being carefully selected to fit the interstices between the large stones. Care shall be taken to see that no dry work or hollow space is left in the masonry. The stones shall be so arranged as to break joints at least every 80 mm and long vertical joints of joints shall be avoided. The joints at the face shall be finished off neatly, being struck and smoothed with a trowel while the mortar is fresh. The upper surface of the work shall be brought to a uniform level at the height of each course. The faces of masonry walls shall be kept in perfect plumb and where batter has to be given it shall, be uniform. The stones at all comers and junctions of walls shall be of large sizes and hammer dressed to the correct angle.

Each stone shall be thoroughly wetted before being used in the work. The masonry shall be kept thoroughly wet during the progress of the work, (care being taken to water it even on Sundays and Holidays, special labour being employed if so required for this purpose) until it becomes hard. As far as practicable, the whole of the masonry shall be raised in one uniform level and no part of the masonry shall he allowed to rise more than 1 metre above the rest to avoid unequal settlement. If raising one part of wall before the other becomes unavoidable the end of the raised portion shall be racked back in steps to prevent cracks developing at the junction of the old and new work. Care shall be taken to see that the sides of the wall are not built separately from the hearting, the faces and internal filling being done simultaneously .The stones shall overlap and cross each other as much as possible. No course shall be laid unless the previous course is perfectly set.

Al least one header or through stone per square metre of wall face shall be built into the work. The headers or through stones shall be at least 0.05 m in area al face and shall have at least 0.025 m area at the back face. Where the thickness of the wall is more than 600 mm a series of through stones shall be laid through the work so as to form a tie from front to back, breaking joints or overlapping each other for at least 150 mm. No stone whose length is less than 600 mm shall be used in such work as a header.

All the through stones shall be marked inside and outside and the marks shall be retained until ordered by the Engineer to be removed. Sufficient number of headers shall be collected on site before commencing any masonry work. Where adequate sized through stones are not available in required quantities, the use of pre-cast plain concrete headers in M-20 mix may be permitted at the discretion of the Engineer. No extra payment will be made for the provision of substitute headers in concrete

Quoins shall be 150 mm high and formed of header stones at least 300 mm long. They shall he laid lengthwise alternately along each face and square on their beds, which shall be dressed to a depth of at least 80 mm.

Weep holes 80 mm wide and 150 mm in height shall be provided in retaining walls at the rate of one per square metre as specified or directed. They shall he pointed with 1:2 cement sand mortar after raking the joints to a minimum depth of 25 mm.

Completed masonry shall be kept wet for a minimum period of 14 days. In wet weather newly laid masonry shall be protected from the effects of heavy rainfall by tarpaulins or other approved material.

Pointing of Uncoursed Masonry

Joints in exposed masonry faces shall be formed while the mortar is still green and shall be finished as flush joints, weathered joints, round-recessed joints or square-recessed joints as directed by he Engineer. Masonry which is to be rendered or plastered shall have the joints raked out to a depth of 15 mm to form a key.

Stone Pitching

Stone pitching: to slopes shall be carried out where specified or as directed by the Engineer. Stone for pitching shall be obtained from an approved source and shall be hard, sound, durable, clean and generally as specified. The minimum dimension of any stone shall be, at least equal to the specified thickness of the pitching.

After excavation and trimming, slopes to be pitched shall be spread with a 75mm thick layer of crusher run rock or graded coarse aggregate ranging from 75mm particle size to fines. The slope shall then be hand packed with hard broken rock to a total thickness of 150 mm, each stone being individually placed and rammed home, with smaller stones edged into the cracks. 50mm dia weep-holes shall be provided where specified at intervals not exceeding two meter's in both directions. Joints in stone pitching shall be flushed up with sand/cement mortar on completion.

Rubble Packing

Rubble used for packing under floors, foundations, etc. shall be hard and durable rock, free from veins, flaws and other defects. The quality and size of the rubble shall be subject to the approval of the Engineer.

Rubble shall be hand packed as directed by the Engineer. They 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 stones and shall not lag behind.

Small interstices shall be filled with hard clean sand and well watered and rammed.

Concrete Block

Masonry Materials

Masonry units of hollow and solid concrete blocks shall conform to the requirements of IS: 2185 (Part I).

Masonry units of hollow and solid light-weight concrete blocks shall conform to the requirements of
IS: 2185(Part 3).

Masonry units of autoclaved cellular concrete blocks shall conform to the requirements of IS: 2185(Part 3).

The height of the concrete masonry units shall not exceed either its length or six times its width.

The nominal dimensions of concrete block shall be as under.
Length 400, 500 or 600 mm
Height 100 or 200 mm
Width 100 to 300 mm in 50 mm increments

Half blocks shall be in lengths of 200, 250 or 300mm to correspond to the full-length blocks. Actual dimensions shall be 10mm short of the nominal dimensions.

The maximum variation in the length of the units shall not be more than 5 mm and maximum variation In height or width of the units shall not be more than 3mm.

Concrete blocks shall be either hollow blocks with open or closed cavities or solid blocks.

Concrete blocks shall be sound, free of cracks, chipping or other defects, which impair the strength or performance of the construction. Surface texture shall as specified. The faces of the units shall be flat and rectangular, opposite faces shall be parallel and all arises shall be square. The bedding surfaces shall be at right angles to the faces of the block.

The concrete mix for the hollow and solid concrete blocks/light weight concrete blocks shall not be richer than one part of cement to six parts of combined aggregates by volume.

Concrete blocks shall be of approved manufacture, which satisfy the limitations in the values of water absorption, drying shrinkage and moisture movement, as specified for the type of block as per relevant IS code. Contractor shall furnish the test certificates and also supply the samples for the approval of Engineer in Charge.

Workmanship

The type of the concrete block, thickness and grade based on the compressive strength for use in load bearing and/or non-load bearing walls shall be as specified. The minimum nominal thickness of non load bearing internal walls shall be 100mm. The minimum nominal thickness of external panel walls in framed construction shall be 200 mm.

The workmanship shall generally conform to the requirements of IS: 2572 for concrete block masonry IS: 6042 for light weight concrete block masonry and IS: 6041 for autoclaved cellular concrete block masonry works.

From considerations of durability, generally concrete block masonry shall be used in superstructure works above the damp-proof course level.

Concrete blocks shall be embedded with a mortar, which is relatively weaker than the mix of the blocks in orde rto avoid the formation of cracks. Cement mortar of proportion 1:6 shall be used for the works.

The thickness of both horizontal and vertical joints shall be 10mm. The first course shall be laid with greater care, ensuring that it is properly aligned, leveled and plumb since this will facilitate in laying succeeding courses to obtain a straight and truly vertical wall. For the horizontal (bedding) joint, mortar shall be spread over the entire top surface of the block including front and rear shells as well as the webs to a uniform layer of 10mm. For vertical joints, the mortar shall be applied on the vertical edges of the front and rear shells of the blocks. The mortar may be applied either to the unit already placed on the wall or on the edges of the succeeding unit when it is standing vertically and then placing it horizontally, well pressed against the previously laid unit to produce a compacted vertical joint. In case of two cellblocks with slight depression on the vertical sides these shall also be filled up with mortar to secure greater lateral rigidity. To assure satisfactory bond, mortar shall not be spread too far ahead of actual laying of the block as the mortar will stiffen and lose its plasticity. Mortar while hardening shrinks slightly and thus pulls away from the edges of the block. The mortar shall be pressed against the units with a jointing tool after it has stiffened to effect intimate contact between the mortar and the unit to obtain a weather tight joint. The mortar shall be raked to a depth of 10mm as each course is laid to ensure good bond for the plaster.

Dimensional stability of hollow concrete blocks is greatly affected by variations of moisture content in the units. Only well dried blocks should be used for th econstruction. Blocks with moisture content more than 25% of maximum water absorption permissible shall not be used. The blocks should not be wetted before or during laying in the walls. Blocks should be laid dry except slightly moistening their surfaces on which mortar is to be applied to obviate absorption of water from the mortar.

As per the design requirements and to effectively control cracks in the masonry, RCC bound beam/studs, joint reinforcement shall be provided at suitable locations. Joint reinforcement shall be fabricated either from mild steel wires conforming to IS:280 or welded wire fabric/high strength deformed basis.

For jambs of doors, windows and openings, should concrete blocks shall be provided. If hollow units are used, the hollows shall be filled with concrete of mix 1:3:6. Hold fasts of doors/windows should be arranged so that they occur at block course level.

At Intersection of walls, the courses shall laid up at the same time with a true masonry bond between at least 50% of the concrete blocks.

Curing of the mortar joints shall be carried out for at least 7 days. The walls should only be lightly moistened and shall not be allowed to become excessively wet.

Double scaffolding shall be adopted for execution of block masonry work.

Cutting of the units shall be restricted to a minimum. All horizontal and vertical dimensions shall be in respectively, adopting modular co-ordination for walls, opening locations for doors, windows etc.

Concrete blocks shall be stored at site suitably to avoid any contact with moisture from the ground and covered to protect against wetting.

Damp-Proof

Course Materials and Workmanship

Where specified, all the walls in a building shall be provided with damp-proof course cover plinth to prevent water from rising up the wall. The damp-proof course shall run without a break throughout the length of the wall even under the door or other openings. Damp-proof course shall consist of 50 mm thick cement concrete of 1:2:1 nominal mix with approved water-proofing compound admixture confirming to IS: 2645 in proportion as directed by the manufacturer. Concrete shall b ewith 10 mm down graded coarse aggregates.

If he surface of brickwork/stone masonry work shall be leveled and prepared before laying the cement concrete. Side shuttering shall be properly fixed to ensure that slurry does not leak through and is also not disturbed during compaction. The upper and side surface shall be made rough to afford key to the masonry above and to the plaster.

Damp-proof course shall be cured properly for at least seven days after which it shall be allowed to dry for taking up further work.

Plasterin

g Relevant IS Codes

IS: 1542 : Sand for plaster
IS: 1661 : C.P. for application of ferrous metals in building
IS: 2394 : C.P. for application of lime plaster finish

Plastering

Cement mortar used for plastering shall be of the mix proportions and thickness as specified on the drawings or bill of quantities or particular specifications for the various different parts of the works.

The materials used i.e. cement, sand and water shall be of the same quality and of the same specifications as indicated for plain and reinforced cement concrete works in the Section D2 of this tender.

Sand further shall meet the specifications as laid down in IS: 1542-1977 Specification for sand for plaster.

The surfaces that are to be applied with plaster shall be thoroughly cleaned to remove dust, dirt, loose particles, oil, soil, slats etc. that may be sticking to the surfaces. The surfaces shall be washed clean and watered properly for 4 hours before applying plaster.

Plaster shall not, in any case, be thinner than specified. It shall have uniform specified thickness. When smooth finishing is required the cement plastering shall be floated over with neat cement within 15 minutes after application of the last coat of plastering.

The plaster shall be protected from the sun and rain by such means as the Engineer-in-charge in charge may approve. The plastered surfaces shall be cured for 7 (seven) days. Construction joints in plastering shall be kept at places approved by the Engineer-in-Charge. When the thickness of the plaster specified is to be made up in more than one layer, the second layer shall be applied only when the lower coat is still green. After applying the first layer the surface should be roughed and wherever specified, approved brands of additives like water proofing compounds shall be added in specified quantities as recommended by the manufacturer of the compound, or as directed by the Engineer-in-Charge.

Wherever scaffolds are necessary for plastering they shall be provided. Stage scaffolding shall be provided for ceiling plaster. To ensure even thickness and true surface, patches of plaster about 15 cms x 15 cms shall be first applied both horizontally as vertically 2 m apart. Plastering shall be done from top to bottom and care shall be taken to avoid joints on continuous surface.

Sand face plaster shall consist of first layer of 12 mm average thick cement plaster in cement mortar 1: 6 (One part cement and six parts coarse sand). A second layer of 4 mm average thick in cement mortar 1:4 (one part cement and four part coarse sand) shall be applied. After the application of final coat, the surface shall be finished with the application of sponge rubber or as directed to obtain a uniform sand particle surface finish.

In case any other finish like rough cast finish or dry dash finis his specified in the drawings the same shall be provided as directed by the Engineer-in-Charge. Surfaces, which are to be plastered, shall be roughened while

they are still green or raked so as to give proper bond between the surface and plaster.

All corner, edges, junctions shall be truly vertical or horizontal as the case may be and carefully finished. Rounding or chamfering of corners shall be carried out with proper templates to the required size and shapes.

No additional charges for works like scaffolding curing etc. are payable over and above the rates quoted for brickwork. The rates quoted shall be deemed to be inclusive of all such works.

Neeru

Material

Neeru shall be made of the best description of lime slaked wit hfresh water and sifted. The lime to be reduced to fine powder by grinding it on a stone or in a hand mill, with a thick solution of mussalla to be made or as may be desired by the engineer. The neeru thus prepared shall be kept moist until used and the quantity to be prepared at one time shall be such that it can be consumed in eight days.

Workmanship

All stone or brick masonry shall be thoroughly wetted and joints raked out to a depth of at least 20mm and walls washed before any plastering is done. The surface shall then rendered with fine sand, to the specified thickness and roughness. The surface shall then be floated or set with a thin coat, 3mm thick of cement and polished, well with a trowel or flat board. The cement mortar shall be used within 30 minutes after it leaves the mixing board or mill. Before any plasterwork is started patches of plaster 150mm x 150mm shall be put on at every 3 meters apart as gauges so as to ensure an even thickness throughout the work. Cement plaster shall be done in even square or strips. Care shall be taken to keep the whole surface thoroughly wetted for at least a week. The finishing surface shall be as specified and directed. If neeru finish is specified then the same shall be applied to the prepared and partially set but somewhat plastic surface with steel trowel to a thickness slightly exceeding 1.5 mm and rubbed down to 1.5mm thickness and polished to a perfectly smooth and even finish working from top to bottom. The surface shall be then colored, if required with 3 coats of white or colour wash for which no extra payment shall be made.

Flooring

Relevant IS Codes

IS:777	**:Glazed earthen ware tiles**
IS:1237	**:Cement Concrete flooring tiles**
IS:1443	**:C.P. for laying & finishing of cement concrete flooring tiles**
IS:2114	**:C.P. for laying in-situ terrazzo floor finish**

General

The materials and workmanship conform to the provisions of the following codes and standards. In particular and with such other standards as mentioned hereinafter. BIS: 269, 385, 515, 653, 712, 809, 1077, 1195, 1196, 1197, 1198, 1237, 1344, 1443.

Cement Concrete

Flooring General

Flooring shall consist of a sub-base laid on the compacted earth or sand fill as required, a base course laid on the sub-base and then a finishing layer of concrete, Terrazzo or any other material as specified to be laid. The materials for filling (Earth or sand as specified in drawings) shall be brought from the source as approved by the Engineer-in-Charge.

Filling

The surface to receive the filling shall be first cleared free of all roots, vegetation and wetted. Filling in plinth or other specified levels shall proceed in layers of 15 cm. Along with the construction of building, it shall be watered and well rammed in layers as mentioned above and compacted to the satisfaction of the Engineer-in-Charge.

Care shall be taken to remove all roots, vegetation, foreign matter, etc. from the earth used for filling. After thorough consolidation, required quantity of the filling corresponding to the thickness of floor shall be scrubbed to make space for the flooring.
Where sand filling is specified, the sand shall be clean, free from vegetation and other deleterious materials and same procedure followed as for earth filling. In case of sand filling, if required, flooding shall be done to achieve required compaction.

Preparation of Bed

The bed for flooring shall be prepared either level or sloped as per relevant drawings or as instructed by Engineer-in-Charge. Care shall be taken that there are no roots, vegetation, foreign matter, etc.

Sub-Base

On the prepared bed as indicated above, boulder, or gravel or broken bricks or sand or cement concrete (1:4:8 as per BIS: 465) shall be laid to thickness as specified. This layer shall be beaten with rammers until thoroughly consolidated. All the material used shall conform to the required specifications.

The materials proportion, mixing, laying, and curing, etc. for cement concrete shall be carried out as specified.
The finished work shall be of uniform depth over the whole floor with surface even and parallel to the prepared bed as per drawing or as directed by Engineer-in-Charge.

a. Boulders as Sub-base Course

Boulders shall be laid over the prepared bed as per general specification and shall be of size 100 to 150 mm and shall be of approved quality. Boulders being used shall be free from decay, weathering and be stacked in such heaps in place as directed by Engineer-in-charge, the thickness being as specified in the relevant drawings.

b. Sand Layer

Sand for sand layer to be laid over the prepared bond shall be clean, free from admixture as per specification. Sand layer shall be spread in one or more layers to the thickness as indicated in drawings or schedule of item watered and rammed.

Base Coarse

Cement Concrete

It shall be of specified mix and shall generally conform to "Construction Specification for Cement Concrete".

Panels

To prevent construction cracks, the floor space shall be divided into square or rectangular panels. The base course of specified thickness shall be laid in alternate panels or any other pattern as approved by Engineer-in-Charge. The panels shall be of uniform size, not exceeding 4.0 m. in any direction for a floor having thickness 40 mm and above. Alternate panels shall be laid on different days.

Construction joints shall be formed in between the sequential panels cast, with straight edges, 20 mm deep and 12 mm wide in groove form. These joints on completion of work, shall be cleaned and washed free of dust with the help of brush and shall be treated with hot bitumen poured in the gap, over which fine sand shall be spread to arrest the flow of bitumen.

Shuttering

The panels shall be bounded by glass strips having the same depth as the concrete floor. These shall be fixed in position with their top at proper level, giving slope. The floors shall butt against masonry of wall before it is plastered.

Concreting

Cement concrete shall be placed in position with or without MS reinforcements as shown in drawings and beaten with trowel and finished smooth or left rough as directed by the Engineer-in-Charge. Beating shall cease as soon as surface is found covered with cream of mortar. The surface shall be checked with the help of straight edge and made true.

The shuttering shall be removed next day. Care shall be taken to see that edges are not damaged and fresh mortar from adjacent panels is not splashed over them. The joints between panels shall come out as fine straight line.

MS reinforcement used for concrete base course with reinforcement shall conform to relevant BIS Specifications as detailed in drawings. Before placing of those reinforcements, they shall be cleared of scales with wire brush and oily stains removed.

Floor Finish Plain Cement Finish

Finishing of the surfaces shall follow immediately after the completion of base course. The surface shall be left for some time till the moisture

disappears from it. Use of dry cement or cement and sand mixture sprinkled on the moisture shall not be permitted.

Fresh quantity of cement at 2.2 kg per square meter of flooring shall be mixed with water to form thick slurry and spread over the surface, while the concrete is still green. It shall b epressed twice by means of iron floats, once when the slurry is applied and second time when cement starts setting.

The junction of floor with wall plaster, clods or skirting shall be rounded off uniformly where so required up to 25 mm radius or as directed. The men engaged on finishing operations shall be provided with raised wooden platform to sit on, so as floor finish is specified, the top surface of floor finish shall be chequered with mesh o rsimilar impression before the finish has set.

Curing

Each finished portion of floor, on completion, shall be kept wet with ponding or moist sand or moist gunny bags as per specifications. At no time, cement concrete layer, plain or reinforced shall be allowed to dry during curing time.

Granolithic (IPS) Flooring

The requirement for filling, preparation of bed, sub-base and base course concrete shall be same as in clauses above.

Finished Layers

Granolithic finish of the thickness as indicated in drawings or as specified shall consist of 2 layer of M15 grade cement concrete. The first layer of concrete shall be laid with 10 mm to 6 mm grade aggregate and well compacted. Within 15 minutes of laying this course the second layer with 6 mm down aggregate shall be laid. The cement and aggregates for the top layer shall be mixed dry.

Sufficient quantity o fwashed sand and water shall be mixed so as to make it plastic but not flowing. This mixture shall be laid on the first layer so that the two layers firmly grip together. The top layer shall be well tamped, spaded, trowelled and finished with neat cement slurry or with non-skid finish as required. At the junction of adjoining panels a thin string shall be given.

The casting of the granolithic finish layer shall be done in rectangular or square panels not exceeding 1.8 M on any side, using glass strips of height equal to the specified thickness of the floor finish. Required slope in the floor shall be given in the base course concrete without reduction in thickness.

Curing

Curing shall be done as per above mentioned clause.

Terrazzo (Mosaic) Tile

The tiles shall be approximately 22 mm thick of approved shade, color and chips. The tiles shall be pressure made conforming to IS: 1237 in all respects. The sizes of the tiles shall be as given in table below:

Table 13 : Sizes of Terrazzo Tiles

Sr.	Nominal Length (cm)	Actual Length (cm)	Nominal Breadth (cm)	Actual Breadth (cm)	Thickness Not less than (mm)
1	20	19.85	20	19.85	20
2	25	24.85	25	24.85	22
3	30	29.85	30	29.85	25

Tolerances

Tolerances on length and breadth shall be ± 1 mm. Tolerance on thickness shall be ± 5 mm. The range of dimension in any one direction of tiles shall not exceed 1 mm on length and breadth and 3 mm on thickness.

Manufacture

The tiles shall be manufactured under hydraulic pressure of not less than 140 kg/cm^2 and shall be given the first grinding with machine before delivery to the site. The proportion of cement to aggregate in the backing of the tiles shall not be leaner than 1:3 by weight. Similarly the proportion of cement to marble chips aggregate in the wearing layer of the tiles and the proportion of pigment to be used therein shall not exceed 10% by weight of cement used in the mix. The finished thickness of the upper layer shall not be less than 5 mm for size of marble chips from the smallest up to 6 mm, and also, not less than 5 mm for size of marble chips ranging from the smallest up to 12 mm, and not less than 6 mm for sizes of marble chips varying from the smallest up to 20 mm.

Laying

The sub-grade concrete or the R.C.C slab on which the tiles are to be laid shall be cleaned, wetted and mopped. The bedding for the tiles shall be with lime mortar of either:

i. **1:1:2 (lime putty: surkhi : coarse sand)**
ii. **1:3 (lime putty : surkhi)**
iii. **1:3 (lime putty : coarse sand)**

The bedding ingredients shall be thoroughly mixed by volume in the dry form. Care shall be taken to ensure that there are no hard lumps present. Water shall then be added and the ingredients thoroughly mixed. The average thickness of the bedding mortar shall be 30 mm.

Lime mortar bedding shall be spread, tamed and corrected to proper levels and allowed to be hardened for a day before the tiles are set. Over this bedding, neat grey cement slurry of honey like consistency shall be spread at the rate of 44 kg of cement per sq.m. over such an area as would accommodate about twenty tiles. Tiles shall be washed clean and shall

be fixed in this grout one after another each tile being gently tapped with a wooden mallet till it is properly bedded and in level with the adjoining tiles. The joints shall be kept as thin as possible not exceeding 1.5 mm and in straight lines or to suit the required pattern.

The surface of the flooring during laying shall be the frequently checked with a straight edge at least 2 m long, so as to obtain a true surface with the specified slope. In situations where full size tiles cannot b efixed, these shall be cut (sawn) to the required size and their edge rubbed smooth to ensure a straight and true joint. Tiles, which are fixed in the floor adjoining the wall, shall enter not less than 12 mm under the plaster, skirting or dado. The junction between the wall plaster and tile work shall be finished neatly and without any waviness. After laying the tiles, the surplus cement grout shall be cleaned off.

Curing, Polishing and Finishing

After laying the tiles the day after all the joints shall be cleaned of the grey cement grout with a wire brush or trowel to a depth of 5 mm and all dust and loose mortar removed and cleaned. Joints shall then be grouted with grey or white cement mixed with or without pigment to match the shade of the topping of the wearing layer of the tiles. The same cement slurry shall be applied to the entire surface of the tiles in a thin coat for protecting the surface from abrasive damage and fill the pin holes that may exist on the surface.

The floor shall then be kept wet for a minimum period of 7 days. The surface shall thereafter be grounded evenly with machine fitted with coarse grade grit blocks No.60. Water shall be used profusely during grinding. The surface shall be washed thoroughly with water to remove all grinding mud, cleaned and mopped. Then it shall be corrected with a thin coat of grey or white cement, mixed with or without pigment to match the colour of the topping of the wearing surface in order to fill any pin hole that appear. The surface shall be again cured; the second grinding shall then be carried out with machine fitted with fine grade grit blocks No. 120.

The final grinding shall be carried out with the machine fitted with finest grade grit blocks No. 320, the same day after the second grinding described above.

The small areas or where circumstances so required hand polishing may be permitted in lieu of machine polishing after laying. For hand polishing coarse grade stone No. 60 Water shall be used for 1st rubbing stone of medium grade No.80 for second rubbing and stone of fine grade No.120 for final rubbing and polishing.

After the final polish oxalic acid shall be dusted over the surface of 33 gm/sq.m sprinkled with water and rubbed hard with a 'namdah' block (pad or woolen rags). The following day the floor shall be wiped with a moist rag and dried with a soft cloth and finished clean.

If any tile is disturbed or damaged, it shall be refitted or replaced, properly jointed and polished. The finished floor shall not sound hollow when tapped with a wooden mallet.

Terrazzo (Mosaic) In-Situ Flooring

The requirements for filling, preparation of bed, sub -bas eand base course concrete shall be same as above.

Trained worker shall carry out terrazzo works.

Material

Best quality marble chips of uniform tint and color, 6 mm maximum and 3 mm minimum size, as approved by Engineer-in-Charge shall be used. They shall be machine crushed, free from foreign matter and of approved quality.

Preparation of Surface and Laying Over Base Course Concrete

Total thickness of cast-in-situ Terrazzo shall be at least 40 mm unless otherwise indicated. This shall be in two layers bottom layer of M:15 concrete bedding with 10 mm down aggregate of specified thickness and the top layer of 1 0mm thickness, consisting of a mix o fcemen tand marble chips in the proportion of 1:1/2 marble powder : 2 marble chips). The bottom layer shall be laid in bays not exceeding 1.2 m on either side and leveled 10 mm below the finished floor level.

The cement and marble chips including powder shall be mixed dry. Water shall be added gradually after through mixing until the mix become plastic but flowing.

Within one hour of laying of the bottom layer of cement concrete the upper layer of marble chips and cement paste shall be laid over a coat of cement slurry and the surface tamped lightly and finished to the required level and slope.

While the bottom layer is still plastic glass dividing strips 35 mm wide x 16 SWG thick shall be fixed on the base course concrete with proper anchoring features to allow top edge to be flushed with the finished floor. The strip shall be laid, forming panels not exceeding 1.2 m x 1.2 m size.

Curing, Polishing and Finishing

The floor shall then be kept wet for a minimum period of six days. The surface shall thereafter be ground evenly to the satisfaction of the Engineer-in-charge with machine grinders in three phase with grade stones from coarse to fine grade. The surface shall receive wash of neat cement mixed with or without pigment and cured before every grinding operation.

After final grinding, surface shall be cleaned and oxalic acid shall be dusted over the surface @ 35 grams. per sq.m. Sprinkled.

Glazed Tile Flooring

White Glazed Tiles

The glazed tiles shall conform to IS:777-1970. They shall be flat and true to shape and free from cracks, crazing spots, chipped edges and corners. The glazing shall be of uniform shade.

Size and Tolerance

The tiles shall be of nominal sizes such as 150 x 150 mm and 100 x 100 mm or as specified. The thickness of the tiles shall be 5 mm, or 6 mm as specified. The tolerance on facial dimension value shall be ± 1.0 mm and ± 0.5 mm on thickness.

The top surface of the tiles shall be glazed. The glaze shall be either glossy or matt as specified. The underside of the tiles shall be completely free form glaze in order that the tiles may adhere properly to the base. The edge of the tiles shall be preferably free form glaze, however any glaze if unavoidable, shall be permissible on any one edge of the tile.

Coloured Tiles

The sizes and specifications shall be the same as for the white glazed tiles described above. The only difference shall be in the colour.

Decorative Tiles

The type and size of the decorative tiles shall be as follows:

Decorated white background tiles shall be of 152 x 152 x 6 mm and 108 x 108 x 6 mm sizes.
Decorated and having coloured background shall be of 152 x 152 x 6 mm and 108 x 108 x 6 mm sizes.
Fantasy glazed tiles (108 x 108 x 6 mm) other specifications will be the same as that of white glazed tiles.

Preparation of Surface and Laying

Sub grade concrete or the R.C.C slab on which the tiles are to be laid shall be cleaned, wetted and mopped. The bedding for the tile shall be with 1:3 (cement: coarse sand) mortar or as specified, having average 10 mm thickness. The bedding thickness under the tiles shall not be less than 5 mm.

The mortar shall be spread, tamped and corrected to proper levels and allowed to harden sufficiently to offer a fairly rigid cushion for the tiles to be set and to enable the mason to place wooden plank across and square on it. Over this mortar bedding neat grey cement slurry of honey - like consistency shall be spread at the rate of 3.3 kg of cement per sq. m over such an area as would accommodate about twenty tiles. Tiles shall be soaked in water washed clean and shall be fixed in this grout one after another each tile gently being tapped with a wooden mallet till it is properly bedded and in level with the adjoining tiles. The joints in between the tiles shall be kept as thin as possible and in straight lines or to suit the required pattern.

The surface or the flooring during laying shall be frequently checked with a straight edge about 2 m long, for obtaining a true surface with the specified slope. Where full size tiles cannot be fixed these shall be cut (sawn) to the required size and their edge rubbed smooth to ensure straight and true joints. The tiles, which are fixed in the floor adjoining the wall, shall enter not less than 10 mm under the plaster, skirting or dado. After laying the tiles the surplus cement grout shall be cleaned off.

Pointing and Finishing

The joints shall be cleaned off the grey cement grout with wire brush or trowel to a depth of 2 mm to 3 mm and all dust and loose mortar removed. Joints shall then be flush pointed with white cement added with pigment if required to match the colour of the tiles. The floor shall then be kept wet for 7 days. After curing, the surface shall be washed and cleaned. The finish floor shall not sound hollow when tapped with a wooden mallet.

Kota Stone Flooring

Kota Stone Slabs- shall be of selected quality hard, sound, dense and homogeneous in texture, free from cracks, decay, weathering and flaws. They shall be hand or machine cut to the requisite thickness and shall be of the colour indicated in the drawings or as directed.

The top (exposed) face of the slabs shall be polished before being brought to site, unless otherwise specified. The slabs shall conform to the size required and samples shall be got approved before starting the work. 20, 30 or 40 mm or specified thickness slabs shall be used.

Tolerances

Of ±2 mm shall be allowed for the thickness. In respect of length and breadth of slabs, a tolerance of ± 5 mm shall be allowed.

Dressing

Each slab shall be cut to the required size and shape and fine chisel dressed on the sides to the full depth, so that a straight edge laid along the side of the stone shall be in full contact with it. The sides (edges) shall be table rubbed with coarse sand or machine rubbed before paving. All angles and edges of the tiles shall be true, square and free from chipping and the surface shall be true and plane.

Surface Preparation and Laying

Sub-grade concrete on the R.C.C slab on which the slabs are to be laid shall be cleaned, wetted and mopped. The bedding for the slabs shall be with cement mortar 1:4 or with lime mortar 1:1:1 (lime putty: surkhi: coarse sand) as given in the description of item. The average thickness of the bedding mortar under the slab shall be 20 mm and the thickness at any place under the slab not be less than 12 mm.

Mortar of the specified mix shall be spread under the area of each slab, roughly to the average thickness as specified. The slab shall be washed clean before laying. It shall be laid on top, pressed, tapped with wooden mallet and brought to level with the adjoining slabs. It shall be lifted and laid aside. The top surface of the mortar shall then be corrected by adding fresh mortar at hallows. The mortar is allowed to harden a bi tand cement

slurry of honey -like consistency shall be spread over the same at the rate of 4.4 kg of cement per sq.m. The edge of the slab already paved shall be buttered with grey or white cement with or without admixture of pigment to match the shade of the kota stone slabs as given or specified. The slab to be paved shall then be lowered gently back in position and tapped with wooden mallet till it is properly bedded in level with and close to the adjoining slabs with as fine joint as possible. All the subsequent slabs shall be laid in the same manner. After each slab has been laid, surplus cement on the surface shall be cleaned off. The flooring shall be cured for at least 7 days.

Slabs, which are fixed in the floor adjoining the wall, shall enter at least 12 mm under the plaster skirting or dado. The junction between wall plaster and floor shall be finished neatly and without any wavings.

Polishing and Finishing

Shall be done as described in the above article of 'Terrazzo Tile Flooring' except that:
First polishing with coarse grade carborundun stone shall not be done.
Cement slurry with or without pigment shall not be applied on the surface before polishing.

Mosaic Finished Dado or Skirting

For skirting and dado the brickwork or concrete surface shall be raked and shall be well watered for four hours. A dubbing coat of cement mortar 1:3 (1 cement: 3 sand) of sufficient thickness shall be applied so as to bring the surface in line with the plastered surface. The surface shall be carried by lines with trowel so as to receive mosaic tiles or the top layer or cement and marble chips in proportion of 1:1/2:2 (1 cement: ½ marble powder: 2 marble chips) of 7 mm thickness with 3-5 mm size for flooring including dividing strips (20 mm x 15 SWG) @ 600 mm c/c.

Hardonite Flooring

These specifications cover the guidelines for providing hardonite topping (industrial flooring) for floor subjected to heavy wear and tear viz., workshop and stores, engine room, and Generator room etc.

The item includes providing hardonite topping as specified to the thickness and satisfaction of the Engineer-in-Charge, supply of all material, labour, tools and plant required for completing the work in best workmanlike manner.

Workmanship

The person executing the topping shall be an experienced mason familiar with flooring works of similar nature. Flooring shall be laid uniformly, the tolerance for variation of level being + 3 mm. Hardonite material shall be mixed with cement concrete thoroughly to give a uniform mix.

Preparation of Surface

Hardonite shall be laid over a wet concrete surface screened to receive the topping. The base shall be leveled to within + 12 mm.

Preparation of Topping

Hardonite shall consist of a mixture of cement concrete in proportion of 1:2:4 and well graded iron fillings added in a proportion of 1.50 kg/bag of cement.

Application

Hardonite shall be placed uniformly in a layer of specified thickness and finished with a steel troned. Care shall be taken to place hardonite in a separate layer while the base concrete is steel wet.

Trowelling

Surface of floor shall be finished with steel trowel only and trowelled just sufficient so as to give a finished surface. The surface shall be left for some time till moisture disappears from it. Trowelling shall be done three times at intervals so as to produce a uniform hard surface in no case cement should come up to the surface.

Curing

The entire surface shall be kept uniformly wet for seven days.

Opening for use

The surface shall be allowed to be used only after curing period is over.

Distempering and Painting

General

Engineer's approval shall be obtained before commencing the painting work. All paints and preserves shall be of approved make and colour and their application shall conform to the manufacture's instructions. Where more than one undercoat is specified it shall be applied in coats of distinctive tints. Workmanship shall conform to the requirement of IS:2395

Unless the manufacturer's instructions state otherwise48 hours drying time shall elapse between successive applications of any primer and 24 hours between applications of all subsequent coats. The surface of bituminous paints shall be left at least 3 days before further handling.

No paints in any coats shall be applied until the engineer is satisfied that the surface is clean and dry. And that any previous coat is satisfactory and has hardened adequately. When a surface has been approved, it must be painted immediately.

Paint work shall be rubbed down with a glass paper between coats. No paint shall be applied to a surface, which is damp, dirty or otherwise inadequately prepared.

Concrete, brickwork and plaster

Where specified to be painted, concrete and plaster shall be rubbed smooth and any cracks, blister holes and other imperfections cut out, filled and made good. The surface shall be dried to the satisfaction of the engineer before painting is commenced and drying time if at least 28 days shall be allowed after laying brickwork and plaster or stripping formwork from concrete. The surface shall be brushed to remove any efflorescence and then painted with the following:

for interior brick work and concrete, apply two coats of oil paint up to 1 meter height and for remaining part two coats of plastic emulsion paint over a coat of primer.
For exterior brickwork and concrete, apply two coats of cement based paint over a coat of primer with a water repellant coat of siliconate solution of app[roved make.

Where painting with plastic emulsion is specified, all uneven surface shall be made up by use of putty of appropriate quality, after the surface has been thoroughly cleaned of all dust and dirt and sand papered.

Ironwork and Ungalvanised Steelwork

Structural steelwork shall be shot blasted to a "white metal" finish, and grease and oil removed prior to painting. Priming shall immediately follow blast cleaning and no cleaned surface shall be left unprimed for more than four hours. Only primers that chemically inhibit corrosion shall be used. Where the iron or steelwork is not in contact with raw or treated water, the primer shall be red lead complying with IS: 57. Where there is a possibility that the steel or ironwork may come in contact with water, the priming treatment shall be non toxic, zinc chromate or equivalent. Where it is anticipated that further welding will be required. an approved welding primer shall be applied to the areas to be welded and re primed with the main primer when welding has been completed. Primer coats shall not be less than 0.05 mm each.

After erection, all damaged areas shall be made good, and re primed where the original coat has spread under the primer, the affected surface shall be cleaned down to bare metal to the satisfaction of the Engineer and then re primed.

Repainting shall be carried out as soon as possible after erection. If it is to he exposed to weather or condensation, it shall receive one further coal of primer.

Metalwork in intermittent or permanent contact with raw or treated water shall have two finishing coats of approved coal tar pitch epoxy paint such as "Epilux 5" by Berger Paints, or equivalent. The total coating shall be minimum of 0.125 mm thick.

After the second coat of primer is hard dry, the entire surface shall be wet rubbed cutting down to a smooth uniform surface. When the surface becomes dry, be undercoat of synthetic enamel paint conforming-to IS: 2932 of optimum thickness shall be applied by brushing with minimum of brush marks. The coat shall be allowed to hard dry. The under coat shall then be wet rubbed cutting down to a smooth finish, taking adequate care to ensure that at no place the undercoat is completely removed. The surface shall then be allowed to dry.

The first finishing coat of paint shall be applied by brushing and allowed to hard dry. The gloss from the entire surface shall then be gently

removed and the surface dusted off. The second finishing coat shall then be applied by brushing.

At least 24 hours shall elapse between the applications of successive coats. Each coat shall very slightly in shade and this shall be got approved by the Engineer.

Galvanized Steelwork

Newly galvanised steelwork shall be primed with an etch primer such as calcium plumbate. Steelwork that has been galvanised for a long period so that the surface has oxidised adequately to allow adhesion of under-coats need not have an initial coat of each primer.

After priming, galvanised steelwork in constant or intermittent contact with raw or treated water shall be given two coats of an approved coat of tar pitch epoxy paint such as "Epilux 5" by Berger Paints, or equivalent. The total coating shall have a minimum thickness of 0.1 25 mm.

Protective coats for galvanised steelwork not in contact with water shall be:
One coat of micaceous iron oxide paint for interior galvanised steel work.
Two coats Of micaceous iron oxide paint for external galvanized steelwork.

Galvanised steelwork not in contact with water shall be finished with at least one coat of gloss paint on top of an approved undercoat.

Bituminous Surfaces

Metalwork items that have been given a shop treatment of bituminous paint shall be painted with two coats of` an approved anti-bleed paint before applying a coat of decorative finishing paint.

Aluminum Surfaces

Aluminum surfaces shall be worked clean, dried and thoroughly degreased before painting, by an appropriate solvent (such as one consisting of equal parts of white spirit and light solvent naptha). Flame cleaning shall not be permitted. The clean degreased surface shall be treated to ensure paint adhesion either by mechanical roughening, chemical adhesion, or etch primers or wash primers applied in strict conformity with the manufacturer's instructions or by other treatment approved by the Engineer.

The pretreated surface shall receive a priming coat with an inhibiting pigment containing not less than 20% by weight of fine chromate or other approved chromate in a suitable water-resisting vehicle.

The priming coat shall not contain any copper or mercury compounds and it shall also be free from graphite and carbonaceous materials and shall not contain any lead. Priming coat shall consist of a tung-oil phenolicresin

which is pigmented with equal parts of zinc tetoroxy chromate and red iron oxide.

Aluminum surfaces in contact with concrete, or resting on pads on concrete, shall be painted with two coats bituminous paint, and the concrete surfaces shall also receive two coats bituminous paint.

Woodwork

Woodwork for painting shall be carefully rubbed down, treated with preservatives and knotted, stopped and primed in the shop. Care shall be taken to ensure that priming is thoroughly brushed into every part of the surface and in particular at end grains, joint and notches where two coats are to be applied. Primers for wood shall he of a standard equivalent to, or better than "Aluminum Wood Primer Sealer A519-3697" by I.C.I. Paints.

After the woodwork has been fitted and all defects in the surfaces have been made good and re primed, one coat of approved undercoat shall be applied to internal surfaces and two coats to external surfaces. An undercoat of quality equal to or better than "Delux Undercoat A522 line" shall be used.

'Timber work shall be decoratively finished with one coat of finishing paint of standard equal to, or better than "Delux Gloss Finish A365 line".

Waterproof Cement Paint

Surface Preparation

The wall should be washed thoroughly with clean soft water and freed of all loose particles, dust, dirt, lichen, moss, efflorescence and Lime wash by Scrubbing with a wire brush. Inequality and holes shall be filled up with cement paste, which should be allowed to set. To get even uniform mat finish it is necessary to keep the surface damp throughout the operation. In hot dry weather the wall should be frequently sprinkled with water to keep it moist.

Mixing the paint

Loosen the contents by either rolling the drum or shaking the container before opening it. Take one measure of water by volume in a clean pot and add two volumes of approved quality waterproof cement paint conforming to IS: 5410. Stir well to make a paste of high consistency then add one more measure of water constantly stirring the mixture. The final composition of water and paint is now 1:1 by volume. Keep stirring the mixture all the time and use it up within an hour. Do not use the mix if it is left over 'for more than two hours.

Method of Application

Wet the surface by any convenient method. A small surface can be wetted by brush. When applying paint surface should be damp and not wet. While applying the first coat brush hard into the surface to cover pores and cavities to ensure better bond. Twelve hours after applying the first coat cure the surface by sprinkling the water. Before applying the second coat

damp the surface and after the application of second coat cure it as directed above. In hot climate repeat curing at least twice at the interval of six hours for optimum best results.

Curing

After sprinkling fine spray of water should cure each application paint normally after twelve hours when paint film is hardened satisfactorily. In summer when weather is hot, curing may be done little earlier. Water marks may be left over the surface if a stream of water is allowed to flow before the paint film is hardened.

Silicon Paint

Preparation

A solution for application shall be prepared from Syltrit 1772 or equivalent. The Manufacturer's instructions shall be followed. This solution shall be prepared to a concentration of about 3 % solids by mixing 1 kg. of water dilatable solution of sodium methyl siliconate with 9 kg. of water. Concentration higher than 3% solids are not recommended as they may cause a white precipitate of sodium carbonate formation.

Application

A flooding technique should be used in applying to obtain the best penetration. When spraying, the solution should not be atomized or misted, but flowed on in a solid stream, with the spray gun held, at a distance just enough to eliminate foaming on the masonry surface. If foaming is allowed then certain visible marks might appear after application. The run down of 150 to 300 mm should be maintained with generous overlapping of passes. Dipping and brushing methods are also suitable. After application of the solution, the treated surface should be allowed to dry at least 24 hours to develop maximum water repellency. This interval may be shortened somewhat by force drying at temperatures to 30 degree C. Though this removes the water quickly, time must still be allowed for the curing. Reaction between the solution and the surface being treated. Until the reaction is complete the applied film still remains water soluble and any rain failing during this time can wash it out. So application should be done in dry weather or at least in absence of rain and fog.

Spraying Equipment

Spraying equipment shall be hand operated stirrup pump with stainless steel nozzle fitted with PVC or polyethylene delivery pipe. Components of the spraying, equipment that are in contact with the treating solution should be of black iron, mild steel, stainless steel, Teflon, PVC or polyethylene. They should not be of aluminum or galvanized steel. .

Safety

The solution should always be applied in a liquid stream, not by misting or fogging. If misting occurs, avoid inhalation. Contact with the eyes or skin should be treated immediately by flooding the area with large quantities of water for at least 15 minutes.

Relevant IS Codes

IS: 63 : Whiting for paints
IS: 133 : Enamel, interior, undercoating & finishing colour as required
IS: 2395 : C.P. for painting concrete, masonry & plaster surfaces
IS: 5410 : Cement paint, colour as required
IS: 5411 : Plastic emulsion paint for interior use

Distemperin

g Type

Distempering shall be of the oil or water bound type as specified.

Material

Dry distemper or oil bound washable distemper of approved brand and manufacture for water bound and oil bound respectively conforming to IS:426 shall be used. The proportions of the mix shall be as per the approved manufacturer's instructions.

The dry distemper shall be stirred slowly in clean warm water using 8.6 liters of water per kg. of distemper or as specified by the approved makers. The mixture shall be well stirred before and during use to maintain an even consistency.

Thinner as stipulated by approved manufacturer shall be used in case of distemper for oil bound type.

Dry distemper shall not be mixed in larger quantity than is actually required for one day work.

Preparation of Surface and Priming Coat

The surface shall be thoroughly brushed free from mortar dropping and other foreign matter and sand papered smooth.

A priming coat of whiting shall be applied over the prepared surface in case of water bound distempering and distemper primer or cement primer shall be applied in the case of oil bound distemper. The white washing coat shall be used as priming coat for distemper.

Application

After the primer coat is dried for at least four hours, the entire surface shall be coated uniformly with proper distemper brushed in horizontal strokes, immediately followed by vertical ones which together shall constitute one coat.

Subsequent coats shall be applied in the same way and only after the previous coat has dried. Enough distemper shall be mixed to finish one room at a time. The finished surface shall be even and uniform and shall no brush marks. After each days work, the brushes shall be washed in hot water and hung down to dry. Old brushes, which are dirty or caked with distemper, shall not be used.

Decorative Finish Cement

Paint Surface Preparation

Plastered surface shall be thoroughly cleaned of dust, dirt, grease, oil marks, etc. before the coat is applied. All the holes and depressions

should be filled with gypsum prior to application of the paint. The surface shall be wet with clean water before paint is applied. Application of primer shall be as per specifications recommended by approved manufacturer and as directed by the Engineer-in-charge.

Preparation of Mix and Application

Any approved cement paint shall be mixed in such quantities as can be used up within an hour of mixing. The solution shall be applied on the prepared surface with good quality brushes and no brush mark shall be visible on the finish work.

Painting

Painting General

Paints, oils, varnishes etc. of approved brand and manufacture conforming to relevant Indian Standar dCodes shall be used. Ready mixed paints as received from approved manufacturer without any admixture shall be used. The contractor shall obtain permission for the make and color of the paint he proposes to use and if required, polish for wood work shall be tested as per IS:5807 (parts I and II).

Whenever thinning is necessary, the brand of thinner recommended by approved manufacturer or as instructed by Engineer-in-charge shall be used. Paints, oil, varnishes, thinner, etc. shall be brought to the site in the original containers in sealed condition and shall be kept in the joint custody of contractor and Engineer-in-Charge.

Commencing the Work

Painting except priming coat shall generally be taken in hand after all other building work is practically finished. Approval of Engineer-in-Charge shall be sought before commencing the work.

Workmanship

All the work shall be carried out wherever applicable as per IS:1477 (Parts I & II) and IS:2338 (Part I)

Preparation of Surface

The surface shall be thoroughly cleaned. All dirt, dust, scales and grease shall be removed before painting is started. The surface shall be perfectly dry to permit good absorption. The prepared surface shall receive approval from Engineer-in-Charge for commencing the painting work. For wood surfaces, a priming coat without coloring material should be applied after which all the holes, cracks etc shall be stopped with putty and all knots properly killed with quick lime.

Specially for wood surface, knots if visible shall be covered with red lead conforming to BIS:103. Holes and identification on the surface shall be filled with wood putty and rubbed smooth. Surface should be thoroughly dry.

Application

Paint shall be thoroughly stirred in the container when pouring into smaller containers for use. It shall be continuously stirred while applying on the surface. The painting shall be applied evenly and smoothly in the

direction of grains of wood and perpendicular to it. Each coat shall be allowed to dry before the next coat is applied.

Specified number of coats shall be applied and at least 24 hours shall elapse between application of the first coat and the subsequent second coat. No painting shall be carried out on exterior work in wet weather condition or on surface which are not entirely dry. Each coat shall be lightly rubbed down with sandpaper or fine pumice stone and cleaned of dust before the next coat is laid. No left over paint shall be put back into stock tins.

The finished surface shall be free from hair or brush marks, strokes, clogging of paint puddles in the corners of panels, angles of moulding, etc.

Painting with Synthetic Enamel/Enamel Paint

Material

Synthetic enamel/enamel paint of approved brand and manufacture and of required shade shall be used for the topcoat only. The paint for under coat shall be of shade to match the topcoat, as recommended by approved manufacturer shall be used.

Preparation of Surface

The surface shall be thoroughly cleaned. All dirt scales and grease shall be removed before painting started. The surface shall be perfectly dry to permit good absorption. The prepared surface shall receive approval from Engineer-in-Charge for commencing the painting work.

Specially for wood surfaces, knots if visible shall be covered with red lead conforming to IS: 103. Holes and indentation on the surface shall be filled with good putty and rubbed smooth. Surface should be thoroughly dry.

Application Under Coat

One coat of the specified paint of shade matching with the shade of the top coat shall be applied and allowed to dry overnight. It shall be rubbed next day with the finest grade of wet abrasive paper to ensure smooth and even surface, free from brush marks and all loose particles dusted off.

Top Coat

Top coats of specified paint in the desired shade shall be applied after the under coat is thoroughly dried. Additional finishing coat shall be applied if found necessary to ensure a properly uniform glossy surface.

Expansion Joints and Construction

Joints General

The item of providing expansion joints and construction joints in concrete includes all the material, labour, tools and plants necessary for completing the item in best workmanlike manner.

Material

The Material to be used in the joints shall be ribbed PVC water stop of specified width approved by the Engineer, bitumen impregnated fibre board as filler conforming to IS:10566 and approved sealant material (In case of movement joint only). In addition, IS:12220-1987 and 1838 shall also be adhered.

Joints in Floor

Joints in floor shall be provided as specified on drawings. In case of PVC water stops to be provided horizontal position flat-footed PVC water stops shall be used. The water stops shall be provided in such a way that half the portion of water stop (width wise) is embedded in the concrete and half remains exposed for next concrete. Steel reinforcement shall not be discontinued where construction joints in floor are provided.

Joints in Walls

Expansion Joint

Expansion joints shall be provided in the roof slab and wall and divide wall is of R.C.C. The joints shall be so located that in no case the slab shall be more than 45 meters long in one stretch. The general layout of roof slab showing the position of expansion joint is given in the accompanying drawing. The two adjoining portions of the roof slab at the expansion joints shall be separated by a gap of about 25 mm width which shall be bridged by means of 230 mm wide water stop. These water stops shall be fixed in such a manner that it is equally embedded in each portion of the slab on either side of the joint and shall be located at mid section of the slab. The joint shall be continuous in length and shall be properly joined together or welded at all junction along its length. The gap between the adjacent slab below the water stops shall be filled with filler material like thermocol or such compound which may be approved by the Engineer.

This may be achieved by placing a strip of filler material in position adjacent to the face of concreted slab panel while concreting the adjoining panel. The space above, water stop shall be filled with sealant material overlaid by filler material like thermocol and polysulphide sealant as shown in the drawing. The expansion joints in the end wall and divide wall shall be provided in such a manner that the joint shall divide the structure longitudinally and transversely as shown in the drawing. The two adjacent parts of the wall shall be separated by a gap of about 25 mm width which shall be bridged by 300 mm wide PVC water stop. However, no gap shall be provided in the footing of the wall. The gap on water face shall be treated with polysulphide sealant material as shown in the drawing. The water stops shall be either PVC or either equivalent approved by the Engineer as per specifications given hereinafter.

Construction Joint

The construction joints shall be generally provided at the end of the concreting or colcreting operation of an element or a member of a structure, or at boundary of the panels or segments or at pre-determined locations. The construction joints in the R.C.C. slab shall be

characterised by the continuance of the reinforcing steel, being a structural R.C.C. member. The concreting of a slab at the joint shall be done by laying the concrete against the vertical stopping off boards, the adjoining panels being cast butting against each other.

Const6ruction joints in the side wall and the divide wall of reservoir shall be of two types (I) horizontal construction joints and (ii) vertical construction joints.

The horizontal construction joints shall be serrated type where stones from the lower lift of the wall shall be projecting out sufficiently and will be embedding into the over laying lift of the wall masonry giving a well bonded, and consequently, a water tight joint.

The vertical construction joints in the wall shall be of tongue and groove type. The groove of these joints shall be 300 mm x 300 mm and it shall be provided 300 mm away from the water face of the wall. These joints shall be provided with PVC water stop at a depth of 200 mm from water face which shall be primarily responsible for the water from water face which shall be primarily responsible for the water tightness of the joints. These joints shall have a plain finish for a depth of 300 mm from water face by virtue of its casting against vertical face of the centering of vertical face of the previously cast panels cast butting against each other while the remaining depth beyond300 mm shall have masonry facing which will present a rough surface and thus provide a good bond between the consecutive panels.

In the case of divide wall the water stop shall be located at the centre of the key which shall be located at the centre of divide wall. The key shall be of the same dimensions as that in the end walls.

The construction joints in the bottom layer of the floor which shall be case in concrete shall be cast against vertical stopping off boards. On the water face the vertical joints shall have a groove provided with bitumen of 12 mm x 20 mm size which shall be filled with polysulphide sealant material.

No such special treatment need be done for the joints provided in the roof slab, bottom layer of the floor and the horizontal joints in the wall. The joints in roof slab and bottom layer of th efloor shall however, be staggered with those in the overlaying layers such as brick bat coba, I.P.S. and top R.C.C. layer of the floor to minimise the chances of leakage by increasing its path, if any.

Complete Construction Joints

These joints are provided in the top layer of the floor of the reservoir with a view to localise shrinkage cracks at these joints. These joints are characterised by complete discontinuity of steel without any initial gap as in the case of expansion joints. The joints between the adjacent panels of the floor shall be provided with a groove at top of dimension 12 mm x 20 mm and it shall be filled with polysulphide sealant and they shall be provided with water stops as specified earlier.

The joint between top layer of the floor and the walls or between the top layer of the floor and the column footing, shall also be provided with a

groove of 12 mm x 20 mm which shall be filled with sealant material as per specifications given below:

Joint Fillers: Joint fillers shall be of durable, compressible and non-extruding material. It shall be non-staining, non-absorbent and compatible with sealant material used.

Sealant Material: The joint sealing compounds should be capable of properly ensuring water tightness in vertical and horizontal and inclined joints in water retaining and other structures having severe service conditions in respect of anticipated movement or exposure to weather. Typical uses include expansion joints in the walls of water tanks, and in roof and deck slabs exposed to the weather.

The compound should be flexible, durable and weather proof and should have sufficient elasticity to allow joint movements of the concrete components wherever necessary.

The sealant shall be polysulphide rubber sealing compound conforming to BS 4254 of 1967 or ASA-A 116-1-1960 or any other equivalent specifications. It shall be capable of cold pouf application for horizontal joints and cold application of vertical and inclined joints. The sealing compounds shall be suitable for use in the tropics where it will be subjected to high ambient temperatures, humidity and very strong sunlight. It shall no tdegrade under thes econditions and shal lbe suitable for use with raw and treated water including water dosed with chlorine. The sealant shall be odour and taint free from lead. It shall be available in choice of colours and shall give a though, permanent seal, be waterproof, non-staining and remain resilient. Sealing compounds for vertical and horizontal joints shall be used complete with the appropriate quantity of primer as per manufacturer's instruction for use. The primers should ensure good adhesion to the concrete and should be specially developed for respective sealing compounds. The sealants shall be applied with pressure guns or without guns as specified by the manufacturers. Sealing compound shall be fully cured before water is permitted to come in contact.

The sealant material should be formulated as to have a storage period of one year at a temperature of 40^{o}C.

Epoxy Coating and Bituminous

Painting Epoxy Coating

General

Epoxy coating is to be applied to the internal surface of the unit wherever specified. The thickness of epoxy film shall be 300 microns.

Materials

A solvent free epoxy coating like "Araldite GY 255" manufactured by Hindustan CIBA Geigy Limited, Bombay or equivalent product of FOSROC is to be used for forming the film. Incase of use of an equivalent it should be got approved by the Employer placing supply orders. Materials used and process of application to the concrete of other surfaces should be strictly according to the instructions of the suppliers of the epoxy. Araldite GY 255 one part by weight is to be mixed with 1 part by weight of Hardener H Y 45. The viscosity should be such that it is convenient for brush application.

Subsurface Preparation

The concrete surface should be cleaned thoroughly by sand blasting. The mild steel parts also are to be cleaned to be free of grease and thoroughly sand blasted. The coverage should not be more than 6 sq.m. for concrete and 5 sq.m. for mild steel per kg of epoxy respectively.

The moisture content of concrete before application of epoxy coating shall be less than 4%. This has to be checked properly through a small sample. To achieve this epoxy coating shall be done in hot season.

Curing

The curing should be done for 7 days at room temperature. If the temperature is less than 15 c the space should be warmed up by incandescent lamps, heaters, blowers or infrared lamp. The instructions of the supplier manufacturer of the product both as for use of materials and application take priority over the above instructions and they should be followed very rightly.

Bituminous Painting

Two coats of bituminous paint of 80/100 grade, with 1.65 kg/m^2 spread will be provided on internal face of sludge sump.

Material

The material shall be of best quality un-pigmented bituminous base pain of such a composition as to satisfy the requirements of IS-9862.with total volatile matter contained in the paint shall not exceed 55% by weight.

At least 95% of the solid materials shall be soluble, in carbon disulphide or in benzene, and the closed flash point as determined in Abel's apparatus shall not be less than (86 F)30 C. The paint shall remain liquid and retain its consistency at the ordinary atmospheric temperature when packed in suitable containers. The drying time shall not he less than 2 hours and not more than 8 hours, and after drying, paint shall not shoe any surface cracks, tendencies to powder or discoloration due to weathering action or expansion and contraction. It shall also be able to resist the action of acids and alkalis. It shall not soften under the action of mineral turpentine.

The film resulting from brushing the material on a strip of tinned iron, 30 standard wire gauge after being allowed to dry at room temperature not below (65 F) 18.3 C for 48 hours shall not, when bent double over a (quarter inch)6 mm dia rod, show any signs of flaking or cracking. The time occupied for the actual bending shall not exceed one second. When

the paint has dried hard, a 4H pencil should not be capable of scratching it. The weight of the paint shall be firm 0.83 to 1.25 kg per liter, the component of the paint shall he such as not to react with water chlorinated or otherwise and develop poisonous or harmful elements thereto.

The paint shall be of' Indian manufacture of approved make and quality

Application

All corners and junctions shall be properly rounded off to present a uniform and smooth finish. After complete curing of the plaster, it will be allowed to day up. After drying the moisture content shall be brought to a value less than 4% by using a below-lamp. The surface should be well cleaned with smooth brush to make it dust free. The coating shall be allowed to dry and kept in dry condition till final setting takes place.

Door, Windows, Grills, Shutters, etc.

Relevant IS Codes

IS:1003 (I)	**:**	**Timber paneled and glazed door & ventilator shutters**
IS:1003 (II)	**:**	**Timber paneled and glazed window & ventilator shutters**
IS:1038	**:**	**Steel doors, windows & ventilators**
IS:1081	**:**	**Fixing & glazing of metal doors, windows & ventilators**
IS:1361	**:**	**Steel windows for industrial buildings**
IS:2202	**:**	**Wooden flush door shutter (solid core type)**
IS:2202 (I)	**:**	**Plywood face panels**
IS:2202 (II)	**:**	**Particle board and hardboard face panel**
IS:4020	**:**	**Methods of test for wooden flush doors**
IS:6248	**:**	**Metal rolling shutters & rolling grills**
IS:7452	**:**	**Hot rolled steel sections for doors, windows & ventilators**
IS:10451	**:**	**Steel sliding shutters**
IS:10521	**:**	**Collapsible gates**

General

The items under this clause cover doors, windows, grills, rolling shutters, collapsible gates etc. normally required to be provide in a building used whether for residential, office, laboratory or industrial purpose.

Doors and windows Shutter shall be of Teakwood as specified in the bill of quantities/drawings or as directed by the Engineer. The sizes of the above items and locations of the same shall be as shown in the drawings.

The frames and shutters shall be of either steel or wood of thickness of members as shown on the drawings. The material used shall be of good quality seasoned timber of specified wood or rolled steel sections as the case may be.

They shall be provided with all necessary fittings like hold fasts, hinges, locking arrangements stoppers, eyes and hooks, tower bolts, handles, fixing lugs etc., of sizes and quality grade as specified.

They shall be provided in complete form including painting, glazing, fixing in position true to level and plumb.

Steel rolling shutters shall be of approved make and shall conform to IS 6248 - 1979. Metal rolling shutters and rolling grills.

The builder's hardware shall all be as per relevant Indian Standards.

Woodwork in Doors, Windows, Partitions, Louvers, Railings etc.

Wood used for all work shall be the best of the respective class specified, and properly seasoned by at least 6 months air drying, suitable for joiner's work, should be of natural growth, uniform in texture, straight grained, free from sapwood, dead knots, open shakes, boreholes, rot, decay and any and all other defects and blemishes.
The thickness specified for joiner's wrought timbers are, unless otherwise specified, prior to planning and 3 mm will be allowed from the thickness stated for each wrought faces.
All joining shall be wrought on all faces and finished off by hand with sandpaper, with slightly rounded arises.

The joints shall be pinned with hard wood pins and put together with white lead. Jointing shall be by means of mortise and tenor or dovetailed joints as approved.

Any joiner's work which shall split, fracture, shrink, or show flaws or other defects due to unsoundness, inadequate seasoning or bad workmanship, shall be removed and replaced with sound material at the Contractor's expense.

Doors, windows and ventilator frames, transoms and mullions shall be rebated. All dimensions shall be as per drawings. The top framing member of doors and top and bottom framing of windows and ventilators shall project about to mm below finished floor. Surface coming in contact with brickwork shall be painted with bitumen as directed by the Engineer-in-charge. Each of the door and window frames shall be provided with 3 Nos. M. S. 225 x 25 x 6 flat split holdfasts on each side. These holdfasts shall be embedded in masonry of concrete work. The work shall conform to IS:4021.

The doors shall be paneled or solid flush doors as described in the item of work. All flush doors shall be supplied with approved fittings such as hinges, mortise lock of approved make with handles on both sides, oxidised brass tower bolts and latch arrangements, door stops etc. and as shown in drawings but exclusive of door closers. Door closers, where separately specified shall be of heavy duty hydraulic type to be approved by Engineer-in-charge Paneled doors shall have the same fittings except in place of union lock, an aldrop shall be provided. Each door leaf shall

have two 250 mm tower bolts, two aluminum or oxidised brass handles, and one door stopper be made of weatherproof plywood. Flush doors shall conform to IS:2202 (Part-I).

Doors will generally have no sills but if a few have to be provided, the Contractor shall do so at no extra cost to the Owner. The type of window shall be as specified. Each shutter shall have one pair of hinges, two tower bolts (one 225 mm long and another 150 mm long), one handle and one hook with eye and pegstay. Ventilators shall have two M. S. hold fasts and hinges, one handle and one hook and eye at each and one small tower bolt in the centre. Where so directed by the Engineer-in-charge, the doors and windows shall be provided with parliamentary type hinges at no extra cost.

The workmanship of all door and window shutters shall conform to the requirements of IS:1003 (Part-I & II) and IS:2202 (Part-I). If required, flush door panels shall be got tested as per IS:4020.

Cupboards, almirahs and shelves shall be provided as per Engineer-in-charge. The doors could be of either hinged type or sliding type as approved by the Engineer-in-charge. All dimensions as furnished in the drawings shall be followed. Fixtures and fittings as shown on drawings or as directed by Engineer-in-charge shall be used.
Railings and architraves shall conform to the shape shown on drawings or as approved and fixed by means of screws (counter sunk or otherwise) or bolts.

The finish expected is of a very high order and the work shall be all-inclusive weather or not all detailed specifications have been spelt out and the work shall be free from blemish.

No iron bars or grills are proposed to be provided in the windows or ventilators. Glass louvered ventilators where specified shall be provided.

Glazed windows, louvers, ventilators and doors shall be provided with either clear or pinheaded glass 5.5 mm thick which shall be free from all blemishes and shall conform to IS:1761. It should be clearly understood that glass which does not have uniform refractive index or which is wavy will be rejected. Woodwork shall not be painted, oiled or otherwise treated before the Engineer has approved it.

Steel Doors, Windows and Fittings

The steel doors, windows, ventilators shall conform or IS:4351 and IS:1038. All steel doors windows, ventilators, louvres etc. shall be of sizes as specified and conform to the description in the respective item of work. Whether or not specifically mentioned, all fixtures and fittings necessary for the satisfactory operation of the doors and windows shall be provided. Doors, windows and ventilators shall be obtained from an approved manufacturer. Specific approval for such purchase shall be obtained before hand. Sample shall also be got approved before further manufacture starts, unless this is waived in writing by the Engineer-in-

charge. All steel doors shall be of pressed steel (18 gauge) flush type with or without removable transome. All doors shall be provided with a three way bolting device and locking arrangement with duplicate keys and handles of both sides and operable from either side. The Contractor shall obtain windows with friction hinges in place of windows with pegstays if so directed by the Engineer-in-charge. For centre hung and top hung ventilators suitable spring catch/pulley and chord arrangement shall be provided for facility of opening. Whenever fly mesh over windows have been called for, they shall be fixed on the window and suitable lever type or rototype arrangement shall be provided for opening or closing of the glazed panels from inside. Prior approval of Engineer shall be taken before order is placed with the manufacturer.

Where specified, steel doors supplied shall be airtight. For this purpose, the Contractor shall provide necessary padding material such as rubber, felt or any other approved material.

Rolling Shutters

The rolling shutters shall conform to the size indicated in drawings and shall be of quality specified in the Schedule of Quantities. The rolling slats shall be in one piece and be made of heavy gauge steel sheets minimum 18 SWG in thickness. A cylindrical hood shall be provided on the top to enclose the shutter when it is open. The rolling shutters shall be provided with suitable locking arrangements and deep channel guides, In case galvanised rolling shutters are specified the rolling shutter shall be made of hot dip galvanise dslats, hood, deep channel guides all preferably in one piece.

In case of hand operated pull & push type rolling shutters of sizes larger than 10 sq.m. in area and in case of very large gear operated and/or as directed by the Engineer, rolling shutters shall be provided with ball bearings for smooth & efficient operation. In case of large rolling shutters & depending upon local wind conditions, the rolling shutters should be provided with special locking type of wider channel guides or it shall be provided with central moveable channel supports to take up design wind pressures in the area.

Hand Railing

Hand railing and vertical posts shall be made from galvanised mild steel pipes and fittings. The design of the railing shall be approved by the Engineer to whom the Contractor shall submit manufacturer's drawings showing positions of vertical posts, joints, expansion joints and joint details and all fixing details. Fabrication shall not start until these drawings have approved by the Engineer.

Hand railing and vertical posts fabricated from galvanized mild steel pipes and fittings shall conform to the following requirements.

The height of the top railing shall be 1050 mm above finished floor level unless otherwise shown. The lower railing shall 550 mm above finished floor and Toe plate should be provided at the bottom of the rail of the size100mm wide x5 mm thick subject to the Engineer's approval these

and other leading dimensions may be varied slightly to suit manufacturer's standard products.

Unless otherwise shown, handrails and vertical posts shall be made of galvanized mild steel tubes (light class) of 32 mm nominal bore and fittings such as Tees, Bends, Crossed etc. of heavy class conforming to IS:1239. In general the vertical posts shall be spaced at 1.5 meter c/c and shall be built into the concrete or bolted to the MS plate embedded in concrete as shown on detailed drawing.

Hand railing and vertical posts shall be painted with 2 coats of approved paint.

GRATINGS

Gratings shall be provided in all manholes/inspection chambers/ nali on the way and shall be of cast iron capable to carry load may come over it and shall be minimum of 20 mm diameter with epoxy paint for corrosion resistance.

Design Drawings

The tenderer shall be responsible for the correctness and the soundness of the final work and design. The structure shall be as per recognized engineering practice and if any provision are found inadequate or faulty necessary modification will have to be carried out at any stage up to the expiry or the performance guarantee period at no extra cost.

Welding and Structural Steel Work

Structural steel work and design and fabrication of steel shall comply relevant IS code

In all cases where welds are liable to be highly stressed and Contractor shall supply to the Engineer before fabrication commences, detailed drawings of all welds preparation proposed. No such welding shall be carried out before the Engineer has signified his approval of the details proposed. No alteration shall be made to any previously approve detailed of weld preparation without prior approval of the Engineer.

Welders shall be qualified in accordance with the requirements of appropriate section of Indian Standards.

All tests, if required, shall be carried out in the presence of Engineer

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All welded components shall be stress relieved prior to machining.

Water Supply and Sanitary Works

Applicable Codes

The following standards and codes are made a part of this document. All standards, codes of practice referred to herein shall be the latest editions including all official amendments and revisions.

IS : 210	**:**	**Specification for grey iron castings**
IS : 269	**:**	**Specification for ordinary and low heat Portland cement**
IS : 383	**:**	**Specification for coarse and fine aggregates from natural sources for concrete**
IS : 432	**:**	**Specification for mil dsteel and mediu mtensile steel bars and hard drawn steel wire for concrete reinforcement**
IS : 456	**:**	**Code of Practice for plain and reinforced concrete**
		Concrete Pipes (with and without reinforcement)
		Methods of tests for strength of concrete
IS : 458	**:**	**Dimensions for pipe threads where pressure tight joints are required on the threads**
IS : 516	**:**	**Salt glazed stoneware pipes and fittings**
IS : 554	**:**	
IS : 651	**:**	

IS : 774	**:**	**Flushing Cisterns for water closets and urinals**
IS : 775		**supports for wash basins and sinks**
	:	**Sand-cast brass screw-down bib taps and stop taps for water services**
IS : 781	**:**	**Code of practice for laying of concrete pipes**
IS : 783	**:**	**Electroplated coatings of nickel and chromium of iron and steel**
IS : 1068	**:**	**Specification for common burnt clay building bricks**
IS : 1077	**:**	**Code of practice for basic requirements for water supply, drainage and sanitation**
IS : 1172	**:**	**Specification for high strength deformed steel bars and wires for concrete reinforcement**
IS : 1786	**:**	**Mild steel tubes (Part I) and mild steel tubulars and other wrought steel pipe fittings (Part II)**
IS : 1239	**:**	**Centrifugally cast (spun) iron pressure pipes for water, gas and sewage**
IS : 1536	**:**	**Asbestos cement building pipes, gutters and fittings (spigot and socket types)**
IS : 1626	**:**	**Copper Alloy float valves (horizontal plunger type) for water supply purposes**
IS : 1703	**:**	**Cast iron manhole covers and frames**
IS : 1726	**:**	**Sand cast iron spigot and socket soil, waste and ventilating pipes, fittings and accessories**
IS : 1729	**:**	**Code of practice for buildings drainage**
IS : 1742	**:**	**Code of practice for water supply in Buildings**
IS : 2065	**:**	**Specification for sand for masonry mortars**
IS : 2116	**:**	**Code of practice for brickwork**
IS : 2212	**:**	**Code of practice for preparation and use of masonry mortars**
IS : 2250		

cast iron brackets and

IS : 2326	**:**	**Automatic flushing cisterns for urinals**

IS : 2470 : Code of practice for design and construction of appliances (Part I to Part XV)

IS : 2556 : Specification for copper alloy waste fittings for wash basins and sinks

IS : 2963 : Vitreous sanitary septic tanks (Parts I & II)

IS : 3306 : Specification for chemically resistant glazed stoneware pipes and fittings

IS : 3025 : Method for sampling and test (Physical and chemical) for water and waste water (Parts 1 to 44)

IS : 3311 : Waste plug and its accessories for sinks and wash basins

IS : 5455 : Specification for cast iron steps for manholes

IS : 4127 : Code of Practice for laying of glazed stoneware pipes

IS : 3495 : Methods of tests of burnt clay building bricks

IS : 4111 : Code of practice for ancillary structures in sewerage system manholes

IS : 5382 : Specification for rubber sealing rings for gas mains, water mains and sewers

IS : 5329 : Code of practice for sanitary pipe work above ground for buildings

IS : 5434 : Non-ferrous alloy bottle traps for marine use

Sanitary Installation

The work shall be carried out complying in all respects with any specific requirements of the local body in whose jurisdiction the work is situated, and as approved by the Engineer-in-charge.

Any damage caused to the building, or to installations therein, either due to negligence on the part of the Contractor, or due to actual requirements of the work, shall be made good and the building or the installation shall be restored to its original condition by the Contractor.

Licensed plumbers shall carry out all sanitary and plumbing work.

All sanitary appliance including sanitary fittings, fixtures, toilet requisites shall be of size, and design as approved by the Engineer-in-charge.
All white glazed porcelain fixtures, such as wash basin, sink drain board, water closet pan, and urinal, P' trap etc. shall have hard durable white glazed finish they shall be free from cracks and other glazing defects. No chipped porcelain fixtures shall be used.

Joints between iron and earthenware pipes shall be made perfectly air and watertight by caulking with neat cement mortar.

Indian Type Water Closet

Water closets shall be white porcelain Orissa type Indian soil pans, 690mm long conforming to IS: 2556 of approved make and pattern. Flushing cistern of 15b litres capacity with accessories such as chain, handle, stop tap, brass unions, jamb nuts, overflow pipe and bends, etc. shall be provided.

Urinals

Urinals shall be white glazed flat back type of approved make and of size 430 mm x 260 mm x 350 mm conforming to IS 2556. High level automatic CI flushing cistern of 10 litre capacity as per IS 2326 with necessary CI brackets, GI pipes for water connection from cistern to urinals, stop tap, waste pipe upto CI waste shaft etc. shall be provided.

Wash Basin

Wash basin shall be of white glazed earthenware conforming to IS 2556 of approved make and of size 560mm x 410mm. The wash basins shall be provided with water supply GI pipe, chromium plated tap, stopcock, CP bottle trap, GI waste water pipe and all necessary accessories and fittings.

Sinks

Sinks shall be of white glazed earthenware conforming to IS 2556 of approved make and of size 450mm x 300mm x 150mm. The sink shall be provided with CP tap, water supply GI pipe, non-ferrous waste fitting, waste plug and necessary accessories and fittings.

Soak Pit

Soak pit shall be constructed at the location specified by the Engineer-in-charge. Earthwork excavation shall be carried out to the exact dimensions. Brick masonry lining with open joints shall be constructed in the pit upto 150 mm below the outlet pipeline. Brick masonry in cement mortar 1:6 shall be constructed above this level up to ground. Well burnt brick, aggregates of nominal size 40 mm to 80 mm and coarse sand shall be filled within the chamber. Construction of pit lining and filling of the brick ballast shall progress simultaneously.

Manholes/Inspection Chambers Location

Manholes / Inspection chambers shall be constructed at places approved by the Engineer-in-charge.

Excavation

Excavation, shoring, dewatering etc. for the pits of manholes / Inspection chambers, laying of pipes and fittings/specials shall be done in accordance with Engineer-in-charge requirements described elsewhere in the document.

Bed Concrete

The bed concrete for manholes/Inspection Chambers shall be done in accordance with Engineer-in-charge's requirements described elsewhere in the document.

Bricks

Bricks used for construction of manholes / Inspection chambers shall conform to the relevant Indian Standards. They shall be sound, hard, homogeneous in texture, well burnt in kiln without being vitrified, table moulded, deep red, cherry or copper coloured, of regular shape and size and shall have sharp and square and parallel faces. The bricks shall be free from pores, chips, flaws or humps of any kind. Bricks containing unground particles and/or which absorb water more than 1/6th of their weight when soaked in water for twenty-four hours shall be rejected. Overburnt or underburnt bricks shall be liable to rejection. The bricks shall give a clear ringing sound when struck and shall have a minimum crushing strength of 50 kg/sq.cm, unless otherwise noted in drawings. The class and quality requirements of bricks shall be as laid down in IS: 1077.

The size of the brick shall be 23.0 x 11.5 x 7.5 cm unless otherwise specified; but tolerance upto + 3 mm in each direction shall be permitted. Only full size brick shall be used for masonry work. Brickbats shall be used only with the permission of Engineer-in-charge to make up required wall length or for bonding. Sample bricks shall be submitted to the Engineer-in-charge for approval and bricks supplied shall conform to approved samples. If required by the Engineer-in-charge, brick samples shall be tested as per IS:3495 by Contractor. Bricks rejected by the Engineer-in-charge shall be removed from the site within 24 hours.

Cement Mortar

Mortar for brick masonry shall be prepared as per IS:2250, Manholes / Inspection chambers shall be constructed in brick masonry with cement mortar (1:3) unless otherwise specified. Gauge boxes for sand shall be of such dimensions that one bag containing 50 kg of cement forms one unit. The sand shall be free from clay, shale, loam, alkali and organic matter and shall be of sound, hard, clean and durable particles. Sand shall be as approved by the Engineer-in-charge. If required by the Engineer-in-charge and shall be thoroughly washed till it is free of any contamination.

For preparing cement mortar, the ingredients shall first be mixed thoroughly in dry condition. Water shall then be added and mixing continued to give a uniform mix of required consistency. Cement mortar shall be used within 25 minutes of mixing. Mortar left unused in the specified period shall be rejected.

The Contractor shall arrange for tests on mortar samples if so required by Engineer-in-charge. Retempering of mortar shall not be permitted.

Brick Masonry

All bricks shall be thoroughly soaked in clean water for at least one hour immediately before being laid. Brick work 230 mm thick and over shall be laid in English Bond unless otherwise specified. 115 mm thick brick work shall be laid with stretchers. For laying bricks, a layer of mortar shall be spread over the full width of suitable length of the lower course. Each brick shall be pressed into the mortar and shoved into final position so as to embed the brick fully in mortar. Bricks shall be laid with frogs uppermost.

All brickwork shall be plumb and square unless otherwise shown on drawing and true to dimensions shown. Vertical joints in alternate courses shall come directly one over the other and be in line. Horizontal courses shall be leveled. The thickness of brick course shall be kept uniform. For walls of thickness greater than 230 mm both faces shall be kept in vertical planes unless otherwise specified. All interconnected brickwork shall be carried out at nearly one level (so that there is uniform

distribution of pressure on the supporting structure) and no portion of the work shall be left more than one course lower than the adjacent work. Where this is not possible, the work shall be raked back according to bond (and not saw-toothed) at an angle not exceeding 45 degrees. But in no case the level difference between adjoining walls shall exceed 1.25 m. Workmanship shall conform to IS:2212.

Brick shall be so laid that all joints are well filled with mortar. The thickness of joints shall not be less than 6 mm and not more than 10 mm. The face joints shall be raked to a minimum depth of 12 mm by raking tools daily during the progress of work when the mortar is still green, so as to provide a proper key for the plastering to be done. When plastering is not required to be done, the joints shall be uniform in thickness and be struck flush and finished at the time of laying. The face of brickwork shall be cleaned of all dirt before another course is laid on top. If mortar in the lower course has begun to set, the joints shall be raked out to a depth of 12 mm before another course is laid.

Cement Plaster

All joints in masonry shall be raked to a depth of 12 mm with hooked took made for the purpose when the mortar is still green and in any case within 48 hours of its laying. The surface to be rendered shall be washed with fresh clean water free from all dirt, loose material, grease etc. and thoroughly wetter for 6 hours before plastering work is commenced. Concrete surfaces to be rendered will however be kept dry. The wall should not be too wet but only damp at the time of plastering. The damping shall be uniform to get uniform bond between the plaster and the wall.

Cement shall be mixed thoroughly in dry condition and then just enough water added to obtain a workable consistency. The quality of water, sand and cement shall be as per relevant IS. The mortar thus mixed shall be used immediately and in no case shall the mortar be allowed to remain for more than 25 minutes after mixing with water.

Curing of plaster shall be started as soon as the applied plaster has hardened enough so as not to be damaged. Curing shall be done by continuously applying water in a fine spray and shall be carried out for at least 7 days.

Plastering shall be done on both faces of brick masonry in cement mortar (1:2) and 20 mm thick unless otherwise specified.

Plastering work shall be carried out in two layers, the first layer being 14 mm thick and the second layer being 6 mm thick. The first layer shall be dashed against the prepared surface with a trowel to obtain an even surface. The second layer shall then be applied and finished leaving an

even and uniform surface, trowel finished unless otherwise approved by the Engineer-in-charge.

Cement Concrete Channel

The channel for the manhole shall be constructed in cement concrete of M15 grade. Both sides of the channel shall be taken up to the level of the crown of the outgoing sewer. They shall be benched up in concrete and rendered in cement mortar (1:1) of 20 mm thickness and formed to a slope of 1 in 12 towards the channel.

Pipe Entering or Leaving Manhole / Inspection Chamber

Whenever a pipe enters or leaves a manhole / inspection chamber, bricks on edge must be cut to a proper form and laid around the upper end of the pipe so as to form an arch. All around the pipes, there shall be a joint of cement mortar (1:2) 13 mm thick between it and the bricks.

Cast Iron Steps

Cast iron steps shall be as per IS:5455. The steps shall be of grey cast iron of grade 15 as per IS:210. The steps shall be clean, well cast and they shall be free from air and sand holes, cold shuts and wrappings. The portion of the step which projects from the wall of the manhole / inspection chamber shall have a raised chequered design to provide an adequate non-slip grip CI steps shall weigh not less than 4.5 kg each and shall be of 150 mm x 375 mm overall dimensions. These steps shall be coated with a black bituminous composition. The coating shall be smooth and tenacious. It shall not flow when exposed to a temperature of 63 degrees C and shall not be brittle as a chip of at temperature of 0 degree C.

Where the depth of invert of manhole exceeds 800 mm, cast iron steps of approved pattern shall be fixed in the brick work at the interval of 300 mm vertically and staggered at 380 mm horizontally centre to centre. In case of pipe diameter greater than 600 mm, box type CI steps weighing 19 kg each shall be provided at 300 mm vertically in channel of manhole / inspection chamber.

Frame and Covers

Frame and covers for manholes shall be of required type and dimensions as per the relevant drawings prepared by the Contractor. Following information shall be clearly marked on each cover.
Year of manufacture,
Identification mark of the purchaser
SEWERS/SWD
Arrow showing direction of flow

Cast Iron Frame and Cover

The cast iron frame and cover shall be of grey cast iron as per IS: 1726. The general requirements for casting and coating of CI frame and cover shall be as specified for CI steps in Clause 15.15.10. The covers shall have a raised chequered design to provide an adequate non-slip grip. The rise of the chequer shall be not less than 4 mm. The locking device for the cover shall be provided as approved by the Engineer-in-charge. The CI covers for the load test shall be selected at one for every lot of fifty or part thereof for each type and size manufactured and as approved by the Engineer-in-charge. The frame shall be fixed in cement concrete of M15 grade all round and finished with neat cement. The manhole frame shall have 560 mm diameter clear opening and shall weigh not less than 208 kg. including cover. In case of rectangular CI frame and cover of 900 mm x 600 mm clear opening, the total weight shall not be less than 275 kg. In case of scraper manhole the frame shall have clear opening of 1200 mm x 900 mm and shall weigh not less than 900 kg including cover. The manhole / inspection cover and frame shall be painted with three coats of anti-corrosive paint after fixing in position.

Fiber Reinforced Concrete Frame and Cover

Fiber reinforced concrete frame and cover shall be capable of withstanding load of 35 tones. The frame shall be fixed in cement concrete of M15 grade all around and finished with neat cement. The fiber-reinforced frame shall have clear opening of 560 mm diameter and weighing 103 kg. The cover shall have a minimum thickness of 100 mm and weighing 78 kg. Th efibers shall constitute 1% of the weight of the concrete in the form of 50 mm to 100 mm long high tensile steel wires. For the cover, MS sheet lapping of 18 gauge shall be provided to avoid damage to the edges. Similarly for frame, MS angle/flat shall be provided along the edge. Both MS sheet and angle shall be painted with black bituminous paint. The cover should have suitable lifting arrangement. The fiber reinforced frame and cover shall be manufactured as approved.

Reinforced Cement Concrete Frame and Cover

Reinforced cement concrete frame and cover for manholes shall be of required dimensions and shape as shown on the drawing prepared by the Contractor and approved by the Engineer-in-charge. The frame and cover shall be cast in cement concrete of M20 grades. Minimum cover to the reinforcement shall be 40 mm. The edges of frame and covers shall be provided with mild steel angles to avoid damages to the corners. These angles shall be painted with black bituminous paint. The covers should have suitable lifting arrangement.

RCC Manhole

M20 grade of concrete used for construction of RCC manhole shall have min cement content of 390kg/cum of concrete. Min cover to the reinforcement shall be 50mm.

Vent Shafts

General

Vent shafts shall be erected at such places as approved by the Engineer-in-charge.

GI Pipe Vent Shaft

GI pipe vent shall be of 100 mm diameter of 'C' class as per IS: 1239 and 6 meter height from ground level with slotted cap. The vent shaft shall be embedded in concrete of M10 grade and anchored with a 6mm thick MS base plate of 200 mm x 200 mm. The vent shaft shall be painted with one coat of silver paint over one coat of red lead oxide paint. The vent shaft shall be connected to manhole by 150 mm diameter glazed stoneware pipe encased by M10 concrete of 150 mm thickness all around as approved by the Engineer-in-charge.

RCC Vent Shaft

Reinforced cement concrete vent shaft shall be of M20 grade concrete, 200 mm diameter at bottom and tapered to 100 mm diameter at top (both inside clear openings) and 6 m height from ground level. The vent shaft shall be embedded in concrete of M10 grade and anchored by 2 nos. of 16 mm diameter and 600 mm long MS bars. The vent shaft shall be connected to manhole as specified in (b) above through a brick masonry flue chamber.

Septic Tank

The sewer line shall be connected to a septic tank of adequate capacity and design including necessary soak pit. All the works involved, such as excavation, refilling, accessories, fittings, vent pipe, cowl cap, etc. as specified & directed shall be carried out.

Miscellaneous

If any damage is caused to the other services such as water supply pipeline, sewer, cable, etc. during the construction of manholes and erection of vent shafts, the Contractor shall be held responsible for the same and shall replace the damaged services to the full satisfaction of the Engineer-in-charge. The interior of manholes shall be cleared of all debris after construction and before testing the same for water tightness by the Contractor.

Roadside Drains

Applicable Codes and Specifications

All relevant IS codes and specifications, standards and codes are applicable for this work.

All earthwork shall be according to directions of Engineer-in-charge or relevant IS codes and specifications as per satisfaction of Engineer-in-charge.

Slab Culvert

Slab culverts shall be constructed at specified locations of the existing cross drainage works as directed by the Engineer-in-charge. The Concrete works specifications for construction of RC slab and the rubble masonry specifications for the supporting rubble walls shall be followed as per Employer's Requirements described elsewhere:

Bitumen at Location of Contact

The bitumen to be used on the top of the bed concrete at the location of contact of RCC slab above in two coats shall be straight run bitumen of specified grade.

Graded Gravel Free Draining Backfill

On each side of the uncoarsed rubble walls supporting the slab culvert a free draining backfill of thickness 200 mm shall be provided. The material for this backfill shall be granular consisting of sound, tough, durable particles of crushed or uncrushed gravel, crushed stone or brickbats which will not become powdery under loads and in contact with water. The material shall be free from soft, thin, enlongated or laminated pieces and vegetable or other deleterious substances. It shal lbe graded and shall meet the grading requirements given in hereunder.

Sieve Designation	Percent Passing by Weight
10 mm	100
4.75 mm	30-65
425 microns	5-30
150 microns	0-10

Weep Holes

Weep holes as shown on the drawings or as directed by the Engineer-in-charge shall be provided in the masonry to drain water from the backfilling. Weep holes shall be of asbestos cement pipes conforming to IS: 6908 in rubber walls with necessary M10 concrete cushioning 75 mm

thick. They shall extend through the full width of the masonry at a spacing of 1.5 m c/c and with slope of about 1 vertical to 20 horizontal towards the drainage face.

Pipe Drains

Wherever required, pipe drains shall be provided for cross drainage purposes. The sequence of construction shall be as follows:
laying of sand/shingle bedding on the original ground
laying of PCC of M10 grade
laying of concrete pipes of NP2 NP3 class as per IS:458

Constructing embankment above in compacted murum, laying of the sub-base and Water bound Macadam as specified hereinabove.
The details of above works as directed by Engineer-in-charge shall be followed.

Materials for Pipe Drains

All materials used in the construction of pipe drains shall conform to Engineer-in-charge. RCC pipes class NP3 shall conform to IS: 458.

Each consignment of cement concrete pipes shall be inspected, tested if necessary, and approved by Engineer-in-charge at the place of manufacture or at site before their incorporation in the Works.

Excavation for pipes

The foundation bed for pipe drain shall be executed true to the lines and grades shown on the drawings or as directed by the Engineer-in-charge. The pipes shall be placed in shallow excavation of the natural ground in open trenches cut in the existing embankment, taken down to levels as shown in the drawings. Where trenching is involved, its width on either side of pipe shall not be less than 150 mm nor more than one-third the diameter of pipe. The sides of the trench shall be as nearly vertical as possible.

When during excavation, the material encountered is soft, spongy or other unstable soil, unless other special construction methods are called for as indicated on drawings, such unsuitable material shall be removed up to a depth of 600 mm or as directed by the Engineer-in-charge before placing any backfill material.

When bed rock or boulder strata are encountered, excavation shall be taken down at least 200 mm below bottom level of pipe as directed by Engineer-in-charge and space filled with approved sand and shingle. Trenches shall be kept free from water until the pipes are installed and the joints have been hardened.

Bedding for pipe

The bedding surface shall provide a firm foundation of uniform density throughout the length of the pipe drain and shall conform to the specified level and grade. The pipe shall be laid on the concrete bedding before the concrete has set.

Laying of pipes

No pipes shall be placed in position until the foundations have been approved by Engineer-in-charge. When pipes are to be laid adjacent to each other, they shall be separated by a distance at least equal to or greater than half the diameter of pipe subject to a minimum of 450 mm.

The laying of pipes on the prepared concrete foundation shall start from the outlet and proceed towards the inlet and be completed to the specified lines and grades. The pipes shall be fitted and matched so that when laid they form a drain with a smooth uniform invert. Any pipe found defective or damaged during laying shall be removed at the cost of the Contractor.

Jointing

All the joints shall be made with care so that their interior face is smooth and consistent with the interior surface of the pipes. The ends of the pipes should be so shaped as to form a self-centering joint with jointing space 13 mm wide. The jointing space shall be filled with cement mortar (1 cement to 2 sand) mixed sufficiently dry to remain in position when forced with a trowel or rammer. Care shall be taken to fill all voids and excess mortar shall be removed. After finishing the joints shall be kept covered and damp for at least four days.

Back filling

Trenches shall be backfilled with selected materials as per Employer's Requirements given in this part. Backfilling up to 0.3 meter above the top of pipe shall be carefully done and murum shall be thoroughly consolidated under the haunches of the pipe.

Concrete Encasement

Concrete encasement shall be provided at places wherever directed by the Engineer-in-charge.

Brands for different materials used in construction

Following is the list of approved brands for different materials used for construction.

Sl.No.	Material	Approved brands
1	Cement	• ACC,Ultratech,Ambuja
2	Steel	• Tata, SAIL, RINL, JSW, Jindal Steel
3	Concrete Admixtures	• Dr.Fixit,Greens Boro
4	ACC Block	• ACC • Ultratech • Ambuja
5	Flooring Work	• Orient Tiles • Nitco Tiles • Somany Tiles • Kajaria Tiles
6	Paint	• Asian Paints • Dulux Paints • Nerolec Paints
7	Upvc Window/Door	• Fenista • Astrixupvc profiles • Skyler
8	Particle Board & Ply	• Century • Greenply • Green lam
9	White Cement	• Birla White • JK White
10	Plaster of Paris	• Sakrani
11	Structural Steel	• TATA • SAIL • JSW • RINL • Jindal
12	Copper Pipe	• Hindoleo
13	Aluminium	• Hisdoleo • Nalco • Jindal
14	PVC Tank	• Sintex • Moligold • Plesto
15	GI Fitting	• Unique
16	PVC Pipe and Fitting	• Apolo • Finolex
	Water Supply	•
	SANITARY WORK	
1	W.C Indian/European, Urinals, Wash Basin, Laboratory Sink	• Roca • Kohler • Jaquar • Hindware
5	Mirror, Towel Ring , Soap Dish	• Delta • Modi

SPECIFICATION OF FIRE DETECTION AND ALARM SYSTEM WITH PUBLIC ADDRESSABLE SYSTEM

1.0 General

1.1 DESCRIPTION

A. This section of the specifications includes the furnishing, installation, and connection of the fire alarm equipment to form a complete coordinated system ready for operation. It shall include, but not be limited to, alarm initiating devices, alarm notification appliances, control units, fire safety control devices, annunciators, power supplies, and wiring as shown on the drawings and specified.

B. Fire alarm systems shall comply with requirements of NBC 2016 unless variations to NBC 2016 are specifically identified within these contract documents by the following notation: "variation". The design, system layout, document submittal preparation, and supervision of installation and testing shall be provided by a technician that is certified or a registered fire protection engineer. The certified technician shall be on site for the supervision and testing of the system. Factory engineers from the equipment manufacturer, thoroughly familiar and knowledgeable with all equipment utilized, shall provide additional technical support at the site as required by the Contracting Officer or his authorized representative. Installers shall have a minimum of two years experience installing fire alarm systems.

C. Fire alarm signals:

2. Building // s // // identify which buildings // shall have a general evacuation fire alarm signal to notify all occupants in the respective building to evacuate.

D. Alarm signals (by device), supervisory signals (by device) and system trouble signals (by device not reporting) shall be distinctly transmitted to the main fire alarm system control unit located in the // security office // telephone operator's office // boiler plant // fire department //.

E. The main fire alarm control unit shall automatically transmit alarm signals to a listed central station using a digital alarm communicator transmitter in accordance with NBC 2016.

1.2 SCOPE

A. All existing fire alarm equipment, wiring, devices and sub-systems that are not shown to be reused shall be removed. All existing fire alarm conduit not reused shall be removed.

B. A new fire alarm system shall be designed and installed in accordance with the specifications and drawings. Device location and wiring runs shown on the drawings are for reference only unless specifically dimensioned. Actual locations shall be in accordance with NBC 2016 and this specification.

C. Existing fire alarm bells, chimes, door holders, 120VAC duct smoke detectors, may be reused only as specifically indicated on the drawings and provided the equipment:

1. Meets this specification section

2. **Is UL listed or FM approved**
3. **Is compatible with new equipment being installed**
4. **Is verified as operable through contractor testing and inspection**
5. **Is warranted as new by the contractor.**

D. Existing 120 VAC duct smoke detectors, reused by the Contractor shall be equipped with an addressable interface device compatible with the new equipment being installed.

E. Existing reused equipment shall be covered as new equipment under the Warranty specified herein.

F. Basic Performance:

1. **Alarm and trouble signals from each building fire alarm control panel shall be digitally encoded by UL listed electronic devices onto a multiplexed communication system.**
2. **Response time between alarm initiation (contact closure) and recording at the main fire alarm control unit (appearance on alphanumeric read out) shall not exceed five (5) seconds.**
3. **The signaling line circuits (SLC) between building fire alarm control units shall be wired Style 7 in accordance with NBC 2016. Isolation shall be provided so that no more than one building can be lost due to a short circuit fault.**
4. **Initiating device circuits (IDC) shall be wired Style C in accordance with NBC 2016.**
5. **Notification appliance circuits (NAC) shall be wired Style Y in accordance with NBC 2016.**

1.3 RELATED WORK

A. Restoration of existing surfaces.

B. SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES:

FIRE STOPPING: Fire proofing wall penetrations. DOOR HARDWARE

C. PAINTING: Painting for equipment and existing surfaces.

D. REQUIREMENTS FOR ELECTRICAL INSTALLATIONS: General electrical requirements for items which are common to other Division 26 sections.

E. RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS: Conduits and boxes for cables/wiring.

F. LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES (600 VOLTS AND BELOW: Cables/wiring.

1.4 SUBMITTALS

A. General: Submit 4 copies and 1 reproducible in accordance with, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES, and REQUIREMENTS FOR ELECTRICAL INSTALLATIONS.

B. Drawings:

1. **Prepare drawings using AutoCAD software and include all contractors information. Layering shall be by VA criteria as provided by the Contracting Officer's Technical Representative (ARCHITECT/ENGINEER-IN-CHARGE). Bid drawing files on AutoCAD will be provided to the Contractor at the pre-construction meeting. The contractor shall be responsible for verifying all critical dimensions shown on the drawings provided by Architect.**

2. **Floor plans: Provide locations of all devices (with device number at each addressable device corresponding to control unit programming), appliances, panels, equipment, junction/terminal cabinets/boxes, risers, electrical power connections, individual circuits and raceway routing, system zoning; number, size, and type of raceways and conductors in each raceway; conduit fill calculations with cross section area percent fill for each type and size of conductor and raceway. Only those devices connected and incorporated into the final system shall be on these floor plans. Do not show any removed devices on the floor plans. Show all interfaces for all fire safety functions.**
3. **Riser diagrams: Provide, for the entire system, the number, size and type of riser raceways and conductors in each riser raceway and number of each type device per floor and zone. Show door holder interface, HVAC shutdown interface, and all other fire safety interfaces. Show wiring Styles on the riser diagram for all circuits. Provide diagrams both on a per building and campus wide basis.**
4. **Detailed wiring diagrams: Provide for control panels, modules, power supplies, electrical power connections, auxiliary relays and annunciators showing termination identifications, size and type conductors, circuit boards, LED lamps, indicators, adjustable controls, switches, ribbon connectors, wiring harnesses, terminal strips and connectors, spare zones/circuits. Diagrams shall be drawn to a scale sufficient to show spatial relationships between components, enclosures and equipment configuration.**
5. **Two weeks prior to final inspection, the Contractor shall deliver to the ARCHITECT/ENGINEER-IN-CHARGE one (1) set of reproducible, as-built drawings, two blueline copies and one (1) set of the as-built drawing computer files using AutoCAD Release 14 or later. Asbuilt drawings (floor plans) shall show all new and existing conduit used for the fire alarm system.**

C. Manuals:

1. **Submit simultaneously with the shop drawings, companion copies of complete maintenance and operating manuals including technical data sheets for all items used in the system, power requirements, device wiring diagrams, dimensions, and information for ordering replacement parts.**
   a. **Wiring diagrams shall have their terminals identified to facilitate installation, operation, expansion and maintenance.**
   b. **Wiring diagrams shall indicate internal wiring for each item of equipment and the interconnections between the items of equipment.**
   c. **Include complete listing of all software used and installation and operation instructions including the input/output matrix chart.**
   d. **Provide a clear and concise description of operation that gives, in detail, the information required to properly operate, inspect, test and maintain the equipment and system. Provide all manufacturers'**

installation limitations including but not limited to circuit length limitations.

e. Complete listing of all digitized voice messages.

f. Provide standby battery calculations under normal operating and alarm modes. Battery calculations shall include the magnets for holding the doors open for one minute.

g. Include information indicating who will provide emergency service and perform post contract maintenance.

h. Provide a replacement parts list with current prices. Include a list of recommended spare parts, tools, and instruments for testing and maintenance purposes.

i. A computerized preventive maintenance schedule for all equipment. The schedule shall be provided on disk in a computer format acceptable to the Architect facility and shall describe the protocol for preventive maintenance of all equipment. The schedule shall include the required times for systematic examination, adjustment and cleaning of all equipment. A print out of the schedule shall also be provided in the manual. Provide the disk in a pocket within the manual.

j. Furnish manuals in 3 ring loose-leaf binder or manufacturer's standard binder.

k. A print out for all devices proposed on each signaling line circuit with spare capacity indicated.

2. Two weeks prior to final inspection, deliver four copies of the final updated maintenance and operating manual to the ARCHITECT/ENGINEER-IN-CHARGE.

a. The manual shall be updated to include any information necessitated by the maintenance and operating manual approval.

b. Complete "As installed" wiring and schematic diagrams shall be included that shows all items of equipment and their interconnecting wiring. Show all final terminal identifications.

c. Complete listing of all programming information, including all control events per device including an updated input/output matrix.

d. Certificate of Installation as required by NBC 2016 for each building. The certificate shall identify any variations from the National Fire Alarm Code.

e. Certificate from equipment manufacturer assuring compliance with all manufacturers installation requirements and satisfactory system operation.

D. Certifications:

1. Together with the shop drawing submittal, submit the technician's fire alarm certification as well as certification from the control unit manufacturer that the proposed performer of contract maintenance is an authorized representative of the major equipment manufacturer. Include in the certification the names and addresses of the proposed supervisor of installation and the proposed performer of contract

maintenance. Also include the name and title of the manufacturer's representative who makes the certification.

2. **Together with the shop drawing submittal, submit a certification from either the control unit manufacturer or the manufacturer of each component (e.g., smoke detector) that the components being furnished are compatible with the control unit.**
3. **Together with the shop drawing submittal, submit a certification from the major equipment manufacturer that the wiring and connection diagrams meet this specification, UL and NBC 2016 requirements.**

1.5 WARRANTY

A. Warrant all work performed and all material and equipment furnished under this contract subject to the terms of "Warranty of Construction", except that warranty period is five (5) years

2.0 - PRODUCTS

2.1 EQUIPMENT AND MATERIALS, GENERAL

A. Existing equipment may be reused only where indicated on the drawings.//

B. Except as indicated in paragraph A above, // All equipment and components shall be new and the manufacturer's current model. All equipment shall be tested and listed by Underwriters Laboratories, Inc. or Factory Mutual Research Corporation for use as part of a fire alarm system. The authorized representative of the manufacturer of the major equipment shall certify that the installation complies with all manufacturers' requirements and that satisfactory total system operation has been achieved.

2.2 CONDUIT, BOXES, AND WIRE

A. Conduit shall be in accordance with Section 26 05 33, BOXES FOR ELECTRICAL SYSTEMS and as follows:

1. **All new and reused conduit shall be installed in accordance with NBC 2016 70.**
2. **Conduit fill shall not exceed 40 percent of interior cross sectional area.**
3. **All new conduit shall be 19 mm (3/4 inch) minimum.**

B. Wire:

1. **All existing wiring shall be removed and new wiring installed in a conduit or raceway.**
2. **Wiring shall be in accordance with NEC article 760, Section 26 05 21, LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES (600 VOLTS AND BELOW), and as recommended by the manufacturer of the fire alarm system. All wires shall be color coded. Number and size of conductors shall be as recommended by the fire alarm system manufacturer, but not less than 18 AWG for initiating device circuits and 14 AWG for notification device circuits.**
3. **Addressable circuits and wiring used for the multiplex communication loop shall be twisted and shielded unless specifically excepted by the fire alarm equipment manufacturer in writing.**
4. **Any fire alarm system wiring that extends outside of a building shall have additional power surge protection to protect equipment from physical damage and false signals due to lightning, voltage and current**

induced transients. Protection devices shall be shown on the submittal drawings and shall be UL listed or in accordance with written manufacturer's requirements.

5. **All wire or cable used in underground conduits including those in concrete shall be listed for wet locations.**

C. Terminal Boxes, Junction Boxes, and Cabinets:

1. **Shall be galvanized steel in accordance with UL requirements.**
2. **All new and reused boxes shall be sized and installed in accordance with NBC 2016 70.**
3. **New and existing covers shall be repainted red in accordance with Section 09 91 00, PAINTING and shall be identified with white markings as "FA" for junction boxes and as "FIRE ALARM SYSTEM" for cabinets and terminal boxes. Lettering shall be a minimum of 19 mm (3/4 inch) high.**
4. **Terminal boxes and cabinets shall have a volume 50 percent greater than required by the NBC 2016 70. Minimum sized wire shall be considered as 14 AWG for calculation purposes.**
5. **Terminal boxes and cabinets shall have identified pressure type terminal strips and shall be located at the base of each riser. Terminal strips shall be labeled as specified or as approved by the ARCHITECT/ENGINEER-IN-CHARGE.**

2.3 FIRE ALARM CONTROL UNIT

A. General:

1. **Each building shall be provided with a fire alarm control unit and shall operate as a supervised zoned fire alarm system.**
2. **Each power source shall be supervised from the other source for loss of power.**
3. **All circuits shall be monitored for integrity.**
4. **Visually and audibly annunciate any trouble condition including, but not limited to main power failure, grounds and system wiring derangement.**
5. **Transmit digital alarm information to the main fire alarm control unit.**

B. Enclosure:

1. **The control unit shall be housed in a cabinet suitable for both recessed and surface mounting. Cabinet and front shall be corrosion protected, given a rustresistant prime coat, and manufacturer's standard finish.**
2. **Cabinet shall contain all necessary relays, terminals, lamps, and legend plates to provide control for the system.**

C. Power Supply:

1. **The control unit shall derive its normal power from a 120 volt, 60 Hz dedicated supply connected to the emergency power system. Standby power shall be provided by a 24 volt DC battery as hereinafter specified. The normal power shall be transformed, rectified, coordinated, and interfaced with the standby battery and charger.**
2. **The door holder power shall be arranged so that momentary or sustained loss of main operating power shall not cause the release of any door.**

3. **Power supply for smoke detectors shall be taken from the fire alarm control unit.**
4. **Provide protectors to protect the fire alarm equipment from damage due to lightning or voltage and current transients.**
5. **Provide new separate and direct ground lines to the outside to protect the equipment from unwanted grounds.**

D. Circuit Supervision: Each alarm initiating device circuit, signaling line circuit, and notification appliance circuit, shall be supervised against the occurrence of a break or ground fault condition in the field wiring. These conditions shall cause a trouble signal to sound in the control unit until manually silenced by an off switch.

E. Trouble signals:

1. **Arrange the trouble signals for automatic reset (nonlatching).**
2. **System trouble switch off and on lamps shall be visible through the control unit door.**

F. Function Switches: Provide the following switches in addition to any other switches required for the system:

1. **Remote Alarm Transmission By-pass Switch: Shall prevent transmission of all signals to the main fire alarm control unit when in the "off" position. A system trouble signal shall be energized when switch is in the off position.**
2. **Alarm Off Switch: Shall disconnect power to alarm notification circuits on the local building alarm system. A system trouble signal shall be activated when switch is in the off position.**
3. **Trouble Silence Switch: Shall silence the trouble signal whenever the trouble silence switch is operated. This switch shall not reset the trouble signal.**
4. **Reset Switch: Shall reset the system after an alarm, provided the initiating device has been reset. The system shall lock in alarm until reset.**
5. **Lamp Test Switch: A test switch or other approved convenient means shall be provided to test the indicator lamps.**
6. **Drill Switch: Shall activate all notification devices without tripping the remote alarm transmitter. This switch is required only for general evacuation systems specified herein.**
7. **Door Holder By-Pass Switch: Shall prevent doors from releasing during fire alarm tests. A system trouble alarm shall be energized when switch is in the abnormal position.**
8. **HVAC/Smoke Damper By-Pass: Provide a means to disable HVAC fans from shutting down and/or smoke dampers from closing upon operation of an initiating device designed to interconnect with these devices.**

G. Remote Transmissions:

1. **Provide capability and equipment for transmission of alarm, supervisory and trouble signals to the main fire alarm control unit.**
2. **Transmitters shall be compatible with the systems and equipment they are connected to such as timing, operation and other required features.**

H. Remote Control Capability: Each building fire alarm control unit shall be installed and programmed so that each must be reset locally after an alarm, before the main fire alarm control unit can be reset. After the local building fire alarm control unit has been reset, then the all system acknowledge, reset, silence or disabling functions can be operated by the main fire alarm control unit

I. System Expansion: Design the control units and enclosures so that the system can be expanded in the future (to include the addition of twenty percent more alarm initiating, alarm notification and door holder circuits) without disruption or replacement of the existing control unit and secondary power supply.

2.4 ANNUNCIATION

A. Annunciator, Alphanumeric Type (System):

1. **Shall be a supervised, LCD display containing a minimum of two lines of 40 characters for alarm annunciation in clear English text.**
2. **Message shall identify building number, floor, zone, etc on the first line and device description and status (pull station, smoke detector, or trouble condition) on the second line.**
3. **The initial alarm received shall be indicated as such.**
4. **A selector switch shall be provided for viewing subsequent alarm messages.**
5. **The display shall be UL listed for fire alarm application.**
6. **Annunciators shall display information for all buildings connected to the system. Local building annunciators, for general evacuation system buildings, shall be permitted when shown on the drawings and approved by the ARCHITECT/ENGINEER-IN-CHARGE.**

B. Printers:

1. **System printers shall be high reliability digital input devices, UL approved, for fire alarm applications. The printers shall operate at a minimum speed of 30 characters per second. The printer shall be continually supervised.**
2. **Printers shall be programmable to either alarm only or event logging output.**
   a. **Alarm printers shall provide a permanent (printed) record of all alarm information that occurs within the fire alarm system. Alarm information shall include the date, time, building number, floor, zone, device type, device address, and condition.**
   b. **Event logging printers shall provide a permanent (printed) record of every change of status that occurs within the fire alarm system. Status information shall include date, time, building number, floor, zone, device type, device address and change of status (alarm, trouble, supervisory, reset/return to normal).**
3. **System printers shall provide tractor drive feed pins for conventional fan fold 213 mm x 275 mm (8-1/2" x 11") paper.**
4. **The printers shall provide a printing and non-printing self test feature.**
5. **Power supply for printers shall be taken from and coordinated with the building emergency service.**

6. **Each printer shall be provided with a stand for the printer and paper.**
7. **Spare paper and ribbons for printers shall be stocked and maintained as part of the five (5) year guarantee period services in addition to the one installed after the approval of the final acceptance test.**

2.5 ALARM NOTIFICATION APPLIANCES

A. Bells:

1. **Shall be electric, singlestroke or vibrating, heavyduty, underdome, solenoid type.**
2. **Unless otherwise shown on the drawings, shall be 150 mm (6 inches) diameter and have a minimum nominal rating of 80 dBA at 3000 mm (10 feet).**
3. **Mount on removable adapter plates on outlet boxes.**
4. **Bells located outdoors shall be weatherproof type with metal housing and protective grille.**
5. **Each bell circuit shall have a minimum of twenty percent spare capacity.**

B. Speakers:

1. **Shall operate on either 25 VRMS or 70.7 VRMS with field selectable output taps from 0.5 to 2.0W and originally installed at the onehalf watt tap. Speakers shall provide a minimum sound output of 80 dBA at ten feet with the onehalf watt tap.**
2. **Frequency response shall be a minimum of 400 HZ to 4000 HZ.**
3. **100 mm (4 inches) or 200 mm (8 inches) cone type speakers ceiling mounted with white colored baffles in areas with suspended ceilings and wall mounted in areas without ceilings.**

C. Strobes:

1. **Xenon flash tube type minimum 15 candela in toilet rooms and 75 candela in all other areas with a flash rate of 1 HZ. Strobes shall be synchronized where required by the National Fire Alarm Code (NBC 2016).**
2. **Backplate shall be red with 13 mm (1/2 inch) permanent red letters. Lettering to read "Fire", be oriented on the wall or ceiling properly, and be visible from all viewing directions.**
3. **Each strobe circuit shall have a minimum of twenty (20) percent spare capacity.**
4. **Strobes may be combined with the audible notification appliances specified herein.**

D. Fire Alarm Horns:

1. **Shall be electric, utilizing solid state electronic technology operating on a nominal 24 VDC.**
2. **Shall be a minimum nominal rating of 80 dBA at ten feet.**
3. **Mount on removable adapter plates on conduit boxes.**
4. **Horns located outdoors shall be of weatherproof type with metal housing and protective grille.**

5. **Each horn circuit shall have a minimum of twenty (20) percent spare capacity.**

2.6 ALARM INITIATING DEVICES

A. Manual Fire Alarm Stations:

1. **Shall be nonbreakglass, address reporting type.**
2. **Station front shall be constructed of a durable material such as cast or extruded metal or high impact plastic. Stations shall be semiflush type.**
   SPEC WRITER NOTES: Double action pull stations shall be permitted in those locations where accidental activation is possible.

3. **Stations shall be of single action pull down type with suitable operating instructions provided on front in raised or depressed letters, and clearly labeled "FIRE".**
4. **Operating handles shall be constructed of a durable material. On operation, the lever shall lock in alarm position and remain so until reset. A key shall be required to gain front access for resetting, or conducting tests and drills.**
5. **Unless otherwise specified, all exposed parts shall be red in color and have a smooth, hard, durable finish.**

B. Smoke Detectors:

1. **Smoke detectors shall be UL listed for use with the fire alarm control unit being furnished.**
2. **Smoke detectors shall be addressable type complying with applicable UL Standards for system type detectors. Smoke detectors shall be installed in accordance with the manufacturer's recommendations and NBC 2016.**
3. **Detectors shall have an indication lamp to denote an alarm condition. Provide remote indicator lamps and identification plates where detectors are concealed from view. Locate the remote indicator lamps and identification plates flush mounted on walls so they can be observed from a normal standing position.**
4. **All spot type and duct type detectors installed shall be of the photoelectric type.**
5. **Photoelectric detectors shall be factory calibrated and readily field adjustable. The sensitivity of any photoelectric detector shall be factory set at 3.0 plus or minus 0.25 percent obscuration per foot.**
6. **Detectors shall provide a visual trouble indication if they drift out of sensitivity range or fail internal diagnostics. Detectors shall also provide visual indication of sensitivity level upon testing. Detectors, along with the fire alarm control units shall be UL listed for testing the sensitivity of the detectors.**

C. Heat Detectors:

1. **Heat detectors shall be of the addressable restorable rate compensated fixedtemperature spot type.**
2. **Detectors shall have a minimum smooth ceiling rating of 2500 square feet.**

3. **Ordinary temperature (135 degrees F) heat detectors shall be utilized in // elevator shafts and // elevator mechanical rooms. Intermediate temperature rated (200 degrees F) heat detectors shall be utilized in all other areas.**
4. **Provide a remote indicator lamp, key test station and identification nameplate (e.g. "Heat Detector - Elevator P-") for each elevator group. Locate key test station in plain view on elevator machine room wall.**

2.7 SUPERVISORY DEVICES

A. **Duct Smoke Detectors:**
   1. **Duct smoke detectors shall be provided and connected by way of an address reporting interface device. Detectors shall be provided with an approved duct housing mounted exterior to the duct, and shall have perforated sampling tubes extending across the full width of the duct (wall to wall). Detector placement shall be such that there is uniform airflow in the cross section of the duct.**
   2. **Interlocking with fans shall be provided in accordance with NBC 2016 90A and as specified hereinafter under Part 3.2, "TYPICAL OPERATION".**
   3. **Provide remote indicator lamps, key test stations and identification nameplates (e.g. "DUCT SMOKE DETECTOR AHU-X") for all duct detectors. Locate key test stations in plain view on walls or ceilings so that they can be observed and operated from a normal standing position.**

2.8 ADDRESS REPORTING INTERFACE DEVICE

A. **Shall have unique addresses that reports directly to the building fire alarm panel.**
B. **Shall be configurable to monitor normally open or normally closed devices for both alarm and trouble conditions.**
C. **Shall have terminal designations clearly differentiating between the circuit to which they are reporting from and the device that they are monitoring.**
D. **Shall be UL listed for fire alarm use and compatibility with the panel to which they are connected.**
E. **Shall be mounted in weatherproof housings if mounted exterior to a building.**

2.9 SMOKE BARRIER DOOR CONTROL

A. **Electromagnetic Door Holders:**
   1. **New Door Holders shall be standard wall mounted electromagnetic type. In locations where doors do not come in contact with the wall when in the full open position, an extension post shall be added to the door bracket.**
   2. **Operation shall be by 24 volt DC supplied from a battery located at the fire alarm control unit. Door holders shall be coordinated as to voltage, ampere drain, and voltage drop with the battery, battery charger, wiring and fire alarm system for operation as specified.**
B. **A maximum of twelve door holders shall be provided for each circuit. Door holders shall be wired to allow releasing doors by smoke zone.**
C. **Door holder control circuits shall be electrically supervised.**

D. Smoke detectors shall not be incorporated as an integral part of door holders.

E. Where combination holder-closer units are required to match existing, these devices are furnished and installed, DOOR HARDWARE. Connection and wiring shall be as herein specified.

2.10 UTILITY LOCKS AND KEYS

A. All key operated test switches, control units, annunciator panels and lockable cabinets shall be provided with a single standardized utility lock and key.

B. Key-operated manual fire alarm stations shall have a single standardized lock and key separate from the control equipment.

C. All keys shall be delivered to the ARCHITECT/ENGINEER-IN-CHARGE.

2.11 SPARE AND REPLACEMENT PARTS

A. Provide spare and replacement parts as follows (Quantities as per Bill of Quantity):

1. **Manual pull stations**
2. **Key operated manual pull stations**
3. **Heat detectors**
4. **Fire alarm strobes**
5. **Fire alarm bells**
6. **Fire alarm speakers**
7. **Smoke detectors**
8. **Duct smoke detectors with all appurtenances**
9. **Control equipment utility locksets**
10. **Control equipment keys**
11. **2.5 oz containers aerosol smoke**
12. **Printer paper**
13. **Printer replacement ribbons**
14. **Monitor modules**
15. **Control modules**
16. **Fire alarm SLC cable (same as installed)**

B. Keys for key-operated manual pull stations shall be provided 30 days prior to actual installation.

C. Spare and replacement parts shall be in original packaging and submitted to the ARCHITECT/ENGINEER-IN-CHARGE.

D. Furnish and install a storage cabinet of sufficient size and suitable for storing spare equipment. Doors shall include a pad locking device. Padlock to be provided by the VA. Location of cabinet to be determined by the ARCHITECT/ENGINEER-IN-CHARGE.

E. Provide to the VA, all hardware, software, programming tools, license and documentation necessary to permanently modify the fire alarm system on site. The minimum level of modification includes addition and deletion of devices, circuits, zones and changes to system description, system operation, and digitized evacuation and instructional messages.

2.12 INSTRUCTION CHART

Provide a typeset printed or typewritten instruction card mounted behind a Lexan plastic or glass cover in a stainless steel or aluminum frame with a

backplate. Install the frame in a conspicuous location observable from each control unit where operations are performed. The card shall show those steps to be taken by an operator when a signal is received under all conditions, normal, alarm, supervisory, and trouble. Provide an additional copy with the binder for the input output matrix for the sequence of operation. The instructions shall be approved by the ARCHITECT/ Engineer-in-Charge before being posted.

3.0 EXECUTION

3.1 INSTALLATION

A. Installation shall be in accordance with NBC 2016 as shown on the drawings, and as recommended by the major equipment manufacturer. Fire alarm wiring shall be installed in conduit. All conduit and wire shall be installed, RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS ,LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES (600 VOLTS AND BELOW), and all penetrations of smoke and fire barriers shall be protected , FIRESTOPPING.

B. All new conduits, junction boxes, conduit supports and hangers shall be concealed in finished areas and may be exposed in unfinished areas. All existing accessible fire alarm conduit not reused shall be removed.

C. All new or reused exposed conduit shall be painted, PAINTING to match surrounding finished areas and red in unfinished areas.

D. Existing devices that are reused shall be properly mounted and installed. Where devices are installed on existing shallow backboxes, extension rings of the same material, color and texture of the new fire alarm devices shall be used. Mounting surfaces shall be cut and Restoration, and be repainted PAINTING as necessary to match existing.

E. All fire detection and alarm system devices, control units and remote annunciators shall be flush mounted when located in finished areas and may be surface mounted when located in unfinished areas. Exact locations to be approved by the ARCHITECT/Engineer-in-Charge.

F. Speakers shall be ceiling mounted and fully recessed in areas with suspended ceilings. Speakers shall be wall mounted and recessed in finished areas without suspended ceilings. Speakers may be surface mounted in unfinished areas.

G. Strobes shall be flush wall mounted 2,000 mm (80 inches) above the floor or 150 mm (6 inches) below ceiling, whichever is lower. Locate and mount to maintain a minimum 900 mm (36 inches) clearance from side obstructions.

H. Manual pull stations shall be installed not less than 1050 mm (42 inches) or more than 1200 mm (48 inches) from finished floor to bottom of device and within 1500 mm (60 inches) of a stairway or an exit door.

3.2 TYPICAL OPERATION

A. Activation of any manual pull station, heat detector, or smoke detector shall cause the following operations to occur:

1. Operate the emergency voice communication system in Buildings indicate buildings . For buildings without sprinkler protection throughout, flash strobes continuously only on the floor of alarm.

2. **Continuously sound a temporal pattern general alarm and flash all strobes in the building in alarm until reset at the local fire alarm control unit in Buildings indicate buildings .**
3. **Release only the magnetic door holders // in the smoke zone // on the floor from which alarm was initiated // after the alert signal.**
4. **Transmit a separate alarm signal, via the main fire alarm control unit to the fire department.**
5. **Unlock the electrically locked exit doors within the zone of alarm.**

B. Operation of duct smoke detectors shall cause a system supervisory condition and shut down the ventilation system and close the associated smoke dampers as appropriate.

3.3 TESTS

A. Competent, factorytrained engineer or technician authorized by the manufacturer of the fire alarm equipment to technically supervise and participate during all of the adjustments and tests for the system. Make all adjustments and tests in the presence of the ARCHITECT/Engineer-in-Charge.

B. When the systems have been completed and prior to the scheduling of the final inspection, furnish testing equipment and perform the following tests in the presence of the ARCHITECT/Engineer-in-Charge. When any defects are detected, make repairs or install replacement components, and repeat the tests until such time that the complete fire alarm systems meets all contract requirements. After the system has passed the initial test and been approved by the ARCHITECT/ENGINEER-IN-CHARGE, the contractor may request a final inspection.

1. **Before energizing the cables and wires, check for correct connections and test for short circuits, ground faults, continuity, and insulation.**
2. **Test the insulation on all installed cable and wiring by standard methods as recommended by the equipment manufacturer.**
3. **Open each alarm initiating and notification circuit to see if trouble signal actuates.**
4. **Ground each alarm initiation and notification circuit and verify response of trouble signals.**

3.4 FINAL INSPECTION AND ACCEPTANCE

A. Prior to final acceptance a minimum 30 day "burnin" period shall be provided. The purpose shall be to allow equipment to stabilize and potential installation and software problems and equipment malfunctions to be identified and corrected. During this diagnostic period, all system operations and malfunctions shall be recorded. Final acceptance will be made upon successful completion of the "burnin" period and where the last 14 days is without a system or equipment malfunction.

B. At the final inspection a factory trained representative of the manufacturer of the major equipment shall repeat the tests. TESTS and those required by NBC 2016. In addition the representative shall demonstrate that the systems function properly in every respect. The demonstration shall be made in the presence of a Hospital in Charge/ Engineer-in-Charge representative.

3.5 INSTRUCTION

A. The manufacturer's authorized representative shall provide instruction and training to the Hospital Staff as follows:

1. **Six one-hour sessions to engineering staff, security police and central attendant personnel for simple operation of the system. Two sessions at the start of installation, two sessions at the completion of installation and two sessions 3 months after the completion of installation.**
2. **Four twohour sessions to engineering staff for detailed operation of the system. Two sessions at the completion of installation and two sessions 3 months after the completion of installation.**
3. **Three eight-hour sessions to electrical technicians for maintaining, programming, modifying, and repairing the system at the completion of installation and one eight-hour refresher session 3 months after the completion of installation.**

B. The Contractor and/or the Systems Manufacturer's representative shall provide a typewritten "Sequence of Operation" including a trouble shooting guide of the entire system for submittal to the Hospital in Charge/ Engineer-in-Charge. The sequence of operation will be shown for each input in the system in a matrix format and provided in a loose leaf binder. When reading the sequence of operation, the reader will be able to quickly and easily determine what output will occur upon activation of any input in the system. The INPUT/OUTPUT matrix format shall be as shown in completion drawings

C. Furnish the services of a competent instructor for instructing personnel in the programming requirements necessary for system expansion. Such programming shall include addition or deletion of devices, zones, indicating circuits and printer/display text.

4.0 SCHEDULES

4.1 SMOKE ZONE DESCRIPTIONS

Identify all of the notification zones that are to have voice messages for the fire alarm manufacturer to program. They are usually defined by the smoke barriers within the facility. It is preferable to use compass designations versus activities such as "office area" to facilitate future building modifications without having to change the voice messages.

4.2 DIGITIZED VOICE MESSAGES

A. Digitized voice messages shall be provided for each smoke zone of Buildings indicate buildings . The messages shall be arranged with a 3 second alert tone, a message and a description of the fire alarm area (building number, floor, level and smoke zone). A sample of such a message is as follows:

Alert Tone
Building One, Second Floor, East Wing
Building One, Second Floor, East Wing
Building One, Second Floor, East Wing

4.3 LOCATION OF VOICE MESSAGES

A. Upon receipt of an alarm signal from the building fire alarm system, the voice communication system shall automatically transmit a 3 second tone

alert and a pre-recorded fire alarm message throughout the floor in alarm, the floor above and the floor below the building.

SOLAR ENERGY ELECTRICAL POWER GENERATION SYSTEM

PART 1 GENERAL

1.1 DESCRIPTION

A. This section specifies the furnishing, installation,

connection, testing, and commissioning of solar energy electrical power generation systems.

B. The requirements of this Section apply to all sections related to solar energy electrical power generation systems.

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1.3 DEFINITIONS

A. Unless otherwise specified or indicated, electrical and electronics terminology used in these specifications, and on the drawings, shall be as per relevant IS codes

B. Unless otherwise specified or indicated, solar energy conversion and solar photovoltaic energy systemterminology used in these specifications, and on the drawings, shall be as per relevant IS codes

1.4 QUALITY ASSURANCE

A. Solar Energy Electrical Power Generation System installer(s) shall demonstrate that they have successfully installed at least four projects

within the past five years that, in aggregate, equal or exceed the size of the proposed project. References shall be provided for each of the referenced qualified projects.

B. Aluminum frames must be avoided as structural support member for installation of photovoltaic cell arrays

C. Supports and racking for solar photovoltaic system designs shall be prepared under the seal of a licensed Professional Structural Engineer (PE). Where applicable, such as roof top installations, the engineershall also provide adequate review and structural analysis of the existing structure that will be supporting the proposed solar photovoltaic system. Among the documents that shall be submitted by the engineer are environmental loading analyses (including wind, snow,hail, and where applicable, seismic) and the rack and substrate's ability to withstand these environmental forces. In the instance where the rack is installed on the ground, adequate information shall be presented to demonstrate the earth's ability to support the proposed design.

D. If the system will be a tracking system, the mechanical and control systems shall be approved by the using entity. Preference shall be given to closed or hybrid-open/closed logic control for the tracking system.

E. If paralleling arrangement is desired, the system shall have anti-islanding capability such that it is incapable of exporting power to the utility distribution system in the absence of utility power. Paralleling must be approved by serving electric utility.Provide written correspondence from the utility confirming its requirements.

F. Investigate whether the Engineer- in charger,Contracting Officer's Representative (COR) or local environmental entities require environmental impact studies which may include, but are not limited to, effects upon wildlife. The Contractor shall determine which entity has jurisdiction over environmental matters and shall make appropriate inquiry and comply with all applicable regulations.

G. Investigate any other local ordinances that may apply to installation of a solar energy electrical generating system in the proposed location. Bring

any conflicts with the drawings and specifications to the attention of the Engineer- in charge.

H. Warranties: The solar energy electrical generating system shall be subject to the items below:

1. **Solar photovoltaic modules and inverter: 10 year manufacturer's warranty against defects in materials and workmanship.**
2. **Power output: 25 year manufacturer's power output warranty, with the first 10 years at 90% minimum rated power output and the balance of the 25 years at 80% minimum rated power output.**
3. **Existing roof: Notify warrantor of existing roofing system on prior to beginning work and on completion of work, and obtain documentation verifying that existing roofing system has been inspected and warranty remains in effect. Submit documentation at project closeout.**

1.5 SUBMITTALS

A. Where proposed system shall be a Net Meter project, prepare appropriate applications and submittals to the Engineer- in charge. Where proposed system shall be connected before the serving electric utility's meter and tied directly to the grid, prepare appropriate applications and submittals to the Engineer-In charge. In all cases, the serving electric utility may have a requirement for further electrical studies, which may include or not be limited to power factor analysis, short circuit protection studies, grid wiring adequacy, or capacities of upstream equipment. If such requirements exist and are required by the serving electric utility, these requirements shall be fulfilled by the Contractor. Provide written documentation confirming the utility's approval of the interconnection of the solar energy electrical power generation system with the utility system.

B. Submittals shall comply withfollowing requirements:

1. **Shop Drawings:**
   a. **Submit sufficient information to demonstrate compliance with drawings and specifications.**

b. Include electrical ratings, dimensions, mounting details, materials, required clearances, terminations, weight, wiring and connection diagrams, accessories, and nameplate data.

c. Include shop drawings for foundations and other support structures.

2. Product Data:

a. Include detailed information for components of the solar energy electrical generation system.

1. Wiring.

2. Inverter.

3. Photovoltaic modules.

4. Rack and support assemblies.

5. Instrumentation.

6. Switchgear.

7. DC and AC disconnect.

8. Combiner boxes.

9. Monitoring systemsincluding appropriate interfacing with existing facility data collection systems.

b. Certification from the manufacturer that the system has been seismically tested to International Building Code requirements. Certification shall be based upon simulated seismic forces on a shake table or by analytical methods, but not by experience data or other methods.

3. Manuals:

a. Submit, simultaneously with the shop drawings, complete maintenance and operating manuals including technical data sheets, wiring diagrams, and information for ordering replacement parts.

1. Safety precautions.

2. Operator restart.

3. Startup, shutdown, and post-shutdown procedures.

4. Normal operations.

5. Emergency operations.

6. **Environmental conditions.**
7. **Preventive maintenance plan and schedule.**
8. **Troubleshooting guides and diagnostic techniques.**
9. **Wiring and control diagrams.**
10. **Maintenance and repair procedures.**
11. **Removal and replacement instructions.**
12. **Tracking systems (where applicable).**
13. **Spare parts and supply list.**
14. **Parts identification.**
15. **Testing equipment and special tool information.**
16. **Warranty information.**
17. **Testing and performance data.**
18. **Contractor information.**

b. **If changes have been made to the maintenance and operating manuals originally submitted, then submit updated maintenance and operating manuals two weeks prior to the final inspection.**

4. **Certifications: Two weeks prior to final inspection, submit the following.**
   a. **Certification by the manufacturers of all major items of thesolar energy electric generation system that the system conforms to the requirements of the drawings and specifications, and that they have jointly coordinated and properly integrated their equipment and controls to provide a complete and functional installation.**
   b. **Certification by the Contractor that the solar energy electric generation system has been properly installed, adjusted, tested, commissioned, and warrantied. Contractor shall make all necessary field measurements and investigations to ensure that the equipment and assemblies meet contract requirements.**
5. **Estimated Annual Power Output: Submit calculated annual power output for each of the proposed solar photovoltaic systems. Provide independent calculations for each fixed, single-axis tracking, or double-axis tracking system.**

C. If equipment submitted differs in arrangement from that shown on the drawings, provide drawings that show the rearrangement of all associated systems. Approval will be given only if all features of the equipment and associated systems, including accessibility, are equivalent to that required by the contract and acceptable to the Engineer In charge.

D. Submittals and shop drawings for independent but related items shall be furnished together and complete in a group. Coordinate and properly integrate materials and equipment in each group.Final review and approval will be made only by groups.

PART 2 PRODUCTS

2.1 GENERAL

A. Provide materials to fabricate functioning photovoltaic system in accordance with relevant IS codes & certifications.

B. Factory-prefabricated solar equipment packages which include photovoltaic modules, batteries or other energy storage, inverters, and controls and which meet the requirements of this section are acceptable.

2.2 GROUNDING

A. All applicable components of the solar energy electrical power generating system must be grounded per latestIS Code provisions.

B. DC Ground-Fault Protector:

1. Shall be listed per UL 1703.

2. Shall comply with requirements.

2.3 PHOTOVOLTAIC ARRAY CIRCUIT COMBINER BOX

A. Shall be listed to UL 1741.

B. Shall include internal overcurrent protection devices with dead front.

C. Shall be contained in non-conductive NEMA Type 4X enclosure.

D. Up to 48 volts DC: Shall use UL-listed DC breakers that meet latestIS Codes provision.

for overcurrent protection.

E. Up to 600 volts DC, paralleling system: Shall use fuses instead of breakers.

F. Ground and pole-mounted arrays shall have a separate combiner box mounted to the pole itself.

G. Where applicable, combiner box shall be a disconnecting combiner box.

2.4 SWITCH/DISCONNECTING MEANS

A. Shall be UL-listed, in accordance with the NEC, as shown on the drawings, and as specified.

B. Utility External Disconnect Switch (UEDS): Refer to Engineer- In charge , as several states do not require UEDS for small solar photovoltaic systems if the inverter provides the same function should be equippedwith UESD. Coordinate requirements with serving electric utility.

2.5 WIRING SPECIALTIES

- **For the DC cabling, XLPE or, XLPO insulated and sheathed, UV-stabilized single core flexible copper cables shall be used; Multi-core cables shall not be used.**

- **For the AC cabling, PVC or, XLPE insulated and PVC sheathed single or, multi-core flexible copper cables shall be used; Outdoor AC cables shall have a UV-stabilized outer sheath.**

- **The total voltage drop on the cable segments from the solar PV modules to the solar grid inverter shall not exceed 2.0%**

- **The total voltage drop on the cable segments from the solar grid inverter to the building distribution board shall not exceed 2.0%**

- **The DC cables from the SPV module array shall run through a UV-stabilized PVC conduit pipe of adequate diameter with a minimum wall thickness of 1.5mm.**

- **Cables and wires used for the interconnection of solar PV modules shall be provided with solar PV connectors (MC4) and couplers.**

- **All cables and conduit pipes shall be clamped to the rooftop, walls and ceilings with**

thermo-plastic clamps at intervals not exceeding 50 cm; the minimum DC cable size shall be 4.0 mm2 copper; the minimum AC cable size shall be 4.0 mm2 copper. In three phase systems, the size of the neutral wire size shall be equal to the size of the phase wires.

2.6DC-AC INVERTER

A. Safety of power converters for use in photovoltaic power systems Safety compliance (Protection degree IP 65 for outdoor mounting, IP 54 for indoor mounting) As Per IEC 62109-1, IEC 62109-2

B. Photovoltaic Systems □ Power conditioners: Procedure for Measuring Efficiency (10%, 25%, 50%, 75% & 90-100% Loading Conditions) As Per IEC/IS 61683 (For stand Alone System)

D. Overall efficiency of grid-connected photovoltaic inverters:

This European Standard provides a procedure for the measurement of the accuracy of the maximum power point tracking (MPPT) of inverters, which are used in grid-connected photovoltaic systems. In that case the inverter energizes a low voltage grid of stable AC voltage and constant frequency. Both the static and dynamic MPPT efficiency is considered As Per BS EN 50530 (Will become IEC 62891).

(For Grid Interactive system)

E. Utility-interconnected Photovoltaic Inverters - Test Procedure of Islanding Prevention MeasuresAs Per IEC 62116/ UL 1741/ IEEE 1547.

F.Measuring relays and protection equipment - Part 27: Product safety requirementsAs Per IEC 60255-27.

G. Environmental Testing of PV System □ Power Conditioners and Inverters As Per

IEC 60068-2 (1, 2, 14, 27, 30 & 64)

H. Electromagnetic Interference (EMI), and Electromagnetic Compatibility (EMC)

testing of PV Inverters (as applicable) As Per IEC 61000- 2,3,5

2.7SOLAR PHOTOVOLTAIC (PV) MODULES

A. Bypass diodes shall be built into each PV module either between each cell or each string of cells.

B. Hail Protection: Compliant with testing procedure per ASTM E-1038.

C. Lightning Protection: Shall ground according to manufacturer instructions per UL 1703.

D. Access, Pathways, and Smoke Ventilation: Per IFC 605.3, access and spacing requirements must be observed in order to: ensure access to the roof, provide pathways to specific areas of the roof, provide for smoke ventilation opportunities area, and, where applicable, provide emergency access egress from the roof.

E Fire Classification:

1. **Although not technically enforceable, every effort shall be made to ensure the solar photovoltaic module is not combustible.**

2.8 BATTERY CHARGE CONTROLLER

A. Listed per UL 1741.

B. Charge controller or self-regulating system shall be required for a stand-alone system with battery storage. Charge controller's adjusting mechanism shall be accessible only to qualified persons.

C. Shall be capable of withstanding 25% over-amperage while charging for limited time per the NEC.

D. Charge controller shall include maximum power point tracking (MPPT) and temperature compensation.

2.9 BATTERY

A. General: Comply with NEC. Flooded lead-acid, captive electrolyte lead acid and nickel-cadmium are acceptable. Consider climate when selecting battery type.

B. Off-Grid: Always use high-quality, industrial-grade, deep-cycle batteries.

C. Grid-Interactive with Battery Backup: Best to use sealed-absorbed glass mat (AGM) batteries specifically designed for emergency standby or float service.

D. Sizing: For stand-alone systems, size per IEEE 1013 and/or 1562.

E. Installation and Maintenance: Follow practices per IEEE 937.

F. Test and Evaluation:

1. **Stand-Alone System: Follow procedures per IEEE 1361.**
2. **Hybrid System: Follow procedures per IEEE 1661.**

G. Optimize Performance and Life: Follow practices per IEEE 1561.

H. Safety and Ventilation:

1. **Use protective enclosure and proper ventilation per the NEC.**
2. **Exposed battery terminals and cable connections shall be protected, and live parts of batteries shall be guarded. Batteries should be accessible only to a qualified person via locked room, battery box, or other container.**
3. **Spacing around battery enclosures and boxes and other equipment shall be at least 915mm [36inches]; batteries shall not be installed in living areas, or below enclosures, panelboards, or load centers.**
4. **Prohibited are conductive cases for flooded, lead-acid batteries operating above 48-volt nominal. Battery racks shall have no conductive parts within 155 mm [6 inches] of the tops of cases.**
5. **To reduce risk of electric shock, storage batteries in dwellings shall operate at less than 50 volts (48-volt nominal battery bank). Live parts of any battery bank shall be guarded.**

I. Interconnection:

1. **Per NEC, battery cables shall be a standard building wire type conductor. Welding and automobile "battery" cables (listed and non-listed) are prohibited.**
2. **Flexible cables, listed for hard service use and moisture resistance, are permitted (not required) from battery terminals to nearby junction box and between battery cells. Flexible, highly-stranded building-wire type**

cables (USE/RHW and THW) are available. Battery terminals shall be compatible with flexible cables.

2.10 COLLECTOR SUPPORTS

A. Wind Resistance Requirement:As IS Codes

B. Mechanical Load Requirement: per UL 1703.

C. Ground and Pole Mount:

1. **Foundations shall be designed by a licensed ProfessionalStructural Engineer (PE).**
2. **Where possible, combiner boxes shall be mounted directly to the pole itself.**

2.11INSTRUMENTATION

A. Meters: If applicable andsystem is grid-connected, use net smart meter provided by the serving electric utility.

B. Sensors:

1. **Temperature sensor shall be a component in the MPPT control system.**
2. **May install additional data acquisition sensors to measure irradiance, wind speed, and ambient and PV module temperatures. Any additional sensors shall require a conduit separate from the current conductor conduit.**

C. Datalogger/Monitoring System: Shall be a packaged system capable of string-level monitoring or in the case of micro-inverters, capable of monitoring and logging an individual module's information.

PART 3 – EXECUTION

3.1 INSTALLATION

A. Install the solar photovoltaic system in accordance with the NEC, this section, and the printed instructions of the manufacturer.

B. Prior to system start-up, ensure no copper wire remains exposed with the exception of grounding wire as allowed in certain circumstances per manufacturer's instructions.

C. In seismic areas, systems shall be adequately anchored and braced per details on structural contract documents to withstand seismic forces at the locations where installed.

D. Wiring Installation:Workers shall be made aware that photovoltaic modules will be live and generating electricity when there is any ambient light source and shall take appropriate precautions. Utilize on-site measurements in conjunction with engineering designs to accurately cut wires and layout before making permanent connections. Locate wires out of the way of windows, doors, openings, and other hazards. Ensure wires are free of snags and sharp edges that have the potential to compromise the wire insulation. All cabling shall be mechanically fastened. If the system is roof-mounted it shall have direct current ground fault protection according to NEC. Ensure breakers in combiner box are in the off position (or fuses removed) during combiner box wiring.

E. Instrumentation: Install instruments as recommended by the manufacturer. Locate control panels inside a room accessible only to qualified persons.

F. Building-Integrated Photovoltaic Installations: Building-integrated photovoltaic modules/shingles shall be installed in accordance with the manufacturer's installation instructions.

G. Rack-Mounted Photovoltaic Installations: Rack-mounted photovoltaic modules shall be installed in accordance with the manufacturer's installation instructions.

H. Ground and Pole-Mounted Photovoltaic Installations: If structure is used as equipment grounding conductor, ensure compliance with NEC. Wiring shall not be readily accessible.

I. Tracking System Installations: Disconnect shall be within sight of the tracking motor.

J. Provide safety signage per IS codes.

K. Remove, replace, patch, and repair existing roofing materials and surfaces cut or damaged during installation of the solar energy electrical power generation system, by methods and with materials so as not to void existing roofing system warranty. Notify roof warrantor before proceeding.

3.2 FIELD QUALITY CONTROL

A. Field Inspection: Perform in accordance with manufacturer's recommendations. Prior to initial operation, inspect the solar energy electrical power generation system for conformance to drawings, specifications, and NEC. In addition, include the following:

1. Visual Inspection and Tests:

a. Compare equipment nameplate data with specifications and approved shop drawings.

b. Inspect physical, electrical, and mechanical condition.

c. Verify required area clearances.

d. Verifying tightness of accessible bolted electrical connections by calibrated torque-wrench method, or performing thermographic survey after energization.

e. Verify the correct operation of all sensing devices, alarms, and indicating devices.

f. Verify that all cable entries from top of junction boxes are sealed per junction box rating.

g. Verify all connections and integrity of printed circuit boards in all applicable junction boxes.

B. Tests: Provide equipment and apparatus required for performing tests. Correct defects disclosed by the tests and repeat tests. Conduct tests in the presence of the Engineer-Incharge.

1. Module String Voltage Test: Prior to connecting wiring to the combiner box, use a digital multi-meter to ensure each series string's polarity is correct.

2. Operational Tests: Perform tests in accordance with the manufacturer's written recommendations. Tests for stand-alone systems shall be performed per IEEE 1526.

3.3 FOLLOW-UP VERIFICATION

A. Upon completion of acceptance checks, settings, and tests, the Contractor shall show by demonstration in service that the solar photovoltaic electrical

power generation system is in good operating condition and properly performing the intended function.

3.4 COMMISSIONING

A. If the system is grid-tied, the Contractor shall coordinate with the serving electric utility to establish an interconnection agreement.

B. Connect the solar photovoltaic electrical power generation systemto the serving electric utility grid only after receiving prior approval from the utility company.

C. Only qualified personnel shall connect the solar photovoltaic electrical power generation systemto the serving electric utility grid.

3.5 INSTRUCTION

A. A complete set of operating instructions for the solar photovoltaic electrical power generation system shall be laminated or mounted under acrylic glass and installed in a frame near the equipment.

B. Furnish the services of a factory-trained technician for one, 4-hour training period for instructing personnel in the maintenance and operation of the solar photovoltaic electrical power generation system, on the date requested by the Engineer-In charge.

SPECIAL CONDITIONS & TECHNICAL SPECIFICATIONS FOR EXTERNAL AND INTERNAL ELECTRICAL WORKS

1. General:

The following Special Conditions shall be read in conjunction with General Conditions of Contract. If there are any provisions in these Special Conditions, which are at Variance with the provisions in the above-mentioned documents, the Provisions in this Special Conditions shall take precedence.

2. Working Agency:

The electrical work shall be done by "A" Class Electrical Contractor approved by Government having similar nature and value of work executed.

3. Inspection & approval of the work by local authority:

The contractor has to obtain all clearances & approvals from any statuary authority/local bodies pertaining to electrical installations. The contractor shall obtain all information relating to local regulations, Bye- laws,

applicable if any and all laws relate to his work or profession and his having to execute work as required. Contractor shall obtain approval of the installation from the relevant inspection authorities at all stages and on completion of the installation work. Any fee payable to the statutory authority for obtaining approvals is required to be paid by the contractor. However, the necessary reimbursement of the fee deposited by the contractor to any statutory authority (as mentioned above) will be made on production/submission of the valid documentary proof/evidence.

1. Training:

The contractor has to provide training to the client staff and also operate the system (if required) for a period of one month from the date of handing over free of cost.

5. Pre-delivery Inspection & approval:

The contractor shall offer the pre-delivery inspection of all the materials at manufacturers work to the Engineer-in-charge. The intimation for such inspections shall be given at least 15 days in advance from the date of proposed inspection. CLIENT representative may inspect any/all the materials required in this project. All the testing facilities and all the consumables including the fuel etc. shall be provided by the contractor and nothing extra shall be paid on this account.

6 Tender drawings and Shop Drawings:

The work shall be executed as per latest working drawings to be prepared by the contractor after award of work and submitted to the Engineer-in-charge for approval. The Drawings & data provided are for guidance to the contractor. The exact dimensions, location, distance & levels etc shall be governed by the space conditions. The tender drawings are indicative and are for the guidance of the contractor. The drawings appended with the tender documents are intended to show the space allotted for various equipment, bus duct, cable and pipe routes etc. besides general electrical layout. The equipment offered shall be suitable for installation in the spaces shown in these drawings / available at site. The contractor shall prepare and submit for approval detailed shop/working drawings of all works on award of the work. Two set of all such working drawings shall be submitted for approval, including such changes as may have been suggested by the Engineer-in-charge as required at the earliest - within 15 days of awarding of the work.

The contractor shall also take parallel action (after award of work) for submission of applications along with the drawings, documents & details etc. to various Statutory Bodies/Authorities for obtaining their approval/clearances.

The contractor shall re- submit 4 sets of all the drawings within 7 days from date of receiving comments if any from the client after incorporating the comments.

7. Completion Drawings:

After completion of work, the contractor shall have to submit the following set of drawing.

4 set of hard copies + 3 soft copies (in 'Auto CAD' applicable version) in CD of the following layout drawings. (Indicating complete Equipment like switch boards, panels, cabinets, Bus-trunking, Ducting, cable laying, piping, other works installed & single line diagrams of electrification of installations etc.) For final record & maintenance: -

8. Documents to be furnished on completion of installation

a) **Completion Drawings as per Clause 7 above.**
b) **Manufacturer's catalogues of all equipment and accessories, operation and maintenance manuals of all major equipment, detailing all adjustments, operation and maintenance procedure.**
c) **Manufacturer's Guarantee /Warrantee certificates of all the equipments & materials etc.**
d) **Clearances/approval of various Statutory Bodies/Authorities for this system.**
e) **Any other information the Engineer-in-charge may deem fit.**

No completion certificate will be issued until the above drawings and documents are submitted to the Engineer-in-charge.

9. Performance Testing at Site:

After completion of erection at site & a preliminary warm up period, acceptance trial run of a minimum period of 7 days duration shall be conducted at site. The trial shall be conducted in the presence of the Engineer-in-charge and the test results shall be recorded in an approved format. The contractor at his cost shall provide all Testing facilities like testing Engineers, assistants, instruments, materials and consumables etc. as required for the test. Tests proving the satisfactory performance of all operating switch gears, transformers and safety functions and controls shall be carried out. All calibrated instruments, materials, load configuration, fuel, lubricating oil and labour required for carrying out of the test shall be provided by the contractor free of cost. The contractor shall give ample notice of the test to the Engineer-in-charge.

10 The contractor shall be fully responsible for the maintenance including watch and ward of all the Electrical installations provided by him until the works are handed over to client. Thereafter, the work can be handed over to the Client along with all inventories, completion plans etc. as required.

11. CO-ORDINATION:

The Contractor shall co-operate with any other agency working in the same project, compare plans, specifications and the time schedules and so

arrange his work that there will be no interference. The Contractor shall forward to the Engineer-in-charge all correspondence and drawings so exchanged. Failure to check plans for conditions will render the contractor responsible for bearing the cost of any subsequent change found necessary or damages done. However, contractor shall afford necessary facilities to execute the work simultaneously with other agencies executing the works like Civil, architect, horticulture, external services and other building works for the same project. The electrical work shall be executed in close coordination with the progress of building work. This being the essence of the contract, an activity chart clearly showing critical areas should be furnished before commencing the work for proper monitoring and coordination.

12. HANDING OVER THE WORKS ON COMPLETION:

On satisfactory completion of all the works as per the provision of the Contract, the Contractor shall hand over the works to the client. The Contractor shall ensure that all the testing commissioning & trial run operation of all the system are simultaneously carried out so as to make the same functional immediately on completion. It shall be the responsibility of the contractor to obtain clearances from all the Statutory Bodies like Electrical Inspector & Fire Officer etc. as required for the installations prior to commissioning & handing over the same after completion of work.

13. All material to be used on works shall bear I.S. Certification work unless otherwise the make specified in the item or special conditions appended with the tender document. In case I.S. marked materials or the materials mentioned in the tender document are not used due to non-availability, the materials used shall conform to I.S. code or CPWD Specifications applicable in this contract. In such cases the Engineer-in-charge shall satisfy himself about the quality of such materials and give his approval in writing. Only articles classified as "First Quality" by the manufacturers shall be used unless otherwise specified. All materials not having I.S. marking shall be tested as per provision of the Mandatory Tests in CPWD Specifications and the relevant IS specifications. The Engineer-in-charge may relax the condition regarding testing if the quantity of materials required for the work is small. For the products bearing ISI certification work, no further testing is required at site. In all such cases of use of IS certified materials, proper proof of procurement of materials from authentic manufactures shall be provided by the contractor to the satisfaction of Engineer-in-charge.

14. Other agencies involved at site for Civil, Plumbing, Air conditioning or other building work, horticulture work etc. for this project will also simultaneously execute the works and the contractor shall afford necessary coordination for facilities with fellow contractors for the same. The contractor shall leave such necessary holes, openings, etc. as may be required for the electric, sanitary, air-conditioning, fire-fighting, PA system,

telephone system, C.C.T.V. system etc. and nothing extra over the agreement rates shall be paid for the same.

15. **The work shall be carried out in a manner complying in all respects with the requirements of relevant bye-laws of local body under the jurisdiction of which the work is to be executed or as directed by the Engineer-in-charge and nothing extra shall be paid on this account.**

16. **For items, where so required, samples shall be prepared before starting the particular items of work for prior approval of the engineer-in-charge and nothing extra shall be payable on this account.**

17. **CLARIFICATIONS OF DISCREPANCIES:**
In case of any discrepancy between technical specifications, approved drawings and BOQ, or disputes in respect thereof, the interpretation of the Engineer-in-Charge shall be final and binding on the contractor.

TECHNICAL SPECIFICATIONS OF ELECTRICAL WORK

1.00 GENERAL

1.01 The electrical installation work shall be carried out in accordance with Indian Standard Code of practice for Electrical wiring installation IS: 732-1989 and IS:2274-1963. It shall also be in conformity with the current Indian Electricity rules and regulations and requirements of the Local Electricity supply authority and fire insurance regulation. Electrical work in general shall be carried out as per following specifications with upto date amendment.

General Specifications for Electrical Works:

(Part I - Internal) - 2013.
(Part II - External) - 2007.
(Part IV - Substation) - 2013.
(Part VII – DG Set) - 2013

Wherever these specifications calls for a higher standard of material and or workmanship than those required by any of the above mentions regulations and specification then the specification here under shall take precedence over the said regulations and standards.

1.2 SCOPE OF WORK

The scope of work shall cover complete electrical works.

The items / activities covered under the electrical works shall include the following:

i. Supplying, fixing testing and commissioning of Main LT Panel, capacitor Panel, Main Distribution Boards complete in all respect.

ii. Supplying, fixing, laying, testing and commissioning of 11KV and LT Cable complete in all respect.

iii. Supplying, fixing, testing and commissioning of DG Sets of 415V complete in all respect.

iv. Supplying, Fixing, testing and commissioning of 11kV HT Panel and 11KV / 0.415 KV Dry Type Transformers complete in all respect

v. Supplying, Fixing, testing and commissioning of External light pole complete in all respect.

vi. Earthing with maintenance free earthing system complete in all respect.

vii. Main Distribution Boards and Distributions Boards. Switch fuses unit/MCB/Isolator for lifts, major equipment etc. complete in all respect.

viii. **Cables from Main Distribution Board. Sub main wiring from Main Distribution Boards to various final Distribution Boards. Power wiring for equipment, lift etc. complete in all respects.**

ix. **RCC/GI pipes for cables, manholes, cable tray and other items required to complete with electrical installation work in all respects.**

x. **Earthing of electrical installation complete in all respects.**

1.03 STANDARD AND REGULATIONS

All equipments, switchgear, cables and other items of work shall conform to Indian/ IEC Standard specifications.

The installation shall conform in all respects to Indian Standards Code of Practice for Electrical wiring installation IS:732- 1989. It shall also be in conformity with the current Indian Electricity Rules and the Regulations and requirements of the Local Electric Supply Authority, Local laws/by laws in so far as these become applicable to the installation. Wherever these specifications call for a higher standard of materials and /or workmanship than those required by any of the above regulations, these specifications shall take precedence over the said regulations and standard. In general, the materials, equipment and workmanship shall conform to the following Indian Standards, unless otherwise called for.

Sl.No.	Item	Relevant Code
1	XLPE insulated PVC sheathed armoured Cables of 1.1kv grade as per	IS 7098 Part-I & II 1988 / 1985
2	Marking and arrangements for Switchgear: Bus bars, main connection and auxiliary wiring.	IS 375 - 1963
3	Specification for low voltage switchgear and control gear assemblies	IS8623 -1993 to III)
4	Specifications for enclosed distribution	IS 2675 - 1983
5	Installation and maintenance of Switchgear	IS 10118-19 (Part-I to IV)
6	HRC Fuses	IS 9224 -1979
7	Specification for Rigid Steel conduits for electrical wiring.	IS 9537 - 1981(Part-II)
8	Specifications for accessories for rigid steel conduits for electrical wiring.	IS 3837 -1976
9	Code of practice for earthing	IS 3043 -1987

10	**Current transformers**	**IS2705-1992(Part-1**
11	**Shut capacitors for power system**	**IS 2834 -2986**

Inspection and approval of the work by local authority: On completion of this work, the contractor shall obtain and deliver to the Client all the certificates of inspection and approval by the electrical inspectorate as required. The Client shall have access to the manufacturer's premises for inspection of any item of the tender for which contractor has to make arrangement with different manufacturers.

2.0 11KV HT /Panel

2.1 Scope

Manufacturing, testing and supplying of integrated cubicle type metal clad, floor mounted and draw out type free standing, front operated indoor type 11kV switchgear as per specifications given below and mentioned in drawing.

System

The switchgear enclosure shall conform to degree of protection IP 4 The switchgear shall be made from Pretreated Galvanized (GI) sheet 2 mm thick and shall be folded and braced as necessary to provide a rigid support for all components. The switchgear assembly shall form a continuous dead front line up of free-standing vertical cubicles. Each cubicle shall have a lockable front hinged door and a removable bolted back cover. Suitable arrangement for lifting of each cubicle shall be provided. Design and construction of the switchgear shall be such as to permit extension at either end Vacuum Circuit breaker shall be provided with surge arresting device for protection against lightning and switching over voltage. One separate and distinct connections to earth shall be provided for each surge arrestor.

2.2 Breaker Compartment

Vacuum Circuit Breaker shall be of cassette type draw-out with front plate which covers the cubicle when the breaker is in service position. This front plate shall be provided with view glass to facilitate observation of mechanical ON/OFF indication of Circuit breaker, Spring-charged / discharged indication and operation counter. Necessary orifice shall be provided for manual charging of the springs. ON/OFF push button for opening and closing of the circuit breaker shall also be provided. The draw out truck shall have two positions for the circuit breaker VIZ isolated / Test & Service.

The vacuum interrupters shall be completely enclosed inside Epoxy housing.

2.3 Bus Bar Compartment

Bus bars of rectangular cross section of copper conductor supported by cast epoxy insulator to withstand full short circuit currents minimum 25kA for three second for 11 KV system shall be provided at the rear. Bus bar chamber shall be provided with inter panel barriers with epoxy cast seal off bushings.

2.4 CT and Cable Compartments

At the rear of the panel sufficient space shall be available to accommodate three numbers epoxy CT's of double core and two numbers three core cable termination. The cable entry shall be from the top / bottom.

2.5 Separate Compartments

Circuit breakers, instrument transformer, bus bars, cable etc shall be housed in different compartments. All relays, switches, lamps, etc. comprising the control, indication and protective devices shall be housed in a separate compartment on the front of the cubicle.

2.6 Technical Particulars of Vacuum Circuit Breaker

S.NO.	DESCRIPTION	11 KV
A	Rated Current	630A
B	Rated Voltage	12 KV
C	Rated Frequency	50 Hz
D	Rated Short Circuit breaking Current	25 KA
E	Rated Short Circuit withstand capacity 3 sec	25 KA
F	Rated short circuit making current (KAP)	66 KA
G	Rated Power Frequency Withstand Voltage	42kV
H	Rated Lighting Impulse Withstand Voltage	75kV
I	Mechanical Life Operations	20,000

2.7 Earthing Switch

Cable earthing switch shall be provided in the cable chamber and shall be operated from the front of the panel. The ON/OFF position of switch shall be indicated by mechanical indicator. The earthing switch shall be suitably interlocked with the breaker, so that it can be operated only when the breaker is in OFF position. Earthing switch shall also be provided on bus bar side. The ON/OFF Switch shall be indicated by mechanical indicator. The earthing switch shall be suitably interlocked with the breaker, so that it can be operated only when the breaker is in OFF position.

2.8 Isolating Contacts

The breaker isolating contacts shall consist of electrolytic copper silver plated multi-fingers in tulip round shape design with ball point contacts to give a tolerance of ±10 mm in any direction.

2.9 Low Voltage Plug and Socket Connector

A twenty-pin plug and socket connection along with flexible leads shall be provided to connect control instrumentation and interlock circuits on the breaker truck and in the panel. The plug and socket assembly shall be suitably interlocked with the truck positions like service and test/isolated position

2.10 Interlocks and Safety Devices

The following interlocks shall be provided:

a. The truck cannot be moved from either test to service position or vice versa, when the circuit breaker is 'ON'.

b. The circuit breaker cannot be switched 'ON' when the truck is in any position between test and service position.

c. Front part of the truck cannot be removed when the breaker in 'ON' position.

d. The low voltage plug, and socket cannot be disconnected in any position except test/isolated position.

e. The truck cannot be moved inside the panel, when the LT plug and socket is Disconnected.

f. Earthing switch cannot be switched 'ON' when the truck is inside the panel.

g. The truck cannot be inserted when the earthing switch is 'ON'.

2.11 Safety Devices

The following Safety devices shall be provided for the safety of the operating personnel:

a. Individual explosion vents shall be provided for breaker/bus bar/cable chambers on the top of the panel to let out the gases under pressure generated in case of fault inside the panel.

b. Circuit breaker and sheet metal enclosure shall be fully earthed.

c. Self locking shutters shall be provided which shall close automatically when the truck is withdrawn to 'Test position' and no separate padlocking of the shutter shall be required.

2.12 Protective Earthing

The earthing connection between the truck and the cubicle shall be by means of sliding contacts so that the truck is earthed in the isolated position when inserted and remains earthed when the truck is pushed further into the connected position or when the truck is being withdrawn until the truck has moved part the isolated position.

2.13 Current Transformer

I. <u>General Requirements</u>

Accommodation shall be provided in the circuit breaker panel, to mount one set of duel ratio CT. Access to the CTS for cleaning, testing or changing shall be from the front, back or top of the panel.

II. <u>Rating</u>

Duel ratio CTS of suitable burden (but each not less than 15 VA) shall be preferred with 5 amps secondaries.

Instrument Security Factor (ISF) of each CT shall not be more than 5. The CTs shall conform to relevant Indian Standards. The design and construction shall be dry type, epoxy resin cast robust to withstand thermal and dynamic stresses during short circuits. CT terminals shall be shorting type. Current & voltage circuits shall be laid in separate wire ways. Secondary terminals of CTS shall be brought out to a suitable terminal block which will be easily accessible for terminal connections. Test terminal block shall be provided in the front side of the panel for testing purpose.

CT'S shall have 2 Nos. of cores for following application		
	Core -1	**for metering**
	Core -2	**for over current & earth fault protection.**
Class of accuracy of each winding		
	Metering class	**0.5**
	Protection class	**5P10**

2.14 Potential Transformers

The potential transformers shall be confirming to IS 3156/ IEC 60185.The primary windings of the potential transformers shall be insulated and shall be of the cast rest in type.

Potential transformer (PT'S) shall be mounted on a draw out trolley and housed in separate metal compartment and shall have control fuses on the H.V. side and a miniature circuit breaker on the L.V. side of the windings.HT HRC Control fuses shall be confirming to IS – 9385/ IEC –60282.Miniature Circuit breaker shall comply with IS – 8828/ IEC – 60898.

Padlocking facilities shall be provided for both service and isolated position.

The potential transformer shall be as specified below:

Ratio	**11000/ √3/ 110/ √3/ 110 V**
V A Burden	**100 V A for 110/√3 and 110 V winding**
Class	**CL –1 for both the windings.**
Basic Insulation level	**Same as mentioned for VCB in clause -6.**
Over voltage factor	**1.2 Continuous**

Ratio : 11000/ √3/ 110/ √3/ 110 V

V A Burden : 100 V A for 110/√3 and 110 V winding

Class : CL –1 for both the windings.
Basic Insulation level : Same as mentioned for VCB in clause -6.
Over voltage factor : 1.2 Continuous
Single phase PT'S shall be used and shall be connected in Star/ Star.
PT compartments shall be at the bottom of the panels.

2.15 Control Wiring

The control wiring shall be carried out with minimum 2.5 sq. mm. PVC insulated copper conductor cables. The wiring shall be securely fixed and neatly arranged to enable easy tracing of wires. Identification PVC ferrules shall be fitted to all wire terminals to render easy identification and facilitate checking in accordance with IS 5578 and 11353.

2.16 INBUILT POWER PACK

Inbuilt Power Pack with SMF Batteries of suitable capacity shall be provided for protection relays, indication lamps and control with the capacity of at least three operations of the panel.

3.00 11kV/0.415 KV TRANSFORMER

3.01 GENERAL

Power transformer shall be dry type for indoor use having capacities indicated in the schedule. The supply is 11KV/415 volts, 50 Hz and 3 phases. All the transformers shall be with ON LOAD TAP CHANGER type.

The design manufacture and performance of transformer shall comply with all performance of equipment status, regulations and safety codes in the location where the transformers will be installed. Transformers shall conform to the latest applicable standards. All transformers shall be minimum 3 star rated, and BEE certified.

3.02 CODES AND STANDARD

Transformers shall comply with the latest edition of Indian Standards No. IS 2026 Part I to Part V (Power Transformer) and IS11171 for Dry Type Transformer. In case the Provision of Indian Standards are not directly applicable to dry type Transformer, the provision of Latest IEC-726 and any other relevant IEC shall apply. Latest Standards as applicable shall be followed the Insulating materials, Bushing, Installation and Maintenance of the Transformer.

3.03 SERVICE CONDITION

a)	**Altitude**	**Less than 1000 meters.**
b)	**Maximum Ambient Température**	**50 deg. C**
c)	**Minimum Ambient Température**	**0 deg C**
d)	**Relative Humidity**	**100 %**
e)	**Installation**	**Corrosive, dusty, humid and tropical**

3.04 RATING AND TYPE

The Transformer shall have core type construction, 3 phase and shall be suitable for Indoor service under the climatic conditions prevailing at site. The Transformer shall be capable of withstanding thermal and mechanical effects of short circuit at terminals of any winding with full voltage maintained on other winding as per IS: 2026.

3.05 WINDING

The primary and secondary winding shall be of electrolyte copper conductors. The high and low voltage winding shall be totally encapsulated and should be cast under vacuum in moulds with fiber glass reinforce epoxy resin laminate. Both HV and LV winding of each phase shall be separately cast as a rigid tubular coil with no mechanical and electrical connection between their co- axial arrangements. The Transformer shall be free of partial discharges at least unto 1.1 times the rated voltage.

The winding shall absorb no. moisture under the worst tropical conditions collection of moisture and dust over the winding shall not any way affect the insulation strength of the winding.

3.06 CORE

The transformer core shall be build up to with high non-aging low and high permeability CRGO Silicon steel lamination. CRGO sheet shall be coated with inorganic material or equivalent insulation to reduce eddy current to minimum. After shearing, the laminations shall be treated to remove all burrs and shall be annealed to remove all the residual stresses.

Core frame work and clamps shall be arranged and tightened to securely hold lamination in order to prevent any settling or displacement in case of heavy shocks during transport, handling or short circuits. All the Iron parts except the core shall be galvanized and treated with high temperature resistance paint. Core Fastening shall be insulated to reduce losses and avoid spots. Transformer shall be designed to withstand 10 % over fluxing corresponding to rated voltage.

Suitable lugs shall be provided for lifting the complete core and coil assembly of the transformer.

3.07 INSULATION

Inter turn and intercool insulation shall be designed such that di - electric stress is uniformly distributed throughout the winding under all operating conditions. The winding shall be provided with Class 'F' Insulation.

3.08 TEMPERATURE RISE

The Temperature rise of the winding shall not exceed 90deg by resistance on continuous full load above maximum ambient temperature of 50 Deg C and in no case shall reach value that may damage the core itself or other adjacent part.

3.10 VECTOR GROUP:

Transformer shall have the vector group of Dy 11.

3.11 IMPEDENCE

The desired impedance shall be as mentioned in the IS: 2026.

3.12 FLUX DENSITY

The Maximum flux density at any point in the winding shall not exceed 2.2 Amp. Per sq.mm at rated full load, voltage and frequency.

3.13 CURRENT DENSITY

The maximum current density at any point in the winding shall not exceed 1.6 Tesla on the normal rated tap voltage and frequency.

3.14 COOLING

The Transformer shall be designed for natural cooling (AN)

3.15 ENCLOSURE

Transformer shall be provided with a sheet steel enclosure with adequate provision for ventilation. The degree of protection of enclosure shall be IP 21 for indoor installation and IP 33 for outdoor installations. The sheet steel thickness of enclosure shall be minimum 2mm.

3.16 CABLE TERMINATION

The low voltage side of the transformer shall be suitable to receive Aluminium Bus Duct of suitable capacities from the top of the Transformer. A suitable size of flange to be provided for connecting the overhead bus trunking in the LT Box.

H.T. sides of the transformers shall have cable end boxes to receive 3 C X 240 sq.mm desired size of 11KV cables.

All cable end boxes shall have bore holes to match the opening for each cable specified and shown in the single line diagram.

3.17 EARTHING

Two main earthing terminals shall be connected to the terminals provided for transformer.

3.18 FITTINGS AND ACCESSORIES

Rating and Terminal Marking Plate of the Transformer including the details of OFF circuit changing voltage of the links.

Earthing terminal with Lugs.

Transformer Neutral earthing terminal.

Marshal Box with wiring and terminal and temperature scanner.

PT 100 type temperature scanner and its connection with marshal box.

Limit switch in all hinged door fix door and wiring till marshal box.

Neutral CT for restricted earth fault protection and its commotion up to marshal box.

HV cable end box at primary.

ON load Tap changer

4 nos Plan bi- directional rollers.

Inspection windows shall be provided in the cover.

Lifting lugs for both the transformer and core shall be provided.

3.19 ONLOAD TAPCHANGER:

"ON LOAD" circuit tap changing with AVR arrangement on H.V side is to be provided. The tapping is to be provided for variation on high voltage side from + 10% to - 10% steps of 1.25% each. Automatically operated "ON LOAD Tap Changing Switch" having a position indicating lights & Locking device and complete with Automatic Voltage regulator and its Control panel shall be provided separately.

3.20 INSTALLATION OF TRANSFORMER

Installation of transformer shall be carried out in accordance with manufacturer's instructions and/or as directed by purchaser.

All power/control connections and mechanical joints shall be completed, checked and adjusted to ensure safety and satisfactory operation of the transformer.

Transformer shall not be placed on bare ground during unloading but it shall be placed on wooden sleepers. After placing on foundation, alignment, leveling etc. shall be carried out in best workman like manner.

For the power/control cabled projecting above the ground, the termination to cable box shall be run in GI conduits of suitable cross section and the same shall be supported properly and pipe ends shall be sealed with bitumen compound.

The cable box of detachable type of the transformer shall be supported properly so as to facilitate taking out of the transformer for repair without disturbing the cables.

3.21 TEST CERTIFICATES.

Test certificate shall be furnished in required number of copies for approval.

The routine, special and type test certificate of the transformer shall be furnished for approval before the delivery of the equipment from the factory.

The routine and type test certificates of miscellaneous components shall be furnished or approval.

3.22 ROUTINE TESTS

During manufacture and on completion the transformer shall be subjected but not limited to the following Routine Tests as laid down in the latest revision of the IS 11171 IEC - 726

I. Applied voltage test

II. Induced voltage test

III. No-load loss and excitation current tests

IV. Impedance voltage and load loss tests

V. Resistance measurement

VI. Ratio tests

VII. Polarity and phase relation tests

VIII. Insulation resistance tests

IX. Insulation power factor tests

3.23 TYPE TESTS

The type test certificates for the following type tests carried out on similar capacity rating shall be submitted along with the routine test certificates.

i) Heat run test

ii) Impulse test

3.24 FIELD TEST

After installation a site, the transformer shall be subjected to the following field test:

i) Construction inspection

ii) Ratio tests

iii) Polarity test

iv) Tap change operation test.

3.25 DATA SHEET FOR 1000 KVA TRANSFORMER

Nos. required	-	1 no. (one)
Capacity	-	1000 KVA
Type of Cooling	-	Air cooled Dry type Transformer
Rated Primary Voltage	-	11000 volts
Rated Secondary Voltage between phase and neutral.	-	415 V between phases and 240 phase and
Rated supply frequency	-	50 Hz or cycles per second
No. of phases	-	Three (3)
No. of windings	-	Two (2)
Max. Losses at 50% loading	-	6.32 kW
Max. Losses at 100% loading	-	16.8 kW
Winding connection with fully out to secondary	-	Primary Delta, Secondary-Star insulated neutral brought terminals.
Material of Winding	-	Copper
Vector Group	-	DYn 11 to IS: 2026
Protection	-	WTI and Limit switches

Neutral CT class shall be earth fault protection	**-**	**Neutral CT of 1250/1A protection provided for restricted**
Primary side connections	**-**	**Suitable for 3C x 240sqmm 11kV XLPE cable.**
Secondary side connections	**-**	**Suitable for Bus duct/Cable Termination**
Under Carriage with sliding the required without the floor.	**-**	**Suitable under carriage with rollers edges designed so as to permit transformer when damaging**
Marshaling Box	**-**	**To facilities connections of all protection devices like WTI , Ref and Limit switches, etc.**
Fitting & Accessories	**-**	**As per IS specification and as specified.**
Losses	**-**	**max. loss at 50% loading 3000W**
		Max. loss at 100% loading 9800W

3.26 ELECTRICAL & PERFORMANCE REQUIREMENT:

a) **Transformer shall operate without injurious heating at the rated KVA at any voltage within variation of +/ 10% of the rated voltage of that particular tap.**

b) **Measurement and reporting of transformer losses: all measurements of losses shall be carried out by using calibrated digital meters of class 0.5 or better accuracy and certified by the manufacture. All transformer of capacity of 500kVA and above would be equipped with additional metering class current transformer and potential transformer additional 2 requirements of utility so that periodic loss monitering study may be carried out.**

b) **Transformer shall be designed for 110% continuous over fluxing withstand capability.**

c) **The neutral terminals of the winding with star connection shall be designed for the highest over current that can flow through the winding.**

d) **Overloads shall be allowed with in the conditions defined in the loading guide of the applicable standard. Under these conditions, no limitations by terminal bushings, tap changers or other auxiliary equipment shall apply.**

e) **Temperature Rise for continuous full load application shall be guided by Maximum temperature rise clause of IS 2026. The temperature rise shall not exceed 45 degree C by thermometer or 50 degree C for winding over an ambient of 45-degree C.**

3.27.0 DRAWINGS AND O&M MANUALS:

3.27.1 Four copies of manual of complete instructions for the installation, operation, maintenance and repairs circuit diagrams, foundation and trenching details shall be provided with the transformers. List of spare parts shall also be indicated.

3.27.2 Two copies of the drawings incorporating the following particulars shall be submitted with the offer for preliminary study.

a) **GA drawing showing dimension, net weight and shipping weight, quantity of insulating oil etc.**

b) **Crane requirements for assembly and dismantling of the transformer.**

c) **Drawing indicating GA of cable box and its dimension for cable entry cut out requirements etc.**

3.27.3 The drawings in (four sets) to be furnished by the supplier for approval after acceptance of his order shall include the following.

a) **GA showing front and side elevations and plan of transformer and all accessories and external features, detailed dimensions, crane lift for unthanking, H.T./L.T. clearances etc.**

b) **Drawings of Bus duct termination arrangement.**

c) **HV cable box arrangement & disconnecting chamber GA drawings.**

d) **Name plate and terminal making and connection diagram.**

e) **Assembly of OLTC gear mechanism & details of mechanism parts, limits, contours of wearing parts, timing gear adjustments etc.**

3.27.4 Reproducible copy of the above drawings for records

4.0 DG SETS

4.01 SCOPE OF WORKS

The Scope of work shall include under this specification loading, unloading, storage, installation, testing and commissioning of the Diesel engine

alternator sets including labour, tools, tackles and plants, hardware and consumables. All DG sets should be 4 star rated (BEE Certified)

4.02 DIESEL GENERATOR SET

The Diesel Generator Sets shall consist of AC Alternator of 750kVA and 600 kVA 0.8 P.F., capacity coupled with diesel engine with all accessories and control such as starting device, lubricating arrangements, speed control, automatic control devices, protection gear, instruments etc. as required and specific here in after. The diesel Generator shall be factory assembled and factory tested completed in all respects.

4.03 DIESEL ENGINE

Diesel engine shall be of heavy duty, robust construction, suitable for continues duty. Engine shall be enclosed construction and engine case shall be made of grey iron castings. The cylinder head shall be cast iron and shall accommodate one suction valve, one starting valve, one injection valve and one safety valve etc. Piston shall be of cast aluminium and shall be provided with adequate number of sealing ring and strapping rings. The big and small ends shall be fitted with bearings.

4.04 ENGINE

The Diesel Engine shall be naturally aspired water-cooled type, four strokes, 16-cylinder direct injection type, water cooled, electric starting , multi-cylinder diesel engine confirming to BS: 5514/BS:649 with 10% overloading for one hour in any 12 hours duration.

Lubrication shall be full pressure by gear type pump with full flow filters with replace element. An oil temperature gauge, strainer and relief valve shall be fitted.

Fuel injection shall be enclosed in line fuel injection pump with diaphragm type fuel lift pump. Full fuel filters with replacement element s shall be fitted and 24-volt solenoid provided.

The speed governing mechanism shall be hydraulic type and should keep correct frequency at all possible operating condition well within the limit.

Coolant shall be circulated by a gear driven centrifugal pump through a radiator cool by a pusher flow fan completed with fan cool and a hand protection guard. Generator set shall water cooled and having radiator and fan.

Starting type shall be push button electric starting type by an axial type starter motor from a 184-volt lead acid battery.

4.05 ENGINE DETAIL

Dry type air filters shall be fitted.

Type	**Multicylinder diesel.**
Method of starting	**Electric start**
Type of cooling	**Radiator**
Type of governor	**Electronic Governor**

Type of fuel **High speed diesel**

Type of lubricating oil Heavy duty detergent oil

The above engine shall be equipped with the following: -

a. - Radiator

b. -Fuel Tank suitable for 8 hrs. running with necessary piping and fuel gauge.

c. -Fly wheel of suitable diameter and weight.

d. -Fuel and lubricating oil filter.

e. -Fuel injection equipment.

f. -Air cleaner /filter.

g. -Lubricating oil pump.

h. -Flexible coupling.

j. -Governor Electronic for 750KVA & 600KVA DG Set.

K. Batteries and battery charger.

Suitable stop device to stop the engine in case of the controller variable exceed the upper limit (Temperature of cooling water lub. and pressure of lub oil.)

Indicating panel of Engine shall be consisting of the following.

i. Cooling water temperature gauge.

ii. Lub. oil pressure gauge.

iii Lub oil temperature gauge.

iv Starting switch with key.

v RPM meter with hour meter.

vii Oil service tank with all accessories such as level indicator, man hole., valved inlet and outlet, air vent, drain plug, mounting pedestals etc.

4.06 BASE AND MOUNTING

The DG Set shall be mounted on a MS skid base with necessary rein forcement.

4.07 MOUNTING

The set will be mounted on spring loaded cushy - footing pads.

4.08 PERFORMANCE OF DG SET

a. Voltage regulation: Plus, or minus 2.5% from no load to full load and at power factor from 0.8 PF (lag) to unity with 4% speed regulation of the engine.

b. Voltage wave form: Wave form deviation shall not be greater than 10% or within NEMA MG 1-22.43.

c. Telephone influence: As per NEMA requirement.

4.09 ALTERNATOR.

4.09.1 GENERAL

Alternator shall be of silent pole, rotating field type and shall be self exciter suitable for 415 volts, 50 Hz, A C 0.8 P.F. and 1500 RPM. The alternator shall be of drip - proof construction. Alternator shall generally confirm to IS: 4722 and BS 2613.

4.09.2 FRAME

Frame shall be of cast iron construction; the feet and terminal box mounting being cast integral with the frame. A terminal box (adopter) shall be used if required for proper termination of Cables.

4.09.3 STATOR CORE:

Stator core shall be built upto silicon steel lamination compressed hydraulically and rigidly supported by either cast iron or steel end rings. The core shall be design ed for minimum reactance, low voltage wave from distortion and maximum efficiency, stator coils shall be of tropicalized mica or leatheriod. End windings shall be taped with fiber glass tape and the complete windings shall be impregnated with fiber glass tape and complete winding shall impregnated with varnish and spray finished with moisture protection varnish. Otherwise 100% epoxy impregnating with an overcoat of resilient insulating material shall be carried out.

4.09.4 END FRAMES

The end frames shall be of well ribbed cast iron design. The end frames shall spigotted to the stator frame and secured by easily available set screws. Ventilation openings shall be cast into the vertical and bottom side face which shall be screen protection and drip proof.

4.09.5 BEARING

The bearing shall be of heavy duty prelubricated cartridge ball or roller bearings. Single bearing alternators shall have self - align ball on roller bearing. The end frame of the rotor shall be removable from stator without disturbing the bearings.

4.09.6 ROTOR

The rotor shaft shall be turned either from a tensile MS bar or from a MS forging. Field coils shall be wound with synthetic enamel covered or varnish bounded end glass cover copper strips of high conductivity. Poles shall be of bolt on type made of sheet steel of high permeability. The insulation between the pole and coil shall comprises of varnished fiber glass cloth backed mica around the body and thick insulating washers on the top and bottom of the coil. Coil shall be impregnated with resin and the complete rotor shall be spray finished with a moisture protection varnish suitable for tropical conditions. However, 100% epoxy impregnation and an overcoat of resilient insulating material shall be preferable.

4.09.7 DAMPER WINDING

The damper bars of copper brazed to heavy copper and connectors shall be located in a semi closed circular slots situated in the pole faces.

4.09.8 TYPE

Alternator shall be brushless.

4.09.9 COUPLING

Engine and alternator shall be directly coupled through a sturdy flexible coupling.

4.09.10 TEMPERATURE RISE

The alternator shall suitable for temperature rise of 50-degree c above ambient and shall be capable of withstanding 10% over load for one hour continuously in 12 hrs. as per IS 4722.

4.09.11 EXCITER - VOLTAGE REGULATORS

The excitor shall be over hung, rotating type without any bearing excitor of static type or semi conductor may be provided. Solid state voltage regulator with all accessories and relays shall be providing for proper voltage regulation.

4.09.12 BALANCING

All the rotating part shall be dynamically balanced to ensure smooth vibration free running. of number of on load change over switches.

4.09.13 INSTRUMENTATION CONTROL PANEL

The DG Sets shall have the following controller:

Auto starts/ off microprocessor-based controller with a facility for remote start, remote annunciation, and remote communication capability through the telephone /GSM network. It should be possible to monitor the parameters of the engine and the alternator and display the status of the faults on the DG set if any and generate a complete report on the PC individually or on a network. The following minimum monitoring & protection is required for the alternators.

Alternator Monitoring

- **Current. (I1, I2, I3)**
- **Frequency**
- **Voltage (L-L & L-N)**
- **KVA**
- **KVAR**
- **Power Factor**
- **Percentage alternator duty heavily i.e. actual load / KW rating.**

The Generator shall be protected against the following electrical faults

- **Overload and short circuit**
- **Ground fault**
- **Over current**
- **Over frequency**

- **Under frequency**
- **Under Voltage**
- **Over Voltage**
- **Locked Rotor**
- **Reverse power protection.**

It should be possible to read the data i.e. Parameters and Shutdown status locally on the DG Set. All the above Parameters should be displayed on The Local Control Panel through appropriate meters and status on faults should be indicated through a facia annunciator. It should be possible to display all the functions as above on a personal computer.

4.10 SOUND ATTENUATING ACOUSTIC ENCLOSURE

Sound Attenuating Acoustic Enclosure should have pleasant and aesthetical looks and should be able to bring down the noise by 25 decibels when measured at a distance of 1 meter away from the set. The DG set should be supported on a base frame in an MS Sheet enclosure with suitable ducting for air inlet and outlet. The door and enclosure should be given corrosion resistant treatment and painted to be weatherproof and long lasting. Resin bonded Glass / Mineral / Rock wool of high density (greater than 45 Kg / Cu. M) with minimum thickness of 75 mm covered with perforated MS Sheet should be provided and covered with tissue paper. Enclosures should be provided with durable locking system with doors duly gasket with neoprene rubber. Exhaust gases should be taken out from the DG Set by means of MS Pipe and a noise suppressor. Proper care should be taken for engine heat rejection in order to have safe working temperature inside the enclosure by provision of fans etc, as required. The design aspect should ensure free and uninterrupted flow of suction and exhaust air in order that the temperature rise of the enclosure with respect to the ambient is less than 7°C.

4.11 EXHAUST SILENCER PIPING

The exhaust silencer piping system shall be of heavy-duty MS pipes confirming to Class - B. Suitable length of flexible piping shall be used for connecting the exhaust piping to the engine as per the recommendations of the manufacturer. Exhaust pipe along with silencer inside the building shall be provided with mineral wool insulation with chicken mesh wrapping and 26 SWG aluminum cladding. All terminal connections and pipes joint shall be of welded construction. The terminals of sizes 2" and above shall be butt welded, and of sizes 1.5" and below shall be socket welded, complete with flanges, jointing and fasteners. This welding shall be done as per relevant ASME/ASA codes. The Contractor will have to indicate beforehand the welding procedure he proposes to use. After confirmation by the Project Manager the procedure which is finalised shall be strictly adhered to.

4.12 <u>ACCESSORIES</u>

i Battery charging equipment and instrument for starting of the engine and control energization. This shall be Part of Synchronizing panel.

ii Cable alley for incoming and outgoing cable with glands.

iii Removal side panel for easy for access and locking arrangement to prevent tempering.

4.13 OTHER ANCILLARY EQUIPMENT

4.13.1 DAY FUEL TANK

The engine shall be provided with day service fuel tank of 990 ltrs. Capacity. Tank shall be made of 3 mm thick MS sheet. Tank shall be mounted on a pedestal. Tank shall be painted with anti- corrosive paint. Tank shall be completed with oil level indicator, inlet pipe connected, outlet pipe connection drain pipe, air vent pipe cover etc. The cost of the Tank deemed to include in rate of the DG Set.

4.14 SPECIFICATION OF MATERIALS

4.14.1 EXHAUST SILENCER PIPING

The exhaust silencer piping system shall be of heavy-duty MS pipes confirming to class B. Suitable length of flexible piping shall be used for connecting the exhaust piping to the engine as per the recommendation of the manufacturer. MS screws flanges and bends shall be used as per site requirements. Exhaust pipe inside the building shall be logged with 6 mm dia. asbestos rope and suitably bonded with asbestos cloth.

4.14.2 OIL PIPING

Oil piping shall be of MS suitable to withstand the pressure as recommended by manufacturer.

4.14.3 FOUNDATION

Foundation shall be casted by the civil contactor.

4.14.4 24 VOLTS DC BATTERIES AND BATTERY CHARGING EQUIPMENTS

SMF Batteries of required voltage and Ah for the starting of the DG Set shall be fixed inside the enclosure. The battery charger is in the scope of other agency.

. The battery bank shall be provided with the following accessories.

a. Battery stand.

b. Set of connectors with ends take off suitable for connection.

11.15 EXHAUST SILENCER PIPING

The exhaust silencer piping system shall be of heavy-duty MS pipes confirming to class B. Suitable length of flexible piping shall be used for connecting the exhaust piping to the engine as per the recommendation of the manufacturer. MS screws flanges and bends shall be used as per site requirements. Exhaust pipe inside the building shall be logged with heat resistive glass wool of 48 kg / mtre cube and then cladded with Al. foil all along the pipe.

4.16 The Vendor shall be submitted the Vibration Level data and the sound level data of the DG Set along with the quotation of the DG Set and after the commissioning of the DG Set.

5.00 11kV HT CABLES

5.01 GENERAL

The high-tension cables shall be aluminium conductor XLPE insulated armoured construction. The conductors shall be made from electrical purity aluminium wire. The conductor shall be sector shaped stranded conductors. The cables shall conform to IS: 7098 Part -II 1985.

5.02 Rating

The cables shall be rated for a voltage of 11000 volts.

5.03 Core Identification

Core shall be identified by numbers 1, 2 &3 printed on the insulation.

5.04 Current Rating

The current rating shall be based on the following conditions.

a) Max. Conductor temperature : 65 C

b) Ambient Air temperature : 40 C

c) Ground temperature : 30 C

d) Depth of laying : 90 C

5.05 Short Circuit Ratings

Short circuit rating for the cables shall be as per IS:692 (Latest Edition). However, the rating shall be based on the following.

a) Max. conductor temperature under full load conditions : 65 C

b) Max. S. C. Conductor Temperature : 140 C

5.06 Selection of Cables

The cables have been selected considering the following:

a) Max. connected load.

b) Ambient temperature.

c) Grouping of cables.

d) Short circuit level.

5.07 Storing, Laying and jointing

H.T. Cables shall be laid in trenches or ducts unless otherwise specified. Generally, laying, jointing and commissioning shall be as per the regulations of local authorities.

a) Storing

On receipt of H.T. Cables at site, cable shall be inspected to detect any damage. The ends of cables shall be in sealed condition. After inspection, cables shall be in stored in a proper place with battens of

cable drums being replaced. The cable drums shall not be stored `on flat` with flanges horizontal.

b) Laying: Cable laying in trenches

HT cables can be laid in outdoor trenches, if specifically called for although provision exists for pulling cable in existing ducts.
Wherever, cables are laid in outdoor trenches, the depth of the trenches shall no be less than 900 mm plus radius of cable, from upper surface of the ground. Where more than one multicore cable is laid in the same trench, a horizontal internal spacing of 0.25 metres shall be left in order to reduce mutual heating and also to ensure that fault occurring on one cable will not damage the adjacent cable.

Cable shall be laid in asbestos cement pipes encased in concrete or Hume pipes at all road crossings. Cable shall be laid in trenches over rollers placed inside the trenches. After the cable has been properly laid and straightened, it shall be covered with 80mm thick layer of sand. Cable shall then be lifted and placed over this sand cushion. Again, the cable shall be covered with a sand layer of 150mm thick. Over this sand layer a course of cable protection tiles of overlap of 50mm on either side of cable markers made of aluminium of cast iron indicating the voltage grade and direction of run of the cables shall be installed at regular intervals.

5.08 Cable Jointing

Cable jointing shall be made as per the instructions of the cable manufacturer. Cable jointing shall be carried out only by qualified and competent cables jointers. A copy of manufacturers recommendations shall be submitted to the consultants for approval of consultant. Cable shall be jointed using standard cable joining boxes with a lead sleeve and MS/CI rectangular box.

Cable shall be jointed using standard cable joint boxes with a lead sleeve and CI protection box. The box shall be of split type with compound filling hole and plug. The lead sleeve shall be free from pores, impurities etc. The cable box shall be provided with holes and lead seals. Cable shall be jointed as per colour coding or numbering of the cores. The cable seal shall not be removed until all preparations for jointing are completed. Jointing the glands and armour clamp shall establish good electrical contact between cable armour, lead sheath and body of the switchgear. The cable box and gland shall be bonded to the main earth bus with suitable size copper tapes.

5.09 Testing

a) Insulation resistance of both sections of the cables to be jointed should be checked by 1000 V megger.

b) H.T. Cables shall be pressure tested to withstand a voltage after the jointing is completed. However, the test voltage and duration of test shall be in conformity with local standards. Before carrying out the

DC high voltage test, the cable shall be laid in its final position with all the end terminations kept unfinished so that substation equipments are not subjected to the test pressure.

6.00 L.T. CABLES AND CONTROL CABLES

6.01 General

MV cables shall be supplied, inspected laid tested and commissioned in accordance with drawings, specifications, relevant Indian Standards Specifications and cable manufacturer`s instructions, the cable shall be delivered at site in original drums with manufacturers name clearly written on the drum.

The recommendation of the cable manufacturer with regard to joining and sealing shall be strictly followed.

6.02 Material

The MV cable shall be PVC insulated. Aluminium conductor armoured cable conforming to IS: 7098 Part I & II 1988 / 1985 laid in trenches/ducts as shown on drawings.

6.03 All cables shall be inspected upon receipt at site and checked for any damage during transit.

6.04 Joints in Cables

The Contractor shall take care to see that all the cables received at site are apportioned to various locations in such a manner as to ensure maximum utilization and avoidance of joining cables. This apportioning shall be got approved by the architect before the cables are cut to lengths. straight joints are prohibited.

6.05 Testing of cables

Prior of burying of cables, following tests shall be carried out:

a) Insulation test between phases and phase and earth for each length of cable before and after jointing.

On completion of cable laying work, the following test shall be conducted in the presence of owner`s representative.

a) Insulation Resistance Test. (Sectional and overall)
b) Continuity Resistance Test.
c) Sheathing continuity Test.
d) Earth Test.

All tests shall be carried out in accordance with relevant Indian Standard Code of Practice and Indian Electricity Rules. The Contractor shall provide necessary instruments, equipment and labour for conducting the above test and shall bear all expenses in connection with such tests. All tests shall be carried out in the presence of the Architect/Consultant.

7.0 LT PANEL, SYNCHRONISING PANEL, MAIN DISTRIBUTION BOARDS:

7.01 GENERAL:

Main Distribution Boards shall be metal clad totally enclosed, rigid, floor mounting, air insulated, cubicle type for use on 415 volts, 3 phase, 50 cycle system. System shall be suitable for a fault withstand capacity of 50KA RMS symmetrical. Equipment shall be designed for operation in high ambient temperature and high humidity tropical atmospheric conditions.

7.02 <u>STANDARDS</u>:

(A) The equipment shall be designed to conform to the requirements of:

i) IS-8623 - Factory Built Assemblies of switchgear and control gear.

ii) IS-4237 -General requirements for switchgear and control gear for voltages not exceeding 1000 volts.

iii) IS-2147 -Degrees of protection provided by enclosures for low voltage Switchgear and Control gear.

iv) IS-375 - Marking and arrangement of busbars.

(B) Individual equipment housed in the Main Distribution Board shall conform to the following IS specifications:

i) Moulded Case Circuit Breakers - IS 2516 (Parts I & II/Sec 1) - 1977

ii) Fuse Switch and Switch Fuse Units - IS 4064 - 1978

iii) H.R.C. Fuse links - IS 2208-1962 or IS 9224-1979.

iv) Current Transformers - IS 2705

v) Voltage Transformer - IS 3156

vi) Relays - IS 3231

vii) Indicating Instruments - IS 1248

viii) Integrating Instruments - IS 722

ix) Control Switches & Push Buttons - IS 6875

x) Auxiliary Contractors - IS 2959.

7.03 <u>CONSTRUCTIONS</u>:

Main LT Panel, Main Distribution Board shall be metal enclosed, indoor, floor mounted free-standing type made up of the required vertical section, which when coupled together shall form continuous dead front Distribution Board. Main Distribution Board shall be dust and damp protected the degree of protection being no less than IP-45 to IS 2147. All Panels & Main Distribution Board shall be extensible on both sides by the addition of side section after removal of end covers. Main Distribution Board shall be fabricated with a framed structure with rolled/folded sheet steel channel section of minimum 2mm thickness, doors and covers shall be of minimum 2mm thick sheet steel. Sheet steel shroud and partitions shall be of exterior of Main Distribution Board shall be smoothly finished, leveled and free from flaws. The corners to be rounded. Front and rear doors to be fitted with dust excluding neoprene gasket with fasteners designed to ensure proper compression of the gaskets. When covers are provided in

place of doors, generous overlap shall be ensured between sheet steel surfaces with closely spaced fasteners to preclude the entry of dust.

Following minimum clearances to be maintained after taking into account connecting bolts, clamps etc.:

i)	**Between Phases**	**-**	**32 mm**
ii)	**Between Phases and neutral**	**-**	**26 mm**
iii)	**Between Phases and earth**	**-**	**26 mm**
iv)	**Between neutral and earth**	**-**	**26 mm**

All insulating materials used in the construction of the equipment shall be of non hygroscopic materials, duly treated to withstand the effect of high humidity, high temperatures, tropical ambient service conditions. Functional units such as fuse switch / switch fuse unit/ moulded case circuit breakers shall be arranged in multi-tier formation. The design of the Main Distribution Board shall be such that each fuse switch/switch fuse units/MCCB shall be fully compartmentalized.

Insulated barriers shall be provided with a vertical section and between adjacent section to ensure prevention of accidental contact with main busbars and vertical risers during operation, inspection or maintenance of functional units. All doors/covers providing access to live power equipment/circuits shall be provided with tool operated fasteners to prevent unauthorised access, The panel shall be so constructed that the cable alley shall be sufficient enough to accommodate all the outgoing and incoming cables. For each cable, there shall be separate cable gland plate of detachable type at the bottom and/or top of the panel as required. Gland plate shall be 3mm thick.

7.04 METAL TREATMENT AND FINISHING:

All metal work used in the construction of the main Distribution Board should have under gone a rigorous metal treatment process as follows:

i) Effective cleaning by hot alkaline degreasing solution followed by cold water rinsing to remove traces of alkaline solution.

ii) Pickling in dilute sulphuric acid to remove oxide scales & rust formation, if any, followed by cold water rinsing to remove traces of acidic solution.

iii) A recognised phosphating process to facilitate durable coating of the paint on the metal surfaces and also to prevent the spread of rusting in the event of the paint film being mechanically damaged. This again, shall be followed by hot water rinsing to remove traces of phosphate solution.

iv) Passivating in de-oxalite solution to retain and augment the effects of phosphating.

v) Drying with compressed air in a dust free atmosphere.

vi) **Primer coating with two coats of a highly corrosion resistant primer, applied wet on wet and stove dried under strictly controlled conditions of temperature and time.**

vii) **A finishing coat of stoving synthetic enamel paint of gray colour of approved colour / or powder coating.**

7.05 <u>BUSBARS</u> :

The bus bars shall be air insulated and made of high conductivity, high strength aluminum alloy complying with the requirement of grade E-91E of IS-5082.The bus bars shall be suitable braced with non hygroscopic SMC supports to provide a through fault withstand capacity of 50KA RMS symmetrical for one second and a peak short circuit withstand capacity of 105KA for Main LT Panel & 50KA RMS symmetrical for one second for Main Distribution boards and other Panels

The neutral as well as the earth bar should be capable of withstanding the above level. Ridges shall be provided on the SMC supports to prevent tracking between adjacent busbars. Large clearances and creepage distances shall be provided on the busbar system to minimize the possibility of fault. The main phase busbars shall have continuous current rating throughout the length of the panel. The cross section of neutral busbars shall be same as that of the phase busbar for busbars of capacity upto 500 Amp., for higher capacities, the neutral busbar shall not be less than half (50%) the cross section of that of the phase busbars. Connections from the main busbars to functional circuits shall be so arranged and supported to withstand without any damage or deformation the thermal and dynamic stresses due to short circuit currents. Busbars shall be colour coded with PVC Sleeves.

The Main Distribution Board shall be designed that the cables are not directly terminated on the terminals of switch fuse/fuse switch etc. but are terminated on cable termination links. Capacity of aluminium busbars shall be considered as follows :

Sr.No.	Current Rating (Ampere)	Current Carrying Capacity of Al. Bus Bars (Amp. Per sq.mm)
1	100 Amp – 500 Amp	1.0 Amp./ sq.mm
2.	600 Amp – 1600 Amp.	0.8 Amp. / sq.mm
3.	2500 Amp	0.7 Amp. / sq.mm

7.06 <u>DRAW OUT TYPE AIR CIRCUIT BREAKERS</u> :

Power circuit breakers shall comply with standards IEC 60947 – 2 and IS: 13947:1993. The circuit breakers shall have a breaking capacity justified by calculations taking into account their installation location. The Number of circuit – breaker poles is indicated on the appended single – line

diagram. It shall be suitable for switching duty of transformer and other devices.

It shall be possible to push in and withdraw the breaker easily and without much effort. Insulating plugs and sockets for power as well as for control circuit shall be of robust design and fully self aligning. The breaker shall have three distinct positions namely services, test and isolated positions. In test position, it shall be possible to operate the circuit breaker without energizing the power circuits.

The Circuit breaker shall have the breaking capacity justified by calculation taking into account their installation location having no deration at ambient temperature 50degC. Circuit Breaker shall be designed in such a way that maintenance may be carried out as function of their use. The operating mechanism shall be of Open / Close type.

All ACBs should have Icu = Ics = Icw (1 sec) with rated Impulse Withstand Voltage 12kv

OPERATING MECHANISM :

The Circuit Breaker shall be power operated by a motor charged spring operated mechanism. The operating mechanism shall have anti-pumping features under every method of closing.

The main poles of the breaker shall operate simultaneously. Also, there shall not be any objectionable rebound of the moving contact in the fixed contacts.

The mechanism shall be such that any failure of auxiliary spring shall not prevent tripping. When the breaker is in closed position, failure of any auxiliary spring shall not cause damage to the Circuit Breaker or danger the operation.

A mechanical indicator shall be provided on the breaker operating mechanism to indicate open and closed position of the breaker. This shall be visible to a man standing in front of the cubical with the door closed.

It shall be possible to operate the breaker mechanically. This shall be possible only after opening the cubical door.

All working parts of the mechanism shall be of corrosion resistance material. All split pins, bolts, nuts and other parts shall be properly pinned and locked to prevent loosening with repeated operation of the breakers.

Auxiliary switch containing 4 No. + 4NC potential free contacts rated for 240 V AC (Indicative breaking).

SPRING OPERATED MECHANISM :

Spring operated mechanism shall be complete with motor, opening spring, closing spring with limit switch for automatic charging and all necessary accessories to make the mechanism a complete operating unit.

The breaker operation shall be independent of the motor which shall be used only for tensioning/compressing of the spring. The closing operation shall automatically charge the tripping spring.

The closing, opening shall get charged immediately after a closing operation performed. Motor used shall be preferably universal type operated on AC supply.

CONTACTS :

The main contacts shall be designed such that no maintenance shall be required under normal condition of use. The jaw contacts shall be on the breaker portion to enable faster and easier maintenance and replacement of the contacts. Provision for replaceable of arcing contacts.

CONNECTION/ DISCONNECTION MECHANISM :

It shall be possible to disconnect the circuit breaker without having to open the door. The three possible positions (connected , disconnected and test) shall be indicated.

Before carrying out a disconnection or connection operation, the operator shall be required to press a release button located on the front of the chassis.

The door shall be equipped with a locking system preventing door opening with circuit breaker in the connected position. Safety shutters shall be placed over the main incoming and outgoing circuits. A mismatch – prevention system shall block insertion of a draw out circuit breaker with a power rating greater than that of the fixed part.

ELECTRICAL AUXILARIES :

All electrical auxiliaries should be continuous rated, shall be installable on site without requiring adjustments or any tools other than a screw driver. The auxiliaries shall be placed in a compartment which, under normal operating conditions, shall not contain any conducting parts capable of entering into electrical contact with the circuit-breaker poles. It shall be possible to connect all auxiliary wiring from the front of the circuit breaker.

MECHANICAL INDICATORS :

Mechanical indicators on the front panel of the power circuit breakers shall indicate the following status conditions :

1. **"ON" (main contacts closed) Spring charged**
2. **"ON" (main contacts closed) Spring discharged**
3. **"OFF" (main contacts open) Spring charged – circuit breaker ready to close**
4. **"OFF" (main contacts open) Spring charged – circuit breaker not ready to close**
5. **"OFF" (main contacts open) Spring discharged**

TESTING :

Original test certificate of the ACB as per Standard IEC 60947-2/3 shall be furnished.

7.07 MOULDED CASE CIRCUIT BREAKERS :

GENERAL :

Moulded case circuit breakers shall be incorporated in the Main Distribution Board and Sub Distribution Board wherever specified. MCCBs shall be suitable either for single phase AC 230 volts or three phase 415 volts. The Circuit breaker shall comply with IEC60 947-2 and IS 13947 part 2.Icu=Ics=100%

The MCCB shall be with Electronic/Microprocessor trip unit for ratings higher than 250A and with thermal magnetic releases upto 250A .All circuit breakers shall have a rated operational voltage of 415V AC (50 / 60 Hz).

The rated insulation voltage shall be 600 V and 660 V at 50 / 60 Hz for low breaking and high breaking capacity of MCCBs Respectively.

There should be total discrimination b/w ACBs and MCCBs upto the breaking capacity level of downstream device. Total discrimination shall be supported by selection chart for various combinations along with recognized authority test certificates.

All MCCB 's shall have provision for spreaders and phase barriers on each terminal.

The Breaker shall be maintenance free

CONSTRUCTIONS :

The MCCB cover and case shall be made of high strength heat treatment and flame retardant thermo setting insulating material. Operating handle shall be quick make/ quick break, trip-free type. The operating handle shall have suitable "ON" "OFF" and "TRIPPED" indicators. Three phase MCCBS shall have common operating handle for simultaneous operation and tripping of all the three phases.

Suitable for extinguishing device shall be provided for each contact. Tripping unit shall be of thermal magnetic or static type provided in each pole and connected by a common trip bar such that tripping of any one pole operates all three poles to open simultaneously. Thermal magnetic or static tripping device shall have IDMT characteristics for sustained over loads and short circuits.

Contacts trips shall be made of suitable are resistant, sintered alloy for long electrical life. Terminals shall be of liberal design with adequate clearance.

CHARACTERISTICS:

The Protection unit shall have overload and short circuit protection . The setting knob should be centrally adjustable from front, MCCB cover need not be opened for carrying out adjustment. It shall be possible to combine the Auxiliary contact, alarm contact , shunt release and under voltage release to the Circuit breaker.

OPERATION:

If required, the breaker shall be provided with the facility for padlocking and door interlocking.

The Electrical and mechanical endurance of the MCCB should be as defined by IEC 60947-2 standard.

The MCCB shall be equipped with ''Push to trip'' Button in front to test operation and the opening of the poles.

The circuit breaker rating, the '' push to trip'' button, outgoing circuit identification and the contact position indication must be clearly visible and accessible from the front, through the front panel or the door of the switchboard.

THE OPTIONAL :

It shall be possible to combine the earth fault protection if specified in the BOQ for i/c MCCB

MEASUREMENTS:

	Electronic/ Microprocessor Release	Thermal Release	Overload Protection	Short Circuit Protection	Accessories (UV, Shunt, Alarm)	Earth Fault Protection
Upto 250A MCCB	-	Yes	Yes	Yes	Yes	-
Above 250A MCCB	Yes	-	Yes	Yes	Yes	Yes

INSTALLATION :

It should be possible to terminate cable of required size for the defined current carrying capacity. The requisite size should be made available by means of extended terminals in case the direct terminals are not of adequate size. Adequate phase to phase clearance has to be ensures in case of extended terminals.

TESTING :

Original test certificate of the MCCB as per IEC 60947-2 shall be furnished.

7.08 SYNCHRONISING AND LOAD MANAGEMENT OF THE DG SET IN SYNCHRONISING PANEL

The parallel operation of 2 nos. DG sets of 750 kVA & 600KVA each in Synchronization mode shall be completely through Power Control Center Module (PCCM). The PCCM shall be mounted on DG SETs on the DG Set (the supplying and fixing of the PCCM is in the scope of Supplying and fixing of DG Set vendor).

The PLC for the further operation (load management of the DG Set) shall be mounted on the Synchronizing panel with Power Monitors–IV and with the complete SCADA. The Load management among the DG set and interlocking shall be achieved from this PLC. The wiring between the DG Sets, PCCM and Synchronizing Panel is in the scope of LT Panel Vendor.

7.09 MEASURING INSTRUMENTS FOR METERING :

GENERAL :

All the meters shall be of digital type. The accuracy of direct reading shall be 1.0 for voltmeter and 1.5 for ammeters. Other type of instruments shall have accuracy of 1.5. The errors due to variation in temperature shall be limited to a minimum. The meter shall be suitable for continuous operation between 10 degree C to+50-degree C. All meters shall be of flush mounting type of 96mm square pattern. The meter shall be enclosed in a dust tight housing. The housing shall be of steel or phenolic mould. The design and manufacture of the meters shall ensure the prevention of fogging of instruments glass. Instruments meters shall be sealed in such a way that access to the measuring element and to the accessories with in the case shall not be possible without removal of the seal. The meters shall be provided with white dials and black scale markings.

The indications shall be of LED type red in clour and shall have zero position adjustment device which could be operated from outside.

Suitable selector switches shall be provided for all ammeters and voltmeters intended to be used on three phase supply.

The specifications here in after laid down shall also cover all the meters, instrument and protective devices required for the electrical works. The ratings, type and quantity of meters, instruments and protective devices shall be as per the schedule of quantities.

AMMETERS :

The ammeter shall be of Digital type. Ammeters shall be instrument transformer operated and shall be suitable for 5A secondary of instrument transformer. The scales shall be calibrated to indicate primary current, unless otherwise specified. The ammeters shall be capable of carrying sustained overloads during faults conditions without damage or loss of accuracy.

VOLTMETERS :

The Voltmeter shall be of digital type. The range for 415 volts, 3 phase voltmeter shall be 0 to 500 volts. Suitable selector switch shall be provided for each voltmeter to read voltage between any two lines of the systems. The voltmeter shall be provided with protection fuse of suitable capacity.

CURRENT TRANSFORMERS :

Current transformers shall be in conformity with IS:2075 (part I, II & III) in all respects. All current transformers used for medium voltage applications shall be OF Cast resin type rated for 1 kv. Current transformers shall have rated primary current, rated burden and class of accuracy as required.

However, the rated secondary current shall be 5A unless otherwise specified. The acceptable minimum class of various applications shall be as given below:

Measuring :	**Class 1**	**Protection 08**
	Class 5	**Protection10**

Current transformers shall be capable of withstanding without damage, magnetic and thermal stresses due to short circuit fault of 65KA on medium voltage system. Terminals of the current transformers shall be marked permanently for easy identification of poles. Separate CT shall be provided for measuring instruments and protection relays. Each CT shall be provided with rating plate.

Current transformers shall be mounted such that they are easily accessible for inspection, maintenance and replacement. The wiring for CT's shall be copper conductor, PVC insulated FRLS wires with proper termination lugs and wiring shall be bunched with cable straps and fixed to the panel structure in a neat manner. The Panel builder to be produced the original invoice of the manufacturer of the current Transformers.

MISCELLANEOUS :

Control switches shall be of the heavy-duty rotary type with escutcheon plates clearly marked to show the operating position. They shall be semi-flush mounting with only the front plate and operating handle projecting.

Indicating lamps shall be of the filament type of low watt consumption, provided with series resistor where necessary, and with translucent lamps covers. Bulbs & lenses shall be easily replaced from the front.

Push buttons shall be of the momentary contact, push to actuate type fitted with self reset contacts & provided with integral escutcheon plates marked with its functions.

7.10 CABLE TERMINATIONS :

Cable entries and terminals shall be provided in the distribution board to suit the number, type and size of aluminium conductor power cables and copper conductor control cable specified.

Provision shall be made for top or bottom entry of cables as required. Generous size of cabling chambers shall be provided with the position of cable gland and terminals such that cables can be easily and safely terminated.

Barriers or shrouds shall be provided to permit safe working at the terminals of one circuit without accidentally touching that of another live circuit.

Cable risers shall be adequately supported to withstand the effects of rated short circuit currents without damage and without causing secondary faults.

CONTROL WIRING :

All control wiring shall be carried out with 1100V grade single core PVC cable conforming to IS:694/ IS 8130 potential standard copper conductors of minimum 1.5sq. mm for potential circuits and 2.5sq.mm for current transformer circuits. Wiring shall be neatly bunched, adequately supported and properly routed to allow for easy access and maintenance. Wiring shall be identified by numbering ferrules at end. All control fuses shall be mounted in front of the panel and shall be easily accessible.

TERMINAL BLOCKS :

Terminal blocks shall be 500Volts grade of the stud type. Insulating barriers shall be provided between adjacent terminal. Terminal blocks shall have a minimum current rating of 10amps and shall be shrouded. Provisions shall be made for label inscriptions.

THE LABELS :

Labels shall be of anodized aluminium, with white engraving on black background. They shall be properly secured with fasteners.

All cables should be Numbering or Tag

7.11 TEST AT MANUFACTURES WORK :

All routine tests specified in IS: 8623--1977 shall be carried out and test certificates submitted to the Engineer.

TESTING AND COMMISSIONING :

Commissioning checks and tests shall be included all wiring checks and checking up of connections. Primary/secondary injection tests for the relays adjustment/setting shall be done before commissioning in addition to routine meggar test. Checks and tests shall include the following.

a) Operation checks and lubrication of all moving parts.

b) Interlocking function check.

c) Insulation test: When measured with 500V meggar, the insulation resistance shall not be less than 100 mega ohms.

d) Insulation Test of Oil: When tested as per IS: 6792-1972, the oil shall withstand a voltage of 40 KV for a minute without break down.

e) Trip tests & protection gear test.

8.0 POWER FACTOR IMPROVEMENT SYSTEM

GENERAL

The power factor improvement system shall comprise of capacitors and associated switchgear and control gear as per the requirements.

SCOPE

This specification covers design, manufacturing, testing, supply with accessories, installation and commissioning of APFC Panels for Power Factor improvement.

CAPACITORS

TYPE

The capacitor unit shall be made of metallized Polypropylene film with

Zn/Al alloy, special resistivity di-electric impregnated with inert gas. The capacitor unit shall be self-healing type, internally 3-phase delta connected, self-cooled, and suitable for outdoor installation in multi positions (vertical & horizontal) should be fitted with pressure sensitive disconnector in each individual capacitor cell. The capacitors shall be rust -proof in dry type design having sufficient protection against rain, dust and accidental contact.

PERMISSIBLE OVER LOADS

The capacitor unit shall be suitable for over loads as per the relevant clauses of IS 13340-41 and shall be suitable for prolonged operation RMS voltage, 1.1 times the rated voltage and 1.8 times the RMS lines current that occurs at rated voltages and rated frequency excluding transients but taking in account the capacitance tolerance. High inrush current withstand capability that go along without degrading useful life. Capacitor shall comply special edge "wavy cut", plus heavy edge film design to handle inrush current of upto 250 times rated current.

CONSTRUCTION:

The gas filled capacitors should be compact size, 3 phase delta connected to form three-phase bank. Elements should be encapsulated in Aluminum container.

The insulated connecting wires should be individual for each phase/line and terminal block should be suitable for outdoor operation under the atmospheric conditions specified and to totally eliminate the possibility of fault occurrence external to the capacitor unit.

The gas filled in capacitor units must be harmless to environment. The operation and

Disposal of capacitor units must be environmentally friendly. The constructional

Features necessary to prevent leakage and to ensure safety during operation must

be Adopted.

The capacitor units must be suitable for mounting in any desired position.

SAFETY REQUIREMENTS:

Capacitor units shall be provided with directly connected discharge device as per IS:

3340-41 (with latest amendments up to date of tender receipt)

The discharge device shall reduce the residual voltage from crest value of the rated voltage to less than 50 volts within one minute after the unit disconnected from the source of supply.

The capacitor units contain shall be provided with a suitable earth terminal, clearly marked it will be connected by the successful bidder to the system earth.

The capacitor units shall comply with the general safety regulations for power installations as per the latest Indian electricity rules.

Terminal with SIGUT terminal technology should ensure reliable and straightforward connection, even in parallel capacitor circuit.

Capacitor should have overpressure tear-off fuse, self-healing technology, Explosion proof construction, touch proof terminals and nonflammable.

CAPACITOR LOSS

The Di-electric shall not be more than 0.20W/KVAR. This should be indicated in the

Bid. The total capacitor loss shall not exceed 0.5W/KVAR.

DETUNED REACTORS

The reactors should be of 440 V, 3 phase module with 7% detuning factor.

The design entails single layer winding in the entire range of reactor, to allow for maximum dissipation of heat to perform capably in natural air cool work environment.

The copper conductor used either have dual coat enamel insulation or are provided with insulation of nomex paper, capable of withstanding temperature exceeding 180 deg. C.

High linearity (L>0.95 x ln: 220 %)

H- class insulation

Vacuum impregnated.

Tolerance of inductance should not be more than 5%

For the temp, protection a Temp sensor should be there.

IEC 61642:1997; Clause No 3.3 guidelines

LIFE EXPECTANCY

The life of capacitor units shall not be less than up to 1, 30,000 hours.

MARKINGS

As per IS 13340:1993

INTELLIGENT POWER FACTOR CONTROLLER RELAY

Design	**Intelligent Microprocessor Based, 32-digit LCD Display**
Minimum Operating Current	**40 m Amp.**
Measurement current (CT)	**X/1,X/5 Ampere**
Supply Voltage	**230V AC**
Setting	**0.8 ind --0.8 cap**
Power consumption	**5 VA**
Dimension W*H*D	**144*144*60 mm**
Protection Class	**IP 54 For front plate, IP 20 for rear side**
Switching time range	**1-1200 seconds**
Discharge time range	**1-1200 seconds**
Control Modes	**20 series presets +control series editor For free programming LIFO, FIFO and self-optimized intelligent**

Display of instantaneous Power line parameters like
Voltage, apparent current, frequency, power factor, active power, apparent power, missing Kvar, temperature, Harmonic (from 3 to 21 harmonics)
Relay shall have facility to program each stage as Fixed/Auto/Off.

Data logging facility using RS port.

CONTROL AND SELECTOR SWITCHES

Control selector switches shall be :

i) Of the rotary type with enclosed contacts.

ii) Adequately rated for the purpose intended (Minimum acceptable rating is 10A continuous at 240 V AC and 1 A (inductive break) 220 V D.C.

iii) Provided with name plated clearly marked to show the positions.

Control switches shall be:

i) of the spring return to normal type.

ii) provided with pistol grip type handles.

Control switches for circuit breaker control shall be provided with:

i) contact development as specified.

ii) Sequencing device.

Wherever specified in data sheets, control switches with built-in flashing type discrepancy lamps shall be provided to control circuit breakers in lieu of the normal control switch, red, green and amber indicating lamps. The discrepancy lamp shall be replaceable from the front of the module door.

Selector switches shall be:

i) of the maintained contact stay put type. Switches in ammeter circuits shall have make be for break type contact.

ii) provided with oval handles.

PUSH BUTTONS

Push buttons shall be:

i) of the momentary contact, push to actuate type rated to carry 10A at 240V AC and IA (inductive breaking) at 220V DC.

ii) fitted with self reset, 2 No. and 2NC contacts.

iii) Provided with integral escutcheon plates marked with its function.

'Start', 'Open', 'Close' push buttons shall be green in colour.

'Stop' push buttons shall be red in colour.

All other push buttons shall be black in colour.

'Emergency stop' push buttons shall be of the lockable in the pushed position type and shall be shrouded to prevent accidental operation. Key shall not be required for the operation of the push button.

The Capacitor bank shall be facilated with the space.

INTERNAL ELECTRICAL WORKS

1.00 GENERAL

1.01 The electrical installation work shall be carried out in accordance with Indian Standard Code of practice for Electrical wiring installation IS: 732-1989 and IS:2274-1963. It shall also be in conformity with the current Indian Electricity rules and regulations and requirements of the Local Electricity supply authority and fire insurance regulation. Electrical work in general shall be carried out as per following specifications with upto date amendment.

General Specifications for Electrical Works:

(Part I - Internal) - 2013.

Wherever these specifications calls for a higher standard of material and or workmanship than those required by any of the above mentions regulations and specification then the specification here under shall take precedence over the said regulations and standards.

The items / activities covered under the electrical works shall include the following:

i. Point wiring of all lights points, Ceiling fan points, exhaust fan points, cabin fan points, light plug points, general power points, metal clad plug & socket outlet points etc. including supply and fixing of light & power accessories etc. complete in all respects.

ii. Under floor raceways for power and LAN / Voice cabling with junction boxes complete in all respect.

iii. Light fixtures, ceiling fans, exhaust fans and cabin fans.

iv. Provision for telephone system consisting of conduit and cabling from telephone distribution board upto each outlet including main & sub tag blocks, telephone outlets, EPABX and phones etc. complete in all respect.

v. Provision of LAN cabling, racks, conduit, outlet box, junction boxes etc., complete in all respect.

vi. Cables, cable tray and other items required to complete with electrical installation work in all respects.

vii. Earthing of electrical installation complete in all respects.

viii. **Supplying, Fixing testing and commissioning of Addressable Fire Alarm and detection system including Hooters, Manual call point, wiring / cabling Response indicators and the Main Panels and the central monitoring system.**

ix. **CCTV System with internal and external cameras complete in all respects.**

x. **Access control system complete in all respect.**

xi. **Scope of work shall include supply installation, testing and commissioning of complete electrical installation as described above.**

2.0 POINT WIRING

The point wiring work shall be carried out as per CPWD GENERAL SPECIFICATIONS for Electrical work PART – I internal 2013.

3.0 LIGHTING FIXTURE AND FANS

3.01 GENERAL

a. **The Contractor shall supply and install lighting fixtures including lamps, ballasts, accessories fixing hardware necessary for installations, as shown on the Drawings, as required, and as herein specified.**

b. **All fixtures shall be delivered to the building complete with suspension accessories, canopies, hickeys casing, sockets, holders, reflectors, ballasts, diffusing material, louvers, plaster frames, recessing boxes, etc. all wired and assembled as indicated.**

c. **Full -size shop detail drawings of special fixture or lighting equipment, where called for in the fixtures schedule shall be submitted to the Engineer for approval.**

d. **Fixtures, housing, frame or canopy, shall provide a suitable cover for fixture outlet box or fixture opening**

e. **Fixtures shall comply with all applicable requirements as herein outlined unless otherwise specified or shown on the drawings.**

f. **Manufacturer's name and catalogue number of lighting fixtures are given for general reference only. It shall be understood that the actual fixtures supplied shall meet all the requirements of the specification, and if necessary, the standard fixture indicated for reference, shall be modified accordingly.**

g. **Fixtures shall bear manufacturer's name and the factory inspection label.**

h. **Fixtures shall be completely wired and constructed to comply with the IEE wiring regulations requirements for lighting fixtures, unless otherwise specified.**

i. **Relamping the fixture shall be possible without having to remove the fixture from its place.**

j. **Lamps of the proper type, wattage and voltage rating shall be furnished and installed in each fixture.**

k. All lights shall be BEE certified minimum 4 star rated lights. Contractor shall take prior approval of all lighting fixtures before placing order with all technical data sheets required for energy efficiency certification of building

3.02 INSTALLATION

Fixtures shall be installed at mounting heights as detailed on the Drawings or as instructed on site by the Engineer.

Pendent fixtures within the same room or area shall be installed plumb and at a uniform height from the finished floor. Adjustment of height shall be made during installation. Flush mounted recessed fixtures shall be installed so as to completely eliminate leakage of light within the fixture and between the fixture and adjacent finish.

Fixtures mounted outlet boxes shall be rigidly secured to a fixture stud in the outlet box. Hickeys or extension pieces shall be installed where required to facilitate proper installation.

Fixtures located on the exterior of the building shall be installed with non-ferrous metal screws finished to match the fixtures.

3.03 TESTING

After all lighting fixtures are installed and are connected their respective switches, test all fixtures to ensure operation on their correct switch in the presence of the Engineer. All un-operating fixtures or ones connected to the wrong or inconveniently located switch shall be correctly connected as directed by the Engineer.

3.04 CEILING FANS

All ceiling fans shall be provided with suspension arrangement in the concrete/slab/roof member. Contractor to ensure that provision are kept at appropriate stage at locations shown on the drawing. Fan box with MS hook (to be provided under civil works) shall be as per CPWD specification. Ceiling fan shall be double ball bearing type, copper wound motor complete with canopy, down rod, blades etc. and shall conform to relevant IS standards ceiling fan shall be white in colour. Ceiling fan shall be provided with modular electronic stepped regulator. Regulator shall be suitable for 240 volts A.C. supply 50 Hz and shall be of continuous duty type. All ceiling fans shall be BEE certified minimum 4star rated fans.

3.05 EXHAUST FANS

Exhaust fans shall be heavy duty type with double ball bearing & conforming to IS 2312-1967. Exhaust fan shall be complete with copper wound motor, capacitor, louvers/shutter, frame & mounting bracket. Exhaust fan shall be suitable fan operation on 240 volts single phase A.C supply.

PART –C DRAWINGS / PROCURMENT / INSPECTION AND LIST OF APPAROVED MAKES

1.00 DRAWING/PROCUREMENT & INSPECTION OF EQUIPMENT

1.01 Based on the tender drawings and the equipment/scheme finally selected, the contractor shall supply layouts, GA drawings to be submitted for approval are given below :-

a) General Arrangement drawings of all items.

b) The Original documents and the specifications in details of all equipment's and items switchgears and material to be used in the manufacturing and commissioning.

c) Wiring diagram, schematic diagrams and control diagrams for equipment, Switchgear, PCC and the whole system. Schedule and termination details shall also be provided.

d) Technical catalogue for all equipment, switchgear, cables and materials including complete write up/details of operation, interlocks and controls etc.

e) Operation and maintenance manuals along with list of spare parts for all equipment, Switchgear, Cables and materials etc.

1.02 PROCUREMENT & INSPECTION OF EQUIPMENT

Approved makes and vendors are given in approved make list. The makes of equipment/materials supplied shall be strictly as mentioned therein. For items not specially mentioned, prior approval shall be taken before procurement of the same. all equipments/material supplied shall be brand new and shall be procured directly from the manufacturers, dealers or authorized agents.

Client shall have access to the manufacturer's premises for stage inspection/final inspection of any item during its design, manufacturing, and assembly and testing. After carrying out the necessary factory tests and routine tests as per IS Standards, a copy of the routine test certificate shall be forwarded along with the call for carrying out the inspection at the manufacturer's works.

Based on the inspection certificate, Client reserves the right to carry out the inspection at a mutually agreed date and/or give inspection waiver. A minimum of two weeks will be needed after receipt of complete shop inspection report and other details to depute our inspector for inspection.

THE LIST OF APPROVED MANUFACTURES/MAKES		
Sl. No.	**Item**	**Approved Make**
1	**Molded Case Circuit Breakers**	**Legrand, Schneider Electric,ABB, L&T,SIEMENS**
2	**Air Circuit Breaker**	**Legrand, Schneider Electric, ABB,L&T, SIEMENS**
3	**Change Over Switch**	**ABB, L&T, C&S,Areva**
4	**Contactors**	**Legrand, Schneider Electric, ABB, L&T, SIEMENS**
5	**Voltmeter & Ammeter, Digital multifunction Meter**	**Schneider Electric, L&T, Socomec**

6	Current Transformer	BCH, C&S, Crompton Greaves
7	Indication Lamp/Push Button	ABB, BCH, Siemens, L&T
8	Connector Terminal Block	Elmex, Lupco, Phoenix, Connect Well
9	Protection Relay	ABB, L&T, Schneider Electric
10	Cable thimbles and glands	Trinity touch, Comet, Gripwell, Braco
11	Cable thimbles / lugs	Trinity touch, Louts, Comet
12	Capacitors with Relay	Neptune, Epcos, ABB, L&T, Schneider Electric
13	11kv Switch Gear	Schneider Electric, Crompton greaves, Siemens, ABB, L&T
14	11kv/0.415kv Dry Type Transformer	ABB, Crompton Greaves, Essner Transformer
15	DG Set	Cummins, Jackson & Company, Perkins
16	Sealed Maintenance free battery	Standard, Amco, Exide
17	Main LT Panel, Main Distribution Board	Milestone, Adlec, Ambit Electrical, Gauri Switch Gear
18	Distribution Board	Schneider, Legrand, ABB, Siemens, L&T
19	MCB/RCCB/RCBO	Legrand, ABB, Schneider, L&T
20	PVC Insulated copper conductor Single Core Stranded Wires of 1100 Volt grade	Havells, Finolex, Polycab
21	XLPE insulated PVC sheathed armoured cables of 1.1kv & 11kv grade as per IS 7098 Part-I & II 1988/1985	KEI, Havells, Polycab, Finolex
22	Modular type switches, socket etc.(ISI Marked)	Legrand, Havells, Schneider Electric
23	MS Conduit(ISI Marked)	BEC, AKG, Rom com
24	Conduit Accessories(ISI Marked)	Trinity Touch ,M-Kay, RM Com, Noble
25	Industrial Type Sockets	Legrand, Schneider electric ,Hager
26	Exhaust Fan/Ceiling Fans	Crompton Greaves, Orient, Havells
27	Light Fixture	Havells, Philips, Crompton
28	Surge Protection Device	Schneider Electric, OBO, L&T
29	Complete Lighting Arrester System	OBO, Ericko, ABB
30	CAT 6A UTP Cable	Belden, Panduit, Siemen, Legrand
31	CAT 6A I/O	Belden, Panduit, Siemen, Legrand
32	Jack Panel	Belden, Panduit, Siemen, Legrand
33	UTP patch cords	Belden, Panduit, Siemen, Legrand
34	EPBX and IP Phones	Toshiba ,Polycom ,Tadiran, Legrand
35	CCTV Cameras	CP Plus, Hikvision, Vantage
36	NVR with Storage	CP Plus, Hikvision, Vantage
37	Workstations	Dell, Lenovo, HP
38	LED Monitor	Panasonic ,LG, Samsung

39	**24-Port Distribution switch for Data and Voice**	**Cisco, Juniper, Extreme, Brocade**
40	**Wi-Fi radios Indoor**	**Extreme, Juniper, Enterasys**
41	**Cable Tray**	**Legrand, ABB Tata**
42	**Maintenance Free Earthing**	**OBO, LPI, JMV**
43	**Solar water heater**	**Tata Power Solar system, Havells**
44	**Lift**	**ThyssenKrupp, Hitachi Lift, Omega Elevator**
45	**Bus bar**	**Schneider, Le Grand,**

PREFERRED MAKES OF MATERIALS FOR CIVIL WORKS

Preferred makes of materials to be used in the work are as under. In case of non availability of these makes, the Technical approval authority of the project may allow use of alternative BIS makes of materials in the work. Non BIS marked materials may be permitted by the Engineer-in- charge with prior approval of CE.

Sl.No.	Material	List of Preferred make
1.	(i) Ordinary Portland Cement / Portland Pozzolona Cement.	ACC, Ultratech, Ambuja Cement, J.K.Cement, , Vikram Cement
	(ii) White Cement	Birla White , J. K. White
2.	Reinforcement Steel	SAIL, Tata Steel, Rashtriya Ispat Nigam Ltd(RINL), JSW Steel Ltd., Jindal Steel &Power Ltd. Shyam steel industries Ltd.
3.	Water Proofing Compounds, Admixtures, Plasticizer, Super Plasticizer, Curing Compounds	Fosroc, ROFF/Dr. Fixit (Pidilite Industries),CICO, Sika, BASF, Ardex Endura (BalEndura)
4.	Integral Water proofing compound with cement (For Plaster & Mortar)	Fosroc, Conplast 421Dr. Fixit : LW+, Sika : Sikacim,Asian Paints : Smart care vitalia,& equivalent product of BASF, CICO, ArdexEndura
5.	Water proofing for bathroom/ toilet/balcony & other wet areas	Fosroc : Brush Bond,CICO : Tapecrete,Dr. Fixit : Pidifine 2K, Sika : Nito Bond,Asain Paints : Damp Block 2 K& equivalent product of BASF,Ardex Endura
6.	Crystalline water proofing compound	Fosroc : Fosroc Crystalline, Dr Fixit : Dr. Fixit Crystalline, Sika : Sika Crystalline, Asian Paints : Crystalline Quart & equivalent product of BASF, CICO, Ardex Endura, Pentron
7.	Grouts, Tile Adhesive	Latecrete, Kerokoal, BASF, Ardex Endura,
		Ferrous Crete.
8.	Structural Steel	SAIL, Tata Steel, Rashtriya Ispat Nigam Ltd(RINL), and JSW Steel Ltd., Jindal Steel &Power Ltd,
9.	Polycarbonate Sheet	GE Plastic, LEXAN
10.	Profile steel sheet	Ezydeck of TATA, Lloyd Superdeck, JSW / Jindal
11.	Particle Board	Action TESA, Greenlam, Merino, Kitply
12.	Laminates	Kitply, Action TESA, Greenlam, Century Ply, Merino,
13.	Flush door shutters	Duro, Century, Durian, Green ply, Archid ply
14	Fire fighting equipment and alarm system	Cease Fire, Safex Fire Services, Reliance Fire and Safety Limited, UTC Fire and Security India Limited, Tyco.

	Fire Rated Doors	Signum fire protection, shakti Metdoor, Navair, Adhunik Technology, Sukri, Promat international.
15.	False Ceiling System	Armstrong, Hunter Douglas, USG Boral,Saint Gobain, Aerolite, Durlum, Interarch
16.	Plywood/ Veneer	Green ply, Century, Merino, Kitply, Duro,Durian
17.	Melamine Polish	Asian Paints Melamine Gold, Wudfin of Pidilite, Timbertone of ICI Dulux, Nippon.
18	PU- Premium exterior grade polish	Dulux, Nippon, Asian.
19	PU- Premium exterior sealer	Dulux, Nippon, Asian.
20.	Floor Spring & Door Closure	Godrej, Dorma, Dorset, Kich, Geze.
19.(a)	Aluminum Section	Hindalco, Jindal, Indian Aluminum co.
19.(b)	Anodized Aluminum Hardware (Heavy Duty)	Kilong, Alualpha, Classic, Ebco, Hettich
20.	Clear/Float/Frosted/ Toughen Glass/ Refractive Glass	Saint Gobain, AIS, Modiguard.
21.	Stainless Steel Railing, Accessories etc.	JINDAL, Dorma, Kich, GEZE, Godrej, Hettich
22.	S.S. Door & window & Fittings	Jindal, Dorma, Kich, Dorset, Godrej, Ozone, Hettich.
23.	Silicon based water repellant/Weather Sealant	G.E. Plastics, Dow Corning, Wacker, BASF, Pidilite (Dr. Fixit/Roff)
24.	Poly-Sulphide Sealant	Fosroc, Pidilite (Dr. Fixit/Roff), Sika, BASF
25.	Mosaic tiles/ Chequered Tiles	Ultra Tiles, NITCO, Hyper(Mayur), Pavcon
26.	Ceramic Tiles	Kajaria, RAK, NITCO, Johnson Somany.

27.	VitrifiedTiles(Antiskid/Matt/Glazed), (Only Double charged vitrified tile permitted.)	Kajaria, RAK, NITCO, Johnson Somany.
28.	Paver block & Kerb Stone	Pavcon, Hyper Tiles/Dynamic Industries/Mayur, KK, Power, Sharda, Navya, Ultra Tiles.
29.	Dash / Anchoring Fasteners	HILTI, Fischer, Bosch, Wurth.
30.	Cement Based Wall putty	Birla wall care, JK White, Berger, Asian Paints
31.	Oil Bound Washable Distemper / Dry Distemper	Only Low VOC products of Asian Paints (Professional Acrylic Distemper),Nerolac: Beauty Acrylic Distemper,Berger : Bison Acrylic Distemper, Dulux ICI : Maxilite, Nippon.
32.	1st Quality Acrylic Distemper (washable/Ready mix/ Low VOC)	Asian Paints (Tractor Aqua Lock Paint), Berger : Commandoor equivalent paints of Nerolac or ICI-Dulax, Nippon.
33.	Acrylic Emulsion Paints (washable/Ready mix/ Low VOC)	Asian Paints : (Professional Premium Interior Emulsion Paint) Nerolac : Beauty Gold Berger : Rangoli total care ICI-Dulux : Super Cover Nippon

34.	Plastic Emulsion Paint (washable/Ready mix/ Low VOC)	Asian Paints : (Apcolite Heavy Duty Premium Emulsion Paint) Nerolac : Impression Berger : Easy Clean ICI-Dulux : 3 in 1 Nippon.
35.	Premium Acrylic Emulsion Paints(Interior) (washable/Ready mix/ Low VOC)	Asian Paints (Royale Luxury Emulsion) Nerolac : Impression Berger : Silk ICI Dulux : Velvet touch Nippon.
36.	Textured Exterior Paint (Ready mix/ Low VOC)	Asian paints, Nerolac, Berger Paints, Ultratech Paints, Luxture, Nippon.
37.	Acrylic Smooth Exterior Paint (Ready mix/ Low VOC)	Asian Paints : (Apex/ Professional Premium Exterior Emulsion) Nerolac : XL Berger : Weather Coat ICI-Dulux : Weather Shield

38.	Premium Acrylic Smooth Exterior Paint with Silicon additive. (washable/Ready mix/ Low VOC)	Asian Paints : Apex Ultima Nerolac : XL Total Berger : Weather Coat all guard ICI-Dulux : Weather Shield max Nippon
39.	Synthetic Enamel Paint (Ready mix/ Low VOC)	Asian : Apcolite Premium gloss enamel, Nerolac : Synthetic Hi gloss Berger : Luxol Hi gloss ICI -Dulux : Gloss Synthetic enamel Nippon.
40.	Cement Primer	Nerolac, Berger, BP White(Berger), Decoprime WT(Asian), White primer (ICI), Nippon
41.	Steel Primer(Red Oxide Zinc Chromate Primer)	Asian Paints, Nerolac, Berger, ICI-Dulux, Nippon.
42.	Wood Primer	Asian Paints (Wood Primer - White/Pink),Berger ICI, Nerolac, Nippon.
43.	Epoxy Paint	Asian, Nerolac, Berger, ICI, Kansai AkzoNobel, Nippon.
44.	Fire Paint	Asian Paints, Akzo Nobel Coatings IndiaLtd., PROMAT, Jotun, Nippon.
45.	G.I. / M.S. Pipe	Tata, Jindal (Hisar)
46.	G.I. Fittings	Unik, AVR, Zoloto
47.	HDPE Pipes	Reliance,JainPipes,ORIPLAST, Supreme
48.	DI PIPES	Electrosteel, Jindal, TATA DUCTURA, Kapilansh, Kesoram
49.	DI Fittings	Electrosteel, Jindal, TATA DUCTURA, Kapilansh, Kesoram
50.	UPVC pipe and Fittings	Astral, Supreme, Prince, Ashirwad
51.	Centrifugally Cast (spun) Iron Pipes& Fittings	NECO, Kapilansh, Electrosteel, SKF
52	C.I. Manhole covers, frames & GIGratings	NECO, RAJ Iron Foundary Agra, BIC, SKF,Kapilansh
53.	SFRC Manhole covers & gratings	KK, JAIN, PARGATI
54.	CP Brass Fittings (Superior Range)	Jaquar, Grohe, Roka
55.	CP Brass Fittings (Normal Range)	Hindware, Jaguar, ESSCO.
56.(a)	Sanitary ware, Fittings & accessories (Superior Range)	Jaguar, Kohler, Roca, Hindware,
56.(b)	Sanitary ware, Fittings & accessories (Normal Range)	Hindware, Jaguar.
57.	Mirror Glass	Atul, Modi Guard, Golden Fish
58.	CPVC Pipe & fitting	Astral, Supreme, Prince, Ashirwad
59.	Stainless Steel Sink	Neelkanth, Niralli, Jyna
60.	RCC Pipes (NP-2)	Lakshmi, Sood & Sood, Jain Pipe Co. (Newai), Mahaveer Enterprises (Newai),Work well spun pipes, Pali.
61.	UPVC Doors & Windows (PROFILE	Fenesta, VEKA, RHEAU, Prominance, LG Hausys,

	makers & their authorized Fabricators only)	Aluplast, Wintech, Kommerling.
62.	Extruded Polystyrene Insulation Board	Dowcorning, Supreme, Texas, Analco
63.	Heat Resistant Tiles	Swastik, Thermatek
64.	Gypsum Plaster	Ferrous Crete, Gyproc Saint Gobain, UltraTech
65.	Floor hardener	Ironite, Ferrok, Hardonate
66.	Modular Expansion Joint	Herculus, Sanfield India Ltd. Vexcolt
67	UPVC doors and window hardware	Rotto, Dorset, Kinlong,Hettich.
68	AAC Block Adhesive	UltraTech, Ardex Endura, Ferrous Crete
69	AAC Block	Modicrete, Sri, Ambuja,Jindal.
70	Glass wool Insulation	SIPLA, Llyod Insulation, Twiga
71	Roof Insulation	SIPLA, Llyod Insulation, Twiga
72	Under Deck Insulation	SIPLA, Llyod Insulation, Twiga
73	Pre fabricated Aluminum Windows	Kalco, Tata, SCHUCO
74	Stainless Steel Doors Fittings	Dorma, GEZE, Hettich
75	Under deck Insulation	SIPLA, Llyod Insulation, Twiga
76	**Sports light**	**Osram, Philips, ventura- USL**
77	**Maple wood flooring**	**Action, Robbins, Connors**
78	**Synthetic flooring**	**Decoturf, Sport Turf, Plexipave**
79	**Synthetic turf hockey**	**Demo Grass, Act Global,Condor**
80	**Synthetic PVC**	**Trioflor, Gerflor, Tarket**
81	**Aluminum Composite Panel (ACP)**	**VIRGO.**
82	**High Pressure Laminates (HPL)**	**VIRGO.**
83	**PVC Doors & Frames & Boards**	**RAJSHRI Plastiwood**
84	**WPC & Doors & Frame & Boards**	**RAJSHRI Plastiwood**
85	**Washroom Automation Products**	**EURONICS INDUSTRIES**
86	**Air Curtain**	**EURONICS INDUSTRIES**
87	**Acoustical Wall Paneling**	**GYPTECH**
88	**Dry Wall Partition (Boards & Channels)**	**WESTERN**

Preferred makes for various Electrical Items

Preferred makes of materials to be used in the work are as under. In case of non availability of these makes, the Technical approval authority of the project may allow use of alternative BIS makes of materials in the work. Non BIS marked materials may be permitted by the Engineer-in- charge with prior approval of CE.

S.No.	Details of Materials / Equipment	Manufacturer's Name
	I.E.I., MCBDB & MCB, Cables & Wires	
1	**MCB, Isolator, Industrial Plug Socket, RCCB, RCBO's**	**Schneider Electric ACTI-9 (N) / Legrand (DX^3) / Hager/ L&T (Exora) / ABB (S200M) / Siemens (Betaguard) / C&S (Wintrip2) / Indoasian (Optipro)**
2	**MCBDB & Loose Wire Box**	**Legrand (EKINOX-3) / L&T (EXORA) / Hager / Schneider (ACTI-9) / ABB (Elegance) / C&S(Winclass) / Indoasian (Optipro)**
3	**Change Over Switches**	**L& T / Havells / HPL / Hager / C&S/ Socomac / ABB**
4	**Automatic Transfer Switch (ATS)**	**Asco / Russel / Socomac / Hager /ABB**
5	**FRLS PVC insulated copper conductor single core cable for wiring. (ISI marked)**	**Finolex / RR Kabel / KEI /Havells / Polycab / Bonton / Grandlay**
6	**Armoured/ Unarmoured telephone cable, Coaxial Cable/LAN Cable**	**Delton / Finolex / RR Kabel / Havells/ Bonton / Grandlay / KEI**
7	**MS Conduit (ISI Marked) with heavy duty MS conduit pipe accessories**	**BEC / NIC / AKG / RMCON (Note : The make of accessories will be same that of conduit pipe & will comply to IS / 4768 part 2 2003)**
8	**PVC Conduit (ISI Marked) with heavy duty PVC conduit pipe accessories**	**AKG / Norpack / BEC / Polypack / Precision**
9	**Modular Switch, Socket/Telephone Socket/ Cable TV Socket/ Data outlet Socket / Fan Regulator/ G I Boxes Etc (Wiring Accessories) / Regulators etc.**	**Legrand (Arteor) / Schneider Electric (Zencelo) / Honeywell-MK (Aspect) / Wipro (North West – PLATIA) / Hager (Insysta) / ABB (Cheiron)**
10	**Selector Switch & Toggle switch**	**Salzer (Larsen & Toubro) / Siemens / Kaycee / C&S**
11	**PVC Trunking**	**MK / Legrand / Schneider / Hager / C&S**
12	**GI pipe**	**Tata / Jindal (Hissar) / Jindal Star / Prakash Surya**

13	Paints	ICI / Asian / Berger
14	Terminal Blocks and Connectors	Elmax / Wago / Hensel / Connectwell
15	Phenolic Laminated Sheet / Bakelite Sheet	Hylam / Formica (P-I Grade) / Mylam/ Greenlam
16	Cat-6 Cable, Wires & Fiber Optic Cable	Amp / AVAYA / Beldon / Legrand / D- Link / Krone Communication / Molex

	Fans & Fittings	
1	Fluorescent fittings	Wipro / Phillips / Crompton Greaves / Havells / Osram
2	LED fittings	Wipro / Crompton Greaves / Jaquar / Havells / Philips / Syska / Osram
3	Exhaust Fan 5 star rating	Havells /CromptonGreaves / USHA/ Almonard
4	Ceiling Fan 5 star rating	Havells / Crompton Greaves / USHA / Orient
5	Wall Bracket Fitting	Havells / Crompton Greaves / Decon / Jaquar / Philips / Syska
6	Lamps / Fluorescent Tubes / T5 Fluorescent Tubes / LED Lamp	Philips / Osram / Wipro / Crompton / Havells / Syska / Jaquar
7	Geysers 5 star rating	CG / Havells / Jaquar / AOSmith / Usha
8	Air circulator / wall fan 5 star rating	Havells / Usha / Almonard /Crompton
	Street Lighting	
1	LED Post Top fitting / Street Light fitting	Wipro / Crompton Greaves / Havells / Philips / Keselec Schreder / Syska / Lighting Technology / Jaquar
2	LED Street Lights with inbuilt Solar Panel & Controller	Havells / CG / Twinkle / Philips / Wipro
3	Ornamental Pole (Factory Finish)	Keselec Schreder / Valmont / Philips / Crompton Greaves / Twinkle / Wipro /Bajaj / KI
4	Hot Dipped Galvanized Octogonal Pole (Factory Finish)	Crompton Greaves / Phillips / Valmont / Bajaj / Wipro
5	Polycarbonate Junction Box / Enclosure	Hensel / Spelsberg / Naptune-Bals / Syntex
6	XLPE insulated PVC sheathed Alum. / Copper Conductor Armored cable of 1.1 KV grade	Finolex / Universal / Polycab / Nicco / RPG Cables / KEI / Havells / RRKabel / Bonton / Grandlay
	Sub Station Equipments	

1	**LT Panel / Meter Panel Board/Outdoor Feeder Pillar / APFC Panels (Less than 200 KVAR) / BusDucts**	**Tricolite Electrical Industries / Control & Switchgears Pvt. Ltd. / Sterling & Wilson / Milestone / Adlec Control System Pvt. Ltd. / Advance Panels & Switchgear Pvt. Ltd. / Indo Asian / Pristine / ASPL (Associated Switch Gears Pvt. Ltd.) / Engineers & Engineers (Electricals) Pvt. Ltd. L&T.**
2	**Air Insulated Rising Main**	**C&S / L&T / Schneider / Legrand / Godrej**
3	**Sandwich type Bus Trunking**	**C&S / L&T / Schneider / Legrand / Godrej**

4	**Moulded Case Circuit Breaker (MCCB) Thermal Release/ Microprocessor based (Ics=Icu=100%)**	**Schneider Electric (NSx Series) / Siemens (VL Series) / L&T (D-Sine) / Legrand (DPX^3) / ABB (TMax) / C&S (Winbreak-1/2)**
5	**Power / Aux. Contactor 3 / 4 pole**	**Schneider Electric / L&T / BCH / Siemens / Legrand / ABB / C&S / Hager**
6	**Potential Transformers / Current Transformer**	**Automatic Electric / Matrix / Precise / L&T / Kappa**
7	**LED type indicating lamps / Push Button**	**Schneider Electric / L&T / Siemens / Vaishno / C&S**
8	**Overload relays with built in Single Phase Preventer**	**Schneider Electric / L&T / Siemens / ABB / C&S**
9	**Conventional / Electronic Digital Meters (A/V/PF/Hz/KW/KWH)**	**Conzerv / Larsen & Toubro / Secure / AE / C&S / Socomac**
10	**Timer**	**Siemens / L&T / Legrand / ABB / Schneider Electric / C&S / Hager**
11	**Fasteners / GI Clamps**	**Hilti / Fisher / Chilli / GMGR**
12	**D.W. Corrugated HDPE Pipe (ISI marked)**	**REX / Dura plast / Zenduct / Triputi / Duraline**
13	**Compact sub station (Dry type) as per IEC 62271-202.**	**Crompton / ABB / Raychem / Schneider / A&Y, L&T.**
14	**HT Panel / Ring Main Unit**	**Crompton / Siemens / ABB / L&T / Schneider**
15	**H.T. cable (ISI marked)**	**CCI / Polycab / Universal / Nicco / KEI / Havells**
16	**HT End Termination / Cable Jointing Kit**	**Reychem / Denson / Cap Seal / Safekei/ 3M**
17	**ACBs (with display)**	**Siemens (3WL–ETU45B) / L&T (U-Power-OMEGA) / ABB (Emax)PR122 / C&S (Win Master 2 4.1 / Legrand (DMX^3 MP4) Schneider (Masterpact NW6.0 A)**

18	**Rubber Mat**	**Jyoti / Deep Jyoti / Premier (duly ISI marked)**
19	**Ammeter**	**AE / Rishab / L&T / C&S / Conzerve**
20	**Voltmeter**	**AE / Rishab / L&T / C&S / Conzerve**
21	**Fire Extinguishers**	**Minimax / Safex / Life Guard / Kanex / Omex**
22	**Capacitors & Reactors / APFCRelay**	**EPCOS / L&T / DUCATI / ABB / Siemens / Schneider**
23	**APFC Panel (200 KVAR & Above) (Accessories make will be as per manufacturer's standards)**	**L&T / Schneider / ABB / Siemens / Legrand / C&S**
24	**XLPE insulated PVC sheathed Alum. / Copper ConductorArmored / Unarmored cable of 1.1 KV grade**	**Finolex / Universal / Polycab / Nicco / RPG Cables / KEI / Havells / RRKabel / Bonton / Grandlay**
25	**Cable Glands Double Compression with earthing links**	**Baliga lighting / Comet / Cosmos / Dowells / Lapp / Gripwell**

26	**Bimetallic Cable Lugs**	**Comet / Dowells / Hax Brass (Copper Alloy India) / Jainson / Action**
27	**MS Cable Tray**	**Pilco / Slotco / MEM / BEC / Steelways / Legrand**
28	**Programmable Logic Controller (PLC)**	**Siemens / Woodward / Allen Bradley**
	DG Set	
1	**Diesel operated Power Generating Engine**	Cummins India / Caterpillar / / Ashok Leyland / Kirloskar / / Mahindra
2	**Alternator**	Stamford / Lerroy Sommer / Kirloskar Electric / Caterpillar / Crompton Greaves
3	**DG Set Canopy / Enclosure & AMF Panel**	As per OEM / OEA of respective DG Set manufacturer
4	**Alarm Annunciator**	Advani Oralikon / Larsen & Toubro / Minilec
	Fire Fighting Equipments	
1	**MS Pipe**	Tata / Jindal Hisar / Jindal Star / Prakash Surya
2	**GI Pipe**	Tata / Jindal Hisar / Jindal Star / Prakash Surya
3	**Forged Steel Fittings / Flanges**	Johnson Industries / VS Forge / JKForging / Trueforge
4	**Forged Steel Fittings & Flanges (for welding joints)**	VS Forge / Rohini / Kanwal Forge /Johnson
5	**Pipe Hangers**	Chilli / Hilti / GMGR
6	**Gun Metal / Brass Valve (ISI marked) (Full way Globe valve / Non Return Valve)**	Sant / Leader / Advance / Audco / Zoloto
7	**Butterfly / Sluice Valve (ISI marked)**	Audco/Advance/Kirloskar/Sant/Leader / Zoloto
8	**Check Valve (ISI marked)**	Sant / Leader / Advance / Audco / Zoloto
9	**Foot Valve (Cast Iron / Gun Metal)**	Sant / Leader / Advance / Audco / Zoloto / Kirloskar
10	**Y type Strainer**	Sant / Audco / Kirloskar / Leader / Zoloto
11	**Fire / Sprinkler Pump / Terrace**	Kirloskar / KSB / Grundfos / Mather & Platt

	Fire Pump	+ Wilo
12	**Electrical Motor**	ABB / Siemens / Kirloskar Grundfos / Crompton / NGEF
13	**Diesel Engine for Fire Pump**	Kirloskar / Ashok Leyland / Mather & Platt + Wilo / Cummins
14	**Couplings (Tyre – Type)**	Lovejoy / Fenner
15	**Anti Vibration Mountings**	Kanwal Industrial Corporation / Dunlop / GERB / Resistoflex
16	**Pressure Switch (ISI marked)**	System Sensor / Indfoss / Danfoss / Switzer
17	**Pressure Gauge (ISI marked)**	H Guru / Fiebig / Dwyer
18	**Double / Single Headed Landing Valve (ISI marked)**	New Age / Safeguard / Lifeguard / Padmini / Omex
19	**Male Female Fire Hose Coupling (SS 304) (ISI Marked)**	New Age / Safeguard / Lifeguard / Padmini / Omex
20	**First Aid Hose Drum / Fire Hose Reels / Shut off Nozzle (Gunmetal / ABS) (ISI Marked)**	New Age / Safeguard / Lifeguard / Padmini / Omex
21	**SS 304 / Gun metal Branch Pipe & Nozzle (ISI Marked)**	New Age / Safeguard / Lifeguard / Padmini / Omex
22	**Fireman Axe**	Minimax / New Age / Safeguard
23	**Water Flow Switch (FM / UL listed)**	System Sensor / Switzer / Rapid Control / Potter
24	**Rust preventive polymeric 4mm thick tape for pipes directly buried in ground Pipe ProtectionPypkoat (AW4) Wrapping (ISI Marked)**	Pypcoat / Makphalt / Rustech / Safex
25	**Level Controller & Indicator (Water) (ISI Marked)**	Auto Pump / Cirrus Engineering / Techtrol
26	**Fire Brigade Inlet Connection (ISI Marked)**	New Age / Safeguard / Lifeguard / Padmini / Omex
27	**Thermoplastic pipe for First Aid Hose Reel (ISI Marked)**	New Age / Safeguard / Lifeguard / Padmini / Premier Omex
28	**Fire Sealent**	Promat / Birla 3 M / Hilti
29	**Overload relays with built in Single Phase Preventer**	Schneider Electric / L&T / Siemens / ABB / C&S
30	**Power / Aux. Contactor 3 / 4 pole**	Schneider Electric / Larsen & Toubro / BCH / Siemens / Legrand / ABB / C&S
31	**LED type indicating lamps / Push Button**	Schneider Electric / L&T / Siemens / C&S
32	**Overload relays with built in Single Phase Preventer**	Schneider Electric / L&T / Siemens / ABB / C&S
33	**LT Jointing Kit / Termination**	Reychem / Denson / Cap Seal / Safekei/ 3M
34	**RRL Hose Pipe (ISI Marked)**	New Age / Safeguard / Lifeguard / Padmini / Omex
35	**Dry Battery**	Exide / Rocket / HBL / Pulse / Amco / Amaraja
36	**Battery Charger**	Statcon / Amarraja / CDC / AE / Expofyn / Thycon India
37	**Epoxy Paint**	ICI / Berger / Asian / Nerolac
38	**Fire Extinguisher**	Minimax / Safex / Life Guard / Kanex / Omex
39	**Air Release Valve**	Rb / Tbs / Cimbrio / Zoloto
40	**Analogue / Digital Measuring Instruments (Voltmeter / Ammeter / Energy meter / KW / PF / Multi function meter)**	AE / Rishab / L&T / C&S / Conzerve

41	**Aluminium / Copper power cable / Control Cable (Armoured / Unarmoured)**	Finolex / Universal / Polycab / Nicco / RPG Cables / KEI / Havells / RRKabel / Bonton / Grandlay
42	**Cable Glands & Lugs**	Comet / Dowells / Hax Brass (Copper Alloy India) / Jainson / Action
43	**Solenoid Valve / Spray Nozzle**	Parker / HD / Tyco / Emersion
44	**Sprinkler**	HD / Tyco / Reliable / Wormald / Viking
45	**Sprinkler Heads / Water Curtain Nozzle**	Tyco / Viking / Omex / Newage / Lifeguard
46	**Steel Flexible Extension**	Omex / Newage / Tyco / Lifeguard
47	**Vibration Eliminator**	Resistoflex / Dwaren / Kanwal
48	**Welding Electrodes**	Advani / ESAB / L&T
49	**Deluge Valve**	Tyco / Viking / HD
50	**Cast Iron Valve**	Kirloskar / Kartar / Kalpana
	Fire Alarm System	
1	**Addressable manual call box**	Johnson Control / Honeywell / EST (Edwards) / Siemens / Bosch make
2	**Addressable type fault isolator**	Johnson Control / Honeywell / EST (Edwards) / Siemens / Bosch make
3	**Strobe lights cum hooter**	Johnson Control / Honeywell / EST (Edwards) / Siemens / Bosch make
4	**Addressable control modules for hooter**	Johnson Control / Honeywell / EST (Edwards) / Siemens / Bosch make
5	**Addressable monitor module for flow switch**	Johnson Control / Honeywell / EST (Edwards) / Siemens / Bosch make
6	**Addressable type fire alarm control panel**	Johnson Control / Honeywell / EST (Edwards) / Siemens / Bosch make
7	**Network repeater panel**	Johnson Control / Honeywell / EST (Edwards) / Siemens / Bosch make
8	**Addressable multi sensing fire detector (Combination of optical type smoke detector and ROR type heat detector)**	Johnson Control / Honeywell / EST (Edwards) / Siemens / Bosch make
9	**Cat-6 Cable, Wires & Fiber Optic Cable**	Amp / AVAYA / Beldon / Legrand/ Krone Communication / Molex
10	**Response Indicator**	Agni devices / Apollo / System Sensor / Electroequip
	Water Supply Pump Sets	
1	**Mono Submersible pump Set**	KSB / CG / Kirloskar / Grundfos
2	**Submersible Pump Set**	KSB / CG / Kirloskar / Grundfos
3	**GI Pipe**	Tata / Jindal Hisar / Jindal Star / Prakash Surya
4	**Sluice Valve / Check Valve / Butterfly Valve / Non Return Valve**	Sant / Leader / Advance / Zoloto
5	**Submersible Cable**	Finolex / RR kabel / Polycab / Havells /KEI
	EPABX System	
1	**EPABX System**	Siemens / Cisco / Alcatel / Coral /Panasonic
2	**Master Console Phone**	Siemens / Cisco / Alcatel / Coral /Panasonic
3	**Analog Telephone instrument**	Beetal / Tata / Panasonic
4	**18 SWG Sheet (Chrone Box)**	Topaz / Coral / Crown
5	**Constant Voltage Transformer**	Topaz / Bhurji / Delta / Servokon
6	**unarmoured telephone wire**	Delton / Bonton / Polycab / Havells
7	**Cat-6 Cable, Wires & Fiber Optic Cable**	Amp / AVAYA / Beldon / Legrand / Krone Communication / Molex

	Air Conditioner & Water Purifier	
1	**H.V.A.C.**	Mitshubshi Electric / Toshiba / O General
3	**Voltage Stablizer**	V Guard / Blue Bird / Voltas / Servocon
4	**RO / Water Purifier**	Kent / Ion Exchange / Aquaguard
5	**Drinking Water cooler**	Voltas / Blue Star / Usha
	Solar Water Heating System	
1	**Solar Water Heating System(with Mono panel).**	Tata BP / Inter solar / Racold / BHEL/ Electrotherm,
	Lifts	
1	**Lift**	OTIS/ Mitsubishi/Johnson Lift Pvt. Ltd./Kone / Schindler
	CCTV System	
1	**IP based Camera (Dome / PTZ / Bullet / C- mounttype)**	Bosch / Honeywell / Pelco / Axis / Sony
2	**Conventional Camera (Dome / PTZ / Bullet / C-mount type)**	Bosch / Honeywell / Pelco / Axis / Sony
3	**DVR / NVR / Server**	Bosch / Honeywell / Pelco / Axis / Sony
4	**Switch**	Cissco / Zyxel / Zuniper / Brocade
5	**Data Network Cable**	Molex / Amp / Awaya / Legrand / D-link
6	**Mounting / Floor Rack**	Netrack / Beldon / Comrack
7	**Media Convertor**	Cissco / Zyxel / Zuniper / Brocade
8	**Fire Bowl**	Zyxel / Fourdinet / Cissco
9	**Connector**	D-link / Molex / Amp / Beldon
	Uninterrupted Power Supply (UPS)	
1	**Online / Offline UPS**	Numeric / Eaton / APC / Vertiv
	Solar Power Generation System	
1	**Solar Power Generation System(with Mono panel).**	REIL / BHEL / BEL / CEL / REC / SOLO / VIKRAM / ABB
2	**Junction Box**	VNT / SUN GARNER / OEM of SPV Modules
3	**SPV Inverter**	Sungrow / Delta / SMA / ABB
4	**Module Mounting Structure**	As per MNRE / Manufactures Standards
5	**XLPE Aluminium / Copper Cable.**	Finolex / Universal / Nicco / RPG Cables / KEI / Grandlay
6	**Solar Cable XLPO Insulated (DC)**	RR Kabel / Polycab / Havells / Finolex / Lapp

Note:- Any other brand approved/empanelment by office of DLDA U.S Nagar, DLDA U.S Nagar can also be considered after approval from competent authority. Any brand will only be used after approval from Vice Chairman, DLDA U.S Nagar.

SECTION – VI : DRAWING

Detailed working drawings will be issued to the contractor on his written request, however the basic drawings are being attached with the bid document.

SECTION – VII : CONTRACT DATA

Contract Data

Items marked "N/A" do not apply in this Contract.

The following documents, whether annexed with agreement or not, are also part of the Contract: **Clause Reference**

- **The Methodology and Program of Construction & Environmental Management Plan** **[27]**
- **The Schedule of Key and Critical equipment to be deployed on the work as per agreed program of construction** **[27]**
- **Site Investigation reports** **[14]**

The above insertions should correspond to the information provided in the Invitation of Bids.

The Employer is

Name : Vice Chairman, DLDA U.S Nagar

(1.1)

Address: 1st Floor, Vikas Bhawan Campus, Rudrapur

The Work consist of CONSTRUCTION OF OPEN GYM INFRONT OF L.D BHATT HOSPITAL, KASHIPUR DISTT. UDHAM SINGH NAGAR

Location

At " KASHIPUR Block- KASHIPUR of District Udham Singh Nagar "

Tender with quoted rate as 0.00 (zero) or nil, will not be accepted

~~**Minimum averag e annual financial turnover during immediate last three consecutive years shall not be less than *Rs.* 0 *lakh*. [ITB Cl. 3.5 (c)]**~~

~~**Satisfactory completion of one similar work of value not less than Rs. 0 Lakh of civil work or two similar works of value not less than Rs. 0 Lakh of civil work or three similar works of value not less than Rs. 0 Lakh of civil work completed during last 7 years. [ITB Cl. 3.5 (d)]**~~

The bidder should have experience of successfully completing at least one sculpture work.

~~**Solvency shall be equal to Rs. 0 Lakh.**~~
~~**[ITB Cl. 3.5 (h)]**~~

~~**Availability of following necessary equipment and machinery (either owned or leased):- [ITB Cl. 3.5 (k)] without which work may not be allowed to start and the delay thus caused will be attributable to the contractor:-**~~

~~**1. Mechanical Concrete Mixer – 2 Nos.**~~
~~**2. Pin Vibrator – 2 Nos.**~~
~~**3. Surface Vibrator- 1 No.**~~
~~**4. Water tanker – 1 No.**~~
~~**5. Electric generator 5 KVA – 1 No.**~~
~~**6. Cube Mould of size 15 X 15 X 15cm 06 Nos.**~~
~~**7. Calibrated jars 500ml, 1000ml 01 No.**~~
~~**8. Water tank for curing of concrete cube (samples) 01 No.**~~
~~**9. Slump Test Apparatus 01 No.**~~

~~**If above required documents/ Proof or Affidavit not attached with the bid will not be consider/accepted.**~~

~~**Availability of following personnel / staff: - [ITB Cl. 3.5 (l)]**~~

~~**1. Supervisor (with 5 years' post qualification experience) -2 Nos.**~~

~~**If above required documents/ Proof or Affidavit not attached with the bid will not be consider/accepted.**~~

~~**Rate of recovery in case of non- compliance of staff requirement will be as below**~~

~~**Sl. No.**~~	~~**Qualification**~~	~~**Experience (years)**~~	~~**Rate of recovery**~~
~~**i**~~	~~**Supervisor**~~	~~**5**~~	~~**15000/-p.m.**~~

~~**Availability of Credit limit of value not less than *Rs.* 0 *Lakh* [ITB Cl. 3.5 (m)]**~~

The Start Date shall be the date of issue of notice to proceed with the work. [1.1]

The Intended Completion Date for whole of the Works is 03 months from the date of start of Work for Complete work with the following milestones: [17, 28]

Physical works to be completed

1 - **Milestone 1 i.e.** CONSTRUCTION OF OPEN GYM INFRONT OF L.D BHATT HOSPITAL, KASHIPUR DISTT. UDHAM SINGH NAGAR **25.00 % .- 1.00 Month.**

2 - **Milestone 2 i.e.** CONSTRUCTION OF OPEN GYM INFRONT OF L.D BHATT HOSPITAL, KASHIPUR DISTT. UDHAM SINGH NAGAR. 50 % **- 1.00 Month.**

3- **Milestone 3 i.e.** CONSTRUCTION OF OPEN GYM INFRONT OF L.D BHATT HOSPITAL, KASHIPUR DISTT. UDHAM SINGH NAGAR 100 % **- 1.00 Month.**

Note:-Progress to be achieved as per the Enclosed Bar Chart

The work is to be done in phase wise manner in accordance with the availability of land by the client department. The Contractor will start the work after the consent of Engineer in charge and the Client Department.

The following documents also form part of the Contract: [2.3]
"Designs & Drawings submitted by the contractor or provided by Engineer "

The Contractor shall submit a revised Program including Environmental Management Plan for the Works (in such form and detail as the Engineer shall reasonably prescribe) within 14 days of delivery of the Letter of Acceptance. [27]

The Site Possession Dates shall be: [21] Date of issue of notice to proceed with the work
The Site is located near "RUDRAPUR **in Block-** RUDRAPUR **of District Udham Singh Nagar " [1]**
and is defined in drawings Attached
Security to be deposited at the time of executing bond 5% of bond value or as per prevailing orders

The Defects Liability Period is 12 months from the date of certification of completion of the whole work by Engineer incharge. [34]

Insurance requirements are as under: [13]

		Minimum Cover for Insurance In Rs. Lakh	Maximum deductible for Insurance In Rs. Lakh
(i)	Works and Plant and Materials	"As equivalent to final Contract Value"	As per actual insurance cost.
(ii)	Loss or damage to Equipment	As required	
(iii)	Other Property	As required	
(iv)	Personal injury or death insurance: a) for other people and department employees	Rs. 15.00 lakhs *for each case*	
	b) for Contractor's Employees	In accordance with the statutory requirements applicable to India	

The period between Program updates shall be 30 days. [27]
The language of the Contract documents is English [3]

In case of any dispute ,juridiction for this contract is District Udham Singh Nagar, Uttarakhand [3]

The currency of the Contract is Indian Rupee. [46]
The proportion of payments retained (retention money) shall be 6% from each bill subject to a maximum of 10% of final contract price including 5% performance security deposited at the time of signing of contract bond or as per prevailing government orders [48]
The liquidated damages will be 0.5% of contract value per week.
The maximum amount of liquidated damages for the whole of the works is 10% ten percent of final contract price. [49]
The amounts of the advance payment after approval from competent authority are: [51]

Note -

Nature of Advance	Amount (Rs.)	Conditions to be fulfilled
1. Mobilization	----NA----	~~On submission of un-conditional Bank Guarantee. (to be drawn before end of 20% of Contract period)~~

2. Equipment (This advance is not applicable for equipment already owned or hired/ leased by the contractor.)	**--- ----NA-------**	**~~After equipment is brought to site as per agreed construction program (provided the Engineer is satisfied that the equipment is required for performance of the contract) and on submission of unconditional Bank Guarantee for amount of advance.~~**
3. Secured advance for non-perishable materials brought to site	**----NA----**	**~~a) The materials are in-accordance with the specification for Works;~~** **~~b) Such materials have been delivered to site, and are properly stored and protected against damage or deterioration to the satisfaction of the Engineer. The contractor shall store the bulk material in measurable stacks.;~~** **~~c) The Contractor's records of the requirements, orders, receipt and use of materials are kept in a form approved by the Engineer and such records shall be available for inspection by the Engineer;~~** **~~d) The contractor has submitted with his monthly statement the estimated value of the materials on site together with such documents as may be required by the Engineer for the purpose of valuation of the materials and providing evidence of ownership and payment thereof;~~** **~~e) Ownership of such materials shall be~~** **~~has submitted an Indemnity Bond in an~~** **~~format; and~~**
		~~f) The quantity of materials is not excessive and shall be used within a reasonable time as determined by the Engineer.~~
4. Advanced against work done at site.	**75% of the total value of work done.**	**after verification by the concerned Engineer and Written reason for not being able to measure the work done.**

(The advance payment will be paid to the Contractor no later than 15 days after fulfillment of the above conditions).

Repayment of advance payment for mobilization and equipment: [51]

The advance shall be repaid with percentage deductions from the interim payments certified by the Engineer under the Contract. Deductions shall commence in the next Interim Payment Certificate following that in which the total of all such payments to the Contractor has reached not less

than 15 percent of the Contract Price or ----NA----, whichever period concludes earlier, and shall be made at the rate of ---NA--- of the amounts of all Interim Payment Certificates until such time as the advance has been repaid, always provided that the advance shall be completely repaid prior to the expiry of the original time for completion.

The Securities shall be for the following minimum amounts equivalent as a percentage of the Contract Price: [52]

Performance Security of contract price to be deposited at the time of making agreement plus Rs. ..... in accordance with Cl. 27.4 of ITB and Cl. 52 of GCC..... as additional security for unbalanced bids as below [*in terms of ITB Cl. 32.1*]:-

The date by which "as-built" drawings in 2 sets are required is within 28 days of issue of certificate of completion of whole or section of the work, as the case may be. [57]

The percentage to apply to the value of the work not completed by contractor, representing the Employer's Additional cost for completing the Works, shall be 20.00%. [59]

SECTION – VIII : FORMS REQUIRED WITH BID

Not Applicable

FORM - I

(will be acceptable only for electrical work)

JOINT VENTURE AGREEMENT (ON RS. 100 STAMP PAPER)

The Joint Venture Agreement is executed on the .....day on month year between M/s .....(hereafter referred as .....) through is authorized representative Shri....., having .....hereinafter called its registered the "First office at Party", M/s.....(hereafter referred as .....) through is authorized representative Shri....., having its registered office at .....hereinafter called the "Second Party" and M/s .....(hereafter referred as .....) through is authorized representative Shri....., having its registered office at .....hereinafter called the "Third Party" for the following works tendered by DLDA U.S Nagar vide their tender notice letter no. .....

The 'First Party', 'Second Party' and 'Third Party' hereinafter to be collectively referred to as the JOINT VENTURE (JV).

Whereas this joint Venture (JV) desire by means of this Agreement for tendering and executing of the aforesaid project works and the respective jobs, right and obligations that have been defined and set-out hereinafter.

Whereas the 'First Party', 'Second Party' and 'Third Party' and collectively the Joint Venture (JV) are competent and have requisite expertise and experience and other resources to successfully execute the project and in consideration of the presence and undertaking contained and defined herein have mutually agreed as under:-

1. That the 'First Party' shall be the 'Lead Partner'.
2. That the 'Lead Partner' is authorized to sign all documents on behalf of the joint venture (JV) and submit the prequalification bid for the aforesaid project works on behalf of the joint venture (JV).
3. That in case of successful bid, all terms and conditions of the Contract Agreement shall be binding.

4. That all partners of JV shall remain liable for over all execution successful completion of the contract to the Employees as per terms and conditions of the Contract Agreement.

5. That the 'All Party' shall be responsible for the detail project and its execution, incur all liabilities, 'First Party' being the lead partner will be eligible to sign on all contractual documents, MOUs with the technology provider and design consolations, and to attend all meetings and receive payment and all instructions for and on behalf of all the JV partners.

6. That the all JV partners have mutually agreed to faithfully fulfill full stake of responsibilities under the contract agreement in respect of planning, design, construction, supply of equipments, financing of the project, execution, commissioning of the project.

7. OBJECTIVE

The objective of the joint venture agreement is to define the rules governing the relationship between the joint venture partners prior to signature and during performance of the contract for satisfactory execution of the projects.

In case the JV partners mutually agrees to slice the work in civil and E&M it can be allowed but the JV Partners shall furnish a mutual agreement of the work with details of work executed by each partner, but work executed by any of the JV partners, all the JV partners shall be responsible and liable for whole work as per the scope of the contract.

8. NATURE OF JOINT VENTURE

The legal status of this joint venture is that of collaboration between the two parties and shall not construe as a partnership as per the Indian act 1932. All the parties accept responsibilities and liabilities among themselves and of the employer for the successful execution of the project in accordance to the terms and conditions of contract agreement.

9. OBLIGATION OF EACH PARTY

Each member of this joint venture agreement shall remain responsible and liable to each other and to the employer for the

execution of this particular project in accordance with the provisions contained in this agreement and scope of work.

10. MODE OF PAYMENT

Payment shall be made to the first being the lead partner but in case of slicing of the works terms of payment can be made as per their mutual agreement but the taxes shall be deducted as per the laws:

11. VALIDATION OF THIS JV:

a) **This JV shall come into force upon it signing by the authorized representative of the First, Second and Third Party.**

b) **After signing of this JV, all previous correspondence and the agreement reached earlier shall be null and void and shall have no effect.**

c) **This JV will remain valid till decision on award of work is taken by the "Client" (UJN). If the work is not awarded to JV, this JV will automatically become Null & Void. In case of award of work to JV, the JV will remain in full force till completion of the contract.**

d) **Each JV party agrees to and undertakes to indemnify and hold harmless the other Party against and liability, loss, cost, damages or expenses sustained as a result of negligent or improper performance or disturbance caused by itself or by any of it sub contractors, suppliers or associates in connection to the scope of work of the contract. If any third party enforces any claim, which is attributable to the scope of work of a certain party, that party shall settle such claims. The parties agree to indemnify each other against all claims made by any third party in respect of any infringements of any rights projected by patents, designs or copyrights or trademarks employed in the project by any party**

e) **In the course of working as associates, the JV partners will be sharing information with each other which may be proprietary/confidential information/knowledge acquired by each other. It is hereby agreed that all the parties will maintain complete secrecy regarding such information/knowledge and will not divulge to any party for any other purpose except for the success of the joint**

execution of the contact. All the parties will also indemnify each other against any claim that may arise out of using information, which are being claimed proprietary.

DECLARATION

The undersigned declare that the statement made and the information provided in the duly completed application are completed, true and correct in all respect.

Executed on the .....(Date) by the duly authorized representative of the parties hereto.

SIGNED FOR AND BEHALF OF M/S

Authorized Signatory

Designation:
Date:

SIGNED FOR AND BEHALF OF M/S

Authorized Signatory

Designation:
Date:

SIGNED FOR AND BEHALF OF M/S

Authorized Signatory
Designation:
Date:

FORM - II

BID VALIDITY

UNDERTAKING

(ON NON-JUDICAL STAMP PAPER OF RS. 100.00)

I, the undersigned do hereby give undertaking that our firm M/s .....agree to abide by this bid for a period 120 days for the date fixed for receiving the same and it shall be binding on us and may be accepted at any time before the expiration of that period.

.....
(Signed by an Authorized Officer of the Firm)

.....
(Title of Officer)

.....
(Name of Firm)

Not Applicable

FORM - III

SAMPLE FORMAT FOR EVIDENCE OF ACCESS TO OR AVAILABILITY OF CREDIT FACILITIES –* CLAUSE 3.5 (m) OF ITB

BANK CERTIFICATE

This is to certify that M/s. ..... is a reputed company with a good financial standing.

If the contract for the work, namely ..... is awarded to the above firm, we shall be able to provide overdraft/credit facilities to the extent of Rs. ..... to meet their working capital requirements for executing the above contract.

Sd.

Name of Bank

Senior Bank Manager

Address of the Bank

FORM - IV

AFFIDAVIT

UNDERTAKING

(ON NON-JUDICAL STAMP PAPER OF RS. 100.00 DULY NOTARIZED)

I / We, the undersigned, do hereby give undertaking that the decision of Departmental Tender Committee regarding the qualified & responsive bids shall be final & acceptable to us.

.....
(Signed by an Authorized Officer of the Firm)

.....
(Title of Officer)

.....
(Name of Firm)

FORM - V

AFFIDAVIT

UNDERTAKING

(ON NON-JUDICAL STAMP PAPER OF RS. 100.00 DULY NOTARIZED)

I / We, the undersigned, do hereby declare that I / We have no relation with persons responsible for technical design & execution of this project on employer side.

.....
(Signed by an Authorized Officer of the Firm)

.....
(Title of Officer)

.....
(Name of Firm)

FORM - VI

AFFIDAVIT

UNDERTAKING

(ON NON-JUDICAL STAMP PAPER OF RS. 100.00 DULY NOTARIZED)

I / We, the undersigned, do hereby declare that I / We have no dues / recovery pending of IT, CST, GST, State Trade Tax or any other Government Department Taxes with any previous employer.

.....
(Signed by an Authorized Officer of the Firm)

.....
(Title of Officer)

.....
(Name of Firm)

FORM - VII

GENERAL INFORMATION

All individual firms applying for prequalification must complete the information in this form. Nationality information should be provided for all owners or applicants that are partnership or individually owned firms.

1	**Name of firm:**	
2	**Head office address:**	
3	**Local office address:**	
4	**Telephone:**	**Contact:** **Nationality:**
5	**Facsimile:**	**E-Mail:**
6	**Place of incorporation/Registration:**	**Year of incorporation/Registration:**
7	**Main line of business:**	

Signature of
Contractor with Seal

Note:- Registration proof has to be attached with the bid. For the companies registered under company- act by the registrar, copy of the certificate and memorandum should be attached along with Registration Certificate.

FORM – VIII
AFFIDAVIT

UNDERTAKING

(ON NON-JUDICAL STAMP PAPER OF RS. 100.00 DULY NOTARIZED)
LITIGATION HISTORY

(A) Litigation

Year	Aware for or against applicant	Name of client/ cause of litigation and matter of dispute	Disputed amount	Actual amount awarded
			Rs. (in Lac)	Rs. (in Lac)

(B) Recoveries / pending recoveries from department/employer:-

Year	Name of department / employer	Amount Recoveries / pending recoveries Rs. (in Lac)	Details

(C) Punishment History (Give details)

Signature of Contractor with Seal

Not Applicable

FORM – IX

FINANCIAL ASSETS DETAIL

Applicant should provide financial information to demonstrate that they meet the requirements of pre qualification. A copy of the audited balance sheet for each of the last five financial years should be attached:

Summarized annual assets and liabilities in Indian Rupees for the previous five years :

Financial Information	Previous five years (Figures in Rs. Lacs)				
	.....	.....	.....	.....	.....
1. Total Assets					
2. Current Assets					
3. Total Liabilities					
4. Current Liabilities					
5. Profits before taxes					
6. Profits after taxes					

Total outside liabilities excluding own capital:

Signature of Contractor with Seal

Not Applicable

FORM – X

ANNUAL TURNOVER DATA

All individual firms must complete the information in this form. The information supplied should by the annual turnover of the Applicant in terms of the amount billed to the clients for each year for similar work in progress or completed.

Annual turnover data (for construction works only)	
Year	**Turnover (Rupees in Lacs)**
……	
……	
……	
……	
……	
……	
……	

Signature of Contractor with Seal

Note : All data to be certified by registered Charted Accountant of firm and turnover details issued by the income tax department.

Not Applicable

FORM – XI

DETAIL OF SIMILAR WORKS PERFORMED OVER LAST 7 YEARS

The information to be filled by the bidder in the following pages will be used for purpose of Prequalification as provided for in instruction to Bidders.

Work performed as prime contractor, on work of a similar nature over the last seven years (Year wise separately):

Year	Project Name	Name of the Employer	Description of work	Contract No.	Value of Contract (Rs. Lacs.)	Date of issue of work order	Stipulated period of completion	Actual date of completion	Cost of work after completion of contract ract (Rs. Lacs.	Remarks explaining reasons for delay & work completed
					Civil				Civil	

Signature of Contractor with Seal

Note:-

Attach certificate (s) from the Engineer (s) in-charge (not below the rank of Executive Engineer)

Not Applicable

~~FORM – XII~~

~~SPECIALISED WORKS~~

~~AFFIDAVIT~~

~~(ON NON-JUDICAL STAMP PAPER OF RS. 100.00)~~

~~MEMORANDUM OF UNDERSTANDING[M.O.U.] BETWEEN~~

~~1- M/s [Name of the firm with full address]~~

~~[Henceforth called the Main Contractor, Both Partners in case of JV]~~

~~2- M/S s [Name of the firm with full address]~~

~~[Henceforth called Associated Manufacturer/Authorized dealer/ registered agency for specialized work]~~

~~For the execution of specialized work as mentioned in ITB under the project of~~

~~We have agreed as under.~~

1. **~~The Associated Manufacturer/Authorized dealer/ registered agency will execute the specialized works as per terms and conditions of the agreement.~~**
2. **~~That the Associated Manufacturer/Authorized dealer/registered agency has gone through the contract and has understood the scope of work required for the purpose of executing the specialize work.~~**
3. **~~That the Associated Manufacturer/Authorized dealer/ registered agency has given its consent to carry out the said work in accordance with the specification and the time schedule prescribed in the above mentioned contract.~~**

~~In witness where of the parties, here to set and subscribed their respective hands the days and year first herein above written.~~

~~SIGNATURE OF MAIN CONTRACTOR~~ **~~MANUFACTURER/AUTHORIZED DEALER/ REGISTERED AGENCY FOR SPECIALISED WORK~~**

~~Date:~~ **~~Date:~~**

~~Place:~~ **~~Place:~~**

Not Applicable

FORM – XIII

SUMMARY OF CURRENT CONTRACT COMMITMENTS / WORKS IN PROGRESS

Applicant should provide information of their current commitments on all contracts that have been awarded or for which a letter of intent or acceptance has been received or for contracts approaching completion but for which an unqualified full completion certificate has yet to be issued:

Name & No. of Contract Agreement	Date of award	Total value of project (Rs. in	Value of work Completed (Rs. in Lacs)	Value of work to be Completed (Rs. in Lacs)	Completion date as per Bond

Signature of Contractor with Seal

Not Applicable

FORM – XIV

PROPOSED SUB CONTRACTING DETAIL

Proposed subcontracts and firms involved. [Refer ITB Clause 4.1 (r)]

Sections of the works	Value of Sub-contract	Sub-contractor (name and address)	Experience in similar work

Signature of Contractor with Seal

Note : Subcontracting of Works is applicable only in case of Individual Contractor or Firm.

FORM – XV

BIDDER'S BANKER DETAIL

If necessary, use separate sheets to provide complete banker information.

Financial Year ..... :–	
Name of Banker :	
Address of Banker :	
Telephone :	**Contact name and title**
Facsimile	**E-mail**

Signature of Contractor with Seal

Not Applicable

FORM – XVI

EQUIPMENT PROPOSED FOR PROJECT :)

S. No.	Equipment Name	Name of Manufacturer	Current Status	Quantity Available	Either Owned / Leased
1	(To be mentioned as per contract data)				
2					
3					
4					
5					
6					
7					
8					
9					
10					

Signature of Contractor with Seal

Not Applicable

FORM – XVII

KEY PERSONNEL PROPOSED FOR PROJECT :

Sl. No.	Staff	Name of Person proposed	Professional Qualification	Experience of relevant field in Years	Detail of experience
1	Supervisor				

Signature of Contractor with Seal

Note: -

1- Attach relevant certificate of each personnel.

Not Applicable

FORM – XVIII

PROPOSED SITE ORGANIZATION CHART FOR PROJECT :

A. Preliminary Site Organization Chart :

B. Narrative Description of Site Organization Chart

Description of relation between Head Office and Site Management

Signature of Contractor with Seal

Not Applicable

FORM – XIX

PROPOSED METHODOLOGY: CONSTRUCTION PROGRAMME & QUALITY CONTROL PROCEDURES FOR :

A. Proposed Methodology :

B. Construction Programme :

C. Quality Control Procedures :

Signature of Contractor with Seal

Note: -

1- **Attach separate sheets, if necessary.**

2- **Gantt / Bar Chart or CPM / PERT Chart may be attached for showing Construction Programme.**

FORM – XX

(Declaration regarding customs / excise duty exemption for materials / construction equipment bought for the work)

To:

VICE CHAIRMAN, DLDA UDHAM SINGH NAGAR, RUDRAPUR, DISTT.-UDHAM SINGH NAGAR

Dear Sir:

Sub: Certificate for Import / Procurement of Goods / Construction Equipment

1. **We confirm that we are solely responsible for obtaining customs / excise duty waivers which we have considered in our bid and in case of failure to receive such waivers for reasons whatsoever, the Employer will not compensate us.**
2. **We are furnishing below the information required by the Employer for issue of the necessary certificates in terms of the Government of India Central Excise Notification No. 108/95 and Customs Notification No. 85/99.**
3. **The goods / construction equipment for which certificates are required are as under:**

Items	Make / Brand Name	Capacity [where applicable]	Quantity	Value	State whether it will be procured locally or imported	Remarks regarding justification for the quantity and their usage in works
Goods						
[a] MS ERW Pipe > 200 mm dia.	NA	NA	NA	NA	NA	NA
[b] GI Pipe > 200 mm dia.	NA	NA	NA	NA	NA	NA
[c] Specials and fittings	NA	NA	NA	NA	NA	NA
[d] Others	NA	NA	NA	NA	NA	NA
Construction Equipment						
[a]	NA	NA	NA	NA	NA	NA
[b]	NA	NA	NA	NA	NA	NA
[c]	NA	NA	NA	NA	NA	NA
[d]	NA	NA	NA	NA	NA	NA

4. **We agree that no modification to the above list is permitted after bids are opened.**

5. **We agree that the certificate will be issued only to the extent considered reasonable by the Employer for the work, based on the Bill of Quantities and the construction programme and methodology as furnished by us along with the bid.**

6. **We confirm that the above goods will be exclusively used for the construction of the above work and construction equipment will not be sold or otherwise disposed of in any manner for a period of five years from the date of acquisition.**

Date: _____ **(Signature)**

_____

Place: _____ **(Bidder's Name and Address)_____**

(Designation)

_____

(Common Seal)

_____

Note - This letter form (duly filled) shall be submitted by the contractor along with his bid. Based on this, a certificate will be issued to the contractor within 60 days of signing of contract and no subsequent changes will be permitted thereafter.

FORM – XXI

Not Applicable

AFFIDAVIT

UNDERTAKING

(ON NON-JUDICAL STAMP PAPER OF RS. 100.00 DULY NOTARIZED)

I / We, the undersigned, do hereby declare that in case our bid is accepted, I / We will register my / our firm in DLDA U.S Nagar in appropriate category within 3 months of acceptance of my / our bid. Failing which the department is free to deduct the prescribed cost of registration form, registration fee and general securities as per departmental registration regulation 2010 from my / ou rfirst running bill.

.....
(Signed by an Authorized Officer of the Firm)

.....
(Title of Officer)

.....
(Name of Firm)

FORM – XXII

AFFIDAVIT

UNDERTAKING

(ON NON-JUDICAL STAMP PAPER OF RS. 100.00 DULY NOTARIZED)

I / We, the undersigned, do hereby declare that all the information and documents submitted by me / us with my / our bid is correct and true to the best of my knowledge.

.....
(Signed by an Authorized Officer of the Firm)

.....
(Title of Officer)

.....
(Name of Firm)

Not Applicable

~~FORM – XXIII~~

~~FORM OF BANKERS CERTIFICATE FROM A SCHEDLED BANK (SOLVENCY CERTIFICATE)~~

~~This is to certify that to best of our knowledge and information that M/s./Sh…..... having marginally noted address, a customer of our bank are/is respectable and can treated as good for any engagement up to a limit of Rs..... (Rupees……)~~

~~This certificate is issued without any guarantee or responsibility on the bank or any of the officers.~~

~~(Signature)~~
~~For the bank~~

~~NOTE~~

~~(1) Bankers certificates should be on letter head of the Bank issued **not before 06 months** from the date of final uploading of the tender.~~

~~(2) In case of partnership firm, certificate should include names of all partners as recorded with the Bank.~~

Not Applicable

FORM – XXIV

(ON NON-JUDICAL STAMP PAPER OF RS. 100.00 DULY NOTARIZED)

Form of Bid Securing Declaration

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

Bid No. : [.....]

To ,

DLDA U.S NAGAR

Name of Work:-

We, the undersigned, declare that:

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

We accept that we will automatically be suspended from being eligible for bidding in any contract, if we are in breach of our obligation(s) under the bid conditions, because we:

(a) have withdrawn our Bid during the period of bid validity specified in the Letter of Bid : or (b) having been notified of the acceptance of our Bid by the Department during the period of bid validity, (i) fail or refuse to execute the Contract, if required, or (ii)fail or refuse to furnish the performance security, in accordance with ITB 32.1.

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

Signed: [insert signature of person whose name and capacity are shown] In the capacity of [insert legal capacity of person signing the Bid-Securing Declaration]

Name: insert complete name of person signing the Bid-Securing Declaration]

Duly authorized to sign the bid for and on behalf of : [insert complete name of Bidder]

Dated on .....day of ....., ... [insert date of signing]
Corporate Seal (Where appropriate)

Note: in case of a Joint Venture, the Bid-Securing Declaration must be in the name of all partners to the Joint Venture that submits

SECTION – IX : SECURITIES AND OTHER FORMS

Forms of Securities

Acceptable forms of securities are annexed. Bidders should not complete the Advance Payment Security forms at this time. Only the successful Bidder will be required to provide Advance Payment Securities in accordance with one of the forms, or in a similar form acceptable to the Employer.

Annexure-A: **Performance Bank Guarantee**
Annexure-B **Bank Guarantee for Advance Payment**

Other forms

Annexure-C: **Letter of Acceptance**

Annexure-D: **Issue of notice to proceed with work**

Annexure-E: **Agreement Form**

Annexure-A

Form of Performance Guarantee / Bank Guarantee Bond

In consideration of the Vice Chairman of DLDA U.S Nagar (hereinafter called "The DLDA U.S Nagar") having offered to accept the terms and conditions of the proposed agreement between ……..……and …….. (Hereinafter called "the said contractor(s)" for the work ……. (hereinafter called "the said agreement"} having agreed to production of an irrevocable Bank Guarantee for Rs…….(Rupees…….……only) as a security/guarantee from the contractor(s) for compliance of his obligations in accordance with the terms and conditions in the said agreement.

1. We ……(hereinafter referred to as the "Bank") hereby undertake to (indicate the name of the Bank) pay to the DLDA U.S Nagar an amount not exceeding Rs ……..…. (Rupees……..only) on demand by the DLDA U.S Nagar.

2. We …… do hereby undertake to pay the amounts due and payable (indicate the name of the Bank) under this Guarantee without any demur, merely on a demand from the DLDA U.S Nagar stating that the amount claimed is required to meet the recoveries due or likely to be due from the said contractor(s). Any such demand made on the Bank shall be conclusive as regards the amount due and payable by the Bank under this Guarantee. However, our liability under this Guarantee shall be restricted to an amount not exceeding Rs……. (Rupees……only).

3. We, the said Bank, further undertake to pay to the DLDA U.S Nagar any money so demanded notwithstanding any dispute or disputes raised by the contractor(s) in any suit or proceeding pending before any Court or Tribunal relating thereto, our liability under this present being absolute and unequivocal. The payment so made by us under this bond shall be a valid discharge of our liability for payment thereunder, and the contractor(s) shall have no claim against us for making such payment.

4. We …… further agree that the Guarantee herein contained shall (indicate the name of the Bank) remain in full force and effect during the period that would be taken for the performance of the said agreement, and it shall continue to be enforceable till all the dues of the DLDA U.S Nagar under or by virtue of the said agreement have been fully paid, and its claims satisfied or discharged, or till the Engineer-in-charge, on behalf of the DLDA U.S

Nagar, certifies that the terms and conditions of the said agreement have been fully and properly carried out by the said contractor(s), and accordingly discharges this guarantee.

5. We …… further agree with the Authority that the Government

(indicate the name of the Bank) shall have the fullest liberty without our consent, and without effecting in any manner our obligations hereunder, to vary any of the terms and conditions of the said agreement or to extend time of performance by the said contractor(s) from time to time or to postpone for any time or from time to time any of the powers exercisable by the DLDA U.S Nagar against the said contractor(s), and to forbear or enforce any of the terms and conditions relating to the said agreement, and we shall not be relieved from our liability by reason of any such variation or extension being granted to the said contractor(s) or for any forbearance, act of omission on the part of the DLDA U.S Nagar or any indulgence by the DLDA U.S Nagar to the said contractor(s) or by any such matter or thing whatsoever which under the law relating to sureties would, but for this provision, have effect of so relieving us.

6. This Guarantee will not be discharged due to the change in the constitution of the Bank or the contractor(s).

7. We ……..lastly undertake not to revoke this Guarantee except with (indicate the name of the Bank) the previous consent of the DLDA U.S Nagar in writing.

8. This Guarantee shall be valid up to ……unless extended on demand by the DLDA U.S Nagar. Notwithstanding anything mentioned above, our liability against this Guarantee is restricted to Rs …….. (Rupees …….only), and unless a claim in writing is lodged with us within six months of the date of expiry or extended date of expiry of this Guarantee all our liabilities under this Guarantee shall stand discharged.

Dated the …….day of…….For …….....……..... (Indicate the name of the Bank)

Annexure-B

BANK GUARANTEE FOR ADVANCE PAYMENT

To:

VICE CHAIRMAN_____
DLDA U.S NAGAR,
1ST FLOOR, VIKAS BHAWAN CAMPUS, RUDRAPUR
DISTT.- UDHAM SINGH NAGAR, 263153
_____***[name of Contract]***

Gentlemen:

In accordance with the provisions of the Conditions of Contract, sub clause 51.1 ("Advance Payment") of the above-mentioned Contract, _____----------_____----------_____----------_____***[name and address of Contractor]*** **(hereinafter called "the Contractor") shall deposit with** __ VICE CHAIRMAN, DISTRICT LEVEL DEVELOPMENT AUTHORITY, RUDRAPUR (UDHAM SINGH NAGAR) **a bank guarantee to guarantee his proper and faithful performance under the said Clause of the Contract in an amount of** _____ ***[amount of guarantee]*** [1]_____ ***[in words].***

We, the _____ ***[bank or financial institution],*** **as instructed by the Contractor, agree unconditionally and irrevocably to guarantee as primary obligator and not as Surety merely, the payment to** _____ ***[name of Employer]*** **on his first demand without whatsoever right of objection on our part and without his first claim to the Contractor, in the amount not exceeding** _____ **[amount of guarantee]**[1] _____ ***[in words].***

We further agree that no change or addition to or other modification of the terms of the Contract or of Works to be performed thereunder or of any of the Contract documents which may be made between _____ ***[name of Employer]*** **and the Contractor, shall in any way release us from any liability under this guarantee, and we hereby waive notice of any such change, addition or modification.**

This guarantee shall remain valid and in full effect from the date of the advance payment under the Contract until _____ ***[name of Employer]*** **receives full repayment of the same amount from the Contractor.**

Yours truly,

Signature and seal: _____

Name of Bank/Financial Institution: _____

Address: _____

Date: _____

1 **An amount shall be inserted by the bank representing the amount of the Advance Payment, and denominated in Indian Rupees.**

Annexure-C

Sample Letter of Acceptance of Tender / Award Letter

(On Letterhead paper)

(BY REGISTERED / SPEED POST)

No……../…….……/……..…….. Dtd:…….

From …….

…….

DLDA US NAGAR.

To (Name and address of the contractor)

Subject;.....…….. (Name of the work as appearing in the tender for the work)

Dear Sir (s),

Your tender for the work mentioned above has been accepted on behalf of the Managing Director, UPJN at your tendered/negotiated tender amount of Rs…….(Rupees……only), which is .....% below/above the estimated cost of Rs. .....(Rupees…….only).

1. You are requested to submit the performance security/guarantee of Rs…… (Rupees…… ……..only) within …… days* of issue of this letter. The performance guarantee shall be in the prescribed form as provided in clause 1 of the General Conditions of Contract for UPJN Works, and shall be valid up to ……..
2. On receipt of the prescribed performance guarantee, necessary letter to commence the work shall be issued, and the site of work will be handed over to you thereafter.
3. Please note that the time allowed for carrying out the work as entered in the tender (……. days/ weeks/months) shall be reckoned from the ……day* after the date of issue of this letter.

Yours faithfully,

SECRETARY

For and on behalf of VICE CHARIMAN

Annexure-D

Issue of Notice to proceed with the work
(Letterhead of the Engineer / Employer)

———— (date)

To

——————————— (name and address of the Contractor)

———————————

———————————

Dear Sir:

Pursuant to your furnishing the requisite security as stipulated in ITB clause 32.1 and signing of the contract agreement for the ……. ……. Bid Price of Rs.————, you are hereby instructed to proceed with the execution of the said works in accordance with the contract documents.

Yours faithfully,

(Signature, name and title of signatory authorized to sign on behalf of Employer)

Annexure-E

Agreement
Form

Agreement

This agreement, made the _____ day of _____, between___

VICE CHAIRMAN
DLDA U.S NAGAR
RUDRAPUR, DISTT-UDHAM SINGH NAGAR.

[name and address of Bond executing officer] (hereinafter called "the Employer)" of the one part and ……. ……. [name and address of contractor] (hereinafter called "the Contractor") of the other part.

Whereas the Employer is desirous that the Contractor execute CONSTRUCTION OF OPEN GYM INFRONT OF L.D BHATT HOSPITAL, KASHIPUR DISTT. UDHAM SINGH NAGAR identification mark - CONSTRUCTION OF OPEN GYM INFRONT OF L.D BHATT HOSPITAL, KASHIPUR DISTT. UDHAM SINGH NAGAR [name and identification number of Contract] (hereinafter called "the Works") and the Employer has accepted the Bid by the Contractor for the execution and completion of such Works and the remedying of any defects therein, at a contract price of Rs.……
……

NOW THIS AGREEMENT WITNESSED as follows:

1. **In this Agreement, words and expression shall have the same meanings as are respectively assigned to them in the Conditions of Contract hereinafter referred to, and they shall be deemed to form and be read and construed as part of this Agreement.**

2. **In consideration of the payments to be made by the Engineer to the Contractor as hereinafter mentioned, the Contractor hereby covenants with the Engineer to execute and complete the Works and remedy any defects therein in conformity in all aspects with the provisions of the Contract.**
3. **The Engineer hereby covenants to pay the Contractor in consideration of the execution and completion of the Works and the remedying the defects wherein the Contract Price or such other sum**

as may become payable under the provisions of the Contract at the times and in the manner prescribed by the Contract.

4. The following documents shall be deemed to form and be read and construed as part of this Agreement, whether annexed or not with the agreement viz.:

i) Letter of Acceptance;
ii) Notice to proceed with the works;
iii) Contractor's Bid;
iv) Contract Data;
v) General Conditions of contract (including Special Conditions of Contract);
vi) Specifications;
vii) Drawings; IF ANY
viii) Bill of Quantities; and
ix) Any other document listed in the Contract Data as forming part of the contract. IF ANY

In witness whereof the parties thereto have caused this Agreement to be executed the day and year first before written.

The Common Seal of ------ Employer and Contractor

was hereunto affixed in the presence of:

Signature of SECRETARY -Signed,
Sealed and Delivered by the said –

SECRETARY
DLDA U.S NAGAR

in the presence of: 1- Signature –
Name -
Address -

2 - Signature –
Name -
Address -

Binding Signature of departmental officer

SECRETARY, DLDA U.S Nagar Rudrapur

Binding Signature of Contractor _____
Name of contractor -

SECTION – X : FORM OF BID

DISTRICT LEVEL DEVELOPMENT AUTHORITY, US NAGAR

FORM OF BID

Name of Work: - CONSTRUCTION OF OPEN GYM INFRONT OF L.D BHATT HOSPITAL, KASHIPUR DISTT. UDHAM SINGH NAGAR

To,

SECRETARY,
DLDA U.S NAGAR
Rudrapur (Udham Singh Nagar).

We offer to execute the work described above and remedy any defects there in conformity with the conditions of contract, Specification, Drawing, Bill of Quantities and Addenda for the sum (s) of Rs. ___ _____

We undertake if our Bid is accepted to commence the works as soon as is reasonable possible after the receipt of the Engineer's notice to commence, and to complete the whole of the work, comprised in the contract with in the time stated in the document.

We agree to abide by this Bid for the period as prescribed in Clause 15 of the Instruction to Bidder (Section 1) and it shall remain binding upon us and may be accepted at any time before the expiration of that period.
Unless and until a formal Agreement is prepared and executed this BID, together with written acceptance thereof, shall constitute binding contract between us.
We understand that you are not bound to accept the lowest or any tender you may receive.

Date this _____ day of _____ 20 _____

Signature _____ in the capacity of _____ authorized in sign Bid for and on behalf of _____

(In blank capital or typed)

Address. :-

Name of Witness: -

_____

_____

Address of Witness: -

_____

Signature of Witness:

_____

_____

Occupation of Witness:-

_____

_____

SECTION – XI : SCHEDULES AND BILL OF QUANTITY

SCHEDULE – A

Name of Work: - CONSTRUCTION OF OPEN GYM INFRONT OF L.D BHATT HOSPITAL, KASHIPUR DISTT. UDHAM SINGH NAGAR

SCHEDULE – B

(DRAWINGS)

Proposed Drawings are attached with Bid and detailed drawings if any shall be provided during construction work.

SCHEDULE – C

LIST OF EQUIPMENT FOR FIELD TEST LABORATORY

as per contract data

SCHEDULE – D

(LIST OF SAMPLES TO BE SUBMITTED)

The samples of materials used in constructions (cement, steel brick, stone agreegate, sand, RCC& cement mortar, sanitary fitting, wood work etc. During Execution) shall be got approved before use by the contractor from the Executive Engineer on his authorized representative. For testing purpose, the contractor will make available the adequate quantities of materials at his own cost and all the test are to be done by contractor at his own cost without any extra payment.

1. The contractor will maintain stock and daily consumption register of cement/steel at site and will be made available at all times for checking to the officers/engineers of the Authority.

SCHEDULE – E

(TESTS)

All the necessary and required tests before commencement of the work, during the construction and after all construction regarding material, items and work shall be conducted as per latest I.S. specifications or as desired by the Engineer / as per terms and conditions of the contract documents. All the cost of testing shall be borne by the contractor. Contractor have to make necessary arrangement for the factory inspection of material/equipment as decided by engineer/ Client department. any material/equipment will not be delivered at site before the approval of engineer in charge

SCHEDULE – F

(TIME OF COMPLETION)

The complete work as specified herein shall be completed in all respects, passed to the satisfaction of Engineer and tested as per latest PWD/ CPWD or I.S. Specifications / codes within

06 month (calendar months) from the date of written order to the contractor for commencement of the work.

In addition, defect liability period of 18 month is proposed which will start after completion of the work.

SCHEDULE – G (Bill of Quantities)

IMPORTANT NOTES:

ii. **Contractors are requested to read carefully the specification and General conditions of works included in this contract before quoting their rates in Schedule G.**

iii. **The contractors are also requested to first visit the site of work to make themselves well acquainted with the nature of work, the local conditions, which may include cartage of materials even by head load or other than the normal conventional modes, all topographical, geological and hydrological aspects including soil and sub soil water conditions as no extra payment will be made on account of them. The contractor should access the actual execution period likely to be available in a year.**

iv. **Quantities given in the Schedule "G" are approximate and may vary (+/-) to any extent and some items may be deleted altogether. No claim in regard of change of scope of work will be acceptable..**

v. **The rate tendered herein shall apply for finished item of work and shall include supply of all material, labour, T&P etc. and finishing the work in real workmanship manner whether specifically mentioned in the specifications or not.**

vi. **The contractor shall provide caution signs / lights near excavations, trenches, fencing (barricading arrangement) etc. and employ watchman during nights and off working days and hours to avoid any accident.**

vii. **The contractor shall provide all appliances, pumps, engines, machinery, suction and delivery pipes, fasteners, fuel, electricity, petrol and diesel to run plants, lubricants, cotton waste etc. and all labour (skilled and unskilled) for proper pumping of any other flow and also sub soil water to be pumped during execution of work and contractor shall make his rates sufficiently comprehensive to cover the cost of such works. All works shall be carried out in dry and clean trench conditions.**

viii. **The rates quoted in Schedule G shall be written legibly in figures as well as in words without any cutting. In case cutting, if necessary, it should be initialed. There should be no overwriting. All writing should be in same ink and hand writing. -Not Applicable**

ix. **Since the work is of typical nature, contractor should have sufficient T&P and skilled masons, and labour etc. required for carrying out the work within specified period as the work is of very urgent nature and time bound.**

x. **The contractor should make sufficient provision in his rates to safe guard the electric pole, water pipe, sewer, shift / reinstate the water conduits (including all required materials, labour, T&P etc.) met with during the excavation, diversion, cleaning, repair, strengthening, reinstatement of the drain, construction of manhole or any structures damaged of dismantled during execution of works as there will be no extra payment on his account other than mentioned in the Schedule G.**

xi. **While dismantling the bituminous surface, P.C.C. and other Roads, dismantled material should be properly stacked at convenient or suitable safe site for reinstatement of Roads. If any damaged or short fall in the materials is found to reinstate the Roads, the contractor has to supply the required materials at his own cost for completion of work in all respect. Reinstatement of roads shall commence only after testing of works after refilling of trenches by available excavated earth.**

xii. **All the labour and employees at site for execution of work shall be duly insured. Contractor will be fully responsible for any accident due to toxic gases and other type of accident which may occur during execution of work. No compensation for accident on any ground will be paid to the contractor by the department. However, the contractor shall indemnify the department against such accidents.**

xii (i)- **All materials shall be supplied strictly as per relevant Indian Standard Specification with its / their latest amendments wherever applicable.**

(ii)- **The materials will be required to be packed strictly as per provisions of relevant I.S. Code.**

(iii)- **Materials with "ISI certification mark" shall only be accepted. For materials not available with ISI mark, it shall be accepted "as per BIS" or relevant codes of standards.**

(iv)- **The Contractor should have adequate testing facilities at site to carry out tests as laid down in the relevant Indian Standard Specifications or required by Engineer-in-charge.**

xiii. **The contractor must seek clarifications regarding any ambiguity, whatsoever, immediately but not later than pre-bid meeting in writing (in three copies), otherwise the department interpretation in this regard will be binding upon him with no liability to the department in this regard.**

xiv. **Tenders are liable to be rejected for failure to observe any or all of the instructions.**

Note:-

1. **Price for Units shall be F.O.R. destination excluding of GST. inclusive all taxes and duties, till the completion of contract.**
2. **There will be no change in price quoted in Schedule G due to increase in a cost index hence no escalation will be given in the prices till the completion of the project.**

Attached separately

PREAMBLE

The Bill of Quantities shall be read in conjunction with the instruction to Bidders, Conditions of Contract, and Technical Specifications & Drawings.

The quantities given in Bill of quantities are estimated and provisional and are given to provide common basis for Bidding. The quantities can be increased/decreased up to any extent. The basis of payment will be the actual quantities of work ordered and carried out, and as measured by the contractor and verified by the engineer and valued at the rates and the prices tendered in the Bill of Quantities where applicable and otherwise at such rates and prices as the engineer may fix within the terms of the contract.

The rate and the prices tendered in the priced Bill of Quantities shall, accept in so far as it is otherwise provided under the contract include all constructional plant, Labour, supervision, Material, Cartage, Erection, Maintenance, Insurance, Profit, Taxes and duties together with all general risks, liabilities and obligation set out or implied in the contract, excluding GST.

The rates shall be quoted item wise and entirely in Indian Currency.

The whole cost of complying with the provision of the contract shall include in the items are provided in the priced Bill of Quantities and where no items are provided the cost shall be deemed to be distributed among the rates and prices entered for the related items of work.

General direction and description of work and materials are not necessary repeated or summarized in the Bill of Quantities. Reference to the relevant sections of the contract documentation shall be made before entering Rates / Prices again each item in the Bill of Quantities.

The method of measurement of completed work for payment shall be in accordance with specification for Uttarakhand Peyjal Nigam and / if not available then as per I.S. codes relevant for the measurement.

Bidders are advised to visit the respective sites before quoting their rates. Once the bids are opened, no claim whatsoever will be acceptable.

BILL OF QUANTITIES (SCHEDULE G)

(Attached Separately)

I / We have gone through all the instructions, conditions, specifications and bill of quantities etc. of the tender form which shall be part of the agreement and here by agree to abide by them fully and offer to execute the work on the rates quoted above by me / us in the bill of quantities.

Signature of Contractor

Note:

1. **Item for which no rate of price has been entered in will not be paid for by the Employer when executed and shall be deemed covered by the other rates and prices in the bill of quantities (Refer ITB Clause 14.2 and GCC Clause 43.3)**
2. **Unit rates and prices shall be quoted by the bidders in Indian Rupee only (ITB Clause 15.1)**

OFFICE OF THE VICE CHAIRMAN, DISTRICT LEVEL DEVELOPMENT AUTHORITY, RUDRAPUR (UDHAM SINGH NAGAR)

PAYMENT PROCEDURES

- **Monthly payment shall generally be made on receipt of bills.**
- **For the purpose of payment of R/A bills, proportionate payment of items at various stages of execution will be admissible as approved by engineer-in-charge.**
- **Recovery, if any, shall be made from the above payment as per the provisions of contract.**
- **Payment to the contractor of monthly invoice as aforesaid shall not be deemed to affect in any manner the contractor's responsibility for carrying out the whole works in accordance with requirements of the Contract until certification of the whole works and acceptance thereof by the owner.**
- **however department will ensure timely running payments to the contractor but non payment due to non availability of funds will not be a justification for the delayed progress. work should not be stopped unless department ask to stop due to some unavoidable conditions.**

MODE OF PAYMENT FOR WORKS OF LIFT, DG SET, CSS & SOLAR PLANT

Contractor shall be paid interim payment as per following schedule of the cost to facilitate the execution of work.

S.No.	Description of Work	Percent of payment which will be released	Progressive percentage of released
1	Supply of all material/equipment at site.	60%	60%
2	Installation and commissioning of equipment at site	30%	90%
3	Testing and O&M for 6 MonthS	10%	100%

Note:-

1- The mode of payment given by contractor will not be accepted.

2- Contractor have to make necessary arrangement for the factory inspection of material/equipment as decided by engineer/ Client department. Any material/equipment will not be delivered at site before the approval of engineer in charge.

Contractor **Project Managar.**

SCHEDULE – H

(ADDITIONAL ITEM RATES)

Additional work or extra work which is not included in bond will be paid only if contractor or Engineer takes written permission of employer in advance before starting of work o fadditional item or extr aitem. All extra or additional work done or substituted work in place of work omitted by order of Engineer shall be valued at the rates and price set out in the contract, if in the opinion of the Engineer, the same shall be applicable. If the contract does not contain any rates or prices applicable to the extra or additional work then the rates shall be minimum of the following:

- **Derived from the tendered / contract rates of the contract of similar class of work.**
- **Minimum of rate derived from the DSR / SOR of PWD Uttarakhand schedule of rates for the District Udham Singh Nagar / work place of the year in which the work is actually done / Market rates / combing these all or some.**

If the rates are not find and cannot be decided as above for additional / extra work, then such type of work shall be agreed upon between the Engineer and Contractor in writing prior to the work being taken up in hand. But it shall be based on PWD / Irrigation / CPWD / DSR / PWD SOR schedule of rates / local market rate. Rate must be got approved prior to start of work. Otherwise it will not be paid and assumed covered in rates of other items executed or are being executed.

SCHEDULE – I

No materials will be issued by department. The contractor has to arrange himself all the materials to be used in this Project. Quality of material should be as specified in specifications and quality specified in specifications will be final. Any change in quality and material beyond

specifications of this bond must be got approved in written prior of start of work.

ABREVIATIONS

Abbreviation	For
I.F.B	Information for Bid
I.T.B	Instruction to bidders
G.C.C.	General Conditions of Contract
S.C.C.	Special Conditions of Contract
Rs.	Indian Rupee
L.S. or SUM	Lump Sum
No.	Number
M or m	Linear Meter
KM or Km,	Kilometer
Hec	Hectare
M^2/ m^2 or Sqm	Square Meter
M^3/ m^3 or Cum	Cubic Meter
CM^3/ cm^3 or Cu.cm	Cubic Centimeter
KG or kg	Kilogram
T	Tonne
Mld	Million Liter per day
HP	Horse Power
TPH	Tonne Per Hour
PS	Provisional Sum
BIS	Bureau of Indian Standards
BS	British Standard
IS	Indian Standard
Prov.	Provisional
Eqpt. Hrs	Equipment Hours
P.O.L.	Petrol, Oil & Lubricants
Veh. Day	Vehicle Day
DRB	Dispute Resolution Board
WP	Working Pressure
MS ERW	Mild Steel Electric Resistant Welded
GI	Galvanized Iron
API	American Petroleum Institute
DI	Ductile Iron
CI	Cast Iron
E.E.	Executive Engineer