

# TRIPURA INDUSTRIAL DEVELOPMENT CORPORATION

(A Government of Tripura Undertaking)

Press Notice Inviting

**Tender No TIDC/LCS/CIVIL/MUHURIGHAT/01/2018-19**

Tripura Industrial Development Corporation (TIDC), Agartala is Setting up a Land Custom Station at Muhurighat, Belonia, Tripura and invites PWD Form 7 Tender for the below mentioned work from eligible bidders registered with Government/ Semi Government organizations.

S. No	DNIT No.	Name of Work	Estimated Cost (in Lakh)	Time for Completion	Dropping Date	Class of Contractor
1	TIDC/ LCS/ CIVIL/ MUHURI GHAT/ 01/2018-19	Setting up of Land Custom Station at Muhurighat, Belonia, South, Tripura	Earnest Money (in Lakh)	Cost of Form	Place of Dropping	PWD Form
			1136	24 (Twenty Four) Months	28/11/2018	Class I
			11.36	Rs. 5,000	The Managing Director, TIDCL, Shilpa Nigam Bhawan, Khejurbagan, Agartala - 6 Authorized Representa- tive, IL&FS CDI Ltd, Kunjaban, Agartala - 6	7 (Seven)

All other details can be obtained from the websites – <http://www.tripura.gov.in> and <http://tidc.tripura.gov.in>

*Officer Inviting Bids*

*A. B. Fazal Ali Mazumder*

(Assistant Manager)



**On Behalf of Tripura Industrial Development Corporation**

Authorized Representative, IL&FS Cluster Development Initiative Ltd

North side of Old Raj Bhavan, Das Gupta Villa, Kunjaban, Agartala – 799006

**TRIPURA INDUSTRIAL DEVELOPMENT CORPORATION**

**Tender for Setting up of Land Custom Station Muhurighat, Belonia,  
Tripura**

**TIDC/LCS/CIVIL/MUHURIGHAT/01/2018-19**

**BOOK – 1**

**General Condition of Contracts**

Project Management Consultants: -

November 2018

**IL&FS Cluster Development Initiative Limited**

**TRIPURA INDUSTRIAL DEVELOPMENT CORPORATION**

**Tender for Setting up of Land Custom Station at Muhurighat, Belonia,  
Tripura**

**Serial No.....**

**Date of Issue .....**

**Tender Document issued to:**

M/s .....

.....

.....

**By**  
**Managing Director**  
Tripura Industrial Development Corporation (TIDC)  
Shilpanigam Bhavan,  
Khejurbagan,  
P.O Kunjaban, Agartala,  
Tripura - 799006

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# TRIPURA INDUSTRIAL DEVELOPMENT CORPORATION

## TIDC/LCS/CIVIL/MUHURIGHAT/01/2018-19 COMPETITIVE BIDDING

### (CIVIL WORKS)

NAME OF WORK	:	Tender for Setting up of Land Custom Station at Muhurighat, Belonia, Tripura
PERIOD OF SALE OF BIDDING DOCUMENT	:	FROM: 12.11.2018 TO: 27.11.2018
DATE AND PLACE OF PREBID MEETING	:	19 <sup>th</sup> November 2018, Time :- 15.00 Hours Tripura Industrial Development Corporation Shilpanigam Bhawan, Khejurbagan Agartala, Tripura - 799006
LAST DATE AND TIME FOR RECEIPT OF BIDS	:	DATE: 28 <sup>th</sup> November 2018, TIME: 15-00 Hours.
TIME AND DATE OF OPENING OF BID	:	Date : 28 <sup>th</sup> November 2018 TIME : 15-30 Hours
PLACE OF OPENING OF BIDS	:	Tripura Industrial Development Corporation Shilpa Nigam Bhavan, Khejurbagan, P.O Kunjaban, Agartala, Tripura - 799006
OFFICER INVITING BIDS	:	Executive Engineer Tripura Industrial Development Corporation Shilpa Nigam Bhavan, Khejurbagan, Agartala, Tripura - 799006 Phone : +91 0381-2391057

**INVITATION FOR BID**

**(IFB)**

# TRIPURA INDUSTRIAL DEVELOPMENT CORPORATION

## INVITATIONS FOR BIDS (IFB)

### COMPETITIVE BIDDING

**Date: 12.11.2018**

**Bid No: TIDC/LCS/CIVIL/MUHURIGHAT/01/2018-19**

1. **Tripura Industrial Development Corporation (TIDC)**, Agartala is promoting Setting Up of Land Custom Station at Muhurighat, Belonia, Tripura, under the ASIDE scheme of the Government of India and invites **percentage rate** bids for the below mentioned works from the eligible bidders registered with the Governments/Semi Government organisations.
  
2. The tender documents will be available for download from 12<sup>th</sup> November 2018. The intending Contractors shall download the documents from <https://tripura.gov.in> or <http://tidc.tripura.gov.in> , websites till 15.00 hrs on 27<sup>th</sup> November 2018. Interested bidders may obtain further information from the below mentioned addresses. Bidding documents requested by mail will be despatched by registered/speed post on payment of an extra amount of Rs 500/-. Tripura Industrial Development Corporation, will not be held responsible for the postal delay if any, in the delivery of the documents or non-receipt of the same.  
  
Executive Engineer,  
Tripura Industrial Development Corporation  
Bhodhjungnagar, Agartala,  
Tripura - 799006  
Phone : +91 0381-2391057  
  
IL&FS, Cluster Development Initiative Ltd,  
Dasgupta Villa,  
1<sup>st</sup> Floor, North Side of old Governor's house,  
PO-Kunjaban, Agartala – 799006  
Phone: +91 0381-2300419
  
3. Bids must be accompanied by bid security and cost of document of the amount specified for the work in the table IFB 1, drawn in favour of Tripura Industrial Development Corporation. Bid security and the cost of documents will have to be in the form of Demand Drafts and shall have to be valid for 90 days beyond the validity of the bid.
  
4. A pre-bid meeting will be held on 19<sup>th</sup> November 2018 at TIDC office at 15.00 Hours to clarify the issues, if any.
  
5. Bids must be delivered to Office of the Managing Director, Tripura Industrial Development Corporation, Shilpa Nigam Bhavan, Khejurbagan, P.O Kunjaban, Agartala, Tripura – 799006 on or before 15-00 Hours on 28<sup>th</sup> November 2018 and will be opened on the same day at 15-30 hours, in the presence of the bidders who wish to attend. If the office happens to be closed on the date of receipt of the bids as specified, the bids will be received and opened on the next working day at the same time and venue.
  
6. Other details can be seen in the bidding documents.

**TABLE - IFB 1**

Package No.	Name of work	Estimated Value of work (Rs.in Lakhs)	Bid security / EMD (Rs.in Lakhs)	Cost of document (Rs.)	Period of completion
1	Setting Up of Land Custom Station at Muhurighat, Belonia, Tripura	1136.79	11.36	5,000	24 Months

Seal of office



**SECTION 1: INSTRUCTIONS TO BIDDERS**  
**(ITB)**

**Section 1: Instructions to Bidders****Table of Clauses**

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## A. General

### 1. Scope of Bid

- 1.1 Tripura Industrial Development Corporation, (referred to as Employer in these documents) invite bids for the construction of works (as defined in these documents and referred to as "the Works") detailed in the table No.IFB-1.
- 1.2 This is a single stage Tender ( 2 Envelopes System).
- 1.3 The successful bidder will be expected to complete the works within a period of Twenty Four months including rainy season..

### 2. Source of Funds

- 2.1 The Works in this contract shall be funded by Tripura Industrial Development Corporation and Government Of India.

### 3. Eligible Bidders

#### 3.1 Bidder's Qualification criteria

- The Applicant shall have been involved in the Civil Engineering Construction Business such as building works, road works and water supply distribution works for the last ten years or more. The Applicant must provide necessary supporting documents as proof in respect of the eligibility criteria mentioned below:
- Experience of having successfully completed one similar work costing not less Rs. **11.36 Crores** in a single tender in 24 months in last 7 years
  - Completion report duly certified by the employer is to be submitted.
- Similar work shall mean "Development and Construction of multi-storied Office Buildings/Commercial complex with RCC framed structure, large span steel structure, including Internal and external Electrical works, renewable energy, recycled water management systems, radiant cooling, firefighting works, security systems, interior works"
- The Bidder should also have completed at least one single contract if similar nature, i.e Building works and allied civil works including electrical works in the state of Tripura of value **not less than Rs. 9.09 crores (80% of estimated value of works)** and should also submit documentary evidence duly certified by client.
- **Average Annual Financial Turnover during last 3 years ending 31st March 2018, should be at least 11.36 Crores. (Please submit copies of audited balance sheets of last 3 years i.e. from 2015-16, 2016-17 and 2017-18)**
- Shall have a solvency of Rs.4.54 Crores (40% of the estimated value of works). The applicant shall submit the solvency certificate, not older than three months prior to 31st March 2018, issued by any scheduled bank in original.
- The Bidder should have Permanent A.C. (PAN) with income tax department.
- The Bidder should have P.F & ESI registration with the concerned departments.
- The bidder must possess of his own or hire necessary plant and equipments viz. i) Concrete Batching

Plant 18m<sup>3</sup>/hour capacity, concrete pump 20 m<sup>3</sup>/h capacity, ii) 100 to 120 TPH Batch Type Hot Mix Plant, iii) Vibro Roller, iv) paver finisher and all tool & tackles, instrument etc required for successful execution of the job. For hire. Agreement/lease documents of all the plants and documents should be furnished along with the consent letter from the respected parties for at least 3 to 7 months.

- Shall not be black listed by any State/Central Department or PSU or Autonomous bodies. The Applicant must submit a duly notarized Affidavit to this effect. Bids received without this declaration in original shall stand automatically rejected.
- The applicant must submit information of on-going litigations and litigations had in the past five years. In the event that the applicant has no litigations either in process or in the past 5 years, an Affidavit to this effect, duly notarized must be submitted in original.
- Joint Venture or Consortiums are not allowed to quote for this tender.
- **All certificates/Documents mentioned above must be notarized before submission**

#### **4. Forms of Bid and Qualification Information**

All bidders shall fill in **Section 2, Forms of Bid and Qualification Information**”, and also submit a statement that the Bidder is not associated, nor has been associated in the past, directly or indirectly, with the Construction Manager, Engineer or any other entity that has prepared the design, specifications, and other documents for the Project or being proposed as Project Manager for the Contract.

#### **5. One Bid per Bidder**

- 5.1** Each bidder shall submit only one bid for one contract. A bidder who submits or participates in more than one Bid (other than as a Sub-contractor or in cases of alternatives that have been permitted or requested) will cause all the proposals with the Bidder’s participation to be disqualified.
- 5.2** Tender documents are not transferable

#### **6. Cost of Bidding**

- 6.1** The bidder shall bear all costs associated with the preparation and submission of his Bid, and the Employer will in no case be responsible and liable for those costs.

#### **7. Site visit**

- 7.1** The Bidder, at the Bidder’s own responsibility and risk is encouraged to visit and examine the Site of Works and its surroundings and obtain all information that may be necessary for preparing the Bid and entering into a contract for construction of the Works. The costs of visiting the Site shall be at the Bidder's own expense.

### **B. Bidding Documents**

#### **8. Contents of Bidding Documents**

- 8.1** The set of bidding documents comprises the documents listed in the table below and addenda issued in accordance with Clause 10:

Book 1 Invitation for Bids containing Sections as below.

Sections	1	Instructions to Bidders
	2	Forms of Bid and Qualification Information
	3	Conditions of Contract

- 4 Contract Data
- 5 Forms of Securities

Book-2	Specifications
Book-3	Bill of Quantities

**8.2** Only one set of original bidding document will be provided. The original document prepared for submission have to be photocopied by the Bidder, for submission together with the Original.

## **9. Clarification of Bidding Documents**

**9.1** A prospective bidder requiring any clarification of the bidding documents may notify the Employer in writing or by fax at the Employer's address indicated in the invitation to bid on or before the prebid meeting date. The Employer will respond to any request for clarification which he receives. Copies of the Employer's response will be forwarded to all purchasers of the bidding documents, including a description of the enquiry but without identifying its source.

## **9.2 Pre-bid Meeting**

**9.2.1** The bidder or his official representative having authorization to attend, is invited to attend a pre-bid meeting which will take place at Tripura Industrial Development Corporation, Agartala on 19<sup>th</sup> November 2018 at 15.00 Hours. The purpose of meeting will be to clarify issues if any.

## **10. Amendment of Bidding Documents**

**10.1** Before the deadline for submission of bids, the Employer may modify the bidding documents by issuing tender addenda.

**10.2** Any addendum thus issued shall be part of the bidding documents and shall be communicated in writing or by fax to all the purchasers of the bidding documents. Prospective bidders shall acknowledge receipt of each addendum by fax to the Employer. Addenda shall be incorporated in the bids submitted by the Bidder.

**10.3** To give prospective bidders reasonable time in which to take an addendum into account in preparing their bids, the Employer may extend as necessary the deadline for submission of bids, in accordance with Sub-Clause 20.2 below.

## **C. Preparation of Bids**

### **11. Language of the 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:

- (a) The Bid (in the format indicated in Section 2) and the Bill of Quantities wherein the Bidder shall fill in the rates; original plus one photocopy
- (b) Bid Security; and Qualification Information Form and Documents; original plus one photocopy
- (c) Originals only of Specifications and Drawing Volumes duly stamped on all pages by the Bidder
- (d) any other materials required to be completed and submitted by bidders in accordance with these instructions.

The documents listed under Sections 2 and 5 of Sub-Clause 8.1 shall be filled in without exception.

**13. Bid Prices**

- 13.1** The contract shall be for the whole of works as described in Sub-Clause 1.1. The Tenderer shall quote his unit rates for the items given in the Bill of Quantities and Rates both in figures and words. The unit rate so quoted shall be applicable irrespective of any future change in quantities subject to **clause 38 of Conditions of Contract**
- 13.2** The quoted item rate shall include for all duties, taxes, royalties and other levies payable by the Contractor under the contract, and no claim whatsoever, in this respect shall be entertained by the Employer.
- 13.3** The item rate quoted by the bidder shall be fixed for the duration of the Contract and shall not be subject to adjustment on any account.

**14. Currencies of Bid and Payment**

- 14.1** The rates and the prices given are in Indian Rupees.

**15. Bid Validity**

- 15.1** Bids shall remain valid for a period not less than 90 (Ninety) days after the date for bid submission specified in Clause 20. A bid corrected by the Bidder as valid for a shorter period shall be rejected by the Employer as non-responsive.
- 15.2** In exceptional circumstances, prior to expiry of the original time limit, the Employer may request that the bidders may extend the period of validity for a specified additional period. The request and the bidders' responses shall be made in writing or by fax. A bidder may refuse the request without forfeiting his bid security. A bidder agreeing to the request will not be required or permitted to modify his bid except as provided in 15.3 hereinafter, but will be required to extend the validity of his bid security for a period of the extension, and in compliance with Clause 16 in all respects.
- 15.3** The Contract Price will remain fixed during the extended period of validity.

**16. Bid Security**

- 16.1** The Bidder shall furnish, as part of his Bid, a Bid security in the amount as shown in column 3 of the table No. IFB- 1. This bid security shall be in favour of Tripura Industrial Development Corporation and may be in one of the following forms:
- Demand draft in favour of Tripura Industrial Development Corporation, payable at Agartala
- 16.2** Deleted
- 16.3** Any bid not accompanied by an acceptable Bid Security and not secured as indicated in Sub-Clauses 16.1 and 16.2 above shall be rejected by the Employer as non-responsive.
- 16.4** The Bid Security of unsuccessful bidders will be returned within 30 days of the end of the bid validity period specified in Sub-Clause 15.1.
- 16.5** The Bid Security of the successful bidder will be discharged when the bidder has signed the Agreement and furnished the required Performance Security.
- 16.6** The Bid Security may be forfeited
- (a) if the Bidder withdraws the Bid after Bid opening during the period of Bid validity;
  - (b) if the Bidder does not accept the correction of the Bid Price, pursuant to Clause 27; or

- (c) in the case of a successful Bidder, if the Bidder fails within the specified time limit to
  - (i) sign the Agreement; or
  - (ii) furnish the required Performance Security.

16.7 No interest shall be paid on any Bid security/Performance Security/ or Guarantee in lieu thereof.

#### 17. Alternative Proposals by Bidders

17.1 Alternative bids shall not be considered for any part of the Works.

#### 18. Format and Signing of Bid

18.1 The Bidder shall prepare the Bid as specified in clause 12 and following the instructions in clause 19.

18.2 The original and copy of the Bid shall be typed or written in indelible ink and shall be signed by a person or persons duly authorized to sign on behalf of the Bidder. All pages of the bid where entries or amendments have been made shall be initialed by the person or persons signing the bid.

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

### D. Submission of Bids

#### 19. Sealing and Marking of Bids

19.1 There shall be two parts for the bids, Part "A" and Part "B". The part 'A' shall contain Technical part of the bid and Part "B" shall contain Financial part of the bid. The Bidder shall enclose the original and one photocopy of Part A in one envelope marking it as, Envelope-A, TECHNICAL BID-ORIGINAL- and COPY. **He will then enclose the original and one photocopy of Part-B in another envelope marking it as Envelope- B , FINANCIAL BID ORIGINAL- and COPY.** These envelopes (called as inner envelopes) shall then be put inside one outer envelope.

##### Part 'A', Technical BID of the bid shall contain,

- i Bid Security and Cost of Documents in the form of Demand Draft as per tender requirement. If the Bid Security and Cost of Documents are not deposited, the tender shall be declared as non-responsive and rejected.
- ii The Qualification Information indicated in Section 2, duly filled in original and photocopy
- iii A forwarding letter (in duplicate) from the Bidder shall clearly stating in the forwarding letter ( in duplicate) to be enclosed with the tender document, the deviation from general terms and conditions, if any, with cross references. If no such letter is received, it will be presumed that the Bidder agrees entirely with the General terms and Conditions.
- iv. Book-1 Invitation for Bid, Book-2, Specifications, duly stamped and initialed on each page by the tenderer as proof of their having scrutinized the documents.

##### Part B Financial bid shall contain

- i A forwarding letter from the Bidder clearly stating the percentage above the engineer's estimate.
- ii Book- 3, Bill of Quantities volume wherein the Bidder shall fill in the percentage above the engineer's estimate and each page duly signed and sealed.

19.2 The **inner and outer** envelopes shall

- (a) be addressed to the Employer at the following address:  
Tripura Industrial Development Corporation  
Shilpa Nigam Bhavan,  
Khejurbagan,

P.O Kunjaban, Agartala,  
Tripura - 799006

- (b) bear the following identification:
- Bid for Setting up of Land Custom Station at Muhurighat, Belonia, Tripura.  
  
Bid Reference No.: TIDC/LCS/CIVIL/MUHURIGHAT/01/2018-19
  - DO NOT OPEN BEFORE 15-30 Hours on 28<sup>th</sup> November 2018.

**19.3** In addition to the identification required in Sub-Clause 19.2, the inner envelopes shall indicate the name and address of the bidder to enable the bid to be returned unopened in case it is declared late, pursuant to Clause 21.

**19.4** If the outer envelope is not sealed and marked as above, the Employer will assume no responsibility for the misplacement or premature opening of the bid.

**20. Deadline for Submission of the Bids**

**20.1** Bids must be received by the Employer at the address specified above no later than 15-00 hours on 28<sup>th</sup> November 2018. In the event of the specified date for the submission of bids declared a holiday for the Employer, the Bids will be received up to the appointed time on the next working day.

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

**21. Late Bids**

**21.1** Any Bid received by the Employer after the deadline prescribed in Clause 20 will be returned unopened to the bidder.

**22. Modification and Withdrawal of Bids**

**22.1** Bidders may modify or withdraw their bids by giving notice in writing before the deadline prescribed in Clause 20.

**22.2** Each Bidder's modification or withdrawal notice shall be prepared, sealed, marked, and delivered in accordance with Clause 18 & 19, with the outer and inner envelopes additionally marked "MODIFICATION" or "WITHDRAWAL", as appropriate.

**22.3** No bid may be modified after the deadline for submission of Bids.

**22.4** Withdrawal or modification of a Bid between the deadline for submission of bids and the expiration of the original period of bid validity specified in Clause 15.1 above or as extended pursuant to Clause 15.2 may result in the forfeiture of the Bid security pursuant to Clause 16.

**22.5** Bidders may offer discounts to, or modify the prices of their Bids only by submitting Bid modifications in accordance with this clause, or included in the original Bid submission.

**E. Bid Opening and Evaluation**

**23. Bid Opening**

**23.1** The Employer will open all the Bids received (except those received late), subject to the Bidder having conformed to the submittal procedure set out in clause 19, including modifications made pursuant to Clause 22, in the presence of the Bidders or their representatives who choose to attend at 15.30 Hours



on 28<sup>th</sup> November 2018. In the event of the specified date of Bid opening being declared a holiday for the Employer, the Bids will be opened at the appointed time and location on the next working day.

- 23.2** Envelopes marked "**WITHDRAWAL**" shall be opened and read out first. Bids for which an acceptable notice of withdrawal has been submitted pursuant to Clause 22 shall not be opened. Subsequently all envelopes marked "Modification" shall be opened and the submissions therein read out in appropriate detail.
- 23.3** Bids not accompanied by specified Bid Security shall be considered non responsive and rejected outright.
- 23.4** **The financial bids of only those bidder who have obtained the qualification shall be opened only after evaluating the Technical bids as explained in Clause 29.**
- 23.5** The Employer shall prepare minutes of the Bid opening, including the information disclosed to those present during the Bid Opening. Copies of the minutes shall be distributed to the bidders.
- 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 Bidders or any other persons not officially concerned with such process until the award to the successful Bidder has been announced. Any effort by a Bidder to influence the Employer's processing of Bids or award decisions may result in the rejection of his Bid.
- 25. Clarification of Bids**
- 25.1** To assist in the examination, evaluation, and comparison of Bids, the Employer may, at his discretion, ask any Bidder for clarification of his Bid, including breakdowns of the unit rates. The request for clarification and the response shall be in writing or by fax, but no change in the price or substance of the Bid shall be sought, offered or permitted except as required to confirm the correction of arithmetic errors discovered by the Employer in the evaluation of the Bids in accordance with Clause 27.
- 25.2** Subject to sub clause 25.1, no bidder shall contact the employer on any matter relating to its bid from the time of the bid opening to the time the contract is awarded. If the bidder wishes to bring additional information to the notice of employer, he should do so in writing.
- 25.3** Any effort by the Bidder to influence the Employer in the Employer's bid evaluation, bid comparison or contract award decisions may result in the rejection of the Bidders' bid.
- 26. Examination of Bids and Determination of Responsiveness**
- 26.1** Prior to the detailed evaluation of Bids, the Employer will determine whether each Bid (a) meets the eligibility criteria defined in Clause 3; (b) has been properly signed; (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 deviation 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, inconsistent with the Bidding documents, 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 Employer, and may not subsequently be made responsive by correction or withdrawal of the non-conforming deviation or reservation.
- 27. Correction of Errors**

- 27.1** Bids determined to be substantially responsive will be checked by the Employer for any arithmetic errors. Errors will be corrected by the Employer as follows:
- (a) where there is a discrepancy between the rates in figures and in words, the rate in words will govern; and
  - (b) where there is a discrepancy between the unit and the line item total resulting from multiplying the unit rate by the quantity, the unit rate as quoted will govern.
- 27.2** The amount stated in the Bid will be adjusted by the Employer in accordance with the above procedure for the correction of errors and, with the concurrence of the Bidder, shall be considered as binding upon the Bidder. If the Bidder does not accept the corrected amount the Bid will be rejected, and the Bid security may be forfeited in accordance with Sub-Clause 16.6 (b).

**28.** Not applicable to this Contract

**29. Evaluation and Comparison of Bids**

- 29.1** The technical proposals shall be evaluated, based on the information submitted in the Qualification Information and following the criteria set out below:

Experience of having successfully completed one similar work costing not less Rs. 11.36 Crores in a single tender in 24 months in last 7 years	40
Average Annual Financial Turnover during last 3 years ending 31st March 2018, should be at least 11.36 Crores	30
Solvency of Rs. 4.54 Crores	20
The Bidder should have P.F & ESI registration with the concerned departments	10
<b>Total Marks</b>	<b>100</b>

The minimum qualification marks shall be 70.

- 29.2** The Employer will open, evaluate and compare the financial Bids of only those Bidders determined to be substantially responsive in accordance with Clause 26 and also scoring the qualifying evaluation marks as explained in clause 29.1. The remaining Financial Bids shall be returned unopened.
- 29.3** The Employer reserves the right to accept or reject any variation, deviation from the bid document, or any alternative offer. Variations, deviations and alternative offers and other factors which are in excess of the requirements of the Bidding documents or otherwise result in unsolicited benefits for the Employer shall not be taken into account in Bid evaluation.
- 29.4** If the Bid of the successful Bidder is seriously unbalanced in relation to the Engineer's estimate of the cost of work to be performed under the contract, the Employer may require the Bidder to produce detailed price analyses for any or all items of the Bill of Quantities, to demonstrate the internal consistency of those prices with the construction methods and schedule proposed. After evaluation of the price analyses, the Employer may require that the amount of the performance security set forth in Clause 33 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.

**F. Award of Contract**

**30. Award Criteria**

- 30.1** Subject to Clause 31, the Employer will negotiate if required with the bidder whose bid has been determined to be substantially responsive to the Bidding documents and who has offered the lowest evaluated Bid Price. On completion of negotiations the employer will award the contract to the lowest bidder.

**31. Employer's Right to Accept any Bid and to Reject any or all Bids**

**31.1** Notwithstanding Clause 30, the Employer reserves the right to accept or reject any Bid or part of the 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.

**32. Notification of Award and Signing of Agreement**

**32.1** The Bidder whose Bid has been accepted will be notified of the award by the Employer prior to expiration of the Bid validity period by fax confirmed by 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 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").

**32.2** 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 Clause 33.

**32.3** The Agreement will incorporate all agreements between the Employer and the successful Bidder. It will be kept ready for signature of the successful bidder in the office of employer within 15 days following the notification of award along with the Letter of Acceptance. Within 15 days of receipt of Letter of Acceptance, the successful Bidder will sign the Agreement and deliver it to the Employer.

**32.4** Upon accepting the Performance Security for the Successful Bidder and signing of the agreement, the employer shall issue a 'Notice to Proceed' to the Contractor, in which the date of commencement of the Contract shall be indicated.

**32.5** Upon furnishing of the Performance Security by the successful Bidder, the Employer will promptly notify the other Bidders that their Bids have been unsuccessful.

**33. Performance Security**

**33.1** Within 15 days of receipt of the Letter of Acceptance, the successful Bidder shall deliver to the Employer a Performance Security in any of the forms given below for an amount equivalent to 5 % of the Contract price plus additional security for unbalanced Bids in accordance with Clause 29.4 of IFB and Clause 52 of Conditions of Contract:

- Bank draft, in favour of Tripura Industrial Development Corporation payable at Agartala.

**33.2** If the performance security is provided by the successful Bidder in the form of a Bank Guarantee, it shall be at the Bidder's option, by a Nationalized/Scheduled Indian bank

**33.3** Failure of the successful bidder to comply with the requirements of sub-clause 33.1 shall constitute a breach of contract, cause for annulment of the award, forfeiture of the bid security, and any such other remedy the Employer may take under the contract, and the Employer may resort to awarding the contract to the next ranked bidder.

**34. Advance Payment and Security**

**34.1** The Employer will provide an Advance Payment on the Contract Price as stipulated in the Conditions of Contract, subject to maximum amount, as stated in the Contract Data.

**35. Corrupt or Fraudulent Practices**

**35.1** The Employer expects the Bidders, Suppliers and Contractors observe the highest standard of ethics during the procurement and execution of such contracts. Therefore, 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 the Employer 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 Employer, 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 reject a proposal for award if it determines that the Bidder recommended for award has, directly or through an agent, engaged in corrupt, fraudulent, collusive or coercive practices in competing for the Contract in question;

## **SECTION-2**

### **FORMS OF BID, QUALIFICATION INFORMATION AND LETTER OF ACCEPTANCE**

#### **Table of Forms:**

- **CONTRACTOR’S BID\***
- **QUALIFICATION INFORMATION\***

- **LETTER OF ACCEPTANCE**
- **NOTICE TO PROCEED WITH THE WORK**
- **AGREEMENT FORM**

**NOTE :-**

\* BOTH THESE FORMS ARE TO BE FILLED IN BY THE TENDERER AND RETURNED AS PART OF HIS BID.

**Contractor's Bid**

Description of the Works : Setting Up of Land Custom Station at Muhurighat, Belonia, Tripura

BID No. : TIDC/LCS/CIVIL/MUHURIGHAT/01/2018-19

To : Managing Director,

Address: Tripura Industrial Development Corporation  
Shilpa Nigam Bhavan,  
Khejurbagan,  
P.O Kunjaban, Agartala,  
Tripura - 799006

GENTLEMEN,

Having examined the bidding documents including addendum, we offer to execute the Works described above in accordance with the Conditions of Contract, Specifications, Drawings and Bill of Quantities accompanying this Bid, for a contract price of Rs. \_\_\_\_\_ (Rupees \_\_\_\_\_)

This bid shall be valid for a period of 90 ( Ninety ) days from the day the bid is opened.

This Bid and your written acceptance of it shall constitute a binding contract between us. We understand that you are not bound to accept the lowest or any Bid you receive.

We hereby certify that we have taken steps to ensure that no person acting for us or on our behalf will engage in bribery.

We also undertake that, in competing for (and, if the award is made to us, in executing) the above contract, we will strictly observe the laws against fraud and corruption in force in India namely "Prevention of Corruption Act 1988"

We hereby confirm that this Bid complies with the Eligibility, Bid Validity and Bid Security required by the Bidding documents.

Yours faithfully,

Authorized Signature:

Name & Title of Signatory: \_\_\_\_\_

Name of Bidder : \_\_\_\_\_

Address : \_\_\_\_\_

Company Seal/Stamp

**Qualification Information**

The information to be filled in by the Bidder in the following pages will be used for purposes of Evaluation of Technical Submission as provided for in Clause 29 of the Instructions to Bidders.

The Contractor shall use this format and prepare the submission in as many pages as he wishes. Particular care shall be taken to submit certificate from the previous clients in support of the Bidder's claims.

1.1 Constitution or legal status of Bidder *[Attach copy]*

Place of registration: \_\_\_\_\_

Principal place of business: \_\_\_\_\_

Power of attorney of signatory of Bid *[Attach]*1.2 Total value of Civil Engineering construction work executed and payments received in the last three years  
(in Rs. Lakhs)

## 1.3.1 Work performed as prime contractor (in the same name) on works of a similar nature over the last three years.

<u>Project Name</u>	<u>Name of the Employer*</u>	<u>Description of work</u>	<u>Contract No.</u>	<u>Value of contract (Rs. Lakhs)</u>	<u>Date of issue of work order</u>	<u>Stipulated period of completion</u>	<u>Actual date of completion*</u>	<u>Remarks explaining reasons for delay and work completed</u>

## 1.3.2 Quantities of work executed as prime contractor (in the same name and style) in the last three years

<u>Year</u>	<u>Name of the Work</u>	<u>Name of the Employer*</u>	<u>Cement Concrete (including RCC &amp; PCC)</u>	<u>Electrical Works and Fire Alarm system and PA System</u>	<u>Glazing work/Glass Panels / Double Skin Insulated Roofing system</u>	<u>Plumbing works and HVAC Works</u>	<u>Landscaping works</u>	<u>Remarks *</u>
								<u>(indicate contract Ref)</u>

\*Attach certificate(s) from the Client

# Attach certificate from Chartered Accountant.

1.4 Information on Bid Capacity (works for which bids have been submitted and works which are yet to be completed) as on the date of this bid.

(A) Existing commitments and on-going works:

Description of Work	Place & State	Contract No. & Date	Name and Address of Employer	Value of Contract (Rs. lakhs)	Stipulated period of completion	Value of works* remaining to be completed (Rs. lakhs)	Anticipated date of completion
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)

(B) Works for which bids already submitted:

Description of Work	Place & State	Name and Address of Employer	Estimated value of works (Rs. lakhs)	Stipulated period of completion	Date when decision is expected	Remarks if any
(1)	(2)	(3)	(4)	(5)	(6)	(7)

\* Attach certificate(s) from Client.

1.5 Contractor's Plant and Equipment essential for carrying out the Works shall be listed below.

<u>Item of Equipment</u>	<u>Requirement</u>		<u>Availability / proposals</u>		
	<u>No.</u>	<u>Capacity</u>	<u>Owned/leased/ to be procured</u>	<u>Nos/ capacity</u>	<u>Age/ condition</u>
1. Hydraulic excavator					
2. Dozer					
3. Water tanker					
4. Vibrator					
5. Power Roller					
6. Plate Compactor					
7. Concrete Mixer					
8. Tippers/Trucks					



- 1.6 Qualifications and experience of key personnel proposed for administration and execution of the Contract. Attach biographical data. Refer to Sub Clause 9.1 of the Conditions of Contract.

<u>Position</u>	<u>Minimum Name</u>	<u>Qualifications</u>	<u>Years of experience (general)</u>	<u>Years of experience in the proposed position</u>
Project Manager (1 No)		Civil Engineering Graduate	10	7
Site Engineers (2 Nos.)		Civil Engineering Graduate	7	5
Quantity Surveyor (1 No)		Civil Engineering Graduate	5	3
Material Engineer (1 No)		Civil Engineering Graduate	5	3
Electrical Cum HVAC Engineer (1No)		Electrical Engineering Graduate	5	3
Water Supply Engineer (1No)		Civil Engineering Graduate	5	3

- 1.7 A statement regarding the number of Skilled and unskilled workers, the company has on its rolls at the time of tender submission. The statement also should indicate the number of skilled and unskilled workers proposed to be deployed on this project.

- 1.8 Proposed subcontracts and firms involved.

<u>Sections of the works</u>	<u>Value of Sub-contract</u>	<u>Sub-contractor (name and address)</u>	<u>Experience in similar work</u>

- 1.9 Evidence of access to financial resources to meet the qualification requirements: cash in hand, lines of credit, etc. List them below and attach copies of support documents *[sample format attached]*.

- 1.10 Name, address, and telephone, telex, and fax numbers of the Bidders' bankers who may provide references if contacted by the Employer.

- 1.11 Information on litigation history in which the Bidder is involved.

<u>Other party(ies)</u>	<u>Employer</u>	<u>Cause of dispute</u>	<u>Amount involved</u>	<u>Remarks showing Present status</u>

- 1.12 Statement of compliance under the requirements of Sub Clause 4.0 of the instructions to Bidders.

- 1.13 Proposed work method and schedule. The Bidder should attach descriptions, drawings and charts as necessary to comply with the requirements of the Bidding documents.

**SAMPLE FORMAT FOR EVIDENCE OF ACCESS TO OR AVAILABILITY OF CREDIT FACILITIES –\***

**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

**Letter of Acceptance**  
**(letterhead paper of the Employer)**

\_\_\_\_ - \_\_\_\_ - 2018

To: \_\_\_\_\_ [name and address of the Contractor]

Dear Sirs,

This is to notify you that your Bid dated \_\_\_\_\_ for execution of the  
\_\_\_\_\_ (Bid No.  
\_\_\_\_\_) for the Contract Price of Rs. \_\_\_\_\_  
\_\_\_\_\_ (Rupees \_\_\_\_\_  
\_\_\_\_\_) as corrected and modified in accordance with the Instructions to  
Bidders<sup>1</sup> is hereby accepted by our Agency.

We note that as per bid, you do not intend to subcontract any component of work.

[OR]

We note that as per bid, you propose to employ M/s. \_\_\_\_\_ as sub-contractor for  
executing \_\_\_\_\_

*[Delete whichever is not applicable]*

You are hereby requested to furnish Performance Security, plus additional security for unbalanced bids in terms of ITB clause 29.4, in the form detailed in Para 33.1 of ITB for an amount of Rs. \_\_\_\_\_ within 15 days of the receipt of this letter of acceptance valid up to 28 days from the date of expiry of Defects Liability Period i.e. upto \_\_\_\_\_ and sign the contract, failing which action as stated in Para 33.3 of ITB will be taken.

Yours faithfully,

Managing Director,  
Tripura Industrial Development Corporation (TIDC)  
Shilpa Nigam Bhawan,  
Khejurbagan,  
P.O Kunjaban, Agartala,  
Tripura - 799006

**Notice to proceed with the work**  
**(letterhead of the Employer)**

To \_\_\_\_\_ (date)  
\_\_\_\_\_  
\_\_\_\_\_ (name and address of the Contractor)  
\_\_\_\_\_  
\_\_\_\_\_

Dear Sirs:

Pursuant to your furnishing the requisite security as stipulated in IFB clause 33.1 and signing of the contract \_\_\_\_\_ agreement \_\_\_\_\_ for \_\_\_\_\_ the \_\_\_\_\_ @ a Bid Price of Rs. \_\_\_\_\_ (Rupees \_\_\_\_\_ ) you are hereby instructed to proceed with the execution of the said works in accordance with the contract documents. The date of commencement will be \_\_\_\_\_

Yours faithfully,

Managing Director,  
SPV

**Agreement Form****Agreement**

This agreement, made the \_\_\_\_\_ - 2018 between

\_\_\_\_\_ (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 \_\_\_\_\_ (Bid No. \_\_\_\_\_ (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. \_\_\_\_\_ (Rupees \_\_\_\_\_)

NOW THIS AGREEMENT WITNESSETH 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 Employer to the Contractor as hereinafter mentioned, the Contractor hereby covenants with the Employer to execute and complete the Works and remedy any defects therein in conformity in all aspects with the provisions of the Contract.
3. The Employer 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, viz.:
  - i) Letter of Acceptance;
  - ii) Contractor's Bid;
  - iii) Contract Data;
  - iv) Conditions of contract (including Special Conditions of Contract);
  - v) Specifications;
  - vi) Drawings;
  - vii) Bill of Quantities and Rates; and
  - viii) Any other document listed in the Contract Data as forming part of the contract.

In witness whereof the parties thereto have caused this Agreement to be executed the day and year first before In witness whereof the parties thereto have caused this Agreement to be executed the day and year first before written.

**For (Name of SPV)**

Signed by **Mr.**  
(Name of SPV),  
in the presence of the following witnesses.

Binding Signature of Employer:  
Employer:

Common Seal of the Company  
  
(Authorized Signatory for Affixing  
Common Seal)

Witnesses

Signature: \_\_\_\_\_  
Name: \_\_\_\_\_  
Address: \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

Signature: \_\_\_\_\_  
Name: \_\_\_\_\_  
Address: \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

**For (Contractor name)**

Signed by **Mr.**  
**(Contractor name)**  
in the presence of the following witnesses.

Binding Signature of Contractor:  
Contractor:

Common Seal of the Company  
  
(Authorized Signatory for Affixing Common Seal)

Witnesses

Signature: \_\_\_\_\_  
Name: \_\_\_\_\_  
Address: \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

Signature: \_\_\_\_\_  
Name: \_\_\_\_\_  
Address: \_\_\_\_\_

**SECTION 3: CONDITIONS OF CONTRACT**

**Conditions of Contract****Table of Contents**

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## General Conditions of Contract

### A. General

#### 1. Definitions

- 1.1 Terms which are defined in the Contract Data are not also defined in the Conditions of Contract but keep their defined meanings. Capital initials are used to identify defined terms.

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

**Compensation Events** are those defined in Clause 44 hereunder.

The **Completion Date** is the date of completion of the Works as certified by the Construction Manager in accordance with Sub Clause 55.1.

The **Contract** is the contract between the Employer and the Contractor to execute, complete and maintain the Works. It consists of the documents listed in Clause 2.3 below.

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

The **Contractor** is a person or corporate body whose Bid to carry out the Works has been accepted by the Employer.

The **Contractor's Bid** is the completed Bidding document submitted by the Contractor to the Employer.

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

**Date of Commencement** is the date as stated in the letter to proceed from the employer to the contractor.

**Days** are calendar days; **months** are calendar months.

A **Defect** is any part of the Works not completed in accordance with the Contract.

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

The **Employer** is the party who will employ the Contractor to carry out the Works.

**Construction Manager / Engineer** is IL&FS Cluster Development Initiative Limited (the person appointed by the employer as to deal to all the matters related to the execution and operation of the contract).

**Construction Manager's Representative or Engineer's Representative** shall be appointed by the Construction Manager and be responsible to the Construction Manager and shall carry out such duties and exercise such authority as may be delegated to him by the Construction Manager.

**Equipment** is the Contractor's machinery and vehicles brought temporarily to the Site to construct the Works.

The **Initial Contract Price** is the Contract Price listed in the 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 only by the Construction Manager by issuing an extension of time.

**Materials** are all supplies, including consumables, used by the Contractor for incorporation in the Works.

**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 area defined as such in the Contract Data.

**Site Investigation Reports** are those which were included in the Bidding documents and are factual interpretative reports about the surface and sub-surface conditions at the site.

**Specification** means the Specification of the Works included in the Contract and any modification or addition made or approved by the Engineer.

**A Sub-contractor** is a person or corporate body who has a Contract with the Contractor to carry out a part of the work in the Contract which includes work on the Site.

**Temporary Works** are works designed, constructed, installed, and removed by the Contractor which are needed for construction or installation of the Works.

**A Variation** is an instruction given by the Construction Manger which varies the Works.

The **Works** are what the Contract requires the Contractor to construct, install, and turn over to the Employer, as defined in the Contract Data.

## 2. Interpretation

- 2.1 In interpreting these 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 language of the Contract unless specifically defined. The Construction Manager 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 as follows and their order of priority shall be interpreted in the given order
- (1) Agreement
  - (2) Letter of Acceptance, Notice to proceed with work.
  - (3) Contractor's Bid
  - (4) Contract Data
  - (5) Conditions of Contract including Special Conditions of Contract
  - (6) Specifications
  - (7) Drawings
  - (8) Bill of Quantities
  - (9) any other document listed in the Contract Data as forming part of the Contract.

## 3. Language and Law

- 3.1 The language of the Contract and the law governing the Contract are stated in the Contract Data.

## 4. Construction Managers Decisions

- 4.1 Except where otherwise specifically stated, the Construction Manager will decide contractual matters between the Employer and the Contractor in the role representing the Employer.

## 5. Delegation

- 5.1 The Construction Manager may delegate any of his duties and responsibilities to other people after notifying the Contractor and may cancel any delegation after notifying the Contractor.

## 6. Communications

- 6.1 Communications between parties which are referred to in the conditions are effective only when in writing. A notice shall be effective only when it is delivered (in terms of Indian Contract Act).

## 7. Subcontracting

- 7.1 a) All bidders are expected to indicate clearly in the bid, if they propose sub-contracting elements of the works amounting to more than 20 percent of the Bid Price. For each such proposal the qualification and the experience of the identified Sub-contractor in the relevant field should be furnished along with the bid to enable the Employer to satisfy himself about their qualifications before agreeing for such sub-contracting and include it in the contract. In view of the above, normally no additional sub-contracting should arise during execution of the contract.

b) However, [a] sub contracting for certain specialized elements of the work is not unusual and will be acceptable for carrying out the works more effectively; but vertical splitting of the works for subcontracting is not acceptable. [b] In any case, proposal for sub-contracting in addition to what was specified in bid and stated in contract agreement will not be acceptable if the value of such additional sub-contracting exceeds 20% of value of work which was to be executed by Contractor without sub-contracting.

c) Assignment of the contract may be acceptable only under exceptional circumstances such as insolvencies/liquidation or merger of companies etc.

d) The Contractor may subcontract with the approval of the Engineer / Construction Manager but may not assign the Contract without the approval of the Employer in writing. Subcontracting does not alter the Contractor's obligations.

- 7.2. The Contractor shall not be required to obtain any consent from the Employer for:

- a) the sub-contracting of any part of the Works for which the Sub-contractor is named in the contract;
- b) the provision of labour; and
- c) the purchase of materials which are in accordance with the standards specified in the Contract.

Beyond this if the Contractor proposes sub-contracting any part of the work during execution of works, because of some unforeseen circumstances to enable him to complete the work as per terms of the contract, the Engineer / Construction Manager will consider the following before according approval:

The Contractor shall not sub-contract the whole of the Works.

The Contractor shall not sub-contract any part of the Work without prior consent of the Construction Manager. Any such consent shall not relieve the Contractor from any liability or obligations under the contract and he shall be responsible for the acts, defaults and neglects of any Sub-contractor, his agents or workmen as fully as if they were the acts, defaults or neglects of the Contractor, his agents or workmen.

They should satisfy whether (a) the circumstances warrant such sub-contracting; and (b) the Sub-contractors so proposed for the Work possess the experience, qualifications and equipment necessary for the job proposed to be entrusted to them in proportion to the quantum of work to be sub-contracted.

## 8. Other Contractors

**8.1** The Contractor shall cooperate and share the Site with other contractors, public authorities, utilities, and the Employer between the dates given in the Schedule of Other Contractors. The Contractor shall as referred to in the Contract Data, also provide facilities and services for them as described in the Schedule. The Employer may modify the schedule of other contractors and shall notify the Contractor of any such modification.

**9. Personnel**

**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 the functions stated in the Schedule or other personnel approved by the Engineer. The Engineer will approve any proposed replacement of key personnel only if their qualifications, abilities, and relevant experience are substantially equal to or better than those of the personnel listed in the Schedule.

**9.2** If the Engineer or Construction Manager asks 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 seven days and has no further connection with the work in the Contract.

**10. Force Majeure**

**10.1** Force Majeure Event: A Force Majeure Event shall mean any unforeseeable act or event that prevents the affected party from performing its obligations under the Contract or complying with any conditions required by the other party under the Contract and such act or event is beyond the reasonable control and not because of any fault of the affected party and such party has been unable to avoid such an act or event by the exercise of prudent foresight and due diligence.

Without prejudice to the foregoing, the occurrence of any of the events shall also be deemed to be a Force Majeure Event:

- (a) War and other hostilities (whether war to be declared or not), invasion, act of foreign enemies, mobilization, requisition or embargo that directly impacts the execution of the Works by the Contractor.
- (b) Rebellion, revolution, insurrection, military or usurped power and civil war that directly impacts the execution of the Works by the Contractor
- (c) Riot, civil commotion, terrorism or disorder that directly impacts the execution of the Works by the Contractor
- (d) Pestilence, epidemics, inclement weather causing floods or lightning or cyclone, typhoon or earthquake and which directly impacts the execution of the Works by the Contractor

**11. Exclusion from Force Majeure**

**11.1** The following events are explicitly excluded from and do not constitute a Force Majeure Event and are solely the responsibility of the affected party:

- (e) Strikes, collective bargaining agreements of either party resulting in delay in the execution of the Works or stoppage of Works; or
- (f) Labour disputes of any kind; or
- (g) Economic hardship; or
- (h) Any act, event, or occurrence listed above or asserted as a Force Majeure Event that results materially from the negligence or intentional acts of the affected party

**12. Consequences of Force Majeure**

**12.1** Neither Party shall be considered to be in default or breach of its obligations under this Agreement to the extent that the performance of such obligations is prevented due to a Force Majeure Event

**13. Insurance**

- 13.1** The Employer will provide all risk policy for works as given in the contract data.
- 13.2** The contractor shall provide, in the joint names of the Employer and the Contractor, insurance cover from the Start Date to the end of the Defects Liability Period, in the amounts and deductibles stated in the Contract Data for the following events which are due to the Contractor's risks:
- (a) loss of or damage to Contractor's Equipment;
  - (b) loss of or damage of property (Except the Works) in connection with the Contractor
  - (c) personal injury or death.
- 13.3** Policies and certificates for insurance shall be delivered by the contractor to the engineer for the engineers approval before the start date All such insurance shall provide for compensation to be payable in the types and proportions of amount required to rectify the loss or damage incurred.
- 13.4** If the contractor does not provide any of the policies and certificates required, the employer may effect the insurance which the contractor should have provided and recover the premiums paid by the employer from payments due to the contractor or, if no payment is due, the payment of the premiums shall be a debt due.
- 13.5** Alterations to the terms of insurance shall not be made without the approval of the engineer.
- 13.6** Both the parties shall comply with any conditions of the insurance policies.
- 13.7** It will be the responsibility of the contractor to bear the losses upto minimum deductible under the insurance policies for each and every claim
- 13.8** The contractor shall do all the necessary requirements as per the terms of insurance for any claim. The employer will assist the contractor in recovering the claim as per the terms of insurance. However in the event of accidents, insurance claims recovery shall not vitiate the obligation of the contractor with regard to executions of project as per schedule.
- 14. Site Investigation Reports**
- 14.1** The Bidder shall be given a copy of the Site investigation report. The Report is only preliminary and the Contractor upon award of Contract is expected to make his own investigation to establish the soil and foundation conditions. The Contractor, in preparing the Bid, shall rely on the Site Investigation Reports referred to in the Contract Data, supplemented by any information available to the Bidder, However, such reference to the site investigation report shall not transfer any of the Contractor's responsibility to the Employer nor shall enable the Contractor to make any claim on the Employer on the basis of information available or not available in the Site Investigation Report.
- 15. Queries about the Contract Data**
- 15.1** The Construction Manager will clarify queries on the Contract Data.
- 16. Contractor to Construct the Works**
- 16.1** The Contractor shall construct and install the Works in accordance with the Specification and Drawings, and as per instructions of Engineer.
- 17. The Works to Be Completed by the Intended Completion Date**
- 17.1** The Contractor may commence execution of the Works on the Date of commencement and shall carry out the Works in accordance with the program submitted by the Contractor, as updated with the approval of the Engineer, and complete them by the Intended Completion Date.
- 18. Approval by the Engineer**

- 18.1** The Contractor shall submit Specifications and Drawings showing the proposed Temporary Works to the Engineer, who is to approve them if they comply with the Specifications and Drawings.
- 18.2** The Contractor shall be responsible for design of Temporary Works.
- 18.3** The Engineer's approval shall not alter the Contractor's responsibility for design of the Temporary Works.
- 18.4** The Contractor shall obtain approval of third parties to the design of the Temporary Works where required.
- 18.5** All Drawings prepared by the Contractor for the execution of the temporary or permanent Works, are subject to prior approval by the Engineer before their use.

**19. Safety**

- 19.1** The Contractor shall be responsible for the safety of all activities on the Site.

**20. Discoveries**

- 20.1** Anything of historical or other interest or of significant value unexpectedly discovered on the Site is the property of the Employer. The Contractor is to notify the Construction Manager of such discoveries and carry out the Construction Managers instructions for dealing with them.

**21. Possession of the Site**

- 21.1** The Employer shall give possession of all parts of the Site to the Contractor. If possession of a part is not given by the date stated in the Contract Data, the Employer is deemed to have delayed the start of the relevant activities and this will be Compensation Event.

**22. Access to the Site**

- 22.1** The Contractor shall allow the Construction Manager, Engineer and any person authorized by the Construction Manager or Engineer access to the Site, 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 manufactured / fabricated / assembled for the works.

**23. Instructions**

- 23.1** The Contractor shall carry out all instructions of the Engineer which comply with the applicable laws where the Site is located.

**24. Disputes**

- 24.1** If the Contractor believes that a decision taken by the Construction Manager or Engineer was either outside the authority given to the Construction Manager or Engineer by the Contract or that the decision was wrongly taken, the decision shall be referred to the Conciliator within 28 days of the notification of the Engineer / Construction Manager's decision.

**25. Procedure for Disputes**

- 25.1** The Arbitration shall be conducted in accordance with the arbitration procedure stated below.

The procedure for arbitration will be as follows :

(a) In case of Dispute or difference arising between the Employer and a domestic contractor relating to any matter arising out of or connected with this agreement, such disputes or difference shall be settled in accordance with the Arbitration and Conciliation Act, 1996. The arbitral tribunal shall consist of 3 arbitrators one each to be appointed by the Employer and the Contractor. The third Arbitrator shall be chosen by the two Arbitrators so appointed by the Parties and shall act as Presiding arbitrator. In case

of failure of the two arbitrators appointed by the parties to reach upon a consensus within a period of 30 days from the appointment of the arbitrator appointed subsequently, the Presiding Arbitrator shall be appointed by the \* Indian Council of Arbitration/President of the Institution of Engineers (India)/The International Centre for Alternative Dispute Resolution (India).

(b) If one of the parties fails to appoint its arbitrator in pursuance of sub-clause (a) and (b) above within 30 days after receipt of the notice of the appointment of its arbitrator by the other party, then the \* Indian Council of Arbitration/President of the Institution of Engineers (India)/The International Centre for Alternative Dispute Resolution (India), both in cases of the Foreign Contractor as well as Indian Contractor, shall appoint the arbitrator. A certified copy of the order of the \*Indian Council of Arbitration /President of the Institution of Engineers (India)/The International Centre for Alternative Disputes Resolution (India), making such an appointment shall be furnished to each of the parties.

(c) Arbitration proceedings shall be at Agartala, Tripura , India, and the language of the arbitration proceedings and that of all documents and communications between the parties shall be English.

(d) The decision of the majority of arbitrators shall be final and binding upon both parties. The cost and expenses of Arbitration proceedings will be paid as determined by the arbitral tribunal. However, the expenses incurred by each party in connection with the preparation, presentation, etc. of its proceedings as also the fees and expenses paid to the arbitrator appointed by such party or on its behalf shall be borne by each party itself.

(e) Where the value of the contract is Rs.500 Lakhs and below, the disputes or differences arising shall be referred to the Sole Arbitrator. The Sole Arbitrator should be appointed by agreement between the parties; failing such agreement, by the appointing authority, namely the Indian Council of Arbitration/President of the Institution of Engineers (India)/The International Centre for Alternative Disputes Resolution (India).

(f) Performance under the contract shall continue during the arbitration proceedings and payments due to the contractor by the owners shall not be withheld, unless they are the subject matter of the arbitration proceedings.

**26. Deleted**

## **B. Time Control**

**27. Program**

**27.1** Within the time stated in the Contract Data the Contractor shall submit to the Engineer for approval a Construction Program including Environmental Management Plan showing the general methods, arrangements, order, and timing for all the activities in the Works along with monthly cash flow forecast and Resource Plan.

A format for submission of Progress Report shall be got approved by the Engineer. During the progress of the work, the Engineer may suggest modification to the format, in which case, the contractor shall follow the directions strictly.

**27.2** An update of the Program shall be a program showing the actual progress achieved on each activity and the effect of the progress achieved on the timing of the remaining work including any changes to the sequence of the activities.

**27.3** 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 after the date on which the overdue Program has been submitted.

- 27.4 The Engineer's approval of the Program shall not alter the Contractor's obligations. The Contractor may revise the Program and submit it to the Engineer again at any time. A revised Program is to show the effect of Variations and Compensation Events.

## **28. Extension of the Intended Completion Date**

- 28.1 The Construction Manager shall extend the Intended Completion Date if a Compensation Event occurs or a Variation is issued which makes it impossible for Completion to be achieved by the Intended Completion Date without the Contractor taking steps to accelerate the remaining work and which would cause the Contractor to incur additional cost.
- 28.2 The Construction Manager shall decide whether and by how much to extend the Intended Completion Date within 30 days of the Contractor asking the Construction Manager for a decision upon the effect of a Compensation Event or Variation and submitting full supporting information. If the Contractor has failed to give early warning of a delay or has failed to cooperate in dealing with a delay, the delay by this failure shall not be considered in assessing the new Intended Completion Date.

## **29. Not Used**

## **30. Delays Ordered by the Engineer**

- 30.1 The Engineer may instruct the Contractor to delay the start or progress of any activity within the Works.

## **31. Management Meetings**

- 31.1 Either the Construction Manager or Engineer or the Contractor may require the other to attend a management meeting. The business of a management meeting shall be to review the plans for remaining work and to deal with matters raised in accordance with the early warning procedure.
- 31.2 The Engineer shall record the business of management meetings and is to provide copies of his record to those attending the meeting and to the Employer. The responsibility of the parties for actions to be taken is to be decided by the Construction Manager either at the management meeting or after the management meeting and stated in writing to all who attended the meeting.

## **32. Early Warning**

- 32.1 The Contractor is to warn the Engineer at the earliest opportunity of specific likely future events or circumstances that may adversely affect the quality of the work, increase the Contract Price or delay the execution of works. The Engineer may require the Contractor to provide an estimate of the expected effect of the future event or circumstance on the Contract Price and Completion Date. The estimate is to be provided by the Contractor as soon as reasonably possible.
- 32.2 The Contractor shall cooperate with the Engineer in making and considering proposals for how the effect of such an event or circumstance can be avoided or reduced by anyone involved in the work and in carrying out any resulting instruction of the Engineer.

## **C. Quality Control**

### **33. Identifying Defects**

- 33.1 The Engineer shall check the Contractor's work and notify the Contractor of any Defects that are found. Such checking shall not affect the Contractor's responsibilities. The Engineer may instruct the Contractor to search for a Defect and to uncover and test any work that the Engineer considers may have a Defect.
- 33.2 The contractor shall permit the Employer's Technical auditor to check the contractor's work and notify the Engineer and Contractor of any defects that are found. Such a check shall not affect the Contractor's or the Engineer's responsibility as defined in the Contract Agreement.

### **34. Tests**



**34.1** If the Engineer instructs the Contractor to carry out a test not specified in the Specification to check whether any work has a Defect and the test shows that it does, the Contractor shall pay for the test and any samples. If there is no Defect the test shall be a Compensation Event.

**35. Correction of Defects**

**35.1** The Engineer shall give notice to the Contractor of any Defects before the end of the Defects Liability Period, which begins at Completion and is defined in the Contract Data. The Defects Liability Period shall be extended for as long as Defects remain to be corrected.

**35.2** Every time notice of a Defect is given, the Contractor shall correct the notified Defect within the length of time specified by the Engineer's notice.

**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 assess the cost of having the Defect corrected, and the amount will be recovered from the Contractor.

**D. Cost Control**

**37. Bill of Quantities**

**37.1** The Bill of Quantities shall contain items for the construction, installation, testing, and commissioning work to be done by the 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.

**38. Changes in the Quantities**

**38.1** If the final quantity of the work done differs from the quantity in the Bill of Quantities for the particular item by more than + / - 40 percent, provided that, the change exceeds 10% of initial Contract price the Construction Manager shall adjust the rate for the said item to allow for the change.

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

**38.3** The Construction Manager shall not adjust rates from changes in quantities if thereby the Initial Contract Price is exceeded by more than 25% except with the Prior approval of the Employer.

**39. Variations**

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

**40. Payments for Variations**

**40.1** The Contractor shall provide the Construction Manager with a quotation (with breakdown of unit rates) for carrying out the Variation when requested to do so by the Engineer. The Construction Manager shall assess the quotation, which shall be given within seven days of the request or within any longer period stated by the Construction Manager 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 above the limit stated in Sub Clause 38.1 or the timing of its execution do not cause the cost per unit of quantity to change, the rate in the Bill of Quantities shall be used to calculate the value of the Variation. If the cost per unit of quantity changes, or if the nature or timing of the work in the Variation does not correspond with items in the Bill of Quantities, the quotation by the Contractor shall be in form of new rates for the relevant items of work.

**40.3** For items not existing in the Bill of Quantities or substitutions to items in the Bill of Quantities, rate payable shall be determined based on;

Rates and prices in Contract, if applicable

Rates and prices in the latest Schedule of Rates published by relevant Government Agencies

- 40.4** If the Contractor's quotation is unreasonable (or if the contractor fails to provide the Construction Manager with a quotation within a reasonable time specified by the Construction Manager in accordance with Clause 40.1, the Construction Manager may order the Variation and make a change to the Contract Price which shall be based on Engineer's own forecast of the effects of the Variation on the Contractor's costs.
- 40.5** If the Construction Manager decides that the urgency of varying the work would prevent a quotation being given and considered without delaying the work, no quotation shall be given and the Variation shall be treated as a Compensation Event.
- 40.6** The Contractor shall not be entitled to additional payment for costs that could have been avoided by giving early warning.
- 40.7** For items existing in Bill of Quantities but where quantities have increased beyond the variation limits, the rate payable for quantity in excess of BoQ quantity plus the permissible variation, shall be rates developed as per Clause 40.3.,

**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 upon completion of every mile stone indicated in the Contract Data. The value of work claimed shall be the value of work completed till the date of valuation, 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 statement and within 14 days certify the amounts to be paid to the Contractor after taking into account any credit or debit for the period in question in respect of materials for the works in the relevant amounts and under conditions set forth in Clause 51.4 of GCC and also Clauses 22 and 24 under Contract Data.
- 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 Schedule of Quantities and Rates 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 in a previous certificate or reduce the proportion of any item previously certified in any certificate in the light of later information.

**43. Payments**

**First RA Bill shall be prepared and submitted by the contractor only after completion of 25% of Tended value.**

For remaining RA Bills, the Bills shall be prepared and submitted by the contractor for a value of not less than Rs.100 Lacs. Joint measurement shall be taken continuously and need not be connected to billing stage. System of five copies of measurement one for contractor, two for engineer, one for

Construction Manager and one for Employer and signed by both contractor and Engineer shall be followed.

50% of the monthly bill amount will be paid within 15 days of submission of the bill. The balance amount of the verified bill by the engineer should be paid within 15 days of the submission of bill after adjustment for deductions for advance payments, retention, other recoveries in terms of the contract and taxes, at source, as applicable under the law.

For delay in payments, not attributable to the contractor, beyond the periods specified in 43.2 above, interest at a rate of 12 % per annum should be paid.

Items of the Works for which no rate or price has been entered in will not be paid for by the Employer and shall be deemed covered by other rates and prices in the Contract.

The contractor shall send to the Engineer once every month an account giving particulars (as full and detailed as possible) of all claims for any additional expense to which the Contractor may consider himself entitled. He shall also send to the Engineer a claim list of all extra or additional work ordered in writing by the Engineer, in the preceding month.

The contractor shall submit final bill within 60 days of issue of completion certificate. Engineer shall check the bill within 60 days after its receipt and return the bill to contractor for corrections if any. 50% of undisputed amount shall be paid to the contractor at the stage of returning the bill.

Contractor should resubmit the bill, with corrections within 30 days of its return by the Engineer. The resubmitted bill shall be checked and paid within 60 days of its receipt.

Interest @ 12 % per annum shall be paid if the bill is not paid within the time limit specified above.

If an amount certified is increase in a later certificate as a result of award by the contractor shall paid the interest upon delayed payment as set out in this clause. Interest shall be calculated @ 12% per annum from the date upon which the increase amount would have been certified in the absence of dispute.

#### **44. Compensation Events**

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

- (a) The Employer does not give access to a part of the Site by the Site Possession Date stated in the Contract Data.
- (b) The Employer modifies the schedule of other contractors in a way which affects the work of the contractor under the contract.
- (c) The Engineer orders a delay or does not issue drawings, specifications or instructions required for execution of works on time.
- (d) The Engineer instructs the Contractor to uncover or to carry out additional tests upon work which is then found to have no Defects.
- (e) Ground conditions are substantially more adverse than could reasonably have been assumed before issuance of Letter of Acceptance from the information issued to Bidders (including the Site Investigation Reports), from information available publicly and from a visual inspection of the Site.
- (f) The Engineer gives an instruction for dealing with an unforeseen condition, caused by the Employer, or additional work required for safety or other reasons.
- (g) Other contractors, public authorities, utilities or the Employer does not work within the dates and other constraints stated in the Contract, and they cause delay or extra cost to the Contractor.
- (h) The advance payment is delayed.
- (i) The effect on the Contractor of any of the Employer's Risks.
- (j) The Engineer unreasonably delays in issuing a Certificate of Completion.
- (k) Other Compensation Events listed in the Contract Data or mentioned in the Contract.

**44.2** If a Compensation Event would cause additional cost or would prevent the work being completed before the Intended Completion Date, the Contract Price shall be increased and/or the Intended Completion Date is extended. The Construction Manager shall decide whether and by how much the

Contract Price shall be increased and whether and by how much the Intended Completion Date shall be extended.

- 44.3** As soon as information demonstrating the effect of each Compensation Event upon the Contractor's forecast cost has been provided by the Contractor, it is to be assessed by the Engineer / Construction Manager and the Contract Price shall be adjusted accordingly. If the Contractor's forecast is deemed unreasonable, the Construction Manager shall adjust the Contract Price based on Engineer's own forecast. The Engineer / Construction Manager will assume that the Contractor will react competently and promptly to the event.
- 44.4** The Contractor shall not be entitled to compensation 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 all taxes, levies and expenses that the Contractor will have to pay for the performance of this Contract. The Employer 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. Not Used**
- 48. Retention**
- 48.1** The Employer 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** Retention money shall be refunded within 60 days after issue of Completion Certificate.
- 49. Liquidated Damages**
- 49.1** If the Contract period is extended due to the omissions and/or commissions of Contractor, the cost of supervision for the extended period shall be borne by the Contractor. This payment shall be paid monthly and shall be equal to the full fee for Supervision of the Construction Manager divided the number of months in the contract Period. This money will be deducted from any monies due to the Contractor, by way of periodical payment or otherwise.
- 49.2** If the Contractor fails to complete the work under contract within the stipulated completion date, he shall pay liquidated damages to the Employer at the rate stated in the Contract Data for each week or part 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. Even if, a part of the work is completed, if it cannot be put into operation because of the non completion of the remaining works, the liquidated damages shall be calculated on the full value of the contract. The total amount of liquidated damages shall not exceed the amount defined in the Contract Data. The Employer may deduct liquidated damages from payments due to the Contractor. Payment of liquidated damages does not affect the Contractor's liabilities.
- 49.3** If the Intended Completion Date is extended after liquidated damages have been paid, the Engineer shall correct any overpayment of liquidated damages by the Contractor by adjusting the next payment certificate. interest shall not be paid on such overpayments.
- 49.4** Delays requiring payment of full liquidated damages shall be sufficient clause for termination of contract and forfeiture of security deposit against performance bond ( performance guarantee)
- 49.5** "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."

**50. Bonus**

- 50.1** For early completion of contract before the stipulated date of completion or such later date as authorized by the Employer, incentive shall be paid to the Contractor at 0.5% of the Contract price per week of early completion, subject to a maximum of 5% of contract price. This incentive shall be applicable in cases where completion of work before scheduled dates lead to tangible benefits.

**51. Advance Payment**

- 51.1** The Employer 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 intended date of completion, but the amount of the guarantee shall be progressively reduced by the amounts repaid by the Contractor.
- 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 relevant documents to the Engineer.
- 51.3** The advance payment shall be recovered by deducting proportionate amounts from payments otherwise due to the Contractor, following the schedule of completed percentages of the Works on a payment basis. No account shall be taken of the advance (mobilization and equipment only) payment or its repayment in assessing valuations of work done, Variations, price adjustments, Compensation Events, or Liquidated Damages.

**51.4 Not Use****52. Performance Security**

- 52.1** The Performance Security shall be provided to the Employer no later than the date specified in the Letter of Acceptance and shall be issued in an amount and form and by a bank or surety acceptable to the Employer, and denominated in Indian Rupees. The Performance Security shall be valid until a date 28 days from the date of expiry of Defects Liability Period and the additional security for unbalanced bids shall be valid until a date 28 days from the date of issue of the certificate of completion

**53. Day works**

Any work shall be executed on a Day work basis only if the Engineer instructs the same in writing. The Instruction from the Engineer shall clearly state the nature and volume of work, the expected personnel to be employed and the period for completion. The Instruction so issued shall be accepted by the Contractor, subject to revision on completion of the work. Upon completion of the work, The Contractor shall submit a statement indicating the names, occupation of the personnel worked, the number of equipment used and the quantity of the materials used. The payment for the work shall be made on the basis of the day works rate quoted by the contractor.

**54. Defect Liability and Cost of Repairs**

- 54.1** Loss or damage to the Works or Materials to be incorporated in the Works between the Date of Commencement 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. The Contractor shall be responsible to make good at his own expense any defect which may develop within the period mentioned as defect liability period in the Contract Data. The Employer shall give the Contractor a notice in writing about the defects and the Contractor shall repair the defect in maximum of 7 days. If the contractor fails to repair/remove the defect, the Employer may execute the work by himself and deduct the expense towards the work from any monies due to the Contractor. The employer shall have the right to appropriate all or part of the security deposit towards the expense in repairing the defects.

**E. Finishing the Contract****55. Completion**

- 55.1** After completion of the work, the contractor will serve a written notice to the Construction Manager to this effect. The Construction Manager upon receipt of this notice shall conduct a complete joint survey of the work within 7 days and prepare a defects list jointly. The defects pointed out by the Construction Manager or his nominee would be rectified by the contractor within 14 days and thereafter acceptance report be signed jointly by the contractor, Construction Manager and the Employer. This joint acceptance report shall be treated as 'Completion Certificate'.

**56. Taking Over**

- 56.1** The Employer shall take over the Site and the Works within seven days of the Construction Manager issuing a certificate of Completion.

**57. Deleted****58. As Built Drawings**

- 58.1** The Contractor shall supply "As Built" Drawings by the dates stated in the Contract Data.
- 58.2** If the Contractor does not supply the Drawings 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.

**59. Termination**

- 59.1** The Employer or the Contractor may terminate the Contract if the other party causes a fundamental breach of the Contract.
- 59.2** 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 Engineer / Construction Manager instructs the Contractor to delay the progress of the Works and the instruction is not withdrawn within 28 days;
  - (c) the Employer or the Contractor is made bankrupt or goes into liquidation other than for a reconstruction or amalgamation;
  - (d) a payment certified by the Engineer / Construction Manager is not paid by the Employer to the Contractor within 56 days of the date of the Engineer's certificate;

- (e) the Engineer / Construction Manager gives Notice that failure to correct a particular Defect is a fundamental breach of Contract and the Contractor fails to correct it within a reasonable period of time determined by the Engineer;
- (f) the Contractor does not maintain a security which is required;
- (g) 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; and
- (h) if the Contractor, in the judgment of the Employer has engaged in fraud and corruption, as defined in ITB Clause 35.1, in competing for or in executing the Contract.
- (i) in case the Contractor has awarded more than 20 % of value of works on sub contract (excluding works awarded to nominated contractor).
- (j) the contractor has defaulted in fulfilling his obligations under this contract.

**59.3** When either party to the Contract gives notice of a breach of contract to the Engineer / Construction Manager for a cause other than those listed under Sub Clause 59.2 above, the Engineer / Construction Manager shall decide whether the breach is fundamental or not.

**59.4** Notwithstanding the above, the Employer may terminate the Contract for convenience.

**59.5** If the Contract is terminated the Contractor shall stop work immediately, make the Site safe and secure and leave the Site as soon as reasonably possible.

## **60. Payment upon Termination**

**60.1** If the Contract is terminated because of a fundamental breach of Contract by the Contractor, the Engineer / Construction Manager 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 taxes due to be deducted at source as per applicable law and less the percentage to apply to the work not completed 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.

**60.2** If the Contract is terminated at the Employer's convenience or because of a fundamental breach of Contract by the Employer, the Engineer / Construction Manager shall issue a certificate for the value of the work done, the reasonable cost of removal of Equipment, repatriation of the Contractor's personnel employed solely on the Works, and the Contractor's costs of protecting and securing the Works and less advance payments received up to the date of the certificate, less other recoveries due in terms of the contract and less taxes due to be deducted at source as per applicable law.

## **61. Property**

**61.1** 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.

## **62. Release from Performance**

**62.1** 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 Construction Manager shall certify that the Contract has been frustrated. The Contractor shall make the Site safe and stop work as quickly as possible after receiving this certificate and shall be paid for all work carried out before receiving it and for any work carried out afterwards to which commitment was made.

## **Special Conditions of Contract**

**1. General**

The Contractor is advised to note that the following Special Conditions are part of the Contract and he will not have any right to claim at any time for delays or for expenditure incurred by him in fulfilling the following special conditions.

**2. Scope of Works**

The scope of work includes Construction of civil works for LCS Muhurighat, Belonia with internal and external plumbing works, electrical works, fire alarm system, PA system and landscaping works .

**3. Tender Drawings**

The drawings issued with these Tender Documents are Tender Drawings. Tender Drawings are prepared in such detail as are necessary to give a comprehensive idea of the works. The good for construction drawings will be issued during the construction stage based on the requirements as per the construction program submitted by the contractor as per GCC clause 27.

**4. Working Drawings**

The Contract Drawings shall be supplemented by working drawings or shop drawings prepared by the Contractor which are required for the execution of the works. These working drawings shall include all details required for execution of job and any other detail the Engineer may ask during construction.

All drawings shall be computerized and shall be submitted both in hard copy as well as digital data.

Approval by the Engineer of the Contractor's working drawings shall not relieve the Contractor from responsibility for the accuracy of dimensions and details, nor shall such mutual agreement and compliance to his working drawings constitute an acceptance by the Employer of the correctness and adequacy of the drawings.

Working drawings as required or as directed by the Engineer shall be prepared and submitted by the Contractor sufficiently in advance. All working drawings shall be checked by the Engineer / Construction Manager and work can commence only upon getting approval of the working drawing.

Delays to work by reason of lack of approvals of working drawings and shop drawings are deemed to be a risk the Contractor is taking with full knowledge and no compensation shall be claimed by the Contractor or none given by the Employer, on account of such delay.

The costs of furnishing working drawings shall be included in the rates for various paying items given in the Bill of Quantities.

In this respect the Contractor shall employ his Engineers and AutoCAD Draughtsman specifically for planning and preparation of working drawings. The Contractor shall also provide as part of the mobilization to site, a latest Computer and software together with new colour printer, for the preparation of his working Drawings. The Engineer shall have access to this Computer.

**5. Additional Work**

Any additional works, instructed during the Contract Period and within the Contract Amount, will be paid as per Bill of Quantity rates and it shall not be considered as a cause for the Contractor to claim for delay, incurred overhead, mobilization etc.

**6. Protection of the Works during Contract Period**

It is clearly understood that any damage occurring to the Works (completed or under execution) is the Contractors responsibility and no claims will be entertained by the Employer since the matter shall be covered by the relevant Insurances.



**7. Discrepancies in alignment**

Discrepancies in alignment and levels etc., noticed during construction and/or on completion shall be rectified by the Contractor at his own cost, Engineer's approval does not relieve the Contractor of his responsibilities.

**8. Temporary Power and Water Supply**

All costs, both for power supply and temporary installations and Power and Water required for construction and labour shall be borne by the Contractor.

**9. Contractor's Facilities****9.1 Site Offices of the Contractor**

The successful Tenderer is to provide and maintain a site office at a location approved by the Engineer / Construction Manager in consultation with the Employer, within 15 days from the date of issue of Notice to Proceed. A separate Engineers office of about 50 Sqm shall be provided. This Engineers office shall be of standard quality and furnished. The maintenance of this Engineers office is also the responsibility of contractor.

**9.2 Surveying Equipment**

The Contractor shall provide, at his own expense one approved set of surveying and measuring equipment at the site for the sole use of the Surveyors of the Project. It shall also be made available for the Engineer / Construction Manager upon request. The set shall consist of (i) One Total Station/Theodolite, (ii) One pogo with reflector, (iii) One big tripod (iv) One small tripod (v) Two fiber glass tape (cased 30 m ) (vi) Four steel pocket tape 3 m long (vii) Two surveying umbrellas (viii) Ten ranging rods 2.5 m long (ix) Required numbers of level books and field books.

All accessories and assistance required for setting out, measuring etc. shall be supplied as and when required by the Engineer or his representative.

The contractor shall be solely responsible for the maintenance of all such instruments and equipments and shall ensure that they are at all times in good condition.

All the surveying equipments shall remain the property of the Contractor till the end of the Contract. The Contractor is obliged to replace any instrument or part thereof damaged during the Contract Period.

**9.3 Laboratory and Laboratory Testing**

The Contractor shall provide at site and maintain during the entire contract period a Laboratory for testing of concrete or alternatively make arrangements for getting the concrete cubes made at site, tested in an approved laboratory away from the site. If in case the Contractor opts for making alternative arrangements, then the laboratory proposed should be got inspected and approved by the Engineer within 30 days of commencement of work.

**10. Notice Boards**

Two Notice Boards shall be provided and erected as directed by the Engineer. The boards shall be maintained and repainted if directed by the Engineer till the final handing over of project.

The Contractor shall submit for approval of the Employer and Engineer working drawing showing all details needed in the board and the location of the board. Cost of providing and installing the notice board is deemed to be included in various items of the Bill of Quantities.

**11. Progress Photographs and Reports**

Contractor shall submit monthly 12 progress Photographs 12" x 8" size in five copies as part of his monthly progress report, as specified in the Special Specifications..

At the end of the Project the Contractor shall deliver to the Engineer two albums having the most significant Photographs taken during the Contract Period. Each Album shall have a minimum of 20 photographs of 12"x8" Size.

## **12. Safety on Site**

Measures to ensure safety of workers and plant at site shall be taken by the Contractor. Excavations shall be protected by barriers and lighting shall be provided at night to warn pedestrians and vehicles. Motorable access to the site and within the site shall be maintained during the construction period. The Contractor shall designate a Safety Officer who will be in charge of all Safety Measures. The cost of all safety equipments and the cost of providing a safety officer at site would be deemed to be included in various Items of the Schedule of Quantities and Rates. The contractor will prepare a safety manual and submit for Engineer's approval before the commencement of work.

## **13. As Built Drawings**

The Contractor shall prepare As Built Drawings both in hard copy and in digital format.

The drawings shall be prepared for any given section of the work as soon as the work for that particular section is completed. Preparation of As Built Drawings shall keep pace with the work and shall not be left over towards the end of the project. 3 hard copies and one soft copy of all drawings shall be submitted.

No separate payment will be made for the preparation of As-Built Drawings; Cost of preparation of As Built Drawing is deemed to be included in all other priced bill items.

## **14. 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, housing, feeding and transport.

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

### **14.1 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 there under, 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 there under, 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 / Construction Manager 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 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 death in 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 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.
- 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.

## 15. 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 causes arising as a consequence of his methods of operation. The contractor shall be responsible for taking necessary clearances and statutory approval from the respective departments for works such as and not restricted to disposal of debris, procurement of earth for filling etc., outside the site.

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.

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.

**SECTION 4: CONTRACT DATA**

**Contract Data**

**Items marked "N/A" do not apply in this Contract.**

- | 1. The following documents are also part of the Contract:<br><b>Reference</b>   | <b>Clause</b> |
|---|---------------|
| · The Schedule of Operating and Maintenance Manuals<br>N/A  | [58]          |
| · The Schedule of Other Contractors working simultaneously in the area  | [8]           |
| · The Schedule of Key Personnel or nogram to be submitted along with Bio data of Key personnel for approval of Engineer | [9]           |
| · The Methodology and Program of Construction   | [27]          |
| · The Schedule of Key and Critical equipment to be deployed on the work as per agreed program of construction           | [27]          |
| · Site Investigation reports issued at the Tender Stage   | [14]          |
2. The Employer is  
Name: The Managing Director  
Tripura Industrial Development Corporation (TIDC)  
Shilpa Nigam Bhawan,  
Khejurbagan,  
P.O Kunjaban, Agartala,  
Tripura - 799006
- Name of authorized Representative: Executive Engineer
3. The Construction Manager/ Engineer is IL&FS, Cluster Development Initiative Ltd,  
Dasgupta Villa,  
1<sup>st</sup> Floor, North Side of Governor's house,  
Vill & PO-Kunjaban, Agartala – 799006  
Phone: +91 0381-2300419
- Name of Authorized Representative : Mr. Shantanu Roy
4. The Engineer's / Construction Manager's Representative: will be intimated later (1.1)  
Name: Address:
- Name of Authorised Representative:
5. The Name and identification number of the Contract is : Setting up of Land Custom Station at Muhurighat,  
Belonia, Tripura
6. The Works consist of Construction of Construction of Civil Works for Land Custom Station and landscaping works (1.1)
7. The Date of Commencement shall be the date specified in the Notice to Proceed with the work. (1.1)
8. The Intended Completion Date for the whole of the Works is 24 months including monsoon period reckoned from the date of commencement as indicated in the Notice to Proceed, issued by the Employer. The work shall have the following milestones (17,28)
9. Milestone :

Physical completion of worksPeriod from the date of commencement of work

**Milestone 1-** Completion of All Civil Works, Plumbing Works, Electrical work, Fire Alarm System PA system and Landscaping works etc., Complete all the works

24 Months

10. The Contractor shall revise the work Schedule submitted along with the Tender, to include the commencement date, to reflect the ground realities and adhering to the schedule of milestone indicated above. This revised work schedule shall be submitted within 14 days of delivery of the Letter of Acceptance.
11. The Site Possession Date shall be the date within seven days from the date of issue of Notice to proceed with the work.
12. The site is located at Belonia , South district in the state of Tripura.
13. The Defects Liability Period is 12 month from the date of certification of completion of works. (where sectional completion certificate is issued this will apply from those dates for those sections). [35]
14. Insurance requirements are as under: [13]

Sr. No.	Policy for	Insurance cover required
1	All risk insurance for works	By Contractor
2	Loss or damage to Employer's Equipment	By Contractor
3	Other Employers property	By Contractor
4	Personal injury or death insurance: a) Third party	By Contractor
	b) For Contractor's Employee	By Contractor Contractor should ensure such insurance is in force through out the contract period (Including defect liability period) and necessary proof to be submitted before the commencement of the project and at least a fortnight before the expiry of current insurance. The contractor should indemnify and include in the policy the employer , Construction manager and engineer
(iii)	Motor Vehicle Insurance	By Contractor as per statutory requirements, covering third party liability.
	Third party liability insurance (Including the name of Employer)	By contractor Minimum cover Rs. 1Million
	Contractor's Equipments (Including liability arising out of usages of such equipment)	By Contractor.

15. The period between Program updates shall be 30 days. A penalty of Rs. 500 per week will be levied for default. [27]
16. The language of the Contract documents is English [3]
17. The law which applies to the Contract is the laws of Union of India [3]
18. The currency of the Contract is Indian Rupees. [46]
19. The proportion of payments retained (retention money) shall be 5 % from each bill to be released within 60 days after the issue of Completion Certificates. [48]



20. The liquidated damages for the whole of the works are 0.5% of the contract value per week or part [49]
21. The maximum amount of liquidated damages for the whole of the works is five percent of final contract price. [49]
22. The amounts of the advance payment are: [51]

<u>Nature of Advance</u>	<u>Amount (Rs.)</u>	<u>Conditions to be fulfilled</u>
1. Mobilization	10% of the Contract price	On submission of un-conditional Bank Guarantee. (to be drawn before end of 20% of Contract period) 10 % of the contract value.

(The advance payment will be paid to the Contractor no later than 15 days after fulfillment of the above conditions).

23. Repayment of advance payment for mobilization and equipment: [51]

The advance shall be recovered with percentage deductions from the interim payments certified by the Engineer under the Contract. The mobilization advance recovery will start on reaching 20% of contract price and recovered fully by completion of 80% of contract price on pro rata basis. The advance shall be completely recovered prior to the expiry of the original time for completion.

24. Deleted

25. The Securities shall be for the following minimum amounts equivalent as a percentage of the Contract Price: [52]

Performance Security shall be for 5% per cent of contract price to be submitted prior to signing the Contract. Performance Security shall be released within 30 days after the Completion of the defect liability period

The standard form of Performance Security acceptable to the Employer shall be an unconditional and irrevocable Bank Guarantee of the type as presented in Section 5 of the Bidding Documents and valid for one month after the expiry of the defect liability period.

26. Deleted [58]

27. The date by which “as-built” drawings (in scale 1 IN 2000) in 2 sets are required is before issue of certificate of completion of whole or section of the work, as the case may be. The amount to be withheld for non submission is Rs. 10, 00, 000/-. [58]

28. The following events shall also be fundamental breach of contract: [59.2]

The Contractor has contravened any clause / sub-clause of the GCC.

1. The contractor does not adhere to the agreed construction program and agreed environmental management plan (Clause 27 of GCC) and also fails to take satisfactory remedial action as per agreements reached in the management meetings (Clause 31) for a period of 60 days.
2. The contractor fails to carry out the instructions of Engineer / Construction Manager within a reasonable time determined by the Engineer / Construction Manager in accordance with GCC Clause 16.1 and 23.1.
3. The percentage to be applied for the value of work not completed representing the Employer's additional cost for completing the Works shall be 20%. (60.1)



**SECTION 5: FORMS OF SECURITIES**

### **Forms of Securities**

Acceptable forms of securities are annexed. Bidders should not complete the Performance and Advance Payment Security forms at this time. Only the successful Bidder will be required to provide Performance and Advance Payment Securities in accordance with one of the forms, or in a similar form acceptable to the Employer.

- Annex A:** Bid Security (Bank Guarantee)
- Annex B:** Performance Bank Guarantee
- Annex B1:** Performance Bank Guarantee for Unbalanced Items
- Annex C:** Bank Guarantee for Advance Payment

**Annex A****BID SECURITY (BANK GUARANTEE)**

WHEREAS, \_\_\_\_\_ [name of Bidder] (hereinafter called "the Bidder") has submitted his Bid dated \_\_\_\_\_ [date] for the (insert the name of the works) (hereinafter called "the Bid").

KNOW ALL PEOPLE by these presents that We \_\_\_\_\_ [name of bank] of having our registered office at \_\_\_\_\_ (hereinafter called "the Bank") are bound unto \_\_\_\_\_ (hereinafter called "the Employer") in the sum of Rs. \_\_\_\_\_<sup>1</sup> (Rupees \_\_\_\_\_) for which payment well and truly to be made to the said Employer the Bank binds itself, his successors and assigns by these presents.

SEALED with the Common Seal of the said Bank this \_\_\_\_\_ day of \_\_\_\_\_ 2018.

THE CONDITIONS of this obligation are:

- (1) If after Bid opening the Bidder withdraws his bid during the period of Bid validity specified in the Form of Bid;
- or
- (2) If the Bidder having been notified of the acceptance of his bid by the Employer during the period of Bid validity:
- (a) fails or refuses to execute the Form of Agreement in accordance with the Instructions to Bidders, if required; or
  - (b) fails or refuses to furnish the Performance Security, in accordance with the Instruction to Bidders; or
  - (c) does not accept the correction of the Bid Price pursuant to Clause 27;

we undertake to pay to the Employer up to the above amount upon receipt of his first written demand, without any protest or demur or any objection, whatsoever on our part and without any first claim or reference to the Contractor, without the Employer having to substantiate his demand, provided that in his demand the Employer will note that the amount claimed by him is due to him owing to the occurrence of one or any of the three conditions, specifying the occurred condition or conditions.

This Guarantee will remain in force up to and including the date \_\_\_\_\_<sup>2</sup> days after the deadline for submission of Bids as such deadline is stated in the Instructions to Bidders or as it may be extended by the Employer, notice of which extension(s) to the Bank is hereby waived. Any demand in respect of this guarantee should reach the Bank not later than the above date.

DATE \_\_\_\_\_ SIGNATURE OF THE BANK \_\_\_\_\_

WITNESS \_\_\_\_\_ SEAL \_\_\_\_\_

\_\_\_\_\_  
[signature, name, and address]

- 1 The Bidder should insert the amount of the guarantee in words and figures denominated in Indian Rupees. This figure should be the same as shown in Clause 16.1 of the Instructions to Bidders.
- 2 45 days after the end of the validity period of the Bid.

**Annex B****PERFORMANCE BANK GUARANTEE**

To:

WHEREAS \_\_\_\_\_ [name and address of Contractor] (hereinafter called "the Contractor") has undertaken, in pursuance of Contract No. \_\_\_\_\_ dated \_\_\_\_\_ 2018 to execute \_\_\_\_\_ (hereinafter called "the Contract");

AND WHEREAS it has been stipulated by you in the said Contract that the Contractor shall furnish you with a Bank Guarantee by a recognized bank for the sum specified therein as security for compliance with his obligations in accordance with the Contract;

AND WHEREAS we have agreed to give the Contractor such a Bank Guarantee;

NOW THEREFORE we hereby affirm that we are the Guarantor and responsible to you, on behalf of the Contractor, up to a total of \_\_\_\_\_ [amount of guarantee]<sup>1</sup> \_\_\_\_\_ [in words], such sum being payable in the types and proportions of currencies in which the Contract Price is payable, and we undertake to pay you, upon your first written demand without any protest or demur or any objection, whatsoever on our part and without any first claim or reference to the Contractor, and without cavil or argument, any sum or sums within the limits of \_\_\_\_\_ [amount of guarantee]<sup>1</sup> as aforesaid without your needing to prove or to show grounds or reasons for your demand for the sum specified therein.

We hereby waive the necessity of your demanding the said debt from the Contractor before presenting us with the demand.

We further agree that no change or addition to or other modification of the terms of the Contract or of the Works to be performed there under or of any of the Contract documents which may be made between you 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 be valid until \_\_\_\_\_ (i.e.) 28 days from the date of expiry of the Defects Liability Period.

Signature and seal of the guarantor \_\_\_\_\_  
 Name of Bank \_\_\_\_\_  
 Address \_\_\_\_\_  
 Date \_\_\_\_\_

1 An amount shall be inserted by the Guarantor, representing the percentage of the Contract Price specified in the Contract and denominated in Indian Rupees.

**Annex B 1****PERFORMANCE BANK GUARANTEE (for unbalanced items)**

To:

WHEREAS \_\_\_\_\_ [*name and address of Contractor*] (hereinafter called "the Contractor") has undertaken, in pursuance of Contract No. \_\_\_\_\_ dated \_\_\_\_\_ to execute \_\_\_\_\_ (hereinafter called "the Contract");

AND WHEREAS it has been stipulated by you in the said Contract that the Contractor shall furnish you with a Bank Guarantee by a recognized bank for the sum specified therein as security for compliance with his obligations in accordance with the Contract;

AND WHEREAS we have agreed to give the Contractor such a Bank Guarantee;

NOW THEREFORE we hereby affirm that we are the Guarantor and responsible to you, on behalf of the Contractor, up to a total of \_\_\_\_\_ [*amount of guarantee*]<sup>1</sup> \_\_\_\_\_ [*in words*], such sum being payable in the types and proportions of currencies in which the Contract Price is payable, and we undertake to pay you, upon your first written demand without any protest or demur or any objection, whatsoever on our part and without any first claim or reference to the Contractor, and without cavil or argument, any sum or sums within the limits of \_\_\_\_\_ [*amount of guarantee*]<sup>1</sup> as aforesaid without your needing to prove or to show grounds or reasons for your demand for the sum specified therein.

We hereby waive the necessity of your demanding the said debt from the Contractor before presenting us with the demand.

We further agree that no change or addition to or other modification of the terms of the Contract or of the Works to be performed there under or of any of the Contract documents which may be made between you 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 be valid until \_\_\_\_\_ (i.e.) 28 days from the date of issue of the certificate of completion of works.

Signature and seal of the guarantor \_\_\_\_\_  
 Name of Bank \_\_\_\_\_  
 Address \_\_\_\_\_  
 Date \_\_\_\_\_

1 An amount shall be inserted by the Guarantor, representing additional security for unbalanced Bids, if any and denominated in Indian Rupees.

**Annex C****BANK GUARANTEE FOR ADVANCE PAYMENT**

To:

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 \_\_\_\_\_ a bank guarantee to guarantee his proper and faithful performance under the said Clause of the Contract in an amount of \_\_\_\_\_ [amount of guarantee]<sup>1</sup> \_\_\_\_\_ [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 \_\_\_\_\_ 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]<sup>1</sup> \_\_\_\_\_ [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 there under or of any of the Contract documents which may be made between \_\_\_\_\_ 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 \_\_\_\_\_ 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.



**TRIPURA INDUSTRIAL DEVELOPMENT CORPORATION**

**Tender for Setting up of Land Custom Station Muhurighat, Belonia,  
Tripura**

**TIDC/LCS/CIVIL/MUHURIGHAT/01/2018-19**

**BOOK – 2**

**Technical Specification**

Project Management Consultants: -

November 2018

**IL&FS Cluster Development Initiative Limited**

**TECHNICAL SPECIFICATIONS**

**Section I**

**Structural and Architectural Works**

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## **GENERAL SPECIFICATIONS**

**1.0** These specifications shall be read in conjunction with the particular specifications for various items of work. The Contractor shall carefully acquaint himself with the general specifications, coordinate the same with any other specifications forming a part of the Contract Document and determine his contractual obligations for the execution of various items of work in accordance with good engineering practice.

### **2.0 REFERENCE TO THE STANDARD CODES OF PRACTICE**

**2.1** All Standards, tentative specifications, Specifications, Codes of practice referred to shall be the latest editions including all applicable official amendments and revisions. The contractor shall make available at site all relevant Indian Standard Codes of practice as applicable and same shall be handed over to CLIENT. The list of codes mentioned in particular specification is only a broad guideline, the contractor will be requested to maintain only relevant codes at site as directed by Engineer in charge.

**2.2** In case of discrepancy between standards, Codes of practice, tentative specifications, specification referred to and this specification, this specification shall govern.

### **3.0 CONTRACTOR TO PROVIDE**

The Contractor shall provide and maintain at site throughout the period of works the following at his own cost and without extra charge, the cost being held to be included in the Contract Rates.

**3.1** All labour, materials, plant, equipment and temporary works required to complete and maintain the works to the satisfaction of the Engineer.

**3.2** Lighting for night work, and also whenever and wherever required by the Engineer.

**3.3** Temporary fences, safety net, helmet for all workmen, guards, lights and protective work necessary for protection of workmen, supervisors, engineers or any other persons permitted access to the site.

**3.4** All equipment, instruments and labour required by the Engineer for measurement of the Works.

**3.5** A testing room of not less than 20 m<sup>2</sup> equipped with the following, and labour and materials required for carrying out tests therein:

**3.5.1** Set of standard sieves for testing grading of sand and a 75 micron sieve for testing silt content.

- 3.5.2 Sieves with openings respectively of 5mm, 10mm, 20mm for testing grading of aggregates.
  - 3.5.3 Balance, capacity upto 10 kg, reading to 5 g.
  - 3.5.4 Primus stove and pans for drying of sand and aggregates.
  - 3.5.5 Glass measuring flasks of 1/2 and 1 litre capacity.
  - 3.5.6 Flask for determining moisture content of sand.
  - 3.5.7 Slump cone for slump test.
  - 3.5.8 Minimum 24 steel moulds for 150mm x 150mm concrete test cubes. It may be necessary to provide more steel cube moulds depending upon concreting program.
  - 3.5.9 Concrete cube testing machine (Electrically operated )
  - 3.5.10 Concrete permeability test equipment.
  - 3.5.11 Physical testing equipment for steel welding such as gauge meter. die penetration testing instrument, elcometer, vernier, micrometer etc.
  - 3.5.12 Work benches, shelves, desks, sinks and any other furniture and lighting as required by the Engineer.
  - 3.5.13 The contractor shall provide all necessary equipment's to test the approved Materials which are to be incorporated into the works.
- 3.6 All the pegs for setting out the works and fixing the levels required for the execution thereof shall be as desired by Engineer-in-charge, likewise be built in masonry at such places and in such a manner as the Engineer-in-charge may direct. The contractor shall carefully protect and preserve all bench works and other marks used in the setting out the works.

### **3.7 WEIGH BATCHING PLANT**

If desired by Contractor, he shall provide automatic weigh-batching plant of suitable capacity at the location approved by Engineer in charge. Contractor shall also provide platform type of weighing machines of a capacity not less than 650 kg. The plant shall be confirm to RMC (Ready Mix Concrete) requirement as specified in particular specification.

- 3.8 Any layout of equipment not specifically mentioned above which can reasonably be held necessary for the completion and maintenance of the works to the satisfaction of the Engineer.

### **4.0 DIMENSIONS**

- 4.1** Figured dimensions on drawings shall supersede measurements by scale and drawings to a large scale shall take precedence over those to a smaller scale. Special dimensions or directions in the specifications shall supersede all others. All dimensions shall be checked on site prior to execution.
- 4.2** The dimensions where stated do not allow for waste, laps, joints, etc. but the Contractor shall provide at his own cost sufficient labour and materials to cover such waste, laps, joints, etc.
- 4.3** The levels, measurements and other information concerning the existing site as shown on the drawings are believed to be correct, but the Contractor should verify them for himself and also examine the nature of the ground as no claim or allowance whatsoever will be entertained on account of any errors or omissions in the levels or the description of the ground levels or strata turning out different from what was expected or shown on the drawings.

## **5.0 SETTING OUT OF WORKS**

The Contractor shall set out the Works indicated in the Conditions of Contract.

The Contractor shall provide suitable stones with flat tops and build the same in concrete for temporary bench marks. All the pegs for setting out the Works and fixing the levels required for the execution thereof shall, if desired by the Engineer, likewise be built in masonry at such places and in such a manner

as the Engineer may direct. The Contractor shall carefully protect and preserve all bench marks and other marks used in setting out the Works.

## **6.0 MATERIALS**

### **6.1 QUALITY**

All materials used in the works shall be of the best quality of their respective kinds as specified herein, obtained from sources and suppliers approved by the Engineer and shall comply strictly with the tests prescribed hereafter, or where tests are not laid down in the specifications, with the requirements of the latest issues of the relevant Indian Standards.

### **6.2 SAMPLING AND TESTING**

All materials used in the works shall be subjected to inspection and test in addition to test certificates. Samples of all materials proposed to be employed in permanent works shall be submitted to the Engineer for approval before they are brought to the site. Samples provided to the Engineer for their retention are to be labeled in boxes suitable for storage. Materials or workmanship not corresponding in character and quality with approved samples will be rejected by the Engineer. Samples required for approval and testing must be supplied sufficiently in advance to allow for testing and approval, due allowance being made for the fact that if the first samples are rejected further samples may be required. Delay to the works arising from the late submission of samples will not be acceptable as a reason for delay in

completion of the works. Materials shall be tested before leaving the manufacturer's premises, quarry or source, wherever possible. Materials shall also be tested on the site and they may be rejected if not found suitable or in accordance with the specification, notwithstanding the results of the tests at the manufacturer's works or elsewhere or test certificates or any approval

given earlier. The contractor will bear all expenses for sampling and testing, whether at the manufacturer's premises at source, at site or at any testing laboratory or institution as directed by the Engineer. No extra payment shall be made on this account.

### **6.3 DISPATCH OF MATERIALS**

Materials shall not be dispatched from the manufacturer's works to the site without written authority from the Engineer.

### **6.4 TEST CERTIFICATES**

All manufacturer's certificates of test, proof sheets, etc showing that the materials have been tested in accordance with the requirement of this specification and of the appropriate Indian Standard are to be supplied free of charge on request to the Engineer and before the use of material time to time.

### **6.5 REJECTION**

Any materials that have not been found to conform to the specifications will be rejected forthwith and shall be removed from the site by the Contractor at his own cost.

**6.6** The Engineer shall have power to cause the Contractors to purchase and use such materials from any particular source, as may in his opinion be necessary for the proper execution of the work.

### **7.0 STORING OF MATERIALS AT SITE**

All materials used in the works shall be stored on racks, supports, in bins, under cover etc as appropriate to prevent deterioration or damage from any cause whatsoever to the entire satisfaction of the Engineer. The storage of materials shall be in accordance with IS 4082 "Recommendation on stacking and storage of construction materials on site" and as per IS 7969 "Safety code for handling and storage of building materials".

The materials shall be stored in a proper manner at places at site approved by the Engineer. Should the place where material is stored by the Contractor be required by the Employer for any other purpose, the Contractor shall forthwith remove the material from that place at his own cost and clear the place for the use of the Employer.

### **8.0 WATER**

**8.1** Water from approved source :

Clean fresh water only shall be used for the works. The water shall be free from any deleterious matter in solution or in suspension and be obtained from an approved source. The quality of water shall conform to IS 456.

**8.2 STORAGE**

The Contractor shall make his own arrangements for storing water, if necessary, in drums or tanks or cisterns, to the approval of the Engineer. Care shall be exercised to see that water is not contaminated in any way.

**9.0 WORKMANSHIP**

**9.1** All works shall be true to level, plumb and square and the corners, edges and arises in all cases shall be unbroken and neat.

**9.2** Any work not to the satisfaction of the Engineer or his representative will be rejected and the same shall be rectified, or removed and replaced with work of the required standard of workmanship at no extra cost.

**10.0 REJECTION OF THE WORK.**

**10.1.1** The site made concrete test cubes failing to attain the specified strength;

**10.1.2** The shuttering for concrete works being prematurely removed;

**10.1.3** Overloading during construction of the Works or part thereof;

**10.1.4** Concrete improperly cured;

**10.1.5** If any portion of the work is carried out without prior approval in writing of the Engineer or his representative to proceed with such work;

**10.1.6** If concrete is honeycombed or damaged or in the opinion of the Engineer particularly weak in important or critical areas of the structure where weakened concrete will affect the ability of the structure to carry design loads;

**10.1.7** Any other circumstances attributed to alleged negligence on the part of the Contractor which, in the opinion of the Engineer, results in the Works or any part thereof being of less than the expected strength;

**10.1.8** Any reason other than the foregoing.

**10.2** If the loading tests be instructed to be made solely or in part for the reasons 1.11.1.1 to 7 the tests shall be made at the Contractor's own cost whether the results of such tests be satisfactory or otherwise. If the tests be instructed to be made for the reason 1.11.1.8 herein before specified, the Contractor shall make the tests and shall be reimbursed for all costs relating thereto irrespective of the result of the tests.



**10.3** All the loading tests will be carried out strictly in accordance with the instructions of the Engineer. Load testing will generally follow the procedure set out in Indian Standard Codes of Practice, but the Engineer is not bound to follow the Indian Standard Codes of Practice and in his absolute discretion may issue instructions differing from the procedure set out in the Indian Standard Codes of Practice.

**10.4** If in the opinion of the Engineer the result of the loading tests is not satisfactory, the Engineer shall instruct that such parts of the Works as he specifies shall be taken down or cut out and reconstructed to comply with the specifications, or other remedial measures shall be taken to make Works secure to the satisfaction of the Engineer. The Contractor shall take down, or cut out and reconstruct the defective work or shall take the remedial measures instructed at his own cost.

**11.1 TESTING OF MATERIAL NOT COVERED UNDER SPECIFICATIONS**

In case the materials/ finished products are not covered by the specifications in the Contract, the details of specification to be followed and the testing procedure/laboratory where tests are to be carried out shall be specifically brought out and agreed to prior to the signing of the Contract. The Contractor shall furnish to the Engineer a certificate of compliance of tests carried out. In addition, certified mill tests reports clearly identification to the lot of materials shall be furnished at the Contractor's cost. The decision of the Engineer regarding testing procedure and specifications shall be final and binding on the Contractor.

11.2 Specialized materials are to be tested in the lab. Established by manufacturer as per the code of practice established by the manufacturer, at his own cost.

**12. EXECUTION OF WORKS**

All items shall conform to the requirements laid down in PWD Standard specifications and stipulations made herein. In case any item of work is not covered by these specifications/stipulations the works shall be executed as per the latest editions of IS codes of Practice.

## SECTION - A

### EARTH WORK FOR FOUNDATIONS & METAL PACKING

#### LIST OF BUREAU OF INDIAN STANDARD CODE OF PRACTICE (ISI)

3764- Safety code for excavation work

6313 - Code of practice of antitermite measures in building.

- A.1** Excavation for all works and of materials required for filling shall be to the exact width, length and depth shown on the drawings or as directed by the Engineer. If excavation is carried out to greater width, length, depth than required, the Contractor shall make good, at his own cost, the extra depth by sound masonry or concrete filling and extra length or width filled in by well consolidated earth or if the Engineer thinks it necessary for the stability of the work, by masonry or concrete as he may direct.
- A.2** Excavation material required for filling shall be stacked or dumped where indicated by the Engineer. Excavated material not required for filling and any surplus material shall be removed and spread on the site anywhere within the premises and as directed by the Engineer or carted away from the site as directed by the Engineer. Dumping of this surplus material shall be in an orderly manner and according to the levels/grades as indicated by the Engineer. The cost of such removal and spreading shall be borne by the Contractor and held to be included in the Contract Rates.
- A.3** The Contractor shall, at the contract rates make provision for all shoring, pumping, dredging, bailing out or draining water whether subsoil or rain or other water and the excavation shall be kept free of water while the masonry work or concrete work is in progress and until the Engineer considers the work well set (Refer IS: 3764 Safety Code for Excavation Work). The sides of trenches shall be kept vertical and the bottom horizontal and shall be run level throughout or properly stepped as directed by the Engineer. The Contractor shall erect and maintain during progress of works temporary fences around dangerous excavations.
- A.4** Excavation in ordinary soil means excavation in ordinary hard soil including stiff heavy clay, hard shale, or compact soil or any material, which can be removed by the ordinary application of spades, shovels picks and pick axes. This shall also include removal of isolated boulders each having a volume not more than 0.50 cum.
- A.5** Excavation in soft rock includes limestone, sandstone, laterite, etc. or other rock which can be quarried or split with crowbars or wedges. This shall also include excavation of tarred / asphalted pavements / roads, masonry work and rock boulders each having a volume of not more than 0.25 cu.m.

- A.6** Excavation in hard rock includes any rock bound in ledges or masses in its original form or cement concrete, excavation of which in the opinion of the Engineer requires the use of compressed air, equipment, sledgehammer and blasting.
- A.7** In case of any difficulty concerning the interpretation of Clauses A.4, A.5 and A.6 above, the Engineer shall decide whether the excavation in a particular material is in ordinary soil, soft rock or hard rock and his decision in this matter shall be final and binding on the Contractor and without appeal.
- A.8** The foundation trenches shall be inspected and passed by the Engineer before concrete or masonry work is commenced and the Contractor shall hold an order in writing to this effect, otherwise the Contractor shall be liable to have this work removed for inspection.
- A.9** The earth for backfilling/filling in foundation and plinth shall be got approved by the Engineer. In the foundation the backfilling/filling shall be done in layers not more than 200mm thick and shall be thoroughly watered and consolidated by approved method. The rate for backfilling in foundation is deemed to have been included in the excavation rate.
- A.10** The backfilling/filling in plinth and other places, which are required for leveling, shall be done in layers not more than 200mm thick. The Backfilling shall be watered and thoroughly consolidated by power driven roller/pan (8 to 10 ton) vibrator/vibratory roller of approved capacity. The process shall be repeated till the required level is achieved. After the backfilling/filling is completed the surface shall be uniformly dressed and leveled.
- A.11** Filling for subsurface drains (Filter drains)  
Filling materials for subsurface drains shall conform to relevant Standard Specifications of PWD.

The filter material shall be deposited in layers not exceeding 200mm

- A.12** Metal Packing: Unless otherwise specified, stones for metal packing shall consist of crushed or broken stone. It shall be hard, durable and free from disintegrated particles, excessive dust and other objectionable matter. Metal packing shall be conforming to the relevant Standard Specification of PWD.

The metal packing shall be done in layers not more than 100mm compacted thickness. For 150 mm compacted thicknesses, it shall be done in two layers each of 75 mm compacted thicknesses.

After laying, each layer shall be compacted thoroughly either by rollers or small vibratory roller, as specified or by other equivalent method approved by the Engineer. Slight sprinkling of water shall be done at the time of rolling.

After rolling has been completed, screening shall be applied uniformly and gradually to fill the interstices and the surface shall be dry rolled. In no case shall the screenings be dumped in a heap on the rolled surfaces. Rolling shall be accompanied with brooming.

After application of screening and rolling, the surface shall be copiously sprinkled with water and rolled. If necessary, additional screenings applied to fill the voids if any. Rolling shall be continued until the coarse aggregates are well bonded. Care shall be taken that the base or subgrade does not get damaged due to addition of excessive quantities of water during the Construction.

**A.13 Measurements:**

Measurements of excavation shall be solid measurements or actual volume of the materials prior to its removal. Measurements shall be of the exact length, width as indicated in the drawings and depth, measured vertically according to the Engineer's drawing or his instruction.

The measurement for filling shall be based on actual difference of levels before filling and after leveling.

The rate for metal packing shall be based on final compacted thickness and shall include all labour, materials and the cost of rolling with road roller or other equivalent method to obtain full compaction, application of screening, watering etc. complete. It shall be measured in square meters.

**A.14 ANTITERMITE TREATMENT:**

The works shall be carried out as per Bureau of Indian Standards IS 6313 (Part I, II, III) 1981 the code of practice of antitermite measures in buildings.

Antitermite treatment is to form a chemical barrier around the foundations and building to resist the entry of termites into the building.

Stages of Antitermite treatment:

1. Bottom and sides of trenches
2. Backfill in immediate contact with masonry of foundation
3. Junction of wall and floor
4. Top surface of plinth filling
5. External perimeter of building

- 1 Bottom and sides of trenches: The bottom and sides (up to 300mm height) of excavations made for foundations are treated with the chemical at the rate of 5 Lit per sqm. Surface.

- 2 After the foundations and retaining wall of basement come up, the backfill in immediate contact with the foundation structure shall be treated at the rate of 7.5 litres per sqm of the vertical surface of the structure for each side. If water is used for ramming the earthfill, the chemical treatment shall be carried out after the ramming operation is done by rodding the earth at 150mm centers close to the wall surface and spraying the chemical emulsion at the above dosage. After the treatment the soil should be tamped in place. The earth is usually returned in layers and treatment shall be carried out in similar stages. The chemical emulsion shall be directed towards masonry surfaces so that the earth in contact with these surfaces is well treated with the chemical.
- 3 Junction of wall and floor: To achieve this a small channel 30 x 30mm shall be made at the junctions of wall and columns with the floor before laying subgrade and rod holes made in the channels up to the ground level 150mm apart and iron rod moved backward and forward to break up the earth and chemical emulsion poured along the channel at the rate of 7.5 litres per sqm of the vertical wall or column surface so as to soak the soil right to the bottom. The soil should be tamped back in place after this operation.
- 3 Top surface of plinth filling: The top surface of the consolidated earth within plinth walls shall be treated with chemical emulsion at the rate of 5 litres per sqm of the surface before sand bed or subgrade is laid. If the filled earth has been well rammed and the surface does not allow the emulsion to seep through, holes upto 50 to 75mm deep at 150mm centers both ways may be made<sup>3</sup> with 12mm diameter mild steel rod on the surface to facilitate saturation of soil with chemical emulsion.
- 4 External perimeter of building: After the building is complete, the earth along the external perimeter of the building should be rodded at interval of 150mm and depth 300mm. The rods should be moved backward and forward parallel to the wall to break up the earth and chemical emulsion poured along the wall at the rate of 7.5 litres per sqm of vertical surfaces. After the treatment, the earth should be tamped back to the place.

**SECTION - B**  
**CONCRETE - PLAIN AND REINFORCED**

**LIST OF BUREAU OF INDIAN STANDARD CODE OF PRACTICE (ISI)**

12269- 53 grade ordinary Portland cement.

455- Portland slag cement.

1489- Portland pozzolana cement (fly ash based) (Part-I).

383- Coarse and fine aggregates from natural source for concrete.

4031- Method of physical test for hydraulic cement.

4032 – Method of chemical analysis for hydraulic cement.

456- Code of practice for plain and reinforced concrete.

516- Method of test for strength of concrete.

3812- Code for fly ash. (Pulverized fuel ash)

2505- General requirement for concrete vibrator immersion type.

2386 – Method of test for aggregate for concrete.

9103- Admixture for concrete.

3535- Method of sampling of hydraulic cement.

4926- Specification for ready mix concrete.

2722 – Weigh Batching Plant

#### **B.1 Cement:**

The cement used shall be as per IS 456 with the prior approval of the Engineer. Use of mineral admixture may be allowed by the Engineer in charge, if the same satisfy the requirement of relevant codes / standards after necessary approval from Competent Authority.

#### **USE:**

Cement duly tested atleast for 7 days strength shall be used in the order in which it is received on site. Cement in bags in storage for a period more than 3 months, shall be retested before use and rejected by Engineer in charge if found unsuitable. In case

of urgency of work, Engineer in charge may allow use of cement based on the submission of manufacturer's test certified or 3 days laboratory test for strength.

**TESTING :**

A sample shall be tested for every batch (week of manufacturer) of cement delivered on site on once or for every 1000 bags, whichever is more frequent. Tests shall be carried out for consistency fineness, initial and final setting time, and compressive strength (IS : 4031) and the results approved by the Engineer before use of the cement in permanent works. Samples shall be taken immediately on receipt of cement at site. The methods and procedure of sampling shall be in accordance with IS : 3535. The Engineer may specify other forms of sampling and tests including chemical analysis, (IS : 4032) if in his opinion the cement is of doubtful quality; the costs of such additional tests shall be borne by the Contractor. Each and every lot of cement shall be accompanied by manufacturers test certificate.

**B.2 Fine Aggregates (Sand)**

B.2.1 It shall be river sand conforming to IS: 383, obtained from sources approved by the Engineer. These sands, if found coarser, shall be suitably blended with finer sand obtained from Nagla or Pen to obtain the desired grading. The two types of sand will be stacked separately and their mixing in the specified proportions shall be at the Contractor's cost.

The sand shall not contain more than a total of 3 % by weight of shale, clay, silt and other structurally weak particles.

If permitted by the Engineer, crushed stone sand produced from stones, suitable for concrete aggregates, and manufactured in special sand producing crushers such as impactors, hammer mills and processed through stone on stone, vertical shaft crushers such as Barmac / Svedala for particle shaping and excess fines removed by suitable dust extractors. The particle shape shall be nearly cubical. If crushed stone sand contains high percentage of fines, the sand will be separated in two fractions viz. 0 - 2.36 mm and 2.36 - 4.75 mm size. These two fractions will be suitably blended to obtain desired grading of sand. In case of crushed stone sand the fines i.e. (-) 0.15 mm shall be less than 5 %.

B.2.2 The grading of the sand shall conform to IS : 383.

The grading of sand can be improved by mixing two sands. The sand shall be screened on 4.75 mm size vibratory screen to eliminate over - size particles.

The sand shall be washed in screw type mechanical washers in potable water to remove excess silt, clay and chlorides. The screening and washing of sand shall be completed at least one day before using it in concrete.

The washed sand shall be stored on a sloping concrete platform to drain excess water and in such a manner as to avoid contamination.

B.2.3 The aggregate shall be subjected to tests in accordance with IS : 2386 as may be ordered by the Engineer.

### **B.3.0 Course Aggregates:**

B.3.1 Coarse aggregates for the Works shall be crushed stone conforming to IS : 383, obtained from sources , approved by the Engineer.

Aggregates shall be properly screened and if necessary washed clean before use.

B.3.2 Coarse aggregates containing flat or flaky pieces or mica shall be rejected.

B.3.3 Coarse aggregates shall be supplied in the following sizes :

Nominal size	Maximum size	Minimum size
10 mm	12 mm	5 mm
20 mm	25 mm	10 mm
40 mm	40 mm	20 mm
80 mm	80 mm	40 mm

B.3.4 The grading of coarse aggregate shall be such that not more than 5 % shall be larger than the maximum size and not more than 10 % shall be smaller than the minimum size. Between these sizes the coarse aggregate shall be well graded.

B.3.5 The aggregates shall be subjected to tests in accordance with IS 2386 as may be ordered by the Engineer.

B.3.6 Aggregates shall be stored in such a way as to prevent segregation of sizes and avoid contamination with fines.

B.3.7 In order to obtain maximum workability, individual aggregates of nominal size 20 mm, 10 mm, 4.75 mm & 2.36 mm. will be blended in such a way that the grading curve for all in aggregate will be a smooth curve falling within established envelope curve. Contractor shall established envelope grading curve for each grade on concrete for given MSA and get it approved by Engineer in charge before finalizing mix design.

### **B.4.0 Mixers and Vibrators**

B.4.1 For all concreting works, the contractor shall provide weigh batching plant of suitable capacity, conforming to IS 2722 (which shall be got approved before bringing to site) or obtain ready mix concrete from approved RMC supplying



B.4.2 The Contractor shall provide concrete mixers (IS : 1791) - Batch type concrete mixers, (IS : 2439) - Roller Pan Mixer.

B.4.3 The Contractor shall provide at site concrete Vibrators, Immersion Type Also suitable capacity form vibrators will be used.

**B.5.0 Grade of concrete:**

The concrete is designated as follows:-

Concrete M20, M 35, etc. the letter M refers to the mix, the number 30 represents the characteristic compressive strength of 150 mm size cubes in Mpa at 28 days.

**B.6.0 Trial mixes:**

B.6.1 The Contractor is entirely responsible for the design of the concrete mixes. The design is however to be approved by the Engineer, at least 4 weeks before commencing any concreting in the Works. The Contractor shall make trial mixes using samples of coarse aggregates, sand, water, cement and plasticiser typical of those to be used in the works, and which have been tested in an approved laboratory.

A clean dry mixer shall be used and the first batch discarded. In case of urgency work, Engineer in charge may allow use of design mix based on 7 days cube test results.

B.6.2 The minimum cement content and maximum water cement ratio for different grades of concrete and the required average strengths at 28 days for which the mixes shall be designed shall be in accordance with IS 456-2000. However the slump, requirement shall be as per the table-1 given below:

B.6.2.1 If the contractor is unable to obtain the required concrete strength, with the above given minimum dosage of cement, he can with specific approval of Engineer, increase the cement dosage. In such cases, no extra payment will be made for the use of extra cement.

B.6.2.2 Use of approved super plasticiser, at contractor's cost is mandatory.

**Table 1 given below, shows, the range of slump for concreting in various areas and conditions.**

**TABLE - 2**

SR. No.	Area of Concrete work	Slump mm
1a	Structure with exposed inclined surface requiring low slump concrete to allow proper compaction.	15 to 25
1b	Plain C.C.	15 to 25

2	R.C.C. structures with widely spaced rebars. I.e. solid columns, piers, abutments, footings, well-steinings.	40 to 50
3	R.C.C. structures with fair degree of congestion of rebars, viz pier and abutment caps, box culverts, well curbs, well caps, walls with thickness greater than 300 mm.	50 to 75
4	R.C.C. and PSC structures, with highly congested rebars viz deck slab, girders, box girders, walls with thickness less than 300 mm.	75 to 125
5	Under water concreting through tremie, bottom plug, cast in situ piling.	100 to 200

**Note :1)** The slump of concrete with water will be 25 mm. Any slump in excess of 25 mm, shall be obtained by adding suitable dose of approved super plasticizer only.

2) In case of ready mix concrete or pumped concrete the slump may be as per the requirement by adding suitable dose of approved super plastisizer.

B.6.3 The concrete mixes are designed to yield mean strengths ( $f'$  cm) greater than the corresponding specified characteristic strengths ( $f'_{ck}$ ). The value of the current margin shall be set as per BSI standards. The concrete mixes shall be designed on the basis of required strength, impermeability, desired workability, the maximum size of aggregate and also the various cements. Accordingly the required cement content shall be ascertained.

B.6.4. For each grade a total of 18 cubes and 3 cylinders of size 150-mm dia and 160 mm high shall be made. Of these 18 cubes made not more than 6 may be made on any day and further, of the 6 cubes made in one day not more than 2 each representing a different batch of concrete shall be tested at the age of 28 days. The making of the cubes, their curing, storing, transporting and testing shall be in accordance with Indian standards I.S. 516. After 28 days of curing the cylinders will be tested for permeability as per MOST Clause 1716.5. The tests shall be carried out in a laboratory approved by the Engineer.

B.6.5 If the average strength of the concrete cubes falls below the required target mean strength ( $f'$  cm), fresh preliminary mixes for that grade shall be made as

before, until the trial mixes yield cubes of compressive strength at 28 days greater than the required average target mean strength ( $f'_{cm}$ ) at that age.

- B.6.6 Whenever there is a significant change in the quality of any of the ingredients for concrete, the Engineer may at his discretion order the carrying out of fresh trial mixes. All costs for trial mixes and tests shall be to the Contractor's account and held to be included in the contract rates.
- B.6.7 Before commencing the works the Contractors shall submit to the Engineer for approval full details of all preliminary trial mixes and tests including complete calculations of mix design and properties of various ingredients.
- B.6.8 The Contractor shall carry out trials to establish the correctness of grading of aggregates, suitability of plasticiser, formwork, mould release agent etc. To obtain necessary strength and surface finish. All costs of such trial casting shall be included in the contract rates.
- B.6.9 When the proportions of a concrete mix have been approved by the Engineer, the Contractor shall not vary the quality or source of the materials or the mix without the written approval of the Engineer.
- B.6.10 It is the complete responsibility of contractor to design the concrete mixes, by approved standard methods and to produce, the concrete confirming to MOST specifications. It is expected that the contractor employ competent staff to carry out this work .
- B.6.11 where concrete is produced at continuous production unit such as ready mix concrete, the Engineer in charge may allow use of established mix design, provided it complies with all requirements of tender specification. In this case, the responsibility of attending required strength and other properties lies with supplier and contractor. The manufacturer shall submit detailed calculation for mix design if desired by Engineer in charge.

**B.7.0 Concrete Test:**

**B.7.1 Compressive Strength:**

The compressive strength of hardened concrete of all type and grades will be verified by the following procedure during routine work.

**B.7.1.1 Sampling**

**General:**

Sample from fresh concrete shall be taken as per IS 1199 and cubes shall be made, cured and tested at 28 days in accordance with IS 516.

**Sampling procedure:**

A random sampling procedure shall be adopted to ensure that each concrete batch shall have a reasonable chance of being tested that is, the sampling should be spread over the entire period of concreting and cover all mixing units.

**Frequency of sampling:**

The minimum frequency of sampling of concrete of each grade shall be in accordance with following:

Quantity of Concrete in the work, Cubic Metres	Number of Samples
1-5	1
6-15	2
16-30	3
31-50	4
50 and above	4 <u>+1</u> additional for each additional 50 m <sup>3</sup> or part there of

**Note:** - At least one sample shall be taken from each shift. Where concrete is produced at continuous production unit, such as ready mixed concrete plant, frequency of sampling may be agreed upon mutually by supplier and purchasers.

**B7.1.2 Test specimen**

Three test specimens shall be made for each sample for testing at 28 days.

Additional samples may be required for various purposes such as to

Determine the strength of concrete at 7 days or at the time of striking the

Form work, or to determine the duration of curing, or to check the testing

Error additional samples may also be required by accelerated methods as

Described in IS9103. The specimen shall be tested as described in IS 5116.

**B.7.1.3 Test results of Samples**

The test results of the samples shall be the average of the strength of three specimens. The individual variation should not be less more than +/- 15 % of the average. If more, the test results of the samples are invalid.

**B.7.2 Permeability Test procedure:****B.7.2.1 Concrete Cylinders:**

The permeability of hardened concrete used in RCC structures of the main permanent work will be verified by the following procedure:

- B.7.2.2 The Engineer shall select random batches of concrete for examination without warning the Contractor and sampling will generally be done at the point of discharge from the mixer and at placing point.
- B.7.2.3 From the batches thus selected 2 concrete cylinders shall be made in accordance DIN 1048.
- B.7.2.4 All cylinders shall be made, cured, stored, transported and tested in accordance with Clause 1716.5 MOST. The tests shall be carried out in a laboratory approved by the Engineer, if in house facility is not available.
- B.7.2.5 Frequency of testing 1 set (2 cylinders representing concrete from a different batch) for every 40 m<sup>3</sup> of concrete.

### **B.7.3 Permeability Test procedure:**

B.7.3.1 The permeability of hardened concrete will be verified by the following procedure:

- (i) Prepare a cylindrical test specimen 150 mm dia and 160 mm high.
- (ii) After 28 days of curing, test specimen will be fitted in a machine such that the specimen can be placed in water under pressure up to 7 bars. The typical machine shall be similar to one shown in Appendix 1700/II of MOST, 3rd revision, 1997 reprint.
- (iii) At first a pressure of one bar is applied for 48 hours, followed by 3 bars for 24 hours and 7 bars for next 24 hours.
- (iv) After the passage of the above period, the specimen is taken out and split in the middle by compression applied on two round bars on opposite sides above and below.
- (v) The water penetration in the broken core is measured with scale and the depth of penetration assessed in mm (max permissible limit 25 mm).

### **B.8.0 Acceptability criteria**

B.8.1 Test strength of sample:

The test strength of sample shall be the average strength of three specimens. The individual variation should not be more than +/- 15 % of in average.

B.8.2 Standard deviation:

Standard deviation based on the test results:

- a) Number of test results – The total number of test results required to constitute an acceptable record for calculation of standard deviation shall not be less than 30. Attempts should be made to obtained the 30 test results as early as possible, when be a mix is used for the first time.

- b) Standard deviation to be brought up to date. The calculation be of the standard deviation shall be brought up to date after every of mix design and atleast once a month.

**B.8.3 DETERMINATION OF STANDARD DEVIATION:**

- a) Concrete of each grade shall be analyzed separately to determine it's Standard deviation.
- b) The standerd deviation of concrete of a given gread shall be calculated using the following formula from the results of the individual tests of concrete of that grade obtained by average of the strength of three specimens. The individual variation shall not be more than +/- 15 % of the average.

Estimated standard deviation =  $S = \sqrt{\frac{\sum \Delta^2}{n-1}}$

Where:

$\Delta$  = Deviation of individual test standard from the average strength

"n" = number of sample test

**B8.4** When significant change are made in the production of concrete batches (for example change in the material used, mix design, equipment's of technical control) the standard deviation value shall be separately calculated for such batches of concrete.

**B8.5 ASSUMED STANDERD DEVIATION:**

Where a sufficient test results for a particular grade of concrete are not available, the value of standard deviation to be assumed is **4.60 N/mm<sup>2</sup>** for 28 days strength and **3.45 N/mm<sup>2</sup>** for 7 days strength.

**B 9.0 Acceptability criteria**

**B 9.1 Concrete cubes:**

B.9.1.1 The strength required of any particular grade of concrete will be considered satisfactory if the 28 days compressive strength of individual sets (each set consist of 3 cubes) and of individual cubes satisfy the requirement as per IS: 456:2000, clause no.16: Acceptance Criteria.

B.9.1.2 If the concrete procedure at the site does not satisfy the above strength Requirements, the Engineer in charge will reserve the right to required the contractor to improve the methods of batching, the quantity of ingredients, and redesign the mix with increased cement content if necessary. The contractor shall not be entitled to claim any extra cost for the extra cement or plasticiser used for the modification stipulated by the Engineer I charge for fulfilling the strength requirements specified.

**B.9.2 Permeability Test:**

The concrete shall pass the permeability test if it is properly compacted and is not considered permeable when tested as per DIN, and the water penetration in the broken core is less than 25mm. No extra payment shall be made for this test and cost of the same will be included in his rate for concrete work.

**B.10.0 Failure to meet Specified Requirements :**

B.10.1 If from the cube test results it appears that some portion of the works has not attained the required strength, the Engineer may order that portion of the structure be subjected to further testing of any kind whatsoever as desired by the Engineer, including, if so desired by him, full load testing of the suspected as well as adjacent portions of the structure as specified in the Conditions of Contract. Such testing shall be at the Contractor's cost. The Engineer may also reject the work and order its demolition and reconstruction at the Contractor's cost.

B.10.2 If the strength of concrete in any portion of the structure is lower than the required strength, but is considered nevertheless adequate by the Engineer so that demolition is not necessary, the Contractor shall be paid a lower rate for such lower strength concrete as determined by the Engineer.

B.10.3 If the concrete is not able to meet the prescribed acceptance standard the effect of such deficiency on structure shall be investigated by the contractor as directed by the Engineer. The Engineer may accept the work as sub-standard work. Any additional work required by the Engineer for such acceptance shall be carried out by the contractor at his cost. In case the concrete is not found to be acceptable after investigation; the contractor shall remove the rejected work forthwith.

**B.11.0 Test for concrete and concrete making ingredients:**

**As frequently as the Engineer may require, testing shall be carried out in the field for :**

- 1) Moisture content, absorption and density of sand and aggregates.
- 2) Silt content of sand
- 3) Grading of sand and aggregates
- 4) Slump, VEBE, FLOW test of concrete for workability.
- 5) Concrete cube test
- 6) Permeability test for concrete as per DIN
- 7) Density and P H value of plasticiser.
- 8) Tests for water

Before concreting commences on any section of the works contractor shall obtain approval of the Engineer or his representative as regards the formwork and reinforcement conforming with the drawings. He shall also indicate to the Engineer in writing and

obtain his approval for positions of construction joints. The Engineer or his representative's approval shall not relieve the Contractor of any of his obligations to comply with the provisions of this specification or contract.

**B.12.0 Admixtures:**

Use of Melamine or Naphtha based approved admixtures is a must. They shall be permitted by the Engineer provided that the strength and durability requirements are not affected by their use. The admixture will not be paid for separately. Depending on concrete pour sequence, retarding super plasticiser shall be used without any extra cost to CLIENT.

**B.13.0 Water:**

The Engineer or his representative shall approve the quantity of water to be added to the mix at mixer. The quantity of water to be added at mixer, may be adjusted by contractor, with the approval of Engineer in order compensate for prevailing conditions of surface moisture and absorption of aggregates and sand. On no account shall the contractor allow more water to be added to the mix than that specified and approved by Engineer or his representative. In case extra water becomes necessary, corresponding extra quantity of cement will be added by the contractor at his cost to maintain the designed W/C ratio approved by Engineer. Concrete containing excess water, which vitiates design W/C ratio shall be rejected.

**B.14.0 Batching of Concrete ingredients :**

For all structural concreting, only Ready Mixed Concrete (R.M.C.) manufactured at site in automatic weigh batching plant, or obtained from approved R.M.C. supplying agencies or produced at site using mechanical mixer and weigh batchers as per item description, will be used. The R.M.C. supplying agency will supply mix design details in advance before start of delivery. For non structural concreting work such as PCC, concrete may be produced at site using mechanical mixers.

**B.15.0 Transporting, placing, compacting, finishing and curing:**

Transporting, placing, compacting, finishing and curing of concrete shall be in accordance with IS: 456.

**B.15.1 Transporting:**

For all concreting, the concrete after discharge from batching plant will be loaded in transit mixers and kept continuously agitated while mix is in transit. At destination the mix will be unloaded in to the hoppers of concrete pump. For site made concrete suitable prescribed methods shall be adopted.



#### B.15.2 **Placing :**

The concrete, when discharged from transit mixer in pump hopper shall be kept continuously agitated and pumped to destination placing point. The height of any single lift of concrete shall not exceed 1.5 m for walls and 2.0 m for columns. For columns where the height of pour is more than 2.0m, suitable arrangement in formwork should be made so that the vertical drop of concrete is restricted to less than 2.0m. Any such arrangement should be approved from the engineer in advance before execution.

High velocity discharge of concrete causing segregation of mix shall be avoided. The concrete shall be placed in the forms gently and not dropped from a height exceeding 1.5 m except in columns where the maximum allowed will be 2.0 m. Each batch of concrete will be placed in layer. Each layer of concrete shall be compacted fully before the succeeding layer is placed and separate batches shall be placed and fully compacted before the layer immediately below has taken initial set. The layers should be sufficiently shallow, to permit stitching of two layers together by vibration.

Concreting of any portion or section of the work shall be carried out in one continuous operation and no interruption of concreting work will be allowed without approval of the Engineer.

Plain concrete in foundations shall be placed, in direct contact, with the bottom of excavation, the concrete being deposited in such a manner, as not to get mixed with the earth. The concrete placed below the ground level shall be protected from falling earth during and after placing. Concrete placed in ground containing deleterious substances, shall be kept free from contact, with such ground and with water draining there from during placing and for a period of 7 days or otherwise instructed there after. Approved means shall be taken to protect immature concrete from damage by debris, excessive loading, abrasion, vibrations, deleterious ground water, mixing with earth and other materials and other influences that may impair strength and durability of concrete.

Before starting of work contractor will get the concrete pouring program and its sequence approved by Engineer to avoid cold joints.

#### B.15.3 **Compaction :**

External, Internal (needle) and surface (screed board) vibrators of approved make shall be used for compaction of concrete

- (a) External and Internal vibrators shall be used for compaction of concrete in foundations, columns, etc. For sections such as slabs, the concrete shall be compacted by external, internal and surface type vibrators, depending on the thickness of layer to be compacted. 25 mm, 40 mm, and 60-mm dia internal vibrators

will be used. The concrete shall be compacted by use of appropriate diameter vibrator by holding the vibrator in position until :

- i) Air bubbles cease to come to surface
- (ii) Resumption of steady frequency of vibrator after short period of dropping the frequency, when the vibrator is first inserted.
- (iii) The tone of the vibrator becomes uniform.
- (iv) Flattened, glistening surface, with coarse aggregates particles blended into it, appears on the surface.

After the compaction is completed, the vibrator should be withdrawn slowly from concrete so that concrete can flow in to the space previously occupied by the vibrator. To avoid segregation during vibration, the vibrator shall not be dragged through the concrete nor used to spread the concrete. The vibrator shall be made to penetrate, into layer of fresh concrete below if any, for a depth about 150 mm. The vibrator shall be made to operate at regular pattern of spacing. The effective radii of action will overlap, approximately half a radius to ensure complete compaction.

- (v) To secure even and dense surfaces free from aggregate pockets, vibration shall be supplemented by tamping or rodding by hand in the corners of forms and along the form surfaces while the concrete is plastic.
- (vi) A sufficient number of spare vibrators shall be kept readily accessible to the place of deposition of concrete to assure adequate vibration in case of breakdown of those in use.

25 mm diameter immersion vibrators shall be used in thin sections upto 125mm, 40 mm diameter immersion vibrators in fairly wide sections like beams, slabs, columns etc. and 60 mm diameter vibrators in foundations, pilecaps or such large section members. Screed vibrators shall also be used for slab concreting.

- (vii) Plain concrete also shall be vibrated to achieve full compaction, using needle and screed vibrators as necessary.

#### B.15.4 **Curing :**

Curing shall be started at the earliest by spreading wet jute cloth (hessian) and cover top with plastic sheet and subsequently cured with spraying water. In inaccessible area to start with, curing be started by spraying curing compound before starting membrane curing.

#### B.16.0 **Placing temperatures:**

During extreme hot weather, the concreting shall be done as per procedures set out in IS : 7861, Parts I and II.

Fine and coarse aggregates for concreting shall be kept shaded and the concrete aggregates sprinkled with water for a sufficient time before concreting, in order to

ensure that the temperature of these ingredients is as low as possible prior to batching. The mixer and batching equipment shall be also shaded and if necessary painted white in order to keep their temperatures as low as possible. The placing temperature of concrete shall be as low as possible in warm weather and care shall be taken to protect freshly placed concrete from overheating by sunlight in the first few hours of its laying. The time of day selected for concreting shall also be chosen so as to minimize placing temperatures. In case of concreting in exceptionally hot weather the Engineer may in his discretion specify the use of ice either flaked and used directly in the mix, or blocks, used for chilling the mixing water. In either case, no extra payment shall be made to the contractor on this account.

**B.17.0 Construction joints :**

Construction joints in all concrete work shall be made as directed by the Engineer. Where vertical joints are required, these shall be shuttered and two coats of approved surface retarders shall be applied as directed by the Engineer on the surface of formwork in contact with concrete. The joint concrete shall not be allowed to take the natural slope of the concrete.

before fresh concrete is placed against a vertical joint, the old concrete shall be chipped / sand blasted, clean and moistened for 24 hrs. before placing concrete. All standing water should be removed and dried with compressed air. Neat cement slurry shall be applied on the chipped / sand blasted surface and mortar of the same water cement ratio as the concrete and 10 mm thick applied. Where required suitable expansion joint shall be also provided as directed by Engineer in charge.

The time of day selected for concrete shall be chosen so as to minimize placing temperature. In case of concreting in exceptionally hot weather the Engineer may in his discretion specify the use of ice either flaked and used directly in the mix or blocks used for chilling the mixing water. In either case the cost of ice and additional labor involved in weighing and mixing etc. shall be borne by the contractor and nothing will be paid on this account.

**B18.0 Defective concrete:**

Should any concrete be found honey combed or in any way defective, such concrete shall on the instruction of the Engineer in charge be cut out by the contractor and made good at his own expenses.

**B 19.0 Exposed faces, holes and Fixtures:**

On no account shall concrete surfaces be patched or covered up or damaged concrete rectified or replaced until the Engineer or his representative has inspected the work and issued written instruction for rectification. Failure to observe this procedure will render that portion of work liable to rejection, in each case, it will be treated as a work which has failed to meet specified requirements.

Holes for foundation or other bolts or for any other purpose shall be molded, and steel angles, holdfasts or other fixture shall be embedded, according to the drawing or as instructed by the Engineer.

**B.20.0 Cracks :**

- B.20.1 If cracks develop in concrete construction, which in the opinion of the Engineer may be detrimental to the strength of the construction, the contractor at his own expense shall test the slab or other construction as specified in Special Conditions. If under such test loads the cracks develop further, the Contractor shall dismantle the construction, carry away the debris, replace the construction and carry out all consequential work thereto. Without any extra payment.
- B.20.2 If any cracks develop in the concrete construction, which in the opinion of the Engineer, are not detrimental to the strength of the construction, the contractor at his own expense shall grout the cracks with polymer cement grout of approved quality at his own expense and risk and shall make good to the satisfaction of the Engineer the surface finish which in the opinion of the Engineer has suffered damage either in appearance or stability owing to such cracks. The Engineer's decision as to the extent of the liability of the Contractor in the above matter shall be final and binding.

**B21.0 Finishes:**

Unless otherwise instructed the face of exposed concrete placed against formwork shall be rubbed down immediately on removal of formwork to remove irregularities. The face of concrete for which form work is not provided other than slabs, shall be smoothed with a float to give a finish equal to that of the rubbed down face, where formwork is provided. The top face of the slab which is not intend to be covered with other material shall be leveled and floated to a smooth finish at the level or falls shown on the drawings or as directed the floating shall be done so as not to bring an excess of mortar to the surface of the concrete. The top face of the slab intended to be surface of other material shall be left with a spaded finish.

Face of concrete intoned to be plastered shall be roughened by approved means to form a key.

When at site, concrete cube testing machine is used 10 % of the cubes should be tested at independent recognized laboratories approved by Engineer ,at their cost.

**B.22.0 Precast Concrete :**

The provision in this section apply to all precast concrete executed within site and shall be considered supplementary to general provisions for reinforced works.

### **B.22.1 Handling and Storage**

The precast units shall be stored as directed by the Engineer. The area intended for the storage of precast units should be surfaced in such a way that no unequal settlement can occur.

To prevent deformation of slender units, they should be provided with supports at fairly close intervals and should also be safeguarded against tilting. Lifting and handling positions should conform to the Engineer's directions and drawings. In addition, location and orientation marks should be put on the members, as and where necessary. During erection the precast units should be protected against damage caused by local crushing, chafing, effects of lifting and transport equipment.

### **B.22.2 Temporary Supports and Connections:**

Temporary supports provided during erection should take into account all construction loads likely to be encountered during the completion of joints between any combination of precast and in-situ concrete structural elements. The supports should be arranged in a manner that will permit the proper finishing and curing of any in-situ concreting and grouting associated with the precast member being supported when the gaps of joints have to be cleaned, the faces of the joints should be wetted. The mixing, placing and compacting of cement and mortar should be done with special care. Where mortar is specified, of a dry consistency, it should be in the proportion of 1 part of cement to 1 ½ parts of sand and should be placed in stages and packed hard from both sides of the joint.

### **B.22.3 Tolerances**

The following tolerances apply to finished precast products at the time of placement in the structure. The forms must be constructed to give a casting well within these limits.

1. Overall dimensions of members should not vary more than  $\pm 6$  mm per 3 m length with a maximum variation of  $\pm 20$  mm.
2. Cross sectional dimensions should not vary more than the following :
  - $\pm 3$  mm for sections less than 150 mm thick
  - $\pm 4$  mm for section of 150 mm and less than 450 mm
  - $\pm 6$  mm for sections over 450 mm to 1000 mm
  - $\pm 10$  mm for sections over 1000 mm
3. Deviation from straight line in long sections should not be more than  $\pm 6$  mm upto 3 m,  $\pm 10$ mm for 3 m to 6 m,  $\pm 12$  mm for 6 m to 12 m.

### **B.23.0 Measurement:**

Concrete, and reinforcement shall be paid separately unless otherwise specified. The volume of concrete measured shall include that occupied by

- 1 Reinforcement and other metal sections
- 2 Cast in components each less than 0.01 m<sup>3</sup> in volume
- 3 Rebates, fillets or internal splays each less than 0.005 m<sup>2</sup> in cross sectional area.
- 4 Pockets and holes not exceeding 0.01 m<sup>3</sup> in volume
- 5 Rates for precast concrete shall include demoulding, handling, storing, transporting and erecting at site, including all clamping, bolting, bracing that may be required during erection, including erection equipment.

B22.1 In order to exercise the required degree of constant control over the concrete materials and their proportion, the contractor shall setup and maintained at his own expenses a test laboratory at the site. He shall

Provide all apparatus required for sensitive testing of concrete and concrete material. In particular he must have the following equipment set up in the site laboratory.

- i) A set of Standard sieves.
- ii) Sieve shaker.
- iii) Measuring cylinder.
- iv) Slump cones.
- v) Adequate number of standard moulds.
- vi) Weighing balance.
- vii) Curing tank for cubes.
- viii) Concrete cube testing machine 100 T capacity preferably electrically operated.

Any other apparatus deemed necessary by the Engineer for proper control shall be provided by the contractor at his own expense. The lab. shall be staffed by qualified technicians.

When at site, concrete cube testing machine is used 10 % of the cubes should be tested in CLIENT'S lab. or in lab. Approved by Engineer at contractor's cost.

#### B.24.0 **READY-MIXED CONCRETE AND PUMPING CONCRETE**

The provision in this section apply to all Ready Mix Concrete and shall be considered supplementary to general provisions for reinforced concrete works.

B.24.1 Ready-mixed concrete may be manufactured in a central automatic weigh Batching plant and transported to the job in agitating transit mixers.

#### B.24.2 **Coarse Aggregate**

The maximum size of coarse aggregate shall be limited to one-third of the smallest inside diameter of the hose or pipe used for pumping. Provision shall be made for elimination of over-sized particles by screening or by careful selection of aggregates. To obtain proper gradation it may be necessary to combine and blend certain fractional sizes of aggregates. Uniformity of gradation throughout the entire job shall be maintained.

The quantity of coarse aggregate shall be such that the concrete can be pumped, compacted and finished without difficulty.

**B.24.3 Fine aggregates:**

The gradation of fine aggregate shall be such that 15 to 30 percent should pass the 0.30-mm screen and 5 to 10 percent should pass 0.15-mm screen so as to obtain a pumpable concrete. Sands that are deficient in either of these two sizes should be blended with selected finer sands to produce these desired percentages. With this gradation, sands having a fineness modulus between 2.4 and 2.8 are generally satisfactory. However, for uniformity, the fineness modulus of the sand should not vary more than 0.2 from the average value used in proportioning.

**B.24.4 Water, Admixtures and slump :**

The amount of water required for proper concrete consistency shall take into account the rate of mixing, length of haul, time of unloading, and ambient temperature conditions.

Additions of water to compensate for slump loss should not be resorted to nor should the design maximum water-cement ratio be exceeded. Additional dose of retarder be used to compensate the loss of slump at contractor's cost. Retempering water shall not be allowed to be added to mixed batches to obtain desired slump.

**B.24.5 Transportation :**

The method of transportation used should efficiently deliver the concrete to the point of placement without significantly altering its desired properties with regard to water-cement ratio, slump, and homogeneity.

The revolving-drum truck bodies of approved make shall be used for transporting the concrete. The number of revolutions at mixing speed, during transportation, and prior to discharge shall be specified and agreed upon. Reliable counters shall be used on revolving-drum truck units. Standard mixer uniformity tests, conforming to ASTM standards C 94-69 "Standard Specifications for Ready Mix Concrete", shall be carried out to determine whether mixing is being accomplished satisfactorily.

**B.24.6 Pumping of concrete :**

Only approved pumping equipment, in good working condition, shall be used for pumping of concrete. Concrete shall be pumped through a combination of rigid pipe

and heavy-duty flexible hose of approved size and make. The couplings used to connect both rigid and flexible pipe sections shall be adequate in strength to withstand handling loads during erection of pipe system, misalignment, and poor support along the lines. They should be nominally rated for at least 3.5 Mpa pressure and greater for rising runs over 30 m. Couplings should be designed to allow replacement of any section without moving other pipe sections, and should provide full cross section with no construction or crevices to disrupt the smooth flow of concrete.

All necessary accessories such as curved sections of rigid pipe, swivel joints and rotary distributors, pin and gate valves to prevent backflow in the pipe line, switch valves to direct the flow into another pipe line, connection devices to fill forms from the bottom up, extra strong couplings for vertical runs, transitions for connecting different sizes of pipe, air vents for downhill pumping, clean-out equipment etc, shall be provided as and where required. Suitable power controlled booms or specialized crane shall be used for supporting the pipe line.

**B.24.7 Field control :**

Sampling at both truck discharge and point of final placement shall be employed to determine if any changes in the slump and other significant mix characteristics occur. However, for determining strength of concrete, cubes shall be taken from the placement end of line.

**B.25.0 Planning :**

Proper planning of concrete supply, pump locations, line layout, placing sequence, and the entire pumping operation shall be made. The concrete production transportation and placing shall be planned in such a manner that duration between addition of water during mixing and placing of concrete in desired location is well within time limits prescribed by the RMC manufacturer, however this is subjected to fulfillment of slump and other properties of concrete as specified in tender on failure to adhere to the time schedule by the supplier the Engineer in charge may reject the concrete.

The pump wherever used should be as near the placing area as practicable, and the entire surrounding area shall have adequate bearing strength to support concrete delivery pipes. Lines from pump to the placing area should be laid out with a minimum of bends. For large placing areas, alternate lines should be installed for rapid connection when required. Standby power and pumping equipment should be provided to replace initial equipment, should breakdown occur.

The placing rate should be estimated so that concrete can be ordered at an appropriate delivery rate.



As a final check, the pump should be started and operated without concrete to be certain that all moving parts are operating properly. A grout mortar should be pumped in to the lines to provide lubrication for the concrete, but this mortar shall not be used in the placement. When the form is nearly full, and there is enough concrete in the line to complete the placement, the pump shall be stopped and a go-devil inserted and shall be forced through the line by water under pressure to clean it out. The go-devil should be stopped at a safe distance from the end of the line so that the water in the line will not spill into the placement area. At the end of placing operation, the line shall be cleaned in the reverse direction.

## **B.26.0 SPECIFICATION FOR FIBER REINFORCEMENT TO BE PROVIDED FOR VACUUM DEWATERED CONCRETE WEARING COURSE.**

### **B.26.1 PRODUCT SPECIFICATION**

The fibres shall be manufactured from 100% Virgin Polypropylene, containing no reprocessed Olefin materials, and manufactured to an optimum gradation with 25 individual unique fiber designs for use as concrete reinforcement and conforming to ASTP C-1116 type 1114.1.3, ASTM C-1116 Performance level I and residual strength. The chemical and physical properties shall be as follows :

- Absorption : Nil
- Specific gravity : 0.9
- Lengths : Graded (3mm to 50mm)
- Ignition point : 1100 F (590C)
- Melt Point : 320 F tp 340 F (160 C – 170 C)
- Electrical conductivity : Low
- Thermal Conductivity : Low
- Acid, Salt resistance : High
- Alkali Resistance : 100% Alkali Proof

The fibers shall be compatible with all concrete design and admixtures.

### **B.26.2 Application**

The application rate shall be at the rate of 0.9 Kg/m<sup>3</sup> for concrete. It shall be added at the time of mixing in the batching plant / mixer and mixed for atleast 5 minutes for ensure uniform distribution within the concrete. The fibers can be added before or after addition of water to concrete mix.

**B.26.3** The manufacturers shall provide evidence of satisfactory performance using this type of fibres, for similar applications, in any project in India or preferably in Mumbai / Navi Mumbai region

**B.26.4** Approved make is FIBER MESH' of Synthetic Industries, USA marketed by NINA Industries, Mumbai or any other equivalent.

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## SECTION - C

### FORM WORK

#### LIST OF BUREAU OF INDIAN STANDARD CODE OF PRACTICE (ISI)

4990-	Specification for plywood for concrete shuttering work
3696-	Safety code of scaffolds and ladders
4014-	Steel and tubular scaffoldings
8989-	Safety code for erection of concrete framed structures.
456-	Code of practice for plain and reinforced concrete.

#### C.1 Definition :

The term "Formwork" or "Shuttering" shall include all forms, moulds, sheeting, shuttering planks, walers, poles, posts, shores, struts and strutting, ties, uprights, waling, steel rods, bolts, wedges and all other temporary supports to the concrete during the process of setting.

#### C.2 Materials :

- 1 All facing formwork to come in contact with concrete in different elements of the structure shall be of such material and size as specified on drawings or as instructed by the Engineer.
- 2 Timber facing formwork to come in contact with concrete for "Exposed Concrete Surfaces" shall consist of lap-jointed or tongue and grooved planks as directed by the Engineer and no joint shall permit leakage of mortar at all from cast-in-situ concrete.
- 3 The materials for other backing and supporting formwork and their sizes shall be selected by the Contractor and shall be subject to the approval of the Engineer.

#### C.3 Design :

The formwork shall be designed and constructed so that the concrete can be properly placed and thoroughly compacted to obtain the required shape, position and level subject to specified tolerances. It is the responsibility of the Contractor to obtain the results required by the Engineer, whether or not some of the work is sub-contracted. Approval of the proposed formwork by the Engineer will not diminish the Contractor's responsibility for the satisfactory performance of the formwork, nor for the safety and co-ordination of all operations. Similarly it has to be approved by the main consultant.

#### C.4 Formwork for Exposed Concrete Surfaces :

The facing formwork, unless indicated otherwise on drawings, or specifically approved by the Engineer in writing, shall generally be made with materials not less than the thickness mentioned below for different elements of the structure

- 1 Plain slab soffits, and sides of beams, girders, joists and ribs and side of walls, fins, parapets, pardis, sun-breakers, etc shall be made with :
  - a) Steel plates not less than 3mm thick of specified sizes stiffened with a

suitable structural framework, fabricated true to plane with a tolerance of +/- 2mm within the plate.

- b) Plywood plates not less than 12mm thick (IS:4990 - Specification for Plywood for Concrete Shuttering Work) or 3mm thick with a 20mm timber plank backing, of specified sizes stiffened with a suitable timber framework.
- 2 Bottoms of beams, girders and ribs, sides of columns shall be made with :
- a) Steel plates not less than 5mm thick of specified sizes stiffened with a suitable structural framework, fabricated true to plane with a tolerance of +/- 2mm within the plate,
  - b) Timber planks of 35mm actual thickness and of specified surface finish, width and reasonable length,
  - c) Plywood plates not less than 12mm thick, of specified sizes stiffened with a suitable timber framework.

#### **C.5 Erection of Formwork:**

**The following shall apply to all formwork (procedure approved from consultant):**

- 1 To avoid delay and possible rejection of the formwork, the Contractor shall obtain sufficiently in advance, the approval of the Engineer for the design of forms and the type of material used before fabricating the forms. (ref. ACI 347 Formwork for Concrete or equivalent I.S. Code). The contractor shall take the consultants approval for the procedure for erection of formwork.
- 2 All shutter planks and plates shall be adequately backed to the satisfaction of the Engineer by a sufficient number and size of walers or framework to ensure rigidity during concreting. All shutters shall be adequately strutted, braced and propped to the satisfaction of the Engineer to prevent deflection under deadweight of concrete and superimposed live load of workmen, materials and plant, and to withstand vibration. No joints in props shall be allowed.

**C.6** Vertical props shall be supported on wedges or other measures shall be taken where the props can be gently lowered vertically during removal of the formwork. Props for an upper story shall be placed directly over those in the storey immediately below, and the lowest props shall bear on a sufficiently strong area.

- 1 Care shall be taken that all formwork is set plumb and true to line and level or camber or better where required and as specified by the Engineer.
- 2 Provision shall be made for adjustment of supporting struts where necessary. When reinforcement passes through the formwork care should be taken to ensure close fitting joints against the steel bars so as to avoid loss of fines during the compaction of concrete.
- 3 If the formwork is held together by bolts or wires, these shall be so fixed that no iron will be exposed on surfaces against which concrete is to be laid. In any case wires shall not be used with exposed concrete formwork. The Engineer may at his discretion allow the Contractor to use tie-bolts running through the concrete and the Contractor shall decide the location and

size of such tie-bolts in consultation with the Engineer. Holes left in the concrete by these tie-bolts shall be filled as specified by the Engineer at no extra cost.

- 4** Provision shall be made in the shuttering for beams, columns, and walls for a port hole of convenient size so that all extraneous materials that may be collected could be removed just prior to concreting.
- 5** Formwork shall be so arranged as to permit removal of forms without jarring the concrete. Wedges, clamps and bolts shall be used wherever practicable instead of nails.

The formwork for beams and slabs shall be so erected so that forms on the sides of the beams and the soffit of slabs can be removed without disturbing the beam bottoms or props under beams.

- 6** Surfaces of forms in contact with concrete shall be oiled with a mould oil of approved quality or clean diesel oil. If required by the Engineer the contractor shall execute different parts of the work with different mould oils to enable the Engineer to select the most suitable. The use of oil which results in blemishes of the surface of the concrete shall not be allowed. Oil shall be applied before reinforcement has been placed and care shall be taken that no oil comes in contact with the reinforcement while it is being placed in position.

The formwork shall be kept thoroughly wet during concreting and the whole time that it is left in place.

- 7** Immediately before concreting is commenced, the formwork shall be carefully examined to ensure the following:

- a)** Removal of all dirt, shavings, sawdust and other refuse by brushing and washing.
- b)** The tightness of joints between panels of sheathing and between these and any hardened core.
- c)** The correct location of tie bars, bracing and spacers, and especially connections of bracing.
- d)** That all wedges are secured and firm in position.
- e)** That provision is made for traffic on formwork not to bear directly on reinforcing steel.

- 8** The Contractor shall obtain the Engineer's approval for dimensional accuracy of the work and for the general arrangement of propping and bracing. (IS:3696 - Safety Code of Scaffolds and Ladders, IS:4014 Steel Tubular Scaffolding I & II) It is imperative that for scaffolding heights of 3.6m and above timber posts or steel scaffolding be used with adequate bracings in horizontal and vertical planes. Bracings with bamboo will not be permitted. When timber posts are used the bracings shall consist of minimum 25mm thick wooden planks fixed to each post with at least two nails. The contractor shall be entirely responsible for the adequacy of propping, and for keeping the wedges and other locking arrangements undisturbed through the decentering period.

(IS 8989 safety code for erection of concrete framed structures)

- 9 Formwork shall be continuously watched during the process of concreting. If during concreting any weakness develops and formwork shows any distress the work shall be stopped and remedial action taken.

**C.7 Exposed Concrete Work:**

Exposed concrete surfaces shall be smooth and even, originally as stripped without any finishing or rendering. Where directed by the Engineer, the surface shall be rubbed with carborundum stone immediately on striking the forms. The Contractor shall exercise special care and supervision of formwork and concreting to ensure that the cast members are made true to their sizes, shapes and positions and to produce the surface patterns desired. No honeycombing shall be allowed. Honeycombed parts of the concrete shall be removed by the Contractor as directed by the Engineer and fresh concrete placed without extra cost, as instructed by the Engineer. All materials, sizes and layouts of formwork including the locations for their joints shall have prior approval of the Engineer or the Architect.

**C.8 Camber:**

Forms and false work shall be generally cambered as indicated in the drawings or as instructed by the Engineer. However, for beams up to 5m span and slabs upto 4m span camber is not normally required to be provided.

**C.9 Tolerances:**

In accordance with IS:456.

**C.10 Age of Concrete at Removal of Formwork**

In accordance with IS:456.

The Engineer may vary the periods specified in IS:456 if he considers it necessary. Immediately after the forms are removed, they shall be cleaned with a jet of water and a soft brush.

**C.11 Stripping of Formwork**

Formwork shall be removed carefully without jarring the concrete, and curing of the concrete shall be commenced immediately. Concrete surfaces to be exposed shall, where required by the Engineer, be rubbed down with carborundum stone to obtain a smooth and even finish. Where the concrete requires plastering or other finish later the concrete surface shall be immediately hacked lightly all over as directed by the Engineer. No extra charge will be allowed to the Contractor for such work on concrete surfaces after removal of forms.

**C.12 Repropping**

For multistoreyed buildings the floors may need repropping to support the loads of the upper floors under construction. The extent of such repropping shall be as directed by the Engineer (this does not normally exceed one fourth of the props provided above). Such repropping shall not be paid for separately and the cost of such repropping shall be deemed to have been included in the rates.

**C.13 Reuse of Forms**

The Contractor shall not be permitted reuse of timber facing formwork brought new on the works more than 5 times for exposed concrete formwork and 8 times for ordinary formwork. 5 or 8 uses shall be permitted only if forms are properly cared for, stored and repaired after each use. The Engineer may in his absolute discretion order rejection of any forms he considers unfit for use for a particular item, and order removal from the site of any forms he considers unfit for use in the Works. Used forms brought on the site will be allowed proportionately fewer uses as decided by the Engineer. Use of different quality boards or the use of old and new boards in the same formwork shall not be allowed.

**C.14 Hacking-Out:**

- 1 Immediately after removal of forms or after seven days curing whichever is higher, the concrete surfaces to be plastered shall be roughened with a bush-hammer or with chisel and hammer as directed by the Engineer to make the surfaces sufficiently coarse and rough to provide a key for plaster.
- 2 At all construction joints in the beams, slabs and columns etc, laitance and any other loose concrete shall be chipped off immediately after striking the formwork. The chipped surface shall then be thoroughly cleaned with a jet of water.

The cost of form work and shuttering is inclusive in the rate of concrete and no extra or additional payment will be made in for the same.

## SECTION – D

### REINFORCEMENT

#### LIST OF BUREAU OF INDIAN STANDARD CODE OF PRACTICE (ISI)

432-	Mild steel and medium tensile steel bars and hard drawn steel wire for Concrete.
1786-	Specification for HYSD bars and wires for reinforcement
1566-	Hard drawn steel wire fabrics for concrete reinforcement.
2502 -	Code of practice for bending and fixing of bars for concrete reinforcement.
2751-	Recommended practice for welding of mild steel reinforcement.
1139-	Hot rolled deformed bars.

#### D.1 Steel :

Mild Steel, rounds conforming to IS:432, hot rolled deformed bars conforming to IS:1139, Cold twisted bars conforming to IS:1566-1977, or rolled steel made from structural steel conforming to IS:226. Any other steel specified for reinforcement shall conform in every respect to the latest relevant Indian Standard Specifications and shall be of tested quality under the ISI Certification Scheme.

All reinforcing work for concrete work shall be executed in conformity with the drawings supplied and instructions given by the Engineer and shall generally be carried out in accordance with the relevant Indian Standard Specifications (IS:2502).

#### D.2 Inspection & testing:

Every bar shall be inspected before assembling on the works and any defective, brittle, excessively rusted or burnt bars shall be removed. Cracked ends of bars shall be cut out. Specimens sufficient for three Tensile Tests per 10 tonnes of bars and for each different size shall be sampled and tested by the Contractor. Batches shall be rejected if the average results of each batch are not in accordance with the specifications.

#### D.3 Lapping

- 1 As far as possible bars of the maximum length available shall be used. Laps shown on drawings or otherwise specified by the Engineer will be based on the use by the Contractor of bars of maximum length. In case the Contractor wishes to use shorter bars, laps shall be provided at the Contractor's cost in the manner and at the locations approved by the Engineer.
- 2 As and when necessary welded laps shall be provided as specified by the Engineer.

#### D.4 Spacing, supporting and cleaning

- 1 All reinforcement shall be placed and maintained in the positions shown on the drawings.



- 2 The Contractor shall provide at his own cost approved types of supports as specified on the drawings for maintaining the top bars of the slab in position during concreting. All cover blocks shall be of concrete (not sand cement mortar) and of the same strength as that of the surrounding concrete and properly compacted. They shall be circular in shape and not square.
- 3 The Contractor to provide chairs at his own cost 18 SWG GI wire shall be used as binding wire. All bars crossing one another shall be bound with this wire twisted tight to make the skeleton or network rigid so that the reinforcement is not displaced during placing of concrete.
- 4 Bars must be cleaned before concreting commences of all scale, rust or partially set concrete which may have been deposited there during placing of a previous lift of concrete. The bars shall be cleaned with dry gunny bags if they are coated lightly with rust or other impurities. On no account shall the bars be oiled or painted nor shall mould oil used on the formwork be allowed to come in contact with the bars. Cement wash to bars shall not be permitted.

#### **D.5 Welding**

- 1 Wherever specified all welding shall be carried in accordance with IS:2751. Only qualified welders shall be permitted to carry out such welding.
- 2 For cold twisted reinforcement welding operations must be controlled to prevent a supply of large amounts of heat larger than that can be dissipated. The extreme non twisted end portion shall be cut off before welding. Electrodes with rutile coating should be used.
- 3 The welding procedure shall be approved by the Engineer and tests shall be made to prove the soundness of the welded connection.

#### **D.6 Measurement:**

- 1 The weight of steel to be paid for at the contract rates shall be the weight of bars as mentioned on the drawings or as instructed by the Engineer including stirrups, ties, spacer bars, chairs and any other steel works specified as reinforcement but excluding binding wire and cover blocks. Laps as specified on the drawings shall be paid for. Laps required because of the contractor's use of shorter bars will not be paid for.
- 2 The weight of any stirrup, tie bar shall be computed from the dimensions given on the drawings or bending schedules. The weight in kg/metre shall be taken as 0.785 kg/metre per 100mm<sup>2</sup> of cross section. No allowance in the weight paid for shall be made for the rolling margin. No rolling margins will be considered for payments.
- 3 Measurement of steel should be recorded at site before concreting. The payment will be done as per the drawings and as per site measurements whichever is less.
- 4 Rolling margin to be account of and not paid.

## **SECTION – E**

## STRUCTURAL STEELWORK

### LIST OF BUREAU OF INDIAN STANDARD CODE OF PRACTICE (ISI)

- 226- Code of structural steel (Standard Quality)
- 2062 - Structural steel code for Fusion welding quality
- 1599- Method for bend test for steel product.
- 1608- Method for bend test for steel products.
- 7205- Safety code for erection of structural steel work.
- 1477- Code for hot dipped galvanizing
- 1477 - Hot dipped galvanized
- 4130 - Demolishing of building (Code of safety)
- 1200 - Method of measurement of building and civil engineering works  
(Part XVIII) demolition and dismantling

#### **E.1 General:**

**1** Contractor to provide :

The Contractor will provide all materials and equipment required to complete the works in every respect, whether such materials are required as part of the permanent structures or temporary for fabrication or erection or maintenance including specifically structural steel plates, flats, bars, welding rods, rivets, bolts and nuts, paint, welding sets in the shop and at site,, all workshop facilities, derricks, cranes, pulley blocks, wire ropes, hemp or manila ropes, winches, erection cleats and temporary braces or supports and all other materials required to deliver the Works complete in every respect.

All labour required for fabrication and erection for any cleaning, making good, rectifying, hauling, and painting and for any other ancillary work required to complete fabrication and erection.

**2** The Contractor shall observe all safety requirements for erection of structural steelwork as covered in IS 7205.

#### **E.2 Drawings:**

**1** The Engineer will supply to the Contractor profile drawings showing sizes of all structural members and typical connection details.

**2** Should there be any discrepancy in the drawings the Contractor is to refer the matter to the Engineer. The Contractor shall further provide a drawing showing the accurate setting out to line and level of all the anchor bolts intended for the work in sufficient time for their inclusion in the work so as to maintain the building programme.

**3** The Contractor is to prepare all the necessary fabrication shop drawings and these shall be submitted to the Engineer in duplicate and be approved by him before fabrication is

commenced. All such drawings shall show the dimensions of all parts, method of construction, welding and bolting. A further set of all approved fabrication drawings shall be supplied by the Contractor for use of the Engineer as required.

- 4 Approval by the Engineer of drawings or any other particulars submitted by the Contractor shall not relieve the Contractor of full responsibility for any discrepancies, errors or omissions therein. The Contractor shall at his own expense supply such additional copies of his working drawings as are required for the use of the interested parties.

### **E.3 Material**

- 1 **Structural Steel:** All structural steel shall be of tested quality and shall conform to one of the following standards:

IS: 226 structural steel (Standard Quality)

IS:2062 Structural steel (Fusion welding quality)

The Contractor shall supply to the Engineer copies of the manufacturers' certificate that the steel brought to the site for incorporation in the works is of a quality fully complying with the specification. If required by the Engineer, the Contractor shall arrange for testing of the steel samples as per IS 1608 + 1599.

- 2 **Welding Electrodes :** Welding electrodes used for the works shall conform to latest IS 814 and shall be supplied by manufacturer approved by the Engineer and shall be of the grade approved by the Engineer. All Electrodes shall be kept under dry conditions. Any electrode that has part of its flux coating broken away or is damaged shall be rejected.
- 3 **Bolts and Nuts:** Bolts and nuts used for the works shall unless otherwise specified be black bolts and nuts supplied by manufacturer approved by the Engineer and shall conform to IS 1367.
- 4 For all other material required for the works, the approval of the Engineer shall be obtained by the Contractor prior to the use of the material in the works.

### **E.4 Workmanship and Fabrication:**

- 1 For all the works, workmanship shall be of first class quality, throughout, in conformity with latest I.S. 800, and true to line, level and dimension as shown in the drawings or instructed by the Engineer.
- 2 All parts assembled for bolting shall be in close contact over the whole surface and all bearing stiffeners shall bear tightly at top and bottom without being drawn or caulked. The component parts shall be so assembled that they are neither twisted nor otherwise damaged as specified cambers if any shall be provided. Drilling done during assembling shall not distort the metal or enlarge holes. The butting surfaces at all joints shall be so cut and milled so as to butt in close contact throughout the finished joints.

- 3** Hand flame cutting will not be permitted.
- 4** Punching of holes will not be permitted.
- 5** All welding for the works shall be carried out by first class welders and shall be in accordance with I.S.S.816/, I.S: 819, I.S. 1024, I.S. 1261 I.S. 1323 and I.S. 9595. The Engineer may at his discretion order periodic tests of the welder and/or of the welds produced by them. All such tests, shall be carried out by the Contractor at his cost.
- 6** As much work as possible shall be welded in shops. The pieces shall be manipulated to ensure down hand welding for all shop joints as far as possible. All parts to be welded shall be arranged so as to fit properly on assembly. After assembly and before the general welding is to commence the parts are to be tack welded with small fillet or butt welds as the case may be. The tack welding must be strong enough to hold the parts together but small enough to be covered by the general welding. The welding procedure shall be so arranged that the distortion and shrinkage stresses are reduce to a minimum.
- 7** All joints required in structure to facilitate transport or erection shall be shown on the drawings or as specified by the Engineer. Should the Contractor need to provide joints in locations other than those specified by the Engineer he shall submit his proposals and obtain the prior sanction of the Engineer for such joints. The lengths of structural shall be the maximum normally available in the market jointing of shorter length in order to make up lengths required shall not be permitted.
- 8** Each piece of steel work shall be marked distinctly before delivery, indicating the position and direction in which it is to be fixed. Three copies of a complete marking plan are to be supplied to the Engineer before erection commences.
- 9** In the case of welded fabrication any distortion remaining in the member after welding operations are completed shall be rectified by and/or at the expense of the Contractor to the approval of the Engineer.
- 10** All members of trusses and lattice girders shall be straight throughout their length, unless shown otherwise on the drawings, and shall be accurately set to the lines shown on the drawings. Sheared edges of gussets or other members to be straightened and dressed where necessary.
- 11** Templates and jigs used throughout the work shall be all steel. In cases where actual materials have been used as templates for drilling similar pieces, the Engineer shall decide whether they are fit to be used as parts of the finished structure.

## **E.5 Testing of Welds**

Crane Girders:

Butt welds in top flanges and webs - 100% radiographic testing (IS 2595) of first six welds and 10% thereafter welding of stiffeners, cover plates to flanges, etc. Ultrasonic testing (IS 4260) of 1 in 5 positions initially, decreased to 1 in 10 position if failures are less than 1 in 10.

Column, Roof elements, Bracing:

Butt welds - Radiographic testing of 5% of welds. Fillet welds - Ultrasonic testing of 1 in 20 Positions decreased to 1 in 50 if failures are less than 1 in 10. Dry testing of all the joints is to be done

## **E.6 Protection of Steel Works:**

Hot Dipped Galvanizing:

- i) Hot dipped galvanizing shall be carried out in accordance with IS-802 (Part II), IS: 5358 and IS:4759.
- ii) The steel work, prior to delivery, shall be cleaned for scale, rust, dirt, grease etc. by means of chipping, scrapping, wire brushing mechanical buffing using skilled operators and dipping in caustic soda bath and then in a bath containing dilute solution of hydrochloric acid.
- iii) The steel shall then be fluxed with ammonium chloride by immersion in a prefluxing bath or other approved means.
- iv) After prefluxing, the steel shall be dipped into the pure (98.5%) molten Zinc held at a temperature between 440 degrees Centigrade to 470 degrees Centigrade. Proper arrangement shall be made to support the member. The size of bath shall be such that it shall accommodate the individual member in its entirety.
- v) The thickness of hot dipped galvanized coating shall be between 75-125 microns or the mass of zinc coating shall be between 610 to 765 g/m<sup>2</sup>.
- vi) Immediately after the steel has been removed from the bath, it shall be wiped, centrifuged to remove excess zinc and eliminate irregularities.
- vii) Proper vents of approved diameter shall be provided for all box members for proper venting of the enclosed space.
- viii) Care shall be taken to avoid the distortion of the steel member.

## **E.7 Erection & Site Work**

- 1 The Contractor shall be responsible for checking the alignment and level of foundation and correctness of foundation bolt centres, well in advance of starting erection work, and shall be responsible for any consequences for non-compliance thereof. Discrepancies if any shall immediately be brought to the notice of the Engineer for his advice.
- 2 During erection the rough handling of fabricated materials such as bending, straining or pounding with sledges shall be avoided. Any damage to the structure during transportation or erection shall be immediately rectified by the Contractor at his own cost. The straightening of bend edges of plates, angles and other sections shall be done by methods that will not cause fracture.

Following the completion of the straightening, the surface of the member shall carefully be inspected for damage and got approved by the Engineer before further use.

- 3 The Contractor shall be responsible for accurately positioning, leveling and plumbing of all steelwork and placing of every part of the structure in accordance with the approved drawings and to the satisfaction of the Engineer. All stanchion base, beam and girder bearings etc. shall be securely supported on suitable steel packs. All reference and datum points shall be fixed near the work site for facilitating the erection work.
- 4 All equipment used by the Contractor shall be sufficient for the purposed and for the erection of the steel work, in the time specified in the contract. Any lifting or erecting machinery shall be to the approval of the Engineer and shall be removed from the site if he considers such appliances dangerous or unsuitable for their functions. The approval of the Engineer shall not relieve the Contractor of the responsibilities for the loads to which the erection equipment shall be called upon to carry. Adequate arrangement shall be made to resist wind loads and lateral forces arising at the time of erection.
- 5 The Contractor is entirely responsible for the stability of the structure during erection and shall arrange that sufficient tack bolts, braces or guy ropes are used to ensure that work will remain rigid until final bolting, riveting or welding is completed. The Contractor shall supply and fix, without extra charge, any temporary bracing which may be necessary.
- 6 All steelwork shall be erected in the exact position as shown on the drawings. All vertical members shall be truly vertical throughout and all horizontal members truly horizontal, fabrication being such that all parts can be accurately assembled and erected. No permanent bolting, welding or grouting shall be done until proper alignment has been obtained.
- 7 At stanchion splices and at other positions where concrete cover to the steel is liable to be restricted, bolts will be placed with their heads on the outside of the members.
- 8 All field assembly bolting and welding shall be executed in accordance with the requirements for shop fabrication excepting such as manifestly apply to shop conditions only. Where steel has been delivered painted the paint shall be removed before field welding for a distance of at least 50mm on either side of the joints. The number of washers on permanent bolts shall not be more than two for the nut and one for the bolt head.
- 9 Erection to done after applying all coats of paint.

#### **E.8 Rectification of damaged materials**

Any error in shop work which prevents the proper assembly and lifting up of the parts by moderate use of drift pins or reaming or cutting shall be immediately reported to the Engineer and his approval of the method of rectification obtained in writing. Wrongly fabricated material whose erection in the field necessitates extra work shall be the responsibility of the contractor. The entire costs of such operation including the replacement of defective members, if required, shall be borne by the contractor.

## **E.9 Inspection**

- 1 The contractor shall inform the Engineer of the progress in fabrication and as to when individual pieces are ready for inspection. All gauge templates necessary to satisfy the Engineer shall be discretion check the results obtained at the contractor's works by independent tests and should the material so tested be found unsatisfactory, the cost of such tests shall be borne by the contractor.

## **E.10 Grouting of steel bases**

- 1 Before grouting of stanchion bases, the contractor shall take the following action :
  - 1 Inform the Engineer.
  - 2 Clean all holes, openings, recesses and the top of foundations of all dirt, mud, water, oil or other extraneous matter.
  - 3 A frame shall be placed in position around the base plate with a provision for placing or injecting grout.
  - 4 The contractor shall provide screed bars or mild steel flats and fix them in mortar.
  - 5 Holes shall be provided on the stanchion bases for escape of air.
- 2 Grouting of steel beams, steel stanchions, bases and bearings and encasement of steelwork will be carried out by the contractor after the steelwork has been finally aligned and leveled and approval of the Engineer obtained.
- 3 The bolt sleeves shall be grouted as a separate operation using neat cement grout of a creamy consistency, which shall be poured in so as to completely fill the holes. "Non-shrink" cements, additives of approved makes shall be used for all grouting operations.
- 4 The space between the top of the foundations and the underside of the base plate shall be completely filled with a mix 1:2 cement sand mortar and finished flush with edge of the base plate, either :
  - 1 Mixed as a stiff mortar well rammed into place from all sides.
  - 2 Mixed as thickly as possible consistent with fluidity and poured under a suitable head and tamped until the space has been properly filled.

## **E.11 Holding down and Anchor bolts**

- 1 The holding down and anchor bolts should conform to the requirements laid down in IS:5624 or as directed by the Engineer.
- 2 Installation : Individual bolts in groups of holding down bolts shall be positioned accurately within a tolerance of + 6mm. The bolts shall be set vertically to a tolerance of not more than 1 in 250.
- 3 During the casting of concrete the contractor shall ensure that space between the bolt and sleeves is kept clean after removal of shuttering. The contractor shall

- provide and fix timber plugs to maintain this space in a clean condition. The projecting threads of bolts shall be protected by approved wrapping materials.
- 4 Grouting of bolt tubes shall be carried out after the steelwork or equipment have been aligned, plumbed and leveled.

#### **E.12 Tolerances**

- 1 All tolerances shall be in accordance with IS-7215 unless otherwise specified.
- 2 The maximum deviation for line and level shall be + 3.0mm for any part of the structure including for location of column centres.
- 3 The maximum deviation from plumb for columns shall be + 3.0mm in 10.0m height subject to a maximum of + 6.0mm in a total height of 30.0m.
- 4 The deviation at the center of the upper chord member from vertical plan running through the center of the bottom chord shall not be more than 1/1500 of span but in no case more than 10.0mm. The lateral displacement of top chord at centre of span from vertical plane running through centre of supports shall not be more than 1/250 of the depth of truss but in no case more than 20.0mm
- 5 The crane rails shall not deviate from the true location by more than + 2.0mm.

#### **E.13 Mode of measurement**

- 1 The pricing must include for all rolling margins, extras for length and size, allowance for waste, complete fabrication, delivery and erection, and caulking the gap between base plate and foundation, and primer coats of paints as specified. The final coats of paints, however, will be measured and paid separately on the basis of tonnage fabricated and erected.
- 2 Any temporary strutting, tying or anchor bolts, black bolts, fasteners, welding required to withstand the stresses of erection and carrying of plant are to be included in the price.
- 3 The payment for the steelwork will be for the weight of the steelwork actually erected, i.e. plates, rolled sections, shear connections, cleats, splice plates.  
Dimensions of the steelwork will be taken on site or from the actual shop working drawings as preferred by the Engineer. In calculating the weights of gusset plates, payment will be made for the least enclosing parallelogram or triangle. For structural sections the weight will be calculated on lengths actually used with no deduction for splay cut or mitred end. In case of imported sections, the weights chargeable shall be the weight according to the relative standards of the country of origin. Full weight of the bolts and nuts will be paid for as per Indian Standard Codes weights without any deduction for shanks, etc. No account shall be taken of the weight of weld in



calculating the weight of steel work. Erection packing plates bedded in mortar and wedges shall not be measured but shall be included in the rates. No deduction shall be made for openings less than 0.1m<sup>2</sup> in area measured in plane for bolt holes. The weight of sheet steel, plate, strips and rolled sections shall be taken from relevant Indian Standards.

- 4 Unless otherwise specified, foundation and anchor bolt assemblies shall be measured separately including nuts and washers.

#### **E14 STAINLESS STEEL ITEMS.**

##### **Process of Manufacture**

The raw material shall be preferably manufactured by an ISO 9002 accredited plant with good manufacturing facilities for rolling of stainless steel sheets with proven history of supplies to critical industrial applications in India and abroad.

There should be in-house testing facilities and quality assurance system, which will ensure supply of material as per the specification. There should be in-house bending facilities to get required shape.

Material shall be in form as per requirement in cover width of minimum 1000m for sheeting. On one side of the sheet continuous marking indicating grade, size manufacturer's identification / ISI certification mark, cast number shall be incorporated using on - line ink jet marking.

##### **Packing, Transportation and Storage**

Special care shall be taken during transportation of the material to the site so as to avoid damages, scratches, removal of coating etc.

SS sheet packing shall be done as per IS 6911.

Proper storage and handling arrangement shall be made by the supplier so as to make the material available as and when required by the fixing agency.

Material received in good condition will only be accepted.

##### **Testing**

Original test certificate of the manufacturer shall be made available for the parent material (stainless steel sheet / coil), indicating the chemical composition, mechanical properties etc. as per ASTM A 312.

A separate test certificate shall be made available for the resin coating carried out on the stainless steel sheets.

Sampling for analysis chemical and mechanical test shall be done as per IS 6911 / ASTM. If desired by the purchaser / client the testing shall be carried out in the presence of client's representative in the laboratory approved by the purchaser. All expenses towards the same shall be borne by the supplier.

The material shall be summarily rejected if the testing results are found non-satisfactory.

#### **Precautions during storage and erection**

Sufficient care is to be taken to see that no material is stacked over the Stainless steel material.

Industrial cloth lined gloves shall be used to avoid scratches / cuts on the labourer's hand.

Method statement for fixing of stainless steel sheets of the desired profile shall be submitted and same shall be approved by Engineer-in-charge.

#### **E14.a) HANDRAILS/ LIGHT POLES**

Supplying handgrip stainless steel pipe with brackets of various outer diameters as per architectural drawings and with minimum 1.66 mm thick, should be confirming to ASTM A 312 TP34 and ANSI B 36.19 E schedule 5S. The fabrication shall be of best workmanship. All the joints shall be finished off in a proper manner, planned. Intermediate joints shall be not permitted. Sample of handrail section shall be tested in an approved laboratory for chemical composition.

The handrails shall be erected in accordance with manufacturers specification. It shall be aligned and kept in plumb by suitable supporting arrangement. Fixing of handrail shall be done by using 12mm dia wedge bolts or equivalent approved by architect or by welding to inserts plate. Handrails shall be protected with a layer of clear transparent lacquer based methacrylic or cellulose butyrate. The coating shall be removed after installation is completed and after completion of finishing work in the adjoining area. All the joints between civil work and handrail brackets shall be sealed by applying silicone seal of approved type and make.

#### **MODE OF MEASUREMENT AND PAYMENT**

Actual weight including that of brackets/flashing as per approved drawings shall be measured and paid on weight basis. The rate shall include the cost of wedge bolts, silicone sealant, fixing glue welding to inserts plates and these shall not be measured for the payments.

#### **E15 STAINLESS STEEL ITEMS.**

##### **Process of Manufacture**

The raw material shall be preferably manufactured by an ISO 9002 accredited plant with good manufacturing facilities for rolling of stainless steel sheets with proven history of supplies to critical industrial applications in India and abroad.

There should be in-house testing facilities and quality assurance system, which will ensure supply of material as per the specification. There should be in-house bending facilities to get required shape.

Material shall be in form as per requirement in cover width of minimum 1000m for sheeting. On one side of the sheet continuous marking indicating grade, size manufacturer's identification / ISI certification mark, cast number shall be incorporated using on - line ink jet marking.

##### **Packing, Transportation and Storage**

Special care shall be taken during transportation of the material to the site so as to avoid damages, scratches, removal of coating etc.

SS sheet packing shall be done as per IS 6911.

Proper storage and handling arrangement shall be made by the supplier so as to make the material available as and when required by the fixing agency.

Material received in good condition will only be accepted.

##### **Testing**

Original test certificate of the manufacturer shall be made available for the parent material (stainless steel sheet / coil), indicating the chemical composition, mechanical properties etc. as per ASTM A 312.

A separate test certificate shall be made available for the resin coating carried out on the stainless steel sheets.

Sampling for analysis chemical and mechanical test shall be done as per IS 6911 / ASTM.

If desired by the purchaser / client the testing shall be carried out in the presence of client's representative in the laboratory approved by the purchaser. All expenses towards the same shall be borne by the supplier.

The material shall be summarily rejected if the testing results are found non-satisfactory.

#### **Precautions during storage and erection**

Sufficient care is to be taken to see that no material is stacked over the Stainless steel material.

Industrial cloth lined gloves shall be used to avoid scratches / cuts on the labourer's hand.

Method statement for fixing of stainless steel sheets of the desired profile shall be submitted and same shall be approved by Engineer-in-charge.

#### **E15.a) HANDRAILS/ LIGHT POLES**

Supplying handgrip stainless steel pipe with brackets of various outer diameters as per architectural drawings and with minimum 1.66 mm thick, should be confirming to ASTM A 312 TP34 and ANSI B 36.19 E schedule 5S. The fabrication shall be of best workmanship. All the joints shall be finished off in a proper manner, planned. Intermediate joints shall be not permitted. Sample of handrail section shall be tested in an approved laboratory for chemical composition.

The handrails shall be erected in accordance with manufacturers specification. It shall be aligned and kept in plumb by suitable supporting arrangement. Fixing of handrail shall be done by using 12mm dia wedge bolts or equivalent approved by architect or by welding to inserts plate. Handrails shall be protected with a layer of clear transparent lacquer based methacrylic or cellulose butyrate. The coating shall be removed after installation is completed and after completion of finishing work in the adjoining area. All the joints between civil work and handrail brackets shall be sealed by applying silicone seal of approved type and make.

#### **MODE OF MEASUREMENT AND PAYMENT**

Actual weight including that of brackets/flashing as per approved drawings shall be measured and paid on weight basis. The rate shall include the cost of wedge bolts, silicone sealant, fixing glue welding to inserts plates and these shall not be measured for the payments.

#### **E16 HOT DIPPED GALVANIZED STEEL HANDRAILS**

Supplying hot dipped galvanized steel pipe with brackets, as per architectural drawings.

The fabrication of handrail shall be of best workmanship. All the joints shall be finished off in a proper manner, planned, and should be approved by Architect, and then it should be sent for hot dip galvanizing. Hot dip galvanizing shall be confirming to I. S. 1477.

The handrails shall be erected in accordance with manufacturer's specifications. It shall be aligned and kept in plumb by suitable supporting arrangement. Fixing of handrail shall be done by using 12mm dia. wedge bolts or equivalent or by welding to inserts plates. One coat of epoxy based finishing paint to be done after completion of finishing work in the adjoining area, as per specification of painting. All the joints between civil work and handrail brackets shall be sealed by applying silicone seal of approved type and make.

#### **MODE OF MEASUREMENT AND PAYMENT**

The rate shall be inclusive of cost of all materials including cost of wedge bolts, silicone sealant, welding to inserts plates, and epoxy based painting. Sections shall be measured and paid on the running meter basis, used in the work but contractor should consider the cost of brackets, wedge bolts, applying protective cover, fixing materials, etc while quoting for.

## SECTION - F

### MASONRY WORK

#### LIST OF BUREAU OF INDIAN STANDARD CODES (ISI)

1077 -	Common burnt clay building bricks
2212 -	Code of practice for brick work
1129 -	Recommendation for dressing of natural building stones
1597 Part - I	Code of practice for construction of rubble stone masonry
1805 -	Glossary of terms relating to stones, quarrying and dressing
8112 -	43 grade ordinary Portland cement
2250 -	Code of practice for preparation and use of masonry mortar
2116 -	Sand for masonry mortar

#### BRICKS

- F.1** All bricks used on the works shall be burnt clay building bricks of second class quality having minimum crushing strength of 35 kg/cm<sup>2</sup> and shall conform to IS:1077 latest. All bricks shall be uniform in quality and size. The bricks shall be got tested as per IS:3495 latest at the contractor's cost.
- F.2** Bricks shall be unloaded by hand and carefully stacked and all broken bricks shall be removed from site.
- F.3** All bricks shall be subject to inspection on the site and shall be to the approval of the Engineer who may reject such consignments as are considered by him to be inferior to the quality specified.

#### MORTAR

- F.4** All mortar shall be prepared in accordance with IS:2250 latest. The sand used shall conform to IS:2116 latest and the water shall conform to relevant clauses of Section B (Concrete) of this specification. Only river sand should be used. Restamping of set mortar will not be permitted.
- F.5** Unless otherwise specified in the Schedule of Quantities, the cement mortar proportion shall be as follows :
- (i) 115 thk brickwork and hollow blockwork 1:4
  - (ii) 230 thk brickwork and hollow blockwork 1:6

#### CONSTRUCTION

- F.6** All masonry work shall comply with the requirements of IS:2212 latest. It shall be of English bond. All closure bricks, etc necessary to comply with the requirements of the bond specified or to break joints effectively shall be procured by the Contractor and used for the work.

- F.7** Ordinarily there shall be four courses per 0.3m height or in other words, the horizontal bed joints shall be on average 10mm thick, and the vertical joints 6mm wide. The mortar shall be worked upto all joints and no hollow space shall be left in any portion of the work. All joints shall be laid truly horizontal and all vertical joints shall be truly vertical. Masonry work shall be raised in a uniform manner so that no one portion is being raised more than 1.0m above another portion at one time.
- F.8** For half brickwalls (115mm thk) which exceed 2.0m in height, a reinforced concrete band 75mm thick (concrete band M-15/10) shall be provided at intervals not exceeding 1.0m. The reinforcement in these bands shall consist of 2 Nos 6mm mild steel rounders with 6mm binders spaced at 150mm centre to centre. Such band shall also be provided at the free edge of all masonry work including window cills and top of free standing walls.
- F.9** All bricks shall be thoroughly soaked by keeping them under water for at least 12 hours before use; the practice of dipping bricks in water just before use will not be allowed. All necessary water cisterns for this purpose shall be constructed or tubs brought by the contractor to the satisfaction of the Engineer to ensure proper soaking of bricks.
- F.10** No bats or broken bricks are to be used otherwise than as closures. No underburnt or overburnt bricks shall be used.
- F.11** All concrete block work shall conform to IS:2572. Well dried blocks shall be laid dry and shall only be moistened to the extent required to compensate the absorption of water from the mortar. Pieces of blocks shall not be used except where they are absolutely necessary to make a closure.
- F.12** Fixtures  
Fixtures, plugs, frames for doors and windows, etc shall be placed in position while laying the course and not later by removing bricks/blocks already laid.
- F.13 Scaffolding**  
Scaffolding consisting of timber ballies, bamboos or steel tubular scaffolding adequately braced to resist all construction loads shall be provided as required by the working stages. Any holes made in the walls for tying the scaffolding shall be made good by filling solidly with M-10/10 grade concrete.
- F.14 Watering**  
The brickwork / blockwork shall be kept wet for a period of at least 14 days after laying. The mortar shall not be allowed to dry at any time.

#### **JOINTS**

- F.15** All unfinished work shall be raked back in courses, unless otherwise directed. When new work is to be joined to unfinished work, the surface of the unfinished work shall be cleaned and thoroughly wetted.
- F.16** The finished work shall be true in line and level. All uneven irregular and disturbed brickwork shall be pulled down and rebuilt with fresh brickwork at the contractor's expense.

- F.17** Joints in brickwork shall be well raked out. Raking out of each day's work shall be done on the same day.
- F.18** Masonry work shall not be raised by more than 8 single courses per day.

#### **TOLERANCES**

**F.19** The permissible tolerance in brickwork shall be as follows :

		<b>TOLERANCES</b>
1	Deviation from position shown on plan of any brickwork more than one storey in height	10mm
2	Deviation from vertical within a storey	5mm per 3m height
3	Deviation from vertical in total height of building	10mm
4	Relative displacement between load bearing walls in adjacent storeys intended to be in vertical alignment	5mm
5	Deviation from line in plan upto 12.0m In any length over 12.0m	5mm 10mm total
6	Deviation of bed joint from horizontal In any length upto 12.0m In any length over 12.0m	5mm 10mm total

#### **UNCOURSED RUBBLE MASONRY STONE**

- F.20** The Stone for the works except where otherwise described shall be of the best quality procurable complying with IS:1805 latest. No stone with flaws, or traversed with seams of perishable materials or quarry faced, or otherwise in any way defective shall be allowed to be used and the Engineer may reject and refuse to permit the use of any stone which, in his opinion, is unfit for the work.
- F.21** Stone masonry, wherever required, shall conform to the requirements of IS: 1597 latest and shall be composed generally of large stone weighing about 25 kgs. The face stones to be squared on all joints and beds shall be hammered and chisel dressed, true and square for at least 75mm back from the face, and the joints for at least 40mm (IS:1127 latest and IS:1129). The face of the stone is to be hammer dressed and "bushing" shall not project



more than 40mm. The stone shall be clean flat bedded properly selected for their places and carefully laid with a suitable proportion of smaller stones and chips to fill up the interstices. The mortar including the constituents shall conform to the requirements of IS: 2250 latest.

- F.22** The whole masonry shall be hand set and solidly bedded in and surrounded with mortar on every side except the face. There shall be no hollows or dry portions in work nor pinning in the face and no joint shall be more than 10mm. The face stone shall be flat bedded, shall tail back and be bound well into the body of the wall and shall not be of a height greater than either the breadth on face or length of the tail. Through stones covering the whole width or thickness of the walls, or 600mm long where the walls are thicker than 600mm, shall be inserted at every 1000mm measured horizontally and vertically. The rate for stone masonry shall include the extra cost of the through stones. The faces of the walls shall be strictly straight. The masonry shall be shaded from the sun, and kept wet for not less than 14 days after completion.
- F.23** All fixtures, plugs, frames shall be placed securely as the work proceeds and not after completion of the masonry. Iron holdfasts shall be given a coating of bitumen to avoid rusting.
- F.24** Scaffolding as described in clause F.13 above shall be provided as required.

#### **MODE OF MEASUREMENTS**

- F.25** The quoted rate shall cover supply of all materials, manufacture of concrete blocks, tools, scaffolding, plant, labour and all other incidental work required to complete the work in accordance with the above specification. All brick and rubble masonry work 230mm and above shall be measured and be paid on a volume basis (m<sup>3</sup>). All other masonry work shall be measured and paid on an area basis (m<sup>2</sup>).
- No deductions shall be made for (1) ends of dissimilar materials like girders, beams, lintels, rafters, etc upto 500 sq.cm. in section and (2) opening upto 0.1 sq.m. in face area.
- Deductions for doors, windows, etc. shall be made for the actual square opening in the masonry at the frames although the jamb, cills etc. may be splayed. No deduction shall be made for the embedded portions of items like cornices, string courses, and corbels etc. which are paid separately on running meter basis.
- Floor and roof slabs, cills, lintels and portion of R.C.C. staircases, which occur in the masonry and are separately paid for shall be deducted.
- F.26** Reinforced concrete bands shall be carried out as per clauses of Sections B (Concrete), Section C (Formwork) and Section D (Reinforcement). But no payment shall be made separately for providing and fixing in position of shuttering, steel reinforcement and concrete for these bands in 115 brickwork. The items 115 brickwork includes all the materials, labour and use of equipment necessary for the satisfactory of construction.
- F.27** All the deductions shall be made as per the I.S.1200 (Part iii and iv ) unless otherwise mentioned.

## **F 28 Providing dry trap rubble stone masonry wall :**

### **General :**

The item provides for the dry rubble stone masonry of the specified type of stone for the toe walls, including necessary excavation etc. complete.

### **Materials :**

The trap stone will be obtained from quarry defined in the special provisions or from other sources approved by the Engineer. The size of the stone shall be as specified for the item or as per directed by the Engineer in charge. The stone shall be kept free from dirt, dust, oil, or any other injurious materials, which may attack the stone or mortar to prevent adhesion of mortar. Stones with skins shall not be used.

Different categories of stones such as face stones headers, quoins, etc. shall be collected in advance to suffice at least for a week's requirement and shall be stacked separately category wise.

### **Method of laying the stones:**

The masonry shall be laid to lines, levels, curves and shapes shown in the plans. Fixture, plugs, frames etc., if any, shall be built in at places shown on the plan or directed by the Engineer while laying the masonry and not later by removing the stones already laid:

(a) Stones in the hearting shall be laid on their broadest face, which gives better opportunity to fill the space between stones.

(b) Stratified stones must be laid on their natural beds. All bed joints shall be normal to the pressure upon them.

(c) In battered walls, the beds of stone and the plane of courses should be at right angles to the batter.

(d) The courses of masonry shall ordinarily be pre-determined. They shall generally be of the same height. Where there is to be a variation in height of courses, larger courses are to be placed at lower levels, the height of courses decreasing gradually towards the top of the wall, unless plans specify otherwise due to architectural requirements.

(e) The dry rubble masonry shall conform to the specifications same as that of uncoursed rubble masonry except that of the following deviations:

1. The masonry will be without mortar (i.e. dry)
2. The quoins may be dressed like khandkies on the face and need not be rough tooled.
3. The spaces between larger stones shall be filled with spalls as tightly as possible.

In case of discrepancies in the description the Standard Specifications as per detailed in Rd 74. may please be referred. The face stones shall be laid without any planning on the exposed faces. In each course the headers or lines of headers as the case may be shall be kept in position at specified intervals and with specified laps where such laps are required before the masonry of the layer is commenced to ensure that they are being laid properly and in required numbers and intervals.

**Item to include :**

Uncoursed rubble masonry includes quoins, headers, etc. and laying of rubble masonry.

Erecting and removing all scaffolding, ladders and use of plant required for execution of the item, safety of the labour and inspection of the work including compensation for any injury damage etc.

Necessary excavations, dewatering etc. complete.

All labour, use of tools, materials and other items incidental to satisfactory completion of the item.

**Mode of measurement and payment :**

The quantity of uncoursed rubble masonry to be paid under this item shall be in number of cubic meters of the finished work including quoins etc., and with the limiting dimensions not exceeding those shown on the plans or as fixed by the Engineer. The contract rate shall be based on a unit of one cu. meter of finished masonry. Dimensions shall be measured and individual quantities calculated correct upto two places of decimals of a meter and cubic meter respectively.

## SECTION-G

### PLASTERING AND POINTING

#### LIST OF BUREAU OF INDIAN STANDARD CODES (ISI)

1542 - Sand for plaster

8112 - 43 grade ordinary Portland cement

1200

Part - XII Method of measurements of building and civil engineering works  
(Part XII) Plastering and Pointing

1661 - Application of cement and cement lime plaster

#### GENERAL:

**G.1** All plaster work shall comply to IS-1661 (Application of cement and cement lime plaster finishes). The cement shall be ordinary Portland cement conforming to IS:8112. The lime shall conform to IS-712 (Building limes). The sand shall conform to IS-1542 (sand for plaster). The sand shall not contain any particle larger than 3mm and shall be washed before use.

The use of crushed sand will not be permitted for finishing items like masonry & plaster etc.

#### PREPARATION OF SURFACES:

**G.2** Concrete surfaces shall be roughened by wire brushing, hacking, or bush hammering or chiselling. If the Engineer is not satisfied with the roughening achieved by these methods he may order other methods such as washing with acid/applying Hack aid etc.

**G.3** Loose layers of dust etc. on surfaces to be plastered shall be washed. The surface shall be cleaned to remove oil, paint or any other material that might interfere with satisfactory bond and saturated with water so as to be damp when the plaster is applied.

**G.4** To avoid cracks at the junction of concrete with brick/block work the plaster shall be reinforced at such junctions by fixing standard wire mesh (G.I - expanded metal) as directed by the Engineer.

### **PROPORTIONING:**

- G.5** The materials used in the preparation of plaster may be measured either by volume using gauge boxes or by weight. The mix proportion of lime, unless otherwise stated generally refers to the volume of putty.
- G.6** Cement and Sand Plaster: Cement and sand shall be mixed dry in the required proportions to obtain a uniform colour. Water shall then be added to get the required consistency for the plaster.
- G.7** Mixing shall be done mechanically in "Mortar Mill". If hand mixing is allowed by the Engineer, mixing shall be carried out on a clean, water tight platform protected from sun and rain.

### **APPLICATION:**

- G.8** Patches of plaster 150mm x 150mm shall be placed about 3m apart as gauge to ensure even plastering. The mortar shall be firmly applied in a thickness slightly more than the required thickness and well pressed into the joints, rubbed and leveled with a flat wooden rule to required thickness.
- G.9** All plastering shall be made good upto metal or wooden frames, skirting and around pipes or fittings.
- G.10** For internal plastering, scaffolding shall be erected independent of walls. No members of scaffolding shall be allowed to be housed in the walls being treated with plaster. Scaffolding for external plaster shall also be supported independent of walls as far as possible to avoid patchy appearance.

### **WETTING & CURING:**

- G.11** Surfaces to be plastered shall be properly watered and in advance before plastering so as to keep the surface damp. Plastered surfaces shall be kept thoroughly wet by sprinkling water for at least 7days as directed by the Engineer. Surface with craziness or cracks shall be rejected and the contractor shall dismantle such plaster forthwith and apply plaster all over again, at his cost.

**G.12 Sand faced plaster:**

The sand faced plaster shall be applied in two coats. The first coat (base coat) shall be of proportion 1:4 and approximately 15mm thick. The base coat shall be trowelled hard so as to ensure a permanent bond. The surface of the base shall be thoroughly combed so that 3mm deep grooves at 12mm apart are formed when the mortar is in the plastic stage. The base coat shall be cured for at least two days. The second coat shall be applied with the mortar of

same proportion but 8mm thickness. The mortar shall contain sand with slightly larger proportion of coarse material. The surface shall be finished with a wooden float, and trowelled to get a uniform surface. A sponge dipped in cement water shall be used with a circular motion to get the sandy appearance.

**G.13 Cement & Sand Plaster Smooth Finished:**

The cement mortar of the proportions 1 cement to 4 sand shall be applied on all the walls brick or concrete surfaces specified to a uniform thickness of about 12mm/15mm or 20mm in one or 2 coats and shall be trowelled smooth using a wooden float. Use of dry cement to obtain smooth finish trowelling shall not be permitted. Care should be taken to ensure that the plastered surface does not dry out too quickly and also it is not over trowelled, in order to avoid crazy cracks.

**POINTING:**

**G.14** The joints of the masonry either brick or stone to be flat / tuck pointed shall be raked to a depth of about 20mm while the mortar in the joint is still fresh and the joints shall be kept well wetted till the pointing is done. The mortar for the pointing shall consist of one part cement and two parts sand and shall be applied to wetted joints uniformly. The joints of the pointed work shall be regular and uniform in breadth. The edges of the pointing shall be cut off parallel so as to leave well defined lines about 200mm apart. The pointing shall be kept well wetted for five days after the pointing is done.

**MEASUREMENT:**

**G.15** The quoted rates shall include the preparation of surfaces, erection and dismantling of scaffolding, materials, labour, curing, all tools and equipment required to complete the plaster work in all respects. The plastered and pointed surfaces shall be measured and paid on an area basis (m<sup>2</sup>) for the area actually plastered in accordance with IS:1200 (Part XII). No separate payment shall be made for curing and finishing around skirting, door and window frames.

## SECTION - H

### PAINTING

#### LIST OF BUREAU OF INDIAN STANDARD CODES (ISI)

- 6278 - Code of practice for white washing and colour washing
- 2932 - Enamel and synthetic, exterior (a) Undercoating (b) Finishing
- 2933 - Enamel and synthetic, exterior (a) Undercoating (b) Finishing
- 5410 - Cement paint
- 427 - Distemper dry colour as required
- 428 - Distemper, plastic emulsion colour as required
- 1200
- Part - XIII Method of measurement of building and civil engineering works  
(Part XIII) White washing, colour washing, distemping and painting of building surface
- 1200
- Part - XV Method of measurement of building and civil engineering works  
(Part XV) Painting, polishing, varnishing etc
- 2395 - Painting of plastered surface

#### **H.1 White washing and colour washing:**

White washing and colour washing shall be in general comply with IS:6278 latest. Only freshly burnt lime of good quality free from stone and other foreign matter shall be used, slaking shall be done at site with an excess of water and the lime allowed to remain under water for two days. The mixture of lime and water shall then be drawn off, placed in a suitable receptacle and clean fresh water added to bring it to the consistency of thin cream. The wash so prepared shall be strained through a coarse cloth or fine sieve and mixed with gum water. The quantity of gum to be used shall be at the rate of 2 Kg/m<sup>3</sup>.

The surface to be white or colour washed shall be thoroughly broomed down so as to remove all dust and holes if any shall be stuffed with materials similar to the surface.

Three coats of white wash shall be applied with proper fibre brushes. Each coat must be allowed to dry and will be subject to inspection before the next coat is applied.

The colour wash shall be prepared by adding a solution of water and lime fast pigment boiled if directed to the lime wash prepared as above which shall be done gradually and stirred until the required tint is obtained.

For all colour wash, a sample must first be applied, allowed to dry and approved by the Engineer-in-charge before the work proceeds. Even colour must be obtained. Three coats are to be given. Patchy or streaky work will be rejected and will be re-executed at the contractor's expense.

## **H.2 Distempering or painting with oil bound water paints etc**

Distemper, washable, shall comply with IS:427 or 428 latest. Ready mixed washable distemper of an approved brand shall be used. Preparation of distemper from ingredients by the Contractor shall not be allowed. The tint of distemper shall be as directed by the Engineer-in-charge and a sample application of it shall be made by the contractor if so desired.

The surface shall be cleaned and all cracks, holes, irregularities etc shall be repaired to get a smooth and even surface. It shall be completely dry and dust-free before commencement of distempering.

## **H.3 Waterproof cement based paints: IS-5410**

The waterproof cement paint shall be of an approved manufacturer such as Snowcem, Oricem or Super Snowcem, or other equivalent and approved and shall be brought to the site in original airtight containers with seal intact.

**Preparatory work:** Surfaces shall be thoroughly cleaned free from dirt, dust, etc by brushing and washing down with clean water. Any grease, oil paint, varnishes and oil bound washable distemper shall be removed by means of an approved paint remover.

**Mixing and application:** The dry cement paint shall be thoroughly mixed with clean fresh water so as to produce a paint of required consistency which for normal work shall be of ordinary paints. In mixing and application, the contractor shall conform to manufacturer's instructions.

Paints for application by brush shall be strained through a paint strainer and paint for spraying shall be twice strained.

The paint shall be kept stirred during use and no paint which has been mixed for a period longer than one hour shall be used.

The paint to surface other than rough cast may be applied by means of brushes or spraying with low pressure pot sprayer. Spraying, however, may only be carried out if the Engineer-in-charge approves. The paint applied to roughcast surface shall be by means of spraying.



Absorbent surface shall be thoroughly dampened so as to give even suction. In dry weather freshly painted surfaces shall be kept damp for at least 2 days and protected from the sun.

When more than one coat is ordered, subsequent coats shall not be applied until the preceding coat has thoroughly hardened and is approved.

**H.4 Painting: oil paint, synthetic enamel, acrylic, plastic emulsion , texture etc :** As per respective IS Codes 2932, 2933

Paints of approved manufacturer only shall be used and shall be applied as per specifications of the manufacturer. Paints appropriate for the surface to be painted shall be used.

**Painting Plastered Surface IS: 2395**

**Primer Coat:** For plastered surfaces to be painted, the same shall be rubbed down with a dry brush to remove loosely adhering matter. One coat of cement primer for other approved primer shall then be applied to the surface. After 24 hours a second coat of primer shall be applied. All cracks in the surface shall be filled with approved putty. Any uneven surface shall be made good by applying approved putty.

**Final Cost:**

The paint shall be constantly stirred and thinned by appropriate thinning agent. It shall be applied uniformly on the surface. The second coat may be applied within three hours of the first coat.

**Painting old surface:**

A surface previously treated with paint or oil bound distemper shall be cleaned properly and rubbed down with sand paper to ensure proper adhesion. No priming coat would be necessary.

Where lime and certain type of dry distemper have been used, the surface shall be washed down with water to remove all traces of alkali. The surface must be allowed to dry for at least 24 hours.

Final coat of paint specified shall then be applied as specified under painting for new plaster work.

**H.5 Quartz reinforced cement, Textured paint**

Method of mixing and application of paint will be as per manufacturers specifications.

a) **Quartz reinforced paint: For Granules :** Providing and applying homogenous coat of not less than 1.5mm thick silica based 100% acrylic polymer bond, grade granular surface coat in

2 pack system of approved shade on a two coat sand faced smooth level plaster without any keying on plastered surface.

- b) **For Flakes or Plaster** : Providing and applying homogenous coat of not less than 1.5mm thick dry flakes made from special grade heat treated china clay or as per manufacturer specification and a 100% acrylic polymer bond exterior grade flakes surface coat in a 2 pack without any keying on cement plastered surface or trowelling plaster of Renovo or equivalent make as per Architects instructions and as specified by manufacturer and painting the same surface with shade as directed by the Architects.

#### **H.6 Mode of measurement & payment :**

The quoted rate for painting shall include the cost of preparing and cleaning the surface as specified, preparing sample of paints for approval, scaffolding and curing wherever required materials, labour, tools and machinery, etc. and cleaning the floor surface from all dirt, paint, etc., after painting has been completed. It shall also include the cost of putty, primer coat, preparation of surface after application of each coat.

Where painted surfaces are to be paid separately, they shall be paid in square metres and the measurement shall conform to IS:1200 Part (XIII) and (Part XV) latest.

## **SECTION - J**

### **FLOORING & CLADDING**

#### **LIST OF BUREAU OF INDIAN STANDARD CODES (ISI)**

1237 - Specification of cement concrete flooring tiles

- 1443 - Code of practice for laying and finishing of cement concrete flooring tiles
- 383 - Coarse and fine aggregate from natural source for Concrete
- 2386 - Method of test for aggregate in concrete work

#### **J.1 TANDUR, SHAHABAD, KOTAH, KADAPPA, MANDANA STONES**

The stone slab shall be from approved quarry and shall be of sizes specified. The edges shall either be machine cut or hand cut as specified. When the stone tiles are machine cut, the corner angles shall be checked before laying and if not found correct, the edges shall be chiseled so as to obtain correct angle between the edges. The hand cut edges shall be smooth and even, and dressing of stone shall be for at least half the thickness of the tile.

The colour of the stone shall be uniform.

The method of preparation of base and laying shall be in accordance with IS:1443 and shall in general be the same as applicable to terrazzo tiles. The top surface shall be polished with grinding machine with carborundum such that there shall not be any scratches on the surface.

#### **J.2 MARBLE/GRANITE SLATE FLOORING**

Stone slabs for flooring, in layers skirting, Dado, treads, risers etc. shall be selected quality marble/granite/slate/slabs/tiles from an approved quarry and of thickness, finish and colour as approved by the Architect. The intent is to use best selected quality White Marble or Jaisalmer yellow marble slabs and Granite/Slate/Slabs/Tiles in appropriate pattern. Stone slabs shall be hard sound, dense, homogenous in texture, free from cracks, decay, weathering and flaws.

Granite stone slab and tiles shall be approved colour and shade and from an approved source from South India.

For polished stone flooring the slabs shall have the top (exposed) face machine polished before being brought to site. Edges of stone shall be machine cut on all sides to a minimum depth of 15mm so that a straight edge

laid along the side of the stone shall be fully in contact with it. The edges of stone slab for counters, stair treads, risers and steps shall also be machine cut and polished to full depth and chamfered or rounded as instructed by the Architect.

The thickness of the stone slabs shall be 20mm to 25mm for flooring work. For stair risers the thickness of slabs shall be 25 mm uniformly. The stone slab for treads shall be 50mm thick

uniformly. Before starting the work, the contractor shall get samples of slabs approved by the Architect. Tiles shall be of sizes and thickness as called for in the Drawing/Documents.

### **MORTAR**

The slabs shall be laid over a bedding of cement mortar 1:4 (1 Cement : 4 clean coarse sand) of thickness 20 mm to 30 mm to make up an overall thickness as called for.

### **LAYING**

The RCC slabs for sub-grade concrete over which the slabs are to be laid shall be cleaned, wetted and mopped. The cement mortar shall be spread over a small area to an average thickness of 20 mm to 30 mm. The slab, washed clean, shall be laid on the mortar pressed, tapped, with a wooden mallet and brought to required level. It shall then be removed and laid aside. The top of the mortar shall then be corrected by adding fresh mortar at hollows. The mortar of the required consistency shall be spread over the same at the rate of 1 bag per 10 sqm area. The edges of the slab already laid shall be buttered with slurry of cement and pigment to match the shade of slabs. The slab to be laid shall then be placed back in position, pressed and properly bedded in level with adjoining slab with as fine a joint as possible. Other slabs are also laid in similar manner to correct levels with fine joints. The surplus slurry on the surface shall be cleaned off. Slabs which are fixed in the floor adjoining the wall shall enter under the skirting or dado as shown on the details. The junction between floor and wall finish neatly as directed. The flooring shall be cured for minimum seven days. Any slight unevenness at the meeting of the slabs shall be cured for at least 10 days.

### **J.3 INLAYS IN MARBLE/GRANITE/SLATE OR STONE FLOORING**

Stone slab for inlays in flooring shall be of selected quality from an approved quarry and of thickness, finish and colour as approved by the Engineer/ Architect.

Specifications for Marble/Granite/Slate flooring shall be applicable for inlays also.

The size of the stone shall be as per drawing, as specified. The stone shall be cut to any odd shaped size to suit the architectural pattern.

Before laying and fixing the stones on the mortar bed, they shall be assembled dry on the floor to ensure the correctness of the pattern and to obtain approval from Engineer/ Architect.

### **J.4 VERTICAL CLADDING IN MARBLE SLATE/GRANITE, KOTAH STONE OR TILES**

Vertical cladding includes the work on internal walls, external walls, isolated RCC columns, etc. Cladding stones or tiles shall be of selected quality from an approved quarry and of thickness, finish and colour as approved by the Engineer/ Architect.

The edges of the exposed right angle corner joints of cladding stones/tiles shall be finished to suit corner angles, and a groove of 6 mm wide shall be cut, the corner edges polished as per detail.

Sufficient numbers of groove, 3 mm wide and 1 mm to 2 mm deep, shall be made on the back of cladding stone/ tiles for proper bonding with mortar or tile adhesive paste.

Wherever specified, chamfers shall be made in the stone.

The joints shall be cut square to the face and shall be at right angles to each other.

### **MOTOR BACKING**

Sand for mortar shall be clean river sand without any salt content.

The thickness of mortar backing specified is nominal and may vary depending upon the thickness of cladding material used.

### **SCAFFOLDING**

Scaffolding for all cladding work shall be of self supporting type. Holes will not be allowed to be made in the masonry or RCC work for anchoring the scaffolding.

Contractor shall ensure proper bonding between backing coat & masonry or RCC work by using approved polymer based bonding agent as per manufacturer's specifications and the rates shall include the cost of this bonding agent. The surface of backing coat shall be roughened for proper bonding with the backing of tiles.

### **CLAMPS**

Cladding stones slab shall additionally be held in position by means of stainless steel/gun metal clamps as specified. The clamps, anchored into the backing masonry/RCC walls or columns in adequate manner, shall be inserted in holes or grooves drilled in cladding stone slabs at specified position and the holes or grooves grouted with appropriate mortar. The number and position of metal clamps shall be as shown in drawing and in any case it shall not be less than two per stone slab. The size of the stainless steel clamps shall be 20mm wide, 1.5mm to 2mm thick and length to suit the detailing. Stainless steel (or other approved material) Anchor fasteners shall be 3.4mm to 3.5mm dia and 35mm long. Contractor shall obtain prior approval from Engineer/ Architect for use of alternatively proven method of fixing stone slabs.

Care shall be taken to protect adjoining works including walls and other elements from staining or damage by cement slurry. Any gaps by which slurry can escape shall be temporarily but properly sealed and slurry removed without staining adjoining work.

Expansion joints as per drawing shall be provided in all cladding work. Spacing of joints both horizontally and vertically shall be between 3 to 4 metres. The face shall be finished as specified or directed after filling the joints with white cement and matching pigment. The surface shall be protected from sun and rain and shall be cured for 10 days.

#### **J.5 GRINDING & POLISHING**

The grinding and polishing shall be commenced about seven days after the slabs are laid. The surface shall be watered and ground evenly with a grinding machine using carborundum stone grade 60. The surface shall then be washed clean and joints grouted with a grout of cement and appropriate pigment mixed in suitable proportion to match the shade of stone. It shall then

be allowed to dry for 4 hours and wet, cured for 7 days. The grinding and grouting operation shall be repeated using carborundum stone grade 80 and 120 till a smooth finished surface is obtained. After thoroughly cleaning the surface, grouting and curing as described earlier, the final grinding shall be carried out using carborundum stone grade 320. The surface shall again be washed clean, dusted over with Oxalic acid at 32 gms per sqm sprinkled with water, rubbed hard with cotton waste and wiped clean the following day. Where use of machine for grinding is not feasible rubbing and polishing shall be done by hand in the same manner as described above.

#### **FINAL POLISH**

When all constructional and finishing work namely painting, joinery work, electrical, plumbing work etc. is completed and just before the area is occupied, the floor shall be worked clean with dilute oxalic acid solution and dried. Non-slip wax polish shall then be applied with soft linen on the clean and dry surface and polishing machine fitted with felt or hessian bobs shall be run over the surface, clean saw dust shall then be spread over the surface, polishing machine applied again mopping up surplus wax and leaving glossy

surface. Care shall be taken that the floor is not left slippery and that ordinary wax is not used under any circumstances. The finished surface shall be true to level and lines. The joints shall be as fine as possible and the surface to finish approved by the Architect.

#### **J.6 PRECAST TILING WORK:**

Terrazo tiles, (marble mosaic tiles), plain or coloured tiles, plain or coloured heavy duty cement floor tiles shall conform to IS:1237 specification for cement concrete flooring tiles :

These tiles shall be of approved colour and size and shall be 25mm thick unless otherwise specified.

**Tolerance:** Tolerance on length or breadth shall be plus or minus one millimeter and on thickness plus 3mm.

**Wearing layer:** Minimum wearing layer shall not be less than 5mm for terrazo tiles and 6mm for heavy duty tiles and terrazo tiles with 20mm chips. Colour and texture of the wearing layer shall be uniform throughout its thickness.

**Laying of tiles:**

IS:1443 Code of Practice for laying and finishing of cement concrete flooring tiles

**Surface preparation:** Minimum 20mm thick under bed of lime mortar (1:2) machine mixed or 1:4 cement mortar spread uniform on the prepared concrete floor base and compacted to proper grade. In the case of lime mortar the bed should be left for some time to harden.

**J.7 SKIRTING**

The skirting shall be of the same materials as that of the floor tiles and shall be of the exact size specified. It shall be fixed to the wall with cement mortar 1:4 bedding. Grinding and polishing shall be carried out by hand using carborundum of appropriate quality.

**J.8 WHITE GLAZED/ MAT FINISHED CERAMIC, SCREEN PRINTED TILES AND VITRIFIED**

**TILE FLOORING AND DADO :** Tiles shall be of approved make, size and shade as stated in the Schedule of Quantities or as per the drawing. No crackled, chipped or warped tiles shall be used in the works. The Architects shall approve all the tiles.

**Preparation of surface :** All masonry faces shall be cleaned thoroughly by removing dirt, loose mortar, efflorescence etc. The concrete surfaces shall be brushed to remove all laitance and roughened to provide a bond for the bedding.

**Fixing :** The masonry and concrete faces shall be given a coat of cement plaster 15-20 mm thick (in proportion 1:4). The surface of the plaster shall be scarified with wire brush for getting a good bond between the tiles and the bedding.

The tiles shall be soaked in clean water for about half an hour before using. The back of the tile shall be buttered with tile adhesive to a thickness slightly in excess of the finished thickness required and the tile pressed to the wall and tapped back in position. Joints shall be uniform, even straight and as thin as possible, in any case not more than 3.0 mm. After tiles have been fixed, the joints shall be cleaned of adhesive and refilled with cement paste or

approved grout of the same shade as that of the tiles. The tiled surface shall be left wet for a period of 7 days.

Glazed rounded corners, convex or concave shall be provided where specified and no extra will be paid for the same.

After the completion of the work the surface shall be cleaned of all stains, etc.

#### **J.9 TILE ADHESIVES FOR CLADDING**

Contractor shall apply evenly tile adhesive of approved manufacturers on the back of the tile without leaving any gap for fixing tile to the prepared surface.

The thickness of such paste shall be 3mm to 4mm and special precaution should be taken when this thickness exceeds while using for tiles for varying thickness. The Contractor shall ensure that the tile adhesive used shall not leach and leave patches of stain on the finished surface of tiles.

Adhesive paste, prepared as per manufacturer's specification shall be used within time limit specified and in no case it shall exceed 15 minutes. If more time has lapsed, fresh paste should be prepared and used. The cost of tile adhesives shall be included in the rate for cladding and no extra payment will be made for extra thickness of tile adhesive.

#### **J.10 CERAMIC TILE FLOORING/CLADDING**

Ceramic tile flooring where called for, shall be of non-slip ceramic tiles. Spartek or other make approved by the Architect. The tiles shall be approved colour, size and shape and shall be laid to the pattern approved by the Architect. The tiles shall be of uniform colour, true to size and shape and free from cracks, twists, uneven edges, and crazing and other defects. The tiles shall be generally of size 200x200 mm or as specified.

The tiles shall be laid over a bed of 20 mm thick cement mortar 1:4 (1 Cement: 4 coarse sand) and levelled to a true surface. The surface of the bedding mortar shall be left rough to provide bond for the tiles. A floating coat of thick cement slurry shall be laid over the screed to proper levels and the tiles set over the same firmly to correct line and levels.

The joints shall be filled and finished neat with cement paste pigmented to the shade of the tile. The joints shall be finished neat as directed and shall be straight, regular and uniform.



On completion, the surface shall be washed with water, rubbed with fine sawdust and left clean.

The finished floor surface shall be true to required levels.

#### **J.11 GLASS MOSAIC TILES**

**Glass Mosaic tiles shall be set to wall or floor in the following manner :**

The surface of the wall or floor is to be plastered with cement mortar 1:4 and allowed to set for a day. A coat of 12mm thick cement mixed in limewater is to be then spread over the surface. After about half an hour, a thin coating of white cement for the light coloured tiles or a coating of grey cement for other coloured tiles is to be then applied. (Adhesives of approved make are alternative) On this, the sheets of mosaic tiles are to be placed and tapped gently with a wooden mallet to get the tiles in proper level. The paper is then soaked with water and peeled out carefully so as not to disturb the tiles from their positions. Any piece not in level or which is broken while tapping shall be pulled out immediately with a sharp instrument and then replaced without leaving time for the cement to set. After removing the paper, the mosaic surface is to be washed with water using a thin brass brush, thus removing the excess cement. On setting of cement, the tiles shall be polished with fine cloth or cotton waste. The surface is to be watered twice a day for four to five days.

#### **J.12 PROTECTION OF WALLS AND ADJOINING WORKS**

The Contractor shall make at his own cost, all necessary arrangements and take requisite precautions to ensure that walls and other adjoining works remain protected from any damages, not only from his own workers/sub-contractor but also from that of other agencies working in co-ordination at the site of work.

#### **J.13 PVC/ALUMINIUM DIVIDING STRIPS**

PVC Dividing strips where called for on the drawings or schedule of finishes shall be "FIXOPAN" (or other approved make) rigid PVC strips of approved shade. The strips shall be fixed on the base to the exact surface level of the floor to divide the surface into required arrangement of panels. The strips cut to profile of the skirting to the full height.

Aluminium strips where called for shall be of the thickness specified.

#### **J.14 MODE OF MEASUREMENT AND PAYMENT**

**Grano flooring:** The rate quoted shall be inclusive of all materials including shuttering if any, permanent edge supports of specified quality, finishing and curing and cleaning the entire surface of all matter and dirt.

It shall be measured and paid per square metre basis for the specified thickness.

**Terrazo tiles, marble mosaic tiles, glass mosaic tiles, cement tiles, insitu mosaic flooring, marble, kotah stone, granite, stone or tiles, glazed or ceramic tile flooring :**

The rate quoted shall be inclusive of all materials, laying, bedding and finishing materials, cutting the tiles, polishing by grinding machine, curing and cleaning etc. complete.

It shall be measured and paid on square metre basis. The area measured shall be exclusive of area of inlay if any. When the range of size of stone or tile is specified, the rate shall be inclusive of cutting stone to any odd shape specified and/or using smaller size of stones or tiles.

**Skirting :** Shall be measured and paid as specified on square metre basis.

For treads and risers these shall be measured and paid as specified on square metre basis.

**Inlays in marble/granite/slate/stones or tiles**

The rate quoted shall be inclusive of all materials and using varieties of stones/tiles in a pattern as per drawing, cutting the tiles, bedding, finishing materials, using of white cement with pigment to suit colour of tiles, polishing by grinding machine curing and cleaning etc.

It shall be measured and paid per square meter basis.

**Vertical cladding in marble/granite/slate/stones or glazed ceramic tile, vitrified and glass mosaic**

The rate quoted shall be inclusive of all materials, cutting the stones/tiles, making grooves, and using various types of stone/tiles in a pattern as per drawing, bedding and finishing materials, approved bonding agents, approved chemical tile adhesive pastes, stainless steel clamps and bolts, self supporting scaffolding, providing expansion joints with approved grade silicone sealant, grouting materials etc. The rate shall also include for cladding on any vertical surface including isolated columns.

**SECTION - K**

**CARPENTRY, JOINERY, ALUMINIUM DOORS & WINDOWS AND SKY LIGHT**

**LIST OF BUREAU OF INDIAN STANDARD CODE OF PRACTICE (ISI)**

**4021 SPECIFICATION FOR TEAK WOOD**

287 - Recommendation for maximum permissible moisture content

1141 - Specification for code of practice for seasoning of timber

2202 - Specification for wooden flush shutters

401 -	Code of practice for preservation of timber
1003 Part I & II	Specification for timber paneled and glazed shutters
6534-	Code for workmanship in wood work
2338	Specification for code of finishing of joinery.
733 -	Specifications for wrought aluminium and aluminium alloys bars and sections
285	Specifications for aluminium alloys bars and sections
1948 -	Specifications for aluminium doors, windows and ventilators
1949 -	Specifications for aluminium windows for industrial buildings
1477 -	Code for hot dipped galvanizing
6248 -	Code for rolling shutter

#### **K.1 Teakwood work :**

Timber used for joinery shall be of good approved quality or Teak wood unless otherwise specified (Ref.IS:4021) and shall be well seasoned (IS:1141) cut square, free from excess wane, from sapwood, dead knot or other defects (Ref.IS:3364).

All timber for carpentry, joinery, rough frame work, backings, grounds, fixing strips and the like shall be treated with an approved wood preservative (Ref.IS:401) and the Contractor shall strictly observe the manufacturer's instructions for using this material. The maximum permissible moisture content in timber shall be in accordance with IS:287-latest.

All workmanship shall be of the best quality (IS:6534) Scantlings and boarding shall be accurately sawn and shall be of uniform width and thickness throughout. All carpenters' work shall be left with a sawn surface except where otherwise specified. Work shall be framed together and securely fixed in the best possible manner and with properly made joints. All nails, screws, plugs, pins, etc. to be provided as necessary and as directed and approved.

Timber of approved quality is to be purchased at the commencement of the contract for further seasoning on the site. The preparation of timber is to commence simultaneously with the beginning of the work generally and to proceed continuously until all the wood work is prepared and stacked on or near the site. All the timber of large scantlings is to be sawn immediately on arrival at site to allow for any shrinkage that may take place. All timber brought to site shall be given anti-termite treatment.

Joints in various members forming any timber frame shall be provided only as shown in the drawings or as directed by the Engineer. Two millimeters will be allowed for each wrought

face of the sizes specified except when described as finished in which case they shall hold to the full dimensions specified.

All work is to be properly, shouldered, wedged, and pinned, etc. to the satisfaction of the Engineer and all properly glued with best quality glue.

All joinery shall be finished off in a proper manner, planed and sand papered as required (IS:2338).

Use of nails shall not be permitted. Fixing of members shall be done by using screws or round brads, heads of which shall be properly punched in ends of timbers built into walls shall have air space left between themselves and the walls.

All exposed faces of woodwork shall be sand papered once before erection for approval of the Engineer. No colour or other preservatives shall be applied without prior approval of the Engineer.

Frames for doors and windows will be provided with Galvanized Iron holdfasts made of 25mm x 6mm thick flats 250mm long and fixed into jambs M-20/10 P.C.C. 1200mm high frames with 6 Nos and frames above 2002mm with 8 Nos holdfasts. Each holdfast will be fixed to the frame with 3 Nos 50mm GI screws.

For fixing timber frames to concrete, rawl plugs and screws of 16 gauge shall be used wherever specified. Rawl plugs and screws of gauge 16 shall also be used for fixing rawl rough grounds, framing, hangers, hat hooks, curtain rails etc. Unless otherwise specified, screws used for the work shall be galvanized.

All timber surfaces coming into contact with masonry or concrete shall be given two coats of wood preservative or solignum approved by the Engineer.

Paneled and glazed shutters, styles and rails shall be as shown in the drawing, molded and mortised together (Ref IS:1003). The shutters shall be square and free from twist.

All glazing is to be of float sheet glass of selected quality and approved by the Engineer. It shall be clear and free from defects make. It shall be cut to the required size and fixed to frame either with spring clips, with approved quality, or with teakwood beading as per details.

The Engineer may order any timber frame to be put together on the ground and submitted to suitable tests to his satisfaction before being placed in position. The cost of any such test shall be borne by the Contractor.

All fixing holes shall be pelted and concealed from view.

## **K.2 40MM THICK FLUSH TYPE BLOCK BOARD (IS:2202)**

Shall be manufactured from selected timber well seasoned and construction with 35mm x 25mm thick teak wood lipping all around the edge. The styles and rails shall be of one piece or alternatively, two or more pieces glued together. The thickness of the cross band shall not be less than 3mm and the thickness of the facing shall be of best quality commercial ply thickness not less than 3mm. Where veneer finish, or formica finishes or any other type is specified they shall be glued separately. All the plywood shall be glued under pressure. Glue used shall be phenol formaldehyde resins.

## **K.3 FIXTURES**

All doors and windows shall be provided with best quality fixtures as specified in the drawing. Samples of all fittings shall be submitted for approval by the Engineer. Unless otherwise specified, hinges, tower bolts, aldrops, handles, baby latches, etc. shall be of best quality brass oxidized of specified size.

Mortise lock, hydraulic closer and other fixtures shall be of approved make. All the fittings shall be fixed with brass screws.

## **K.4 PAINTING**

Painting shall be carried out only after the joinery has been inspected and approved by the Engineer. The surface preparation and applying of primer coats of paint and final coats of paint shall be carried out as per specifications for painting. Unless otherwise specified a minimum of 2 coats of primer paint and 3 coats of final paint to be applied.

Where polishing or varnishing is specified, the surface to be varnished or polished shall be protected from contamination such as inadvertent painting and surface damage. The polishing or varnishing shall be according to the specifications for varnishing or polishing under the section Painting.

## **K.5 ALUMINIUM WINDOWS AND DOORS : IS:1948 & IS:1949**

Aluminium alloy shall conform to IS:733 and IS:285. The Contractor shall submit the sample of section he is proposing to use for the frame, for approval. He shall also indicate the weight of section per one metre length.

Aluminium alloy shall conform to IS:733 and IS:285. The Contractor shall submit the sample of section he is proposing to use for the frame, for approval. He shall also indicate the weight of section per one metre length.

He shall also submit for approval the sample of hinges, handles, pegstays or any other item that may require the approval of the Engineer.

The Contractor shall submit shop drawings for assembly and fixing of Doors & windows and fabrication shall be started only after approval to the shop drawings.

The glass panes, unless otherwise specified, shall be of 5.2mm to 5.5mm thickness for windows and 5.5mm thickness for doors and shall be free from flaws, specks and bubbles. They shall have properly squared corners and straight edges.

Fixing to frames shall be done with approved glazing pins and approved EPDM neoprene gaskets as specified.

Frames consisting of extruded hollow tube sections or other profiles shall be square and flat, the corners of the frame being fabricated to a true right angle. The hinges shall be either of projection type, or friction hinges. Necessary coupling of approved shape shall be provided for composite windows. All holes required for fixing frame, for fixing glazing shall be provided. Only brass screws shall be used for fixing the frame to concrete members.

Vertical and horizontal members shall be of adequate rigidity to resist lateral forces. Design calculation shall be submitted for deflection of members.

All the fixtures for center hung shutters, top and bottom hung shutters, or side hung shutters shall be got approved before they are used. The fixtures used should be such that it should be possible to open the shutter to any angle. The pins of hinges shall be of stainless steel of non-magnetic type.

Whatever friction hinges are specified they shall be stainless steel.

Unless otherwise specified, aluminium doors shall be provided with floor springs of approved quality and make.

All aluminium members shall be supplied in either matt or polished finish including anodizing them by electrochemical process to an approved colour and to a thickness of average 20-micron. The frame shall be protected with a layer of clear transparent lacquer based methacrylates or cellulose butyrate. The coating shall be removed after installation is completed and after completing finishing work in the adjoining area.

The erection of frame shall be same as detailed under steel windows. Where aluminium frames come in contact with steel members, they shall be separated by either a 3mm thick neoprene gasket for full width of aluminium member or any other approved film so as to avoid metallic corrosion.

All joints between Civil work and aluminium work shall be sealed and made airtight by applying Silicone seal of approved type and make.

Rough ground shall be included in the rates for Aluminum works wherever shown in the drawing.

## **SPECIFICATION FOR EXTERNAL SINGLE / DOUBLE GLAZING SYSTEM**

### **1. SCOPE**

1.1 This specification defines the requirement of factory made fabricated and Glazed Single / Double Glazing System consisting of anodized aluminium sections of approved make with Single / Double Glass (colour as per Architects approval) with fixed glass panels fitted with silicone sealant using approved make anchorage system weather seating blocks including accessories to all window panels.

The scope should also include :

- Frameless fixed glazed shop front panel between the two floor slabs.
- Inserts in concrete for the anchorage of all frame works under this scope.
- All sealing and flashing including sealing at junctions.
- Separators. EPDM / Neoprene gaskets, trim, etc.

### **1. APPLICABLE CODES / PARAMETERS**

Glazing should be guaranteed as per following parameters :

- Wind Resistant - UNI EN77, BS-5368 Part-3
- Water Tightness - UNI En86, BS-5368 Part-2
- Air Tightness - UNI EN42, BS-5368 Part-1
- Thermal Insulation - U average value – 1.57 kcal / sq.mts.
- Sound Insulation - R = 30 db for Double glazing and  
R = 40 db for single glazing.

### **2. GENERAL**

Design, manufacturing and installation of aluminium frames shall be in accordance with the Architects instructions and details (whenever required and extruded sections used for installing the frame work shall be of approved manufactures having thickness of 2 mm to 3 mm.

The Contractor shall submit shop drawings showing clearly the relationship of their external façade works to the structure, mechanical and electrical system, floor slabs and other related works. Contractor shall show the arrangement of components, the sequence and details of fabrications assembly and installation of components. They shall include the following :

The Contractor shall also submit samples of joining techniques, relative position of all adjacent walls, beams, columns and slabs, all correctly dimensioned.

The Contractor to provide the following:

Dimension position of Glass edge/faces relative to metal and similarly provide dimensions and edge details for aluminium paneling as applicable.

Full size detail, including isometric drawing of sealing, flashing and jointing methods.

Materials, type, size, location and spacing of all screws, bolts, welds, anchoring devices and accessories.

The Contractor shall submit a fully detailed programme for the presentation of shop drawings to the Architect for approval, and in no case shall the Contractor proceed with any portion of these works without approved shop drawings.

The shop drawings shall include instructions and explanatory details for the sequence of fabrication, assembly, erection and the installation of all materials including the glass and re-glazing procedures.

Details and dimensions of main framing grid as per manufacturers system comprising of mullions, transoms, panel frames, and weight in Kg. per meter length of extruded aluminium sections proposed.

Details of brackets connections of mullions to R.C.C. building frame and connections between transoms and mullions with joint design to withstand wind forces, earthquake forces, building movement forces etc., as per the requirements of the specifications contained in this document and the relevant codes of practice and Structural Design requirements.

Details of weather proofing with E.P.D.M. gaskets of Mac Seal or Eltech or equivalent and weather stripping and details of sealing with imported approved make silicons sealant to prevent leakage of rain water under heavy wind pressure. The E.P.D.M. provided should act as a break in the system to avoid any contact of aluminium with atmosphere.



Infilling Panels of Glass with size of external and internal glass panels in double glazing minimizing wastage due to cutting and details and properties regarding glass offered for the external side.

Details of factory fabricated panels complete with factory formed glazing units ready for quick assembly and erections in positions at site as well as in case of replacement in any event of breakage of glass by factory glazed panel and weight in Kg. per meter length of aluminium extruded sections of heavy gauge in framing.

Insulation of corrosion proof smoke seals of flexible design and construction to prevent air-conditioning and ventilation loss and ensure complete smoke seal of cavity spaces.

The Glazing contractor shall furnish the method of erection and installation also for the Architects approval.

### **3. FRAMES AND GLAZING**

The Glazing shall be fabricated, supplied, erected and installed in position with 6mm thick glass forming uninterrupted glazed surface in accordance with architectural elevation and layout drawings. The glazed surface shall be formed by framing system, which shall be of structurally and mechanically designed technology for fabrication and erection with grid sizes indicated in the drawing and of full window. The horizontal members shall open in length between vertical frames. The perimeter of the frames shall be structurally integrated to form air and waterproof movement joint on all four sides of each panel, Design and sealing of such joints shall ensure that there is no penetration of rainwater through these joints under heavy wind pressures.

For double glazing the infill panels shall be factory made double glazed unit of size as per design and consisting of 6mm thick glass of approved make outside and 6mm clear float glass fixed in precise size on the inner face of the infill panel. The glazed / framing panel shall be formed by means of imported special structural quality silicone adhesive sealant layer manufactured by M/s. Dow Corning, USA or equivalent between glazing panel unit and anodized aluminium framing on all four edges of glasses and internal faces spacer block of required thickness for the joint formed shall be applied with approved quality imported silicone adhesive sealant as specified. Double glazing design must limit the working stress of silicone sealant to 138 Kpa. The applicators of the silicone adhesive structural sealant shall be specially trained tradesmen certified and approved by the adhesive sealant manufacturer namely Dow Corning U.S.A. The procedure laid down by the imported adhesive structural sealant manufacturer shall be strictly followed by these applicators for its application to ensure the high quality and degree of expertise and finish.

All the joints in aluminium framing system and glazed panels as well as joints between aluminium frame with concrete and / or masonry meeting surrounds shall be fully sealed and made air water and weather tight preventing seepage of rain water under heavy wind pressures with provision of adhesive silicone sealant and superior quality of either MACSEAL, ELTECH or equivalent approved make EPDM gaskets shall be free from contract and migrations stain and shall be compatible with all substrates. The details complying with this requirement shall be provided by the contractor along with the tender.

#### **Components of Glazing :**

Fixing Bolts, anchors, Screws and nut shall be manufactured from Galvanized M.S. or alloy of appropriate grade as required. All bolts anchors and others fastening devices shall be self locking unless otherwise noted shall be torque tightened to achieve maximum torque tension where required. Brackets shall be Galvanized M.S. of adequate size to meet design parameters. The bracket joint shall be flexible to allow for all movement deflection and expansion / contraction. All metals to metal joint shall be separated by tough high impact and both side smooth membranes of Teflon of minimum 1.0 mm thickness.

Framing System: The framing system consisting of mullions, transoms, head & sills, Sash & Jamb details shall be of heavy gauge aluminium extruded section to be specially selected to fulfill the requirement of design criteria stipulated herein after in these specifications and Anodizing in specified shade.

Vertical Mullions: Contractor to indicate size, shape, spacing, average weight per meter length to comply with requirement of the specified design parameters. The size of the mullions should not be less than 84mm x 71 mm and thickness of the section should not be less than 2.00mm and the weight of the mullions should not less than 2.440 kg/meter equivalent to EF-4952.

Side Mullions : The size of the Mullions should not be less than 84mm x 43mm and thickness of the section should not be less than 2.00mm and the weight of the mullions should not less than 2.057 kg/meter equivalent to EF-4953.

Horizontal Transom: Contractor to indicate size, shape, spacing and average weight per meter length. Horizontal transom shall not be visible on the floors when seen through the vision panels from inside.

The size of the Transoms should not be less than 64mm x 71 mm and thickness of the section should not less than 2.00mm and the weight of the Transoms should not be less than 2.118 kg/meter equivalent to EF-4991.

Materials : aluminium Extrusions of 6063/T6 quality shall be used of HINDALCO / INDAL or equivalent.

1. Glass : Glass panels shall be of required sizes made up of 6mm thick float glass of approval make and colour of Saint Gobain / Glavertel / Asahi India or other equivalent approved make.
2. Double Glazing : Double glazed insulated glass is made by bonding two parallel glass panes in a hermetically sealed unit with a cavity of dry gas between the sheet of glass. The system is made by using 6mm thick approved glass of approved make on the outer surface and 6mm clear float glass of Gujarat Guardian / Float Glass of India or other approval make inside surface pane. The system is perfected by separating the glass panes with aluminium spacer tube, jointed at each corner and fitted with a special absorbent, which absorbs any remaining moisture. The unit is then sealed with elastic sealant. The primary seal will be polyisobutyle and the secondary seal will be weather sealant of Dow corning.
3. Sealants: Imported silicone adhesive structural sealant DC-995 having excellent properties of adhesion, elasticity, long life and of approved make Dow Corning (U.S.A.) shall be used. All the joints between metal sections in double glazing shall be air and water light and capable of preventing leakage of rainwater under heavy wind pressure and under heavy weather conditions. Wherever the weather sealant is required use DC-789 of Dow Corning. Directions of the manufacturer of the Sealant shall be strictly followed.
4. Openable Shutters: Top hung openable window glazed shutters shall be provided with operating hardware and as per details and requirements of locations to facilitate ventilation, cleaning and maintenance of glass as per layout drawings.
5. Finish to aluminum framing member: 20 Micron thick Anodized of approved shade with PU coating on top for weather protection.
6. The contractor shall furnish details and technical information on all the above requirements.
7. Framing system and connections to building R.C.C. frame:

- 8 For Single glazing stick type system shall be used and for double glazing unitized / Semi unitized type system shall be used.
- 9 Quantities and sizes shall be established by the curtain waller and shall provide for spares to cover construction breakage and future maintenance. Openable window shall be provided as per the drawing with required hardware and shall conform the under mentioned standard.
- 10 Each pane of glass shall be factory bonded with structural silicone to the frame. One site glazing shall be limited to constructional of closure panels only.
- 11 The entire system shall allow for expansion and contraction and building movements and shall be self draining at each horizontal panel joint. Expansion joints details should be submitted for approval.
- 12 Each panel shall be factory prefabricated, pre-glazed and factory cured, and then installed on site.
- 13 Each panel shall have engineered corrosion proof fixing brackets bolted to the side frames, and bolted to the building structure.
- 14 Corrosion proof smoke seals of flexible design and construction between the building structure and the curtain walling shall be provided to ensure a complete smoke seal of cavity spaces.
- 15 The design shall be based on the schematic drawings of Architects. The contractor will be responsible for submitting the design analysis, preparation of detailed shop drawings for Architects approval. The contractor shall be responsible for the quality and efficiency of the design and application of the curtain wall technology required.

It is mandatory that the system be aesthetically pleasing and structurally sound.

#### **16 Aesthetic Design Features**

- a) Vision panels, and spandrel panels and soffit panels shall be of high performance class, selected and manufactured to provide matching external appearance during the day. All framing shall be neatly and accurately formed and be of neat and even thickness.
- b) The junction between unitized panels shall be true to line in case of double glazed systems.

- c) All toughened glass shall have roller lines in a constant direction at all times.
- d) Opening lines shall be extremely frame less in the main facades.

**17 The curtain walling shall be designated to with stand the following forces without failure :**

- a) Wind loading's as per IS 875
- b) Earthquake Forces as per IS 1893 with important factor 1.5.
- c) Building movement – 10mm maximum

18 Before the fabrication of curtain wall, the contractor shall take the actual measurement of building and carryout necessary correction in the shop drawing.

**19 Acceptance Criteria**

- a) Deflection – shall be limited to  $1/1750^{\text{th}}$  of the span of the member.
- b) No distortion – composition of curtain walling member shall be adequate to fully resist distortion.
- c) Movement – The curtain walling system shall be capable of accommodating all stress and movements that are likely to occur during the normal life of 30 years for structural glazing members and not less than 10 years for structural Silicone Sealant.
- d) Plumbing and Alignment – All the members at each joint shall be in perfect line and alignment. Tolerance for plumb of Structural Glazing installed shall be within  $\pm 3\text{mm} / 10 \text{ meter}$ .
- e) Warranty – The contractor shall offer a minimum of 10 year performance warranty for the entire installation carried out and minimum 10 years guarantee for imported structural silicone sealant proposed to be used vis-à-vis similar guarantee from the manufacturer of the silicone sealant to the contractor to fulfill the quality standards stipulated above

**K.6 Rolling Shutters (IS:6248)**

Rolling shutters shall be as per the size to suit the dimensions of the openings shown in the drawing. Unless otherwise specified, they shall be fabricated out of 18 gauge thick G.I laths of convex corrugation with rolling center either 75mm or 65mm and with minimum 12mm corrugation depth. The laths shall be interlocked by alternate end clips.

The side guides shall either be of rolled section or one piece pressed construction and shall be of size 25mm wide, 75mm deep, thickness shall not be less than 3mm.

The shutter shall be provided with bottom lock plate 3mm thick and reinforced by an angle iron stiffener at the bottom and G.I flat at the top.

The suspension shaft shall be of adequate design and unless otherwise specified shall be formed from 8 gauge seamless tube, 60mm O. D. with suitable flange coupling.

The springs shall be of approved high tensile steel flat or coil spring hardened and tempered. These shall be fitted inside the fabricated housing.

The ball bearings shall be double self aligning ball bearings fitted inside CI housing fixed on side brackets holding the suspension brackets at either ends.

The suspension of the shutter shall be bolted on specially fabricated cages formed from G.I. flats and plates all arc welded.

The hood cover shall be made of 20 gauge G.I sheets with necessary stiffeners and framework.

The locking arrangement shall consist of hoop and stable on the bottom plate, lockable from both the sides.

Unless otherwise specified, for overall area of rolling shutters up to 5 sqm pull and push type hand operated shutters shall be provided. Unless otherwise specified, overall areas of rolls shall be carried out to manufacturer's specifications. While fixing to concrete members, only shell anchors shall be used. Chiseling of concrete for fixing bolts will not be allowed.

#### **K.7 ALUMINIUM GRILLS**

The work to be carried out as per the manufacturer specifications (deco grill from Hindalco or other approved manufacturer) and as detailed in Schedule 'A'

## K.8 MODE OF PAYMENT AND MEASUREMENT

**Wooden doors and windows :** The rate quoted shall include the cost of all frames, shutters, glass panes, if any, and all necessary fixtures, wooden preservatives, fixing them in position and embedding the holdfasts in concrete and/or fixing the frames to concrete members with rawl plugs, screws, surface preparation, either applying specified number of coats of approved paint or polishing complete, and shall be paid on square metre basis.

For measurement of doors, the width shall be overall width of the frame measured prior to plastering, and height shall be measured from finished floor level to the top of topmost frame prior to plastering.

For measurement of windows, the width and the height shall be overall frame size measured prior to plastering.

Where only door shutters are to be paid separately as in the case of partition walls, they shall be paid on actual dimension of shutters.

**Aluminium Doors & Windows:** Where specified, in this method aluminium sections shall be measured and paid on the basis of actual weight used in the work which shall include the weight of aluminium fixtures such as hinges, handles, including anodizing, applying protective cover, fixing materials, charges floor springs, door handles etc.

The rate for the glass shall include the cost of all non-aluminium fixtures, such as EPDM gasket, Nylon rollers, anti rattling pieces, Silicone sealant between frame and civil work etc., and the actual area of glass used in the work shall be measured and paid.

**Rolling Shutters & collapsible gate:** The rate quoted shall include the cost of supplying, fabricated, fixing in position with shell anchors, or rawl plugs, bolts, all necessary fixtures including surface preparation and applying paint as specified and shall be paid on square metre basis.

For measurement the basis shall be overall dimension of the rolling shutter.

**Aluminium grill :** The rate quoted shall include the cost of supplying, fabricated, fixing in position with shell anchors, or rawl plugs, bolts, all necessary fixtures including silver anodizing as specified and shall be paid on square metre basis.

to be finished in gel-coat. Shutters to have recess for hinges. The whole shutter to be totally water proof resistant to mild acids, alkalis. Colour/ painting as per direction of Engineer-in-charge.

**Shutters shall be paid on actual dimension of shutters in square metre.**

**SECTION – L  
LANDSCAPING WORKS**

**1. SCOPE OF WORK:**

The landscape contractor shall from the date of commencement of contract, furnish all materials, labour, and related items necessary to complete the work indicated and specified herein.

The landscape contractor will be generally responsible for the-entire site but in particular to works listed below. Along with site management, the responsibilities will include hard landscaping works (civil works related to landscape) and new horticultural works and planting and maintaining\* of these newly created works for a period of 36 months from the date of virtual completion Le from the day of complete execution of the entire works - i.e the day of virtual completion as certified by the LANDSCAPE CONSULTANT.

Maintenance for civil works means ensuring that the constructed works are as intended, cleaned periodically and not damaged. Maintenance for horticultural works includes watering, manuring, weeding (weeding upto 1000 mm around planted areas), fertilizing, using of pesticides or fungicides as required, and other works for the healthy growth of the plants.

After planting, all planted areas that have exposed soil will have to be mulched with straw or hay. Mulching will be evenly spread to cover any exposed soil.



In addition, the contractor will also be responsible for filling gaps, thinning and transplanting, or replanting where plants may need to be replaced. Along with other planting, the contractor will also be responsible for improving soil conditions for planting. This may include import /export of sand/soil to/from site. The contractor will also clear vacant area from existing grasses, keep the site clean and maintain the already planted areas free of weeds, pests or insects that cause diseases. All weeds, unwanted- grasses and plant material will be cleared up to 1000mm from the edge of planting of newly created and already existing horticultural works (such as boundary trees). The contractor will also be responsible for protection of the plants from salt spray that may occur during the monsoons.

## **2. STORAGE SHED:**

No storage area will be provided at site by the Employer. As mentioned In General Conditions of Contract, security of materials at site will be the responsibility of the contractor. Any temporary sheds or structures may be built as working space at the area shown at site and on the approval of the Site Engineer

## **3. ESTABLISHMENT OF NURSERY:**

Due to the expanse of the project, various plants will have to be propagated at the site. For this purpose, a shade net area will be made available by the contractor at site. The contractor will be responsible for the multiplication of plants that will be required on an ongoing basis on the site. The nursery area will have a shade net area with potting shed.

Approximately 2000 sq. ft. of Shade net area using Netlon brand black colour will be required to be maintained and replaced whenever necessary, for which no extra payment will be made by the employer.

It is strongly recommended to actively use the Nursery area for plant propagation and multiplication. It is expected that the rates quoted herein to be cheaper so as to reflect plants grown in the in house nursery. The employer may at any point give an order for plants (indoor or otherwise) to be propagated in the Nursery and compensate accordingly. The contractor will have to have a satisfactory stock of plants specified in this tender in the nursery and share details of the same with the employer and its landscape consultant.

The Contractor will be responsible for maintaining adequate number of all varieties of plants that have been proposed by the Landscape Consultant at any given point of time. The Contractor shall take approval from the Landscape Consultant regarding the plants stocked / propagated before he proceeds with planting in the designated areas. He shall also maintain an additional of 20% of the numbers specified of all the varieties of plants for gap filling and replacement due to mortality.

The Contractor will establish the nursery - within two weeks from the date of Letter of Acceptance and maintain the same for the entire period of the contract and the defects liability period at his own cost. At end of the defects liability period he shall hand over the nursery to the Accepting Officer with adequate number of plants of all species required for filling of gaps, replacement etc. that would have been planted at site as proposed by the Landscape Consultant.

#### **4. WATERING:**

Water will be made available at only one source at site. If the water on site is insufficient or saline or unacceptable, then the contractor shall be responsible for importing water in water tankers for the general upkeep of the plants. No plants shall be allowed to wither or die due to lack of proper watering.

#### **5. REPLACEMENT OF PLANTS:**

Those plants that are not up to the standards, and do not meet specifications shall be replaced by the contractor at no extra cost to the Employer.

When the plants are to be replaced either for filling gaps or poor quality, then the contractor shall replace with plants of equal height, size and age of the plants in that area. For this purpose, extra numbers of plants of those used in the project will have to be maintained in the Nursery.

The contractor shall be responsible for any thefts of plants already planted. While the Employer will provide security at entry and exit points, plants removed by theft shall be the responsibility of the contractor.

#### **6. PLANT REQUIREMENTS:**

Plants and shrubs shall be sourced by the contractor from available nurseries, unless otherwise specified. Seeds shall be acquired from reputed organisations and hybrid seeds will be used where possible - particularly for flower varieties. No plant material shall be changed without the consent of the landscape architect.

#### **7. WEEKLY REPORT:**

The contractor shall also maintain a work report for work completed each week. The same report in

English, will be sent to the landscape architect The landscape architect shall verify completed work as per the report. Contractor will be responsible for meeting deadlines for the completion of the job.

#### **8. RESPONSIBILITY:**

- a) The contractor's work shall not hinder other work, either underground or over ground, such as electrical, phone lines, water or sewage lines, etc. In areas of overlap, the contractor shall work in coordination with other related contractors. -Any damage by the landscape contractor's team to such utilities will be penalized and contractor shall be responsible for cost for such damages.
- b) The contractor shall abide by the Security rules / procedures of the Employer, and shall obtain gate pass, issue I.D. badges to all their employees on site, etc. as prescribed by the Employer.

#### **9. MATERIALS & LABOUR:**

All materials for civil works will be as specified in the Bill of Quantities, unless otherwise noted.

##### **9.1 PLANT MATERIALS:**

All plant materials shall be healthy, found vigorous, free from plant diseases, insect pests or their eggs and shall have healthy well developed root systems. All plants have to be of specified height and should be bushy with plenty of leaves. Plants that are not full grown, or are weak and without adequate leaves will be rejected and not counted towards any payment - partial or full.

Plant supplied shall conform to the names listed on both the plan and the plant list. Numbers of plants will vary depending on area at site. Any discrepancy with numbers from those specified in the Tender should be brought to the attention of the Landscape Architect before proceeding with the work.

##### **9.2 SUPPLY & SUBSTITUTION:**

Upon submission of evidence that certain materials including plant materials are not available at the time of execution, the contractor shall inform the Landscape consultant of the same, who will then provide an alternative to the species. This species checking has to be done within 15 days from the list being made available to the contractor.

##### **9.3 EQUIPMENT:**

All labour should be provided with tools required for regular maintenance and upkeep of a garden.

Lawn mowers, hoses, garden scissors, pruning shears, trowels, spading forks for loosening soil will be available on the labourers at all times.

Safe custody of these tools / equipment shall be the responsibility of the contractor.

#### **9.4 LABOUR & STATUTES:**

All labour force will be of legal age and no child labour will be permitted on site. All payments, salaries and benefits for the labour force will be the responsibility of the contractor. Contractor shall compulsorily abide by the statutory provisions with regards to Construction Labour Act, Workman's Compensation Act, Minimum wages Act, etc. and shall insulate the Employer from any claims in these respects whatsoever.

#### **9.5 TRAINING & MEETINGS:**

The labour will be trained to use proper gadgets required and will use them effectively. Periodical training sessions and meetings with the labour force, in the presence of the landscape architect, if necessary, shall be conducted as and when required or called for.

#### **10. PLANTING:**

Whenever planting, the following specifications will be followed by the contractor. Wherever sand is to be removed, the following specifications shall be followed after refilling the area with good soil.

##### **10.1 DIGGING OF PITS:**

Tree pits of 900mm x 900 mm x 900 mm (approx. 3'x3'x3') shall be dug a minimum of two weeks prior to back filling. The pits for shrubs shall be 600 mm in depth and 300mm diameter. For ground cover, the land will be prepared by digging up to 300 mm (1 ') and soil loosened. While digging the pits the top soil may be kept aside, and mixed with the rest of the soil as specified.

##### **10.2 PLANTING MIXTURE:**

The topsoil will be mixed with 15% farm yard manure or coco-peat. 40% red soil, 20% river sand and 20 % excavated earth (topsoil). This mixture will be filled in pits before and after planting.

##### **10.3 BACK FILLING:**

The soil is back filled, watered thoroughly and gently pressed down -a day previous to planting, to

make sure that it may not further settle down after planting.

#### **10.4 PLANTING:**

No tree pits shall be dug until a final tree position has been pegged out for approval. Care shall be taken that the plant sapling when planted is not buried beyond the level of the pot containing it. Planting should not be carried out in waterlogged soil.

If necessary, a single vertical stake 1 meter (approx. 3 ft) longer than the clear stem of the plant, driven 300 mm to 450 mm (approx. 1 ft to 1'6") into the soil shall be used. Each plant should be secured to the stake so as to prevent excess movement

#### **10.5 STAKING**

If the soil quality is poor, it shall be replaced with soil mixture acceptable to the landscape architect. If the soil quality is satisfactory, then it shall be mixed with manure and river sand. The soil condition will have to be approved by the landscape architect. Pest/termite prevention chemicals or any other approved chemical to be applied into the soil before planting as per supplier's specification.

When planting is in more than one row, then pits will be dug in a zig-zag fashion ensuring a diagonal planting in each row.

#### **10.6 WATERING:**

The landscape contractor shall allow for the adequate watering of all newly planted trees, shrubs and groundcover immediately after planting and during the following growing season, shall keep the plant material well watered.

#### **10.7 MULCHING:**

All planted areas including around trees which have open soil that is exposed will have to be mulched with straw or hay. Rates indicated in the Bill of Quantities shall include such mulching costs. No separate compensation will be paid for mulching.

#### **10.8 PLANTING ALONG THE EDGE OF THE BUILDING:**

All plants proposed to be planted by edge of building in front facade of building should be planted with special care so as to ensure the following :

- a) The painting/cladding of walls is not soiled and kept clean at all times
- b) Watering is done with care so as to ensure water is not entering windows or muddy water is not splashed on walls.
- c) All plants growing over the height of windows should be trimmed below window height.

#### **10.9 PROTECTION:**

The contractor will be responsible and should take measures to protect the planted saplings from cattle, salt spray and high wind pressure. Rates indicated in the Bill of Quantities shall include such costs of protecting the plants including any physical construction such as walls, tree guards, etc. that may be required for the same.

#### **11. SHRUB PLANTING & GROUND COVER: .**

Same specification as for trees, except where specified otherwise

#### **12. LAWNS:**

##### **12.1 PREPARATION:**

period prior to planting the lawn, the area shall be maintained free from weeds, whatever the nature of soil, complete surface shall be trenched over to a depth of 300 - 450 mm. Grading and final levelling of the lawn shall be completed at least 2 weeks prior to the actual sowing.

##### **12.2 SOIL:**

The soil itself shall be ensured to the satisfaction of Landscape Architect to be a good fibrous loam, rich in humus. Pest/termite prevention chemicals to be mixed if required. Top soil shall be mixed. with farm yard manure or coco-peat and mixed with river sand in ratio of 15% manure, 25% river sand. 35% red soil and 25% excavated earth and levelled to maintain positive drainage or specified slopes.

##### **12.3 EXECUTION:**

Nodes of specified grass shall be dibbled not more than 50mm apart on above mentioned soil conditions. Wherever specified. carpet lawn will used. The carpets will be laid next to each other in an even pattern to ensure that all lawn area is covered. After laying of carpet, it should be lightly pressed

into the ground to ensure that it does not shift. and to ascertain that the roots are in soil. Positive slopes will be maintained to ensure that there will be no low lying areas in center where water logging or pools are created.

**12.4 MAINTAINANCE:**

In the absence of rain. lawn shall be watered daily - heavily, soaking the soil thoroughly to a depth of at least 150 mm.

**12.5 CUTTING:**

The scythe must continue to be used for several months until the grass is sufficiently secure in the ground to bear the mowing machine.

**12.6 EDGINGS:**

These shall be kept neat and must be cut regularly with the edging shears.

**12.7 FERTILIZING:**

The lawn shall be fed once a month with liquid fertilizer by dissolving 45 gms of Ammonium Sulphate in 5 litres of water.

**12.8 WEEDING:**

Prior to regular mowing; the contractor shall carefully remove unsightly weeds.

## SECTION - M

### WATERPROOFING

#### LIST OF BUREAU OF INDIAN STANDARD CODE OF PRACTICE (ISI)

- 3067 - Code of practice for general design, details and preparatory work for damp-proofing and waterproofing of buildings

#### GENERAL

The waterproofing work shall be carried out by Contractors who have experience in doing waterproofing work and shall give a guarantee on a stamped paper for good performance of the waterproof treatment for a minimum of **ten years** period and shall, at their own cost, rectify the defects, if any, found during the guarantee period.

#### Surface preparation

Concrete and masonry surface:

Any cracks in the surface (other than hair cracks) shall be cut to V-shape, cleaned and filled with cement mortar 1:2 or with bitumen conforming to IS-702 as directed by the Engineer.

All fungus growth, if any, moss, dust shall be removed by wire brushing.

Masonry drain mouth shall be widened to two and a half times the diameter of the drain and rounded with cement mortar.

When a pipe passes through RCC slab a cement concrete fillet shall be built around the pipe and waterproofing taken over the fillet.



## **M.1 WATERPROOFING OF UNDERGROUND WATER TANKS, BASEMENT AND SUBWAY RAFT**

Boxing shall start immediately after P.C.C. is completed and before the raft concrete is laid. It shall consist of laying rough Shahabad tiles 300 x 300 or other approved size and thickness varying from 20 mm to 25 mm in waterproof cement mortar bedding as specified. The joints between tiles shall be thoroughly grouted with waterproof cement grout in cement mortar with waterproof compound and metal No. 1. The surface shall be finished by laying / plastering 20mm to 25mm thick cement mortar 1:3 with waterproofing compound. After that raft and wall concreting shall be done.

For the vertical surface the waterproofing course shall be continued without break along the external surface after, the vertical elements are cured properly and after necessary injection grouting as specified, in above manner (as done for flooring). While doing vertical surface shahabad cladding, the proper key should be made in base shahabad to make water tight joint. In case, the source of leakage if any, observed during the construction stage shall be located and shall be plugged by injection cement grouting. After completion of the works the tank shall be filled up with water to full capacity and kept under observation for at least one week. If any leakage is observed the same shall be stopped by injection grouting.

### **Mode of measurement and payment**

The rate shall be inclusive of cost of all materials including waterproof admixture, injection grouting, testing the tank and rectifying the defect. It shall be measured and paid on square metre basis.

## **M.2 WATERPROOFING OF BATHROOM, TOILETS AND KITCHEN SUNK ETC**

The treatment shall be done by the following method. But before the work in the floor and wall is done, all chasing or cutting in the floor and / or wall shall be done by the plumber.

A layer of waterproofing plaster in C. M. 1:3 with waterproofing compound of minimum 35 mm thick in the floor area of the depression and minimum 25 mm thick on the side walls of the depression upto floor level shall be laid and finished smooth and hard by trowelling. The waterproof plaster in C. M. in 1:3 with waterproofing compound of minimum 20 mm thick shall then be continued on the walls above the proposed finished floor level upto a minimum height of 600 mm with surface suitable and even to receive tiles to be laid by the contractor. In shower areas in the bathrooms, the treatment shall be for the full height of the wall.

The plumber shall then finish all his plumbing work i.e. of laying and fixing of pans, pipes and traps etc. without and further breaking or disturbing the treatment. The depression shall then

be filled with waterproofing brickbat coba in C. M. 1:4 with waterproofing compound upto the level for putting tiles, the surface being finished even and suitable in 1:15 slope with C. M. 1:3 with waterproofing compound to receive tiles to be laid by the contractor.

#### **MODE OF MEASUREMENT**

- I) Waterproofing plaster shall be measured in square metres for the treated area only. The treatment to the horizontal and vertical area will be measured together. The horizontal area will be measured wall to wall faces before application of treatment and vertical areas shall be measured from top of horizontal waterproofing plastered finished treatment to the top of vertical surfaces.
- II) Brickbat coba filling shall be measured in cubic metre basis. No deducting shall be done for plumbing, piping and fixtures.

#### **M.3 WATERPROOFING OF LIFT PIT OR OTHER SIMILAR WORK**

The lift pit shall be treated inside with injection cement grouting and entire surface shall be given 3 coats of polymer based waterproofing layer (as per manufacturers specification). Then the shahabad tiles of approved sizes shall be laid first at bottom portion over the raft with cement mortar 1:3 with waterproofing compound in 20mm to 25mm gap and it will be grouted with 1:3 waterproofing cement mortar and metal No. 1, then vertical surface shall be clad with shahabad stones with proper key at the joint of base shahabad and vertical surface shall be grouted with cement waterproofing slurry. After necessary curing of three days the entire surface shall be plastered with 20mm to 25mm waterproofing cement mortar 1:3 smoothly. While erecting and fixing of supporting member of lift, precaution shall be taken that no damages shall be done to this waterproofed surface.

#### **M.4 CEMENT BASED WATERPROOFING TREATMENT WITH BRICK BAT COBA**

In general the waterproofing shall be carried out as per specification of the specialist but duly approved by the Engineer.

The roof surface before waterproofing shall be cleaned thoroughly and watered and shall be kept wet at least 12 hours prior to carrying out of waterproofing. If any leakage is observed the source of leakage shall be located and it shall be treated either by injection grouting or by closing of the crack with application of cement mortar 1:2 after cutting a V-shape groove. The treatment shall be continued till the leakage is stopped. Brick pieces of quarter half, and three quarter size are laid piece by piece in the form of horizontal brick masonry in waterproof

mortar with waterproofing compound made up of cement and sand (1:5) and waterproof powder. This treatment is carried out layer by layer to make up the desired thickness to achieve the desired slope as specified in the drawing and as directed.

The brick bat coba is finally covered with jointless waterproofing plaster with waterproofing compound finished smooth with trowel in cement colour, with false markings of 300 mm squares. The treatment is carried along the vertical surface of the parapets and other adjoining walls, upto a height of minimum 300 mm in the shape of round wata. The average thickness of treatment is about 125 mm the minimum thickness at rainwater outlet points being 75 mm with a slope of 1 in 120 or as specified in the drawing.

The surface provided shall be hard and tough suitable for all normal commercial and domestic purposes.

If however, it is desired to cover treatment with decorative tiles, marbles etc then the surface of treatment shall be finished suitable to receive them.

Due to the location of rain water pipes being far apart and due to the span being wider than 9 metres and the water is required to travel on one side only, then the thickness of the treatment increased proportionately to maintain the gradient for the easy flow of rain water and no additional payment will be paid on this account.

Necessary grooves shall be provided in the walls to terminate the waterproofing treatment. At the junction of the wall and the floor a round or triangular fillet of size 200mm x 200mm shall be provided. The entire surface shall be cured for minimum 14 days by storing water to a depth of at least 150mm in the entire area.

During this period if any leakage is observed the same shall be rectified.

## **MODE OF MEASUREMENT**

Waterproofing of the terrace will be paid as per plan area only, measured wall to wall faces before application of treatment. The rounded water and vertical faces will not be paid separately.

## **M.5 CHINA MOSAIC WORK**

**China Mosaic set in cement Mortar :** (For flooring and for wall finish)

**Preparation of Surface :** The surface shall be hacked, roughened and cleaned of all dust and other foreign matter. It shall be wetted before applying the mortar.

**Laying and grouting :** China Mosaic work shall comprise of laying China Mosaic chips/pieces in decorative pattern and design as approved by the Architect. The China

mosaic chips shall consist of about 70% white pieces of 8mm thick broken glazed tiles and about 30% coloured pieces of colour glazed tiles as per colours specified and selected by the Architect and shall not exceed 20mm size. These pieces shall be laid evenly in required pattern and slopes, curves etc. and shall be set in a 20 mm thick bedding of cement mortar 1:3 (1 cement : 3 coarse sand) mixed with approved quality of water proofing compound at 3% by weight of cement content. The finished surface shall be topped with cement slurry applied at the rate of 3.50 kg of cement per sqm so as to ensure proper jointing of the China Mosaic to the bedding mortar, and pointing the joints neatly with white cement.

For wall finish, approved bonding agent shall be used as per manufacturer's specifications between masonry and mortar backing and between surface as plaster and mortar backing for tiles.

### **CURING**

The finished surface shall be properly cleaned and cured for at least 10 days and shall be suitably protected from damage.

### **MODE OF MEASUREMENT**

The rate shall be inclusive of all materials, breaking and mixing assorted coloured glazed tiles, bedding materials using waterproofing admixture, pointing the joints with white cement etc. and shall be measured and paid per square metre basis.

The rates for China mosaic finishes on wall shall, in addition to the above, inclusive of self-supporting scaffolding, approved chemical bonding agent etc.

## **M.6 INJECTION GROUTING**

Injection using waterproofing polymer (as per manufacturers specifications) with cement slurry shall be grouted to the floor and walls as specified and where found necessary.

### **Mode of measurement and payment (M3)**

The rate shall be inclusive of cost of all materials including waterproof admixture, injection grouting, testing and rectifying the defect. It shall be measured and paid on per number basis.

## **M.7. SEALANTS (POLYSULPHIDE)**

All construction joints and saw-cut grooves of the vacuum dewatered concrete wearing course shall be sealed by polysulphide, as per the specifications and procedure given hereunder:

### **M .7.1. Technical specifications:**

The polysulphide sealant shall be formulated from two components:- Base and accelerator (curing agent), to form a flexible rubber like seal. The sealant grade shall be suitable for joints and the grooves of the concrete flooring, which will be subjected to vehicular traffic. For horizontal joints it shall be pour grade, and for vertical joints it shall be gun grade. The sealant shall be UV resistant, and have a movement capacity of at least 25% of the width of joint.

The width to depth ratios of the joint is as follows:

- For joint width  
6 to 12 mm : Depth of sealant = 6mm
- For joint width  
12 to 25 mm : Depth of sealant = Width

2

**M 7.2 Surface preparation :**

The joint to be filled shall be free from loose dirt, dust, oil stains etc.. Remove dust by using compressed air.

**M 7.3 Back-up materials :**

Insert back-up compressible material such as thermacol, polyethylene strip to control depth of sealant as mentioned in (M 9.1) above, and to provide support to the sealant. Bond breaker tape of either celopene or polyethylene self-adhesive tape shall be applied over back-up material if thermacol is used to prevent bonding of sealant to the bottom surface.

**M 7.4 Priming :-**

Two coats of primer compatible with concrete shall be applied on the 2 sides of the joint with an interval of 30 minutes between 2 coats.

**M 7.5** Masking tape of self-adhesive type, polyethylene or celopene shall be applied on both top edges of the joint, to achieve neat and clean joint.

**M 7.6 Filling of joint:**

After 30 minutes of application of primer, the joint shall be filled by simply pouring the same for horizontal joints and inserting by gun for vertical joints. The mixing of accelerator to the base shall be carried out thoroughly to achieve a uniform homogeneous grey colour. Mixing can be done manually with spatula/palette or special flat stirrer attached to a low speed electric mixer less than 500 rpm. It is desirable that a smooth surface is obtained. Tool the sealant by pressing the putty knife or flat tool against the sealant surface, moving along the length of the joint, so as to break any air bubbles, and ensure sealant is compressed to provide good

adhesion to the joint sides. After tooling the masking tape should be removed immediately. Soap solution can be used to smoothen the sealant surface.

**MODE OF MEASUREMENT:**

The item shall be paid on a linear basis RM (running meter) for specified sealant size in specified joint size, including all primer, back-up material, bond breaker tape, masking tape, etc complete.

**M.9 SPECIFICATION NOMENCLATURE OF SUPER THERMOLAY POLYMER MODIFIED POLYESTER REINFORCED MEMBRANE FOR WATERPROOFING**

Providing and laying SUPER THERMOLAY - Torchseal polymer modified Torch-on Membrane waterproofing system (1mx10mx4mm) make, having a thickness of 4mm/3mm non oven polyester carrier of 140gm/sq.m sandwiched between two layers of APP Polymer modified bitumen and both side covered with thermofusible polyethylene film. The membrane will have a softening point above 140 degree C and UV established stabilised to 2,000 hours (equivalent to ten years exposure). The membrane is laid on a properly graded roof in the following manner:

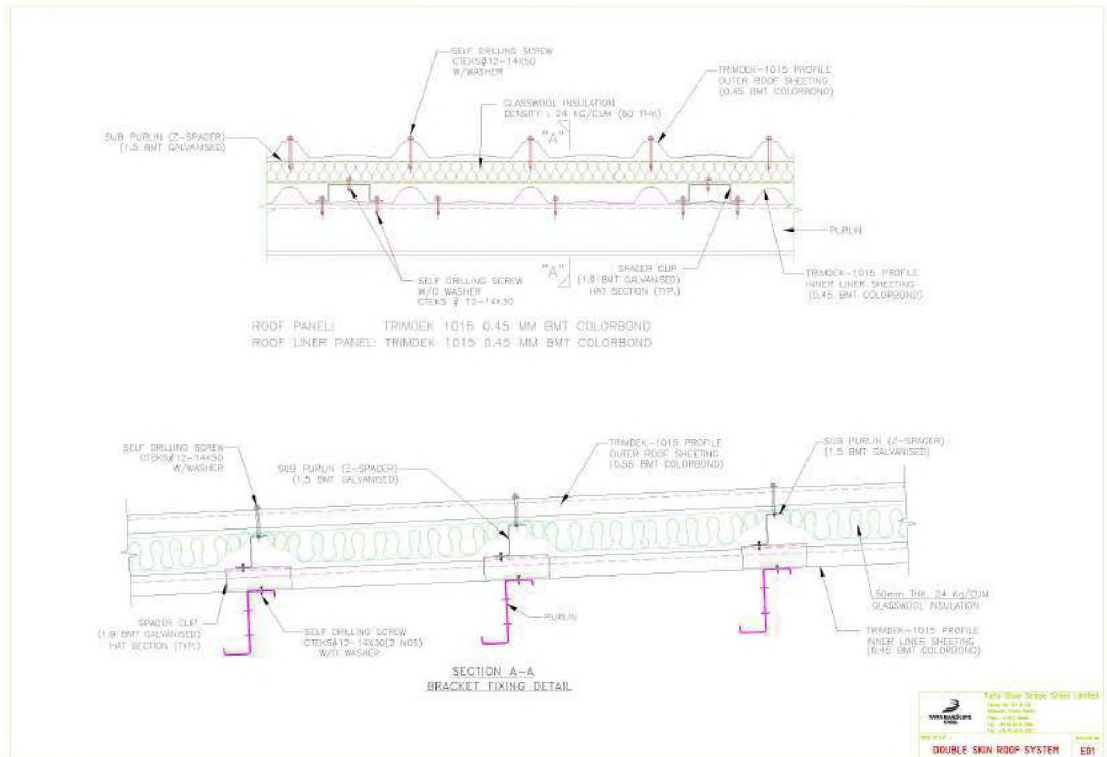
- Make the surface smooth even and free from local depression, loose dirt, etc.
- Prime the dried surface with bituminous primer at the rate of 0.25 litre/m<sup>2</sup>.
- Providing one coat of special grade modified bitumen at the rate of 1.2kg/sq.m.
- Laying of SUPER THERMOLAY - Torchseal 4B by torching with a pressure regulated gas on the above.
- Providing with one coat of special grade bitumen on the surface of the above membrane at the rate of 1.0kg/m<sup>2</sup>.
- The overlapping to be done upto 4 inch at the overlapping joints, the bottom side of the top sheet is to be torch applied and to be loaded to the bottom sheet to make it as per drawings. The drain, parapets, etc to be treated as per drawing to make it sealproof and as per instruction of Engineers at site.

## SECTION - N

### ROOFING & SKYLIGHT

- A) Supply of Double skin LYSAGHT roofing/cladding system with Top & Bottom sheet is trapezoidal TRIMDEK profile sheet of 1015 mm effective cover width and nominal 28.3 mm deep ribs with subtle square fluting in the five pan at nominal 203 mm and centre-to-centre. The feed material for both Top & Bottom sheet is manufactured out 0.45 mm Base Metal Thickness (BMT), (0.50 mm TCT, Color coating Thickness is over and above the thickness stated above), Hi-Tensile steel with min. 550 MPa yield strength, metallic hot dip coated with Zinc/Aluminium alloy (55% Aluminium, 45% Zinc) as per AS 1397 - Zinalume AZ150 (min. 150 gms/sq.mt total on both sides) with Colorbond steel quality paint coat as per AS/NZS 2728 Class 3 of Tata BlueScope Steel make. The paint shall have a total coating thickness of nominal 35  $\mu\text{m}$ , comprising of nominal 20  $\mu\text{m}$  exterior coat on top surface and nominal 5  $\mu\text{m}$  reverse coat on back surface over nominal 5  $\mu\text{m}$  primer coat on both surfaces of approved colour shade for the top & Bottom sheet by the concern authority. The sheet shall have brand marking of the manufacturer giving product details on the back of the sheet at every regular interval for confirming genuinity of the material. The fastener size shall be calculated as per the design for the top and bottom sheet. The sheets shall sandwich a Glass Wool insulation layer with (24kg/m<sup>3</sup> Density) insulation of 50 mm thickness with Single side Aluminum Foil facing.

GI Spacer channel / sub girt shall per provided between the Top & Bottom Sheet .as per the design required and as recommended by the manufacturer. The entire Double skin system is installed over the structure purlin.



- B) POLYCARBONATE SKYLIGHT

1. The work of skylight shall be carried out only by an approved Contractor who has executed this type of work.  
Shop drawings shown aluminium section and fixing detail for Polycarbonate sheets shall be submitted for approval.
2. G.I. Structural supports shall be fabricated by the Contractor for skylight to minimize any mismatch.
3. The cross section of the specially fabricated aluminium member shall conform to profile GE 104 & 105 OF GE plastic India Catalogue or equivalent. Aluminium allow for the profile shall conform to IS 285. The mechanical properties of Aluminium section shall conform to that of designated number 63400 in the above standard.

All aluminium section shall be with anodizing coating of 20 micron of approved shade.

4. the fixing detail shall generally follow manufacturers fixing details : Approved treatment shall be given to avoid galvanic corrosion between aluminium and steel members.
5. Laxan Polycarbonate sheets of embossed type (figured sheets) shall be used. Sheets shall be designated for wind pressure conforming to IS 875. External side of Polycarbonate sheets shall have UV protection. Sample of polycarbonate sheets shall be tested to confirm that the quality of sheets conforms to specification of manufacturers.

Allowance of the thermal expansion shall be made.

Sealing of the joint between the aluminium and Polycarbonate sheets (top and bottom of sheets) shall be made with EPDM neoprene gaskets of approved make.

In addition to the above, Polycarbonate sheets shall also be fixed to cross supporting members, with very high bond, double sided adhesive tape, 12 mm wide x 0.3 mm thick Birla 3 M. brand or other approved make. The spacing of 6.5 mm dia brass screws, connecting aluminium sections 105 & 104, length, shall be to suit the design pressure and it shall not be more than 300 mm. The junction between the washer, and nut and between washer and top of aluminium section sheet shall be treated with neutral Silicone sealant of approved make.

**Mode of Measurement of Payment :**



Method of measurement and payment shall be as follows :

**Structural tubular Steel** : Actual weight as per approved drawings shall be measured and paid per M.T. of steel, as per Section – A.

**Polycarbonate sheets** : Actual area of Polycarbonate sheets of specified thickness used in the work shall be measured and paid on square metre basis. The rate shall include the wastage in cutting sheets to the required profile.

**Aluminium Section** : Actual weight including as per approved drawing shall be measured and paid on weight basis, per MT of Aluminium Section only. The rate shall include the cost of anodizing, EPDM neoprene gasket, clamping plate and Silicone sealant and screws.

Aluminium flashing of specified thickness shall be measured and paid on weight basis.

**SECTION – R  
ROAD WORKS**

1.0 **FILLING MURRUM (EARTHWORK IN EMBANKMENT) :**

1.1 Murrum of approved quality brought by the contractor from outside source having a liquid limit not more than 40 and plasticity index not more than 20 and minimum dry density not less than 1700 kg per m<sup>3</sup> shall be filled and spread in layers to the required line and grade, watered and compacted with a 8 tonnes vibratory/10 to 12 tonnes diesel roller, so as to attain at least 95% of modified proctor dry density.

1.2 The ground levels taken and recorded after rolling of the excavated surface mentioned in 1.6 above shall be the initial ground level for purpose of payment for filling contractor's murrum.

1.3 Except as specifically varied by these tender documents, the works to be executed shall conform to Clauses Nos. 101 to 114, 301 to 309 and Section 900 of the specification for Road & Bridge Work of the Ministry of Surface Transport (Roads wing), Second Revision, 1988.

2.0 **STABILISATION OF SOIL :**

2.1 Soil used shall be good hard murrum.

2.2 Lime for stabilisation shall be approved commercial dry lime slaked at site or pre-slaked lime delivered to the site in suitable packing. The lime shall have a purity of not less than 70% when tested in accordance with IS 1514.

2.2.1 The quantity of lime in the stabilised mix shall be 4% by weight of loose hard murrum.

2.3 The work shall be executed in two layers each of 150mm compacted thickness.

2.4 Mixing and spreading for the stabilised soil shall be done by mechanical means. Spreading shall be done to the required line, grade and camber.

2.5 Rolling for compaction shall be done by 8 tonnes vibratory/ smooth wheeled roller.

2.6 Except as specifically varied by these tender documents, the work to be executed shall conform to Clause Nos. 101 to 114, 402 and Section 900 of the specification for Road & Bridge Work of the Ministry of Surface Transport (Roads Wing), Second Revision, 1988.

### 3.0 GRANULAR SUB-BASE

#### 3.0.1 Scope

This work shall consist of laying and compacting well-graded material on prepared subgrade in accordance with the requirements of these Specifications. The material shall be laid in one or more layers as sub-base or lower sub-base and upper sub-base (termed as sub-base hereinafter) as necessary according to lines, grades and cross-sections shown on the drawings or as directed by the Engineer.

#### 3.0.2 Materials

3.0.2.1 The material to be used for the work shall be natural sand, moorum, gravel, crushed stone, Jhama brick aggregate or combination thereof depending upon the grading required. Materials like crushed slag, crushed concrete, brick metal and kankar may be allowed only with the specific approval of the Engineer. The material shall be free from organic or other deleterious constituents and conform to one of the three gradings given in Table 3.4.

3.0.2.2 While the gradings in Table 3.4 are in respect of close-graded granular sub-base materials, one each for maximum particle size of 75 mm, 53 mm and 26.5 mm.

3.0.2.3 **Physical requirements:** The material shall have a 10 per cent fines value of 50 kN or more (for sample in soaked condition) when tested in compliance with BS: 812 (Part 111). The water absorption value of the coarse aggregate shall be determined as per IS: 2386 (Part 3); if this value is greater than 2 per cent, the soundness test shall be carried out on the material delivered to site as per IS: 383. For Grading II and III materials, the CBR shall be determined at the density and moisture content likely to be developed in equilibrium conditions which shall be taken as being the density relating to a uniform air voids content of 5 per cent.

**TABLE 3.4: Grading for Close-Graded Granular Sub-Base Materials**

IS Sieve Designation	Per cent by weight passing the IS sieve		
	Grading I	Grading II	Grading III
75.0 mm	100	-	-
53.0 mm	80-100	100	-
26.5 mm	55-90	70-100	100
9.50 mm	35-65	50-80	65-95
4.75 mm	25-55	40-65	50-80
2.36 mm	20-40	30-50	40-65
0.425 mm	10-25	15-25	20-35
0.075 mm	3-10	3-10	3-10
CBR value (Minimum)	30	25	20

### **3.0.3 Strength of sub-base**

It shall be ensured prior to actual execution that the material to be used in the sub-base satisfies the requirements of CBR and other physical requirements when compacted and finished.

When directed by the Engineer, this shall be verified by performing CBR tests in the laboratory as required on specimens remoulded at field dry density and moisture content any other tests for the “quality” of materials, as may be necessary.

### **3.0.4 Construction Operations**

**3.0.4.1 Preparation of subgrade:** Immediately prior to the laying of sub-base, the subgrade already finished to Clause 3.1 shall be prepared by removing all vegetation and other extraneous matter, lightly sprinkled with water if necessary and rolled with two passes of 80 – 100 kN smooth wheeled roller.

**3.0.4.2 Spreading and Compacting:** The sub-base material of grading specified in the Contract shall be spread on the prepared subgrade with the help of a motor grader of adequate capacity, its blade having hydraulic controls suitable for initial adjustment and for maintaining the required slope and grade during the operation or other means as approved by the Engineer.

When the sub-base material consists of combination of materials mentioned in Clause 3.3.2, mixing shall be done mechanically by the mix-in-place method.

Manual mixing shall be permitted only where the width of laying is not adequate for mechanical operations, as in small-sized jobs. The equipment used for mix-in-place construction shall be a rotavator or similar approved equipment capable of mixing the material to the desired degree. If so desired by the Engineer, trial runs with the equipment shall be carried out to establish its suitability for the work.

Moisture content of the loose material shall be checked in accordance with IS: 2720 (Part 2) and suitably adjusted by sprinkling additional water from a truck mounted or trailer mounted water tank and suitable for applying water uniformly and at controlled quantities to variable widths of surface or other means approved by the Engineer so that, at the time of compaction, it is from 1 per cent above to 2 per cent below the optimum moisture content corresponding to IS: 2720 (Part 8). While adding water, due allowance shall be made for evaporation losses. After water has been added, the material shall be processed by mechanical or other approved means like disc harrows, rotavators until the layer is uniformly wet.

Immediately thereafter, rolling shall start. If the thickness of the compacted layer does not exceed 100 mm, a smooth wheeled roller of 80 to 100 kN weight may be used. For a compacted single layer upto 225 mm the compaction shall be done with the help of a vibratory roller of minimum 80 to 100 kN static weight with plain drum or pad foot-drum or heavy pneumatic tyred roller of minimum 200 to 300 kN weight having a

minimum tyre pressure of 0.7 MN/m<sup>2</sup> or equivalent capacity roller capable of achieving the required compaction. Rolling shall commence at the lower edge and proceed towards the upper edge longitudinally for stretches of unidirectional crossfall and super-elevation, and shall commence at the edges and progress towards the centre for stretches having crossfall on both sides.

Each pass of the roller shall uniformly overlap not less than one-third of the track made in the preceding pass. During rolling, the grade and crossfall (camber) shall be checked and any high spots or depressions, which become apparent, corrected by removing or adding fresh material. The speed of the roller shall not exceed 5 km per hour.

Rolling shall be continued till the density achieved is at least 98 per cent of the maximum dry density for the material determined as per IS: 2720 (Part 8). The surface of any layer of material on completion of compaction shall be well closed, free from movement under compaction equipment and from compaction planes, ridges, cracks or loose material. All loose, segregated or otherwise defective areas shall be made good to the full thickness of layer and re-compacted.

### **3.0.5 Surface Finish and Quality Control of Work**

The surface finish of construction shall conform to the requirements of Clause 3.15.

Control on the quality of materials and works shall be exercised by the Engineer in accordance with Section 3.15.

### **3.0.6 Arrangements for Traffic**

During the period of construction, arrangement of traffic diversions shall be maintained as per the direction of Engineer.

### **3.0.7 Measurements for Payment**

Granular sub-base shall be measured as finished work in position in cubic metres.

The protection of edges of granular sub-base extended over the full formation as shown in the drawing shall be considered incidental to the work of providing granular sub-base and as such no extra payment shall be made for the same.

### **3.0.8 Rate**

The Contract unit rate for granular sub-base shall be payment in full for carrying out the required operations including full compensation for:

- (i) making arrangements for traffic diversions. Except for initial treatment to verges, shoulders and construction of diversions;
- (ii) furnishing all materials to be incorporated in the work including all royalties, fees, rents where necessary and all leads and lifts;

- (iii) all labour, tools, equipment and incidentals to complete the work to the Specifications;
- (iv) carrying out the work in part widths of road where directed;
- (v) carrying out the required tests for quality control and
- (vi) multiple handling of materials

## INTERLOCKING BLOCKS

### 4.0 Interlocking block :

#### 4.1.1 Scope :

Scope of work consisting of manufacturing of concrete paver blocks of required size, shape and colour . i.e. I – shape/ unipaver as per the specification given below and supplying and fixing of the blocks on walkway.

#### 4.1.2 Dimensions and Tolerances :

Concrete interlocking paver blocks shall be made in size and shall be as specified in the tender document.

Maximum variation in dimension and Interlocking block shall not be more than +/- 2mm.

#### 4.1.3 Cement & Sand

Specification same as per relevant section

#### 4.1.4 Coarse Aggregates :

##### 4.1.4.1 Coarse aggregates for the works shall be river gravel or crushed stone conforming to IS : 383 obtained from sources approved by the Engineer.

Aggregates shall be properly screened and if necessary washed and cleaned at the Contractor's cost before use. The coarse aggregates containing flat or flaky pieces or mica shall be rejected.

##### 4.1.4.2 Prior to deciding on the source for procurement of constituents of concrete viz. fine and coarse aggregate the contractor shall specifically assess the soluble chloride and sulphate contents of fine and coarse aggregates (at source) and their permissible limit shall be approved by Engineer. Regular checks as directed, shall also be carried out, not only at the source of supply of such materials, but also prior to mixing. The material shall not contain impurities exceeding the permissible limits. The various limits permissible for fine and coarse aggregates shall be given as below.

Sr. No.	Requirement of aggregate	Fine	Coarse
a.	Chloride Content (Cl)	0.04% of wt. (Acid soluble)	0.2% of wt. (Acid soluble)
b.	Sulphate content (S 03) max	0.04% of wt. (Acid soluble)	0.04% of wt. (Acid soluble)
c.	Potential alkali reactivity	Absent	Absent
d.	Water absorption max. less than 75 microns	2% by wt.	2% by wt.
e.	Particles of size	3% by wt.	2% by wt.
f.	Sand equivalent	more than 35%	---

NORMAL SIZE	MAXIMUM SIZE	MINIMUM SIZE
10 mm	12 mm	0.5 mm
20 mm	25 mm	10 mm
40 mm	40 mm	20 mm
80 mm	80 mm	40 mm

4.1.4.3 **Coarse aggregates shall be supplied in the following sizes :**

4.1.4.4 The grading of coarse aggregate shall be such that not more than 5% shall be larger than the maximum size and not 10% shall be smaller than the smallest size. Between these sizes the coarse aggregate shall be well graded.

4.1.4.5 The aggregates shall be subjected to tests in accordance with IS: 2386 as may be ordered by the Engineer. The cost of such tests shall be borne by the Contractor.

4.1.4.6 Aggregates shall be sorted in such a way as to prevent segregation or sizes and avoid contamination with fines.

4.2.1 **Water :**

The water used in the manufacture of concrete masonry units shall be free from matter harmful to concrete or reinforcement, or matter likely to cause efflorescence in the units and shall conform to the requirement of IS: 456 - 1978 (Third Revision) .

4.2.2 **Additives or Admixtures :**

Additives or Admixtures may be added either as additives to the cement during manufacture, or as admixtures to the concrete mix. Additives or admixtures used in the manufacture of concrete paver blocks may be :

- a) Accelerating, water reducing and air entraining admixtures conforming to IS : 9103 - 1979.
- b) Fly ash conforming to IS : 3821 (Part II) 1966.
- c) Waterproofing agents conforming to IS : 2645 – 1975
- d) Colouring pigments .

Where no Indian Standards apply, the additives or admixtures shall be shown by test experience, to be not detrimental to the durability of the concrete.

4.3 **Manufacture :**

4.3.1 **Mix :**

4.3.1.1 The concrete mix must be prepared and approval of the Engineer in charge should be taken before proceeding with actual manufacturing of the block.

4.3.1.2 Before commencing the manufacturing of blocks the supplier shall submit to the Engineer for approval full details of all preliminary trial mixes and tests.



4.3.1.3 when the proportions of a concrete mix have been approved by the Engineer, the contractor shall not vary quality or source of materials or the mix without written approval of the Engineer.

4.3.1.4 In case of blocks, where compaction is done by external vibrator, concrete mix very low consistency (zero slump) shall be used in order to vibrate and compact the concrete under pressure.

4.3.2 **Mixing :**

4.3.2.1 Concrete shall normally be mixed in a mechanical mixer.

4.3.2.2 Mixing shall be continued until there is a uniform distribution of materials, and the mass is uniform in colour and consistency.

4.4 **Placing and compaction :**

4.4.1 The mould will be compacted by means of mechanical compaction. The mould shall be filled up to overflow vibrated or mechanically tamped and struck off level.

4.4.2 After demoulding the blocks shall be protected until they are sufficiently hardened to permit handling without damage.

4.5 **Curing :**

4.5.1 The blocks hardened in accordance with 1.4.2 shall then be cured in a curing water or in a curing yard and shall be continuously moist for atleast 14 days. When the blocks are cured in immersion tank, the water of the tank shall be changed at least every 4 days.

4.5.2 Steam curing of blocks hardened in accordance with 1.4.2. may be adopted instead of methods specified in provided the requirements of pressure or non - pressure steam curing are fulfilled.

4.6 **Drying :**

After curing the blocks shall be dried for a period of 4 weeks before being used on the work. They shall be stacked with voids horizontal to facilitate through passage of air. The blocks shall be allowed to complete their initial shrinkage before they are laid in a wall.

4.7 **Surface Texture and Finish :**

4.7.1 The finished concrete paver blocks shall have uniform texture and finish. The colour pigment shall be approved by the Engineer in charge. The colour pigment shall be a non fading and shall not have any deleterious effect on the concrete.

4.8 **Physical Requirements :**

4.8.1 **General :**

All blocks shall be sound and free of cracks or other defects which interfere with the proper placing of the blocks or impair the strength or performance.

4.8.2 The blocks shall be free of chips, cracks or other imperfections.

4.8.3 **Dimensions :**

Same as 1.1.2

4.8.4 **Block Density :**

The block density shall conform to manufacturers' specification or approved by the Engineer - in - charge.

4.8.5 **Compressive strength :**

The minimum compressive strength at 28 days shall be 400 Kg/ cm<sup>2</sup> for 100 mm thick concrete blocks and 350 kg/ cm<sup>2</sup> for 60mm thick concrete paver blocks.

4.8.6 **Water absorption :**

The water absorption shall not be more than 1% at mass.

4.9 **Testing Sampling :**

For every 10000 nos. of paver blocks a set comprising of 12 nos. of paver blocks will be tested as under, either in the manufacturing unit or in an approved laboratory by CLIENT. No payment shall be made for the sample tested.

- 1) For block density - 3 nos.
  - 2) For compressive strength - 6 nos.
  - 3) For water absorption - 3 nos.
- 12 nos

4.10 **Contractor's certificate :**

The contractor shall certify that the paver blocks conform to the requirement of these specifications and shall furnish certificate to this effect along with each consignment obtained from the manufacturer.

4.11 **Independent Testing :**

4.11.1 If CLIENT desire to carry out independent test, same shall be carried out in accordance with the specification by selecting random samples supplied at site.

4.11.2 The contractor shall supply free of charge paver blocks required for testing.

4.11.3 Cost of testing unless otherwise specified shall be borne by the manufacturer.

#### 4.12 Laying and fixing Paver Blocks :

The interlocking paver blocks are to be fixed as indicated in the item description. The ground is to be levelled taking into consideration the thickness of the paver blocks by part excavation part filling and properly compacting using a plate compactor. Sand bed of 50mm is to be provided underneath the paver blocks after leveling the ground as base for fixing the interlocking blocks. These concrete blocks should be placed as per design and shape, as directed by the Engineer in charge. After laying the concrete blocks, fine sand is to be spread over the paver block. The surface should be compacted using plate compactor, so that the fine sand will get filled up in the gaps between blocks and the block will be interlocked.

#### 4.13 Cement Concrete Shot Blasted Tiles of size (Sizes : 250 x 250 x 24mm, 300 x 300 x 28mm, 400 x 400 x 31 mm, 500 x 500 x 32mm)

Supply of High Strength and high wear resistant Cement Concrete Shot Blasted Tiles with –  
- wear resistant aggregates colour coordinated aggregates in face mix  
- Colours specified by the architects, using UV resistant colour Pigments from Lanxess.  
- (optional – Recommended) Two Coats of Acrylic Lacquer coating

Parameters	Minimum Requirements (Testing as per IS 1237:1980)
1 Percentage Water Absorption	Not over 7.5%
2 Wet transverse strength	Not less than 5.5N/mm <sup>2</sup>
3 Average wear in Thickness-Abrasion	Average wear not more than 2mm
4 Size (length + breadth)	< 0.5mm
5 Thickness of wearing layer	Not less than 8mm
6 Variation in Thickness of tiles	Variation not to exceed 3mm
7 Flatness of tile surface	Concavity / convexity not to exceed 0.5mm
8 Colours	UV Light resistant fast colours from BAYFERROX only to be used min 3% to be used.

- The manufacturing company must be an ISO 9001:2000 certified Company or should have equivalent quality management systems in place to ensure quality product.
- The Terrazzo tiles must confirm to IS 1237:1980
- The tiles must be manufactured on automatic machines with mechanical vibration and rubberized moulds.
- The tiles must be ground on Linear Grinding Machine.
- The tiles will be made using wear resistant materials in the face mix as specified by the architects.
- The tiles must be cured in controlled environment to ensure efflorescence free material.
- The manufacture must have in house testing laboratory to carry out all testing including Compressive strength testing, Water absorption, abrasion resistance etc.

#### 4.14 Cement Concrete Pebbled Terrazzo Tiles of size (Sizes: 300 x 300 x 32mm, 400 x 400 x 35mm)

Supply of Customized “Pebblino” Series Terrazzo Tiles with special coloured pebble aggregates specified by Architects acrylic sealed finish.

Parameters	Minimum Requirements (Testing as per IS 1237:1980)
1 Percentage Water Absorption	Not over 7.5%

2 Wet transverse strength	Not less than 5.5N/mm <sup>2</sup>
3 Average wear in Thickness-Abrasion	Average wear not more than 2mm
4 Size (length + breadth)	< 0.5mm
5 Thickness of wearing layer	Not less than 8mm
6 Variation in Thickness of tiles	Variation not to exceed 3mm
7 Flatness of tile surface	Concavity / convexity not to exceed 0.5mm
8 Colours	UV Light resistant fast colours from BAYFERROX only to be used min 3% to be used.

- The manufacturing company must be an ISO 9001:2000 certified Company or should have equivalent quality management systems in place to ensure quality product.
- The Terrazzo tiles must confirm to IS 1237:1980
- The tiles must be manufactured on automatic machines with mechanical vibration and rubberized moulds.
- The tiles will be made using wear resistant materials in the face mix as specified by the architects.
- The tiles must be cured in controlled environment to ensure efflorescence free material.
- The manufacture must have in house testing laboratory to carry out all testing including Compressive strength testing, Water absorption, abrasion resistance etc.

#### Shot blasted Concrete Cobbles

Supply of Shot Blasted Type Solid Concrete Cobbles in colours specified by the architects, of VYARA make, using UV resistant Pigments from Lanxess and Wear resistant colour coordinated aggregates, with 2 coats of acrylic coating.

Size 97x98x60mm thick. Nominal size of 100mm x 100mm

Parameters	Minimum Requirements
1 Percentage water absorption	Average not over 4.5%
2 Compressive strength	Average not less than 250KG/cm <sup>2</sup>
3 Average wear in thickness-abrasion	Average wear not more than 2mm
4 Tolerance in size (length + breadth)	+/- 1.5mm
5 Thickness of wearing layer	Not less than 5mm
6 Tolerance in Thickness of block	+/- 3mm
7 Colours	UV Light resistant fast colours from BAYFERROX only to be used min 3% to be used.

- The blocks must be manufactured on vibropress type machine only. The manufacture must demonstrate feeding of material into the machines by automatic batching plants with capacity of min 30 m<sup>3</sup>/hr.

#### 4.15 Gabions

Gabbions should be factory fabricated boxes made of double twisted hexagonal

Wire mesh .additional protection to the wires is obtained by .5mm thickness of

Pvc coating over galvanized wires.

Pvc coating properties shall be as follows.

- |  |   |             |
|--|---|-------------|
| a) specific gravity                    | : | 1.3 to 1.35 |
| b) tensile strength not less than      | : | 20.6 mpa    |
| c) modulus of elasticity not less than | : | 18.6 mpa    |
| d) hardness between 50 to 60 shores    |   |             |
| e) brittleness temperature             | : | ASTM 2240   |
| f) abrasion resistance                 | : | ASTM D1242  |

- g) salt spray : ASTM B117
- h) ultra violet ray : ASTM D1499 & G23
- i) Appearance : PVC coating shall not crack

Gabbion boxes tolerances shall be confirming to ASTM A975

Diaphragm to be provided at every 1.0meter.

Wire properties shall be as per EN10223 & EN 10224.2

Wire shall be coated with zinc.

Twisted wire mesh shall be used. Mesh type may be 10x12 or 8x10

Gabbions shall be filled with stones and shall be installed as per installation guide of manufacturer.

#### **4.16 Geo reinforcements**

##### **4.16.1 Geo-fabric**

1. The reinforcing element shall be a geogrid manufactured in accordance with a Quality Management System which complies with the requirements of BS EN ISO 9001:2000. If required by the Engineer, the Contractor shall provide evidence that the manufacturer's Quality Assurance System has been certified to conform with BS EN ISO 9001:2000 by an external authenticating authority approved by the Department of Trade and Industry.
2. The reinforcing element shall be a geogrid manufactured from high density polyethylene sheet, oriented in one direction so that the resulting ribs shall have a high degree of molecular orientation which is continued through the integral transverse bar.
3. The creep limited tensile strength, for a design life of 120 years, shall be 23.4 kN/m at a mean temperature of 30°C. This shall be determined by application of standard extrapolation techniques to creep data obtained in accordance with BS EN ISO 13431:1999 and shall be a lower bound value.
4. The geogrid shall have an appropriate partial factor for site installation and construction damage, determined by the particle size distribution of the reinforced fill and in accordance with the values used in the design. This factor shall be based on full scale tests carried out in accordance with BS 8006:1995 Annex D and witnessed by an independent Approval Authority. If required by the Engineer, the Contractor shall provide supporting documented evidence of testing for this and any other partial factors assumed in the design.
5. The Quality Control Strength [expressed as the lower 95% confidence limit in accordance with ISO 2602:1980 (BS 2846:Part 2:1981)] shall be 64.5 kN/m with a peak strain of around 11.5% at that load when tested in accordance with BS EN ISO 10319:1996.  
In addition, the load at 2% and 5% strains [expressed as the lower 95% confidence limit in accordance with ISO 2602:1980 (BS 2846:Part 2:1981)] shall be 16.1 kN/m and 30.9 kN/m respectively.
6. The strength of the junctions between the longitudinal ribs and transverse bars, as determined by the Geosynthetics Research Institute, Drexel University, USA, Test Method GG2-87, shall be not less than 100% of the Quality Control Strength.

7. The reinforcing element shall be the subject of a current and relevant Roads and Bridges Agreement Certificate issued by the British Board of Agreement.
8. The minimum geogrid roll width shall be 1.3m.
9. Any site joints in the reinforcement roll length shall be capable of carrying in excess of 90% of the geogrid Quality Control Strength when tested in accordance with BS EN ISO 10321:1996. If required by the Engineer the Contractor shall carry out testing to demonstrate this.

The geogrid shall be inert to all chemicals naturally found in soils and shall have no solvents at ambient temperature. It shall not be susceptible to hydrolysis, shall be resistant to aqueous solutions of salts, acids and alkalis (pH = 2.0 to 12.5), shall be non-biodegradable and shall have a minimum of 2% finely divided carbon black, as determined by BS 2782:Part 4:Method 452B:1993, well dispersed in the polymer matrix to inhibit attack by ultraviolet light.

#### 4.16.2 Woven Geo Textile

**The individual multifilament yarns shall be woven together into a stable fabric structure with a superior combination of mechanical and hydraulic properties. The product should have excellent resistance to biological and chemical environments normally found in soils and is stable against short-term exposure to ultraviolet radiation.**

Woven Geotextile should be suitable for applications involving the functions of separation, stabilization and filtration.

Woven Geotextile shall conform to the property values listed below, which have been derived from tests carried out at reputed laboratories.

<b>S.No</b>	<b>Property</b>	<b>Test Method</b>	<b>Value (MARV)</b>
<b>I Polymer Composition, Structure and Physical Properties</b>			
1	Polymer	Polypropylene	
2	Structure	Woven with multifilament yarn in both warp and weft directions	
3	Mass per unit area	ASTM D 3776	140 g/m <sup>2</sup>
4	Thickness		0.36
<b>II Mechanical Properties</b>			
1	Tensile strength	Warp	28 kN/m
		Weft	26 kN/m
2	Elongation at designated peak tensile load	Warp	25 %
		Weft	25 %
3	Trapezoid tearing strength	Warp	300 N
		Weft	300 N
4	Puncture strength	ASTM D 4833	250 N
<b>III Hydraulic Properties</b>			
1	Apparent opening size	ASTM D 4751	75 microns
2	Water flow rate normal to the plane	ASTM D 4491	10 l/m <sup>2</sup> /s

1. The elongations reported are the actual fabric elongations at the designated peak tensile load measured over a gauge length of 100 mm

Mode of Measurement:

The item shall be paid on m<sup>2</sup> as unit, Excluding payment for laps, joints etc.

**LIST OF APPROVED MATERIALS FOR CIVIL WORKS.**

<b>No.</b>	<b>Material</b>	<b>Make</b>
1.	Cement 53 Grade / 43 Grade	Gujarat Ambuja, A.C.C., L&T, Rajashree / Birla Super. Indorama slag cement, STAR, Topcem, Crown, Valley Strong, Adhunik
2	Structural Steel	Sail, Tisco, TATA

3.	Mild & Tol Steel	Sail, Tisco, Vizag, TATA
4.	Plasticiser	Sika, Sunanda Chemicals, Forsoc, MC- Bauchemie
5.	Waterproofing Compound	Accorproof Impermo, Pediproof, CICO
6.	Water Cement Paint, Quartz Reinforce Paint	Super Snowcem, Nitocem.
7.	Hardware	Shalimar, Navbharat, Amarbhoy Dossaji
8.	Glazing	Hindustan Pilkington, Triveni, Float Glass of Modi, Asahl India, Saint Goban, GSC.
9.	Red Oxide	Shalimar, Asian, Garware Paints.
10.	Paints & Distempers	Jenson & Nicholson, Burger Asian, ICI, Nerolac
11.	Hardners	Ironite, Ferrok, Hardnate.
12.	Aluminium Doors, Windows, Partitions Etc.	Jindal, Indal, Hindalco, Ajit India, Indian Aluminium Sections or Equivalent
13	Rolling Shutters & Grills	Standard Swastik, Shudhwar or equivalent ISI Marked make
14	Aluminium Grills	Aluminigrile, Deco or equivalent ISI Marked make
15	Vaccum Dewatering Equipment	Tremix
16	Flush Door - I.S.I. Marked	Anand Wood Crafts, M/s Shreeji Doors & Plywood, "Timber Teck" Hyderabad, Silvassa, Century, Green Ply or equivalent ISI Marked make
17	Ceramic Tiles – 300 mm X 300 mm, 200 mm X 300 mm	First Quality tile of Bell Ceramic, H&P, Jhonson, Regancy, Navin Peddar, Kajaria, Somany, Orient.
18	White/ Coloured Glazed Tiles,	First Quality Tiles of H&R Jhonson, Navin, Bell
19	Vitrified Tiles	RAK, Bell granito, Naveen diamond tile, Euro, Pavit, Nitco, Somany, Orient.



20	Glass Mosaic	Mridul, Bisazza, Shon, Kent
21	Membrane Waterproofing	STP Limited Choksey Chemicals Pvt Ltd (Sintoplene 4/25) or Equivalent
22	Polysulphide sealants	STP Limited Choksey Chemicals Pvt Ltd or Equivalent
23	Expansion Joints (Compression seal)	Z-TECH (India) Pvt Ltd D S Brown Company (distributed by Choksey Structural Engineering) Sanfield (India) Limited or Equivalent
24	Waterproofing Polymer	Roofex, Krishna Chemicals, Sunanda chemicals Forsoc, "CICO" or Equivalent
25	Stainless Steel	Sail or Equivalent
26	Patch / Spider fittings	Casma, Dorma, Savex
27	Paver Blocks	Conwood, Basant Batons, Coble stone, Gurjari.
28	Polycarbonate sheets	GE Lexan
29	Aluminium composite Panel	Reynobond, Alucobond.
30	Synthetic plaster	Renovo or Ruff & Tuff

## Chapter 3

### ROAD WORKS

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## CHAPTER 3: ROAD WORKS

### 3.1 EMBANKMENT CONSTRUCTION

#### 3.1.1 General

3.1.1.1 **Description:** These Specifications shall apply to the construction of embankment including subgrade, earthen shoulders and miscellaneous backfills with approved material obtained from roadway and drain excavation, borrow pits or other sources. All embankments, subgrades, earthen shoulders and miscellaneous backfills shall be constructed in accordance with the requirements of these specifications and in conformity with the lines, grades and cross-sections shown on the drawings or as directed by the Engineer.

#### 3.1.2 Materials and General Requirements

3.1.2.1 **Physical requirements:** The materials used in embankments, subgrades, earthen shoulders and miscellaneous backfills shall be soil, moorum, gravel, a mixture of these or any other material approved by the Engineer. Such materials shall be free of logs, stumps, roots, rubbish or any other ingredients likely to deteriorate or affect the stability of the embankment/subgrade.

The following types of material shall be considered unsuitable for embankment:

- a) Materials from swamps, marshes and bogs;
- b) Peat, log, stump and perishable material; any soil that classifies as OL, OI, OH or Pt in accordance with IS : 1498;
- c) Materials susceptible to spontaneous combustion;
- d) Materials in a frozen condition;
- e) Clay having liquid limit exceeding 70 and plasticity index exceeding 45' and
- f) Materials with salts resulting in leaching in the embankment.

3.1.2.1.1 Expansive clay exhibiting marked swell and shrinkage properties ("free swelling index" exceeding 50 per cent when tested as per IS: 2720 – Part 40) shall not be used as a fill material. Where an expansive clay with acceptable "free swelling index" value is used as a fill material, subgrade and top 500 mm portion of the embankment just below subgrade shall be non-expansive in nature.

3.1.2.1.2 Any fill material with a soluble sulphate content exceeding 1.9 grams of sulphate (expressed as SO<sub>3</sub>) per litre when tested in accordance with BS : 1377 Test 10, but using a 2 : 1 water-soil ratio shall not be deposited within 500 mm or other distance described in the Contract, of concrete, cement bound materials or other cementitious materials forming part of the Permanent Works.

Materials with a total sulphate content (expressed as SO<sub>3</sub>) exceeding 0.5 per cent by mass, when tested in accordance with BS: 1377 Test 9 shall not be deposited within 500 mm, or other distances described in the Contract, of metallic items forming part of the Permanent Works.

3.1.2.1.3 The size of the coarse material in the mixture of earth shall ordinarily not exceed 75 mm when being placed in the embankment and 50 mm when placed in the subgrade. However, the Engineer may at his discretion permit the use of material coarser than this also if he is satisfied that the same will not present any difficulty as regards the placement of fill material and its compaction to the requirements of these

Specifications. The maximum particle size shall not be more than two-thirds of the compacted layer thickness.

- 3.1.2.1.4 Ordinarily, only the materials satisfying the density requirements given in Table 3.1 shall be employed for the construction of the embankment and the sub grade.

**TABLE 3.1: Density Requirements of Embankment and Subgrade Materials**

S.No.	Type of Work	Maximum laboratory dry unit weight when tested as per IS: 2720 (Part 8)
1.	Embankments up to 3 metres height, not subjected to extensive flooding;	Not less than 15.2 kN/cu.m.
2.	Embankments exceeding 3 metres height or embankments of any height subject to long periods of inundation	Not less than 16.0 kN/cu.m.
3.	Subgrade and earthen shoulders/verges/backfill	Not less than 17.5 kN/cu.m.

- Notes: (1) This Table is not applicable for lightweight fill material e.g. cinder, fly ash etc.  
 (2) The Engineer may relax these requirements at his discretion taking into account the availability of materials for construction and other relevant factors.  
 (3) The material to be used in subgrade should also satisfy design CBR at the dry unit weight applicable as per Table 3.2.

**3.1.2.2 General requirements:**

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

Haulage of material to embankments or other areas of fill shall proceed only when sufficient spreading and compaction plant is operating at the place of deposition.

No excavated acceptable material other than surplus to requirements of the Contract shall be removed from the site. Should the Contractor be permitted to remove acceptable material from the site to suit his operational procedure, then he shall make good any consequent deficit of material arising therefrom at his own cost.

Where the excavation reveals a combination of acceptable and unacceptable materials, the Contractor shall, unless otherwise agreed by the Engineer, carry out the excavation in such a manner that the acceptable materials are excavated separately for use in the

permanent works without contamination by the unacceptable materials. The acceptable materials shall be stockpiled separately.

The Contractor shall ensure that he does not adversely affect the stability of excavation or fills by the methods of stockpiling materials, use of plants or siting of temporary buildings or structures.

The Contractor shall obtain representative samples from each of the identified borrow areas and have these tested at the site laboratory following a testing programme approved by the Engineer. It shall be ensured that the subgrade material when compacted to the density requirements as in Table 3.2 shall yield the design CBR value of the subgrade.

**TABLE 3.2: Compaction Requirements for Embankment and Subgrade**

S.No.	Type of Work / material	Relative compaction as percentage of max. laboratory dry density as per IS: 2720 (Part 8)
1.	Subgrade and earthen shoulders	Not less than 97
2.	Embankment	Not less than 95
3.	Expansive Clays subject to the explanation in clause 3.1.2.1.1 a) Subgrade and 500 mm portion just below the subgrade b) Remaining portion of embankment	Not allowed  Not less than 90

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

- (i) The values of maximum dry density and optimum moisture content obtained in accordance with IS: 2720 (Part 7) or (Part 8), as the case may be, appropriate for each of the fill materials he intends to use.
- (ii) A graph of density plotted against moisture content from which each of the values in (i) above of maximum dry density and optimum moisture content were determined.
- (iii) The Dry density-moisture content – CBR relationships for light, intermediate and heavy compactive efforts (light corresponding to IS: 2720 (Part 7), heavy corresponding to IS: 2720 (Part 8) and intermediate in-between the two) for each of the fill materials he intends to use in the subgrade.

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

### 3.1.3 Construction Operations

3.1.3.1 **Setting Out:** After the site has been cleared the work shall be set out. The limits of embankment/subgrade shall be marked by fixing batter pegs on both sides at regular intervals as guides before commencing the earthwork the embankment/subgrade shall be suitably prepared to design dimension so that surplus material may be trimmed, ensuring that the



remaining material is to the desired density and in position specified and conforms to the specified side slopes.

- 3.1.3.2 Compacting ground supporting embankment/subgrade:** Where necessary, the original ground shall be levelled to facilitate placement of first layer of embankment, scarified, mixed with water and then compacted by rolling so as to achieve minimum dry density as given in Table 3.2.

In case where the difference between the subgrade level (top of the subgrade on which pavement rests) and ground level is less than 0.5 m and the ground does not have 97 per cent relative compaction with respect to the dry density as given in Table 3.2, the ground shall be loosened up to a level 0.5 m below the subgrade level, watered and compacted in layers in accordance with the subsequent clauses to not less than 97 per cent of dry density as given in Table 3.2.

Where so directed by the Engineer, any unsuitable material occurring in the embankment foundation shall be removed and replaced by approved materials laid in layers to the required degree of compaction.

Embankment or subgrade work shall not proceed until the foundations for embankment/subgrade have been inspected by the Engineer for satisfactory condition and approved.

Any foundation treatment specified for embankments especially high embankments, resting on suspect foundations as revealed by borehole logs shall be carried out in a manner and to the depth as desired by the Engineer. Where the ground on which an embankment is to be built has any of the material types (a) to (f) in Clause 3.1.2, at least 500 mm of such material must be removed and replaced by acceptable fill material before embankment construction commences.

### **3.1.3.3 Spreading material in layers and bringing to appropriate moisture content**

- 3.1.3.3.1** The embankment and subgrade material shall be spread in layers of uniform thickness not exceeding 200 mm compacted thickness over the entire width of embankment by mechanical means, finished by a motor grader and compacted as per Clause 3.1.3.4. The motor grader blade shall have hydraulic control suitable for initial adjustment and maintain the same so as to achieve the specific slope and grade. Successive layers shall not be placed until the layer under construction has been thoroughly compacted to the specified requirements as in Table 3.2 and got approved by the Engineer. Each compacted layer shall be finished parallel to the final cross-section of the embankment.

- 3.1.3.3.2** Moisture content of the material shall be checked at the site of placement prior to commencement of compaction; if found to be out of agreed limits, the same shall be made good. Where water is required to be added in such constructions, water shall be sprinkled from a water tanker fitted with sprinkler capable of applying water uniformly with a controllable rate of flow to variable widths of surface but without any flooding. The water shall be added uniformly and thoroughly mixed in soil by blading, discing or harrowing until a uniform moisture content is obtained throughout the depth of layer.

If the material delivered to the roadbed is too wet, it shall be dried, by aeration and exposure to the sun, till the moisture content is acceptable for compaction. Should circumstances arise, where owing to wet weather, the moisture content cannot be reduced to the required amount by the sufficient time should be spaced for the material to dry up.

Moisture content of each layer of soil shall be checked in accordance with IS: 2720 (Part 2), and unless otherwise mentioned, shall be so adjusted, making due allowance for evaporation losses, that at the time of compaction it is in the range of 1 percent above to 2 percent below the optimum moisture content determined in accordance with IS: 2720 (Part 7) or IS: 2720 (Part 8) as the case may be. Expansive clays shall,

however be compacted at moisture content corresponding to the specified dry density, but on the wet side of the optimum moisture content obtained from the laboratory compaction curve.

After adding the required amount of water, the soil shall be processed by means of graders, harrows, rotary mixers or as otherwise approved by the Engineer until the layer is uniformly wet.

Clods or hard lumps of earth shall be broken to have a maximum size of 75mm when being placed in the embankment and a maximum size of 50mm when being placed in the subgrade.

3.1.3.3.3 Embankment and other areas of fill shall, unless otherwise required in the Contract or permitted by the Engineer, be constructed evenly over their full width and their fullest possible extent and the Contractor shall control and direct construction plant and other vehicular traffic shall be made good by the contractor with material having the same characteristics and strength as the material had before it was damaged.

Embankments and other areas of unsupported fills shall not be constructed with steeper side slopes, or to greater widths than those shown in the Contract, except to permit adequate compaction at the edges before trimming back, or to obtain the final profile following any settlement of the fill and the underlying material.

Whenever fill is to be deposited against the face of a natural slope, or sloping earthworks face including embankments, cuttings, other fills and excavations steeper than 1 vertical on 4 horizontal, such faces shall be benched, immediately before placing the subsequent fill.

All permanent faces of side slopes of embankments and other areas of fill formed shall, subsequent to any trimming operations, be reworked and sealed to the satisfaction of the Engineer by tracking a tracked vehicle, considered suitable by the Engineer, on the slope or any other method approved by the Engineer.

3.1.3.4 **Compaction:** Only the compaction equipment approved by the Engineer shall be employed to compact the different material types encountered during construction. Smooth wheeled, vibratory, pneumatic tyred, sheepsfoot or pad foot rollers, etc. of suitable size and capacity as approved by the Engineer shall be used for the different types and grades of materials required to be compacted either individually or in suitable combinations.

The compaction shall be done with the help of vibratory roller of 80 to 100 kN static weight with plain or pad foot drum or heavy pneumatic tyred roller of adequate capacity capable of achieving required compaction.

The Contractor shall demonstrate the efficacy of the equipment he intends to use by carrying out compaction trials. The procedure to be adopted for these site trials shall first be submitted to the Engineer for approval.

Earthmoving plant shall not be accepted as compaction equipment nor shall the use of a lighter category of plant to provide any preliminary compaction to assist the use of heavier plant be taken into account.

Each layer of the material shall be thoroughly compacted to the densities specified in Table 3.2. Subsequent layers shall be placed only after the finished layer has been tested according to Clause 3.15.2.2 and accepted by the Engineer. The Engineer may permit measurement of field dry density by a nuclear moisture/density gauge used in accordance with agreed procedure and the gauge is calibrated to provide results identical to that obtained from tests in accordance with IS: 2720 (Part 28). A record of the same shall be maintained by the Contractor.

When density measurements reveal any soft areas in the embankment/subgrade/earthen shoulders, further compaction shall be carried out as directed by the Engineer. If in spite of that the specified compaction is not achieved, the material in the soft areas shall be removed and replaced by approved material, compacted to the density requirements and satisfaction of the Engineer.

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

**3.1.3.6 Repairing of damages caused by rain/spillage of water:** This work is carried out directed by the Engineer before next layer is laid and refilled in layers and compacted using appropriate mechanical means such as small vibratory roller, plate compactor or power rammer to achieve the required density in accordance with Clause 3.1.3.4. If the cut is not sufficiently wide for use of rollers, it shall be widened suitably to permit their use for proper compaction. Tests shall be carried out as directed by the Engineer to ascertain the density requirements of the repaired area. The work of repairing the damages including widening of the cut, if any, shall be carried out by the Contractor at his own cost, including the arranging of machinery/equipment for the purpose.

**3.1.3.7 Finishing operations:** Finishing operations shall include the work of shaping and dressing the shoulders/verge/roadbed and side slopes to conform to the alignment, levels, cross-sections and dimensions shown on the drawings or as directed by the Engineer subject to the surface tolerance described in Table 3.24. Both the upper and lower ends of the side slopes shall be rounded off to improve appearance and to merge the embankment with the adjacent terrain.

The topsoil, removed and conserved earlier shall be spread over the fill slopes as per directions of the Engineer to facilitate the growth of vegetation. Slopes shall be roughened and moistened slightly prior to the application of the topsoil in order to provide satisfactory bond. The depth of the topsoil shall be sufficient to sustain plant growth, the usual thickness being from 75 mm to 150 mm.

Where directed, the slopes shall be turfed with sods or if seeding and mulching of slopes is prescribed, this shall be done as per direction of the Engineer.

When earthwork operations have been substantially completed, the road area shall be cleared of all debris, and ugly scars in the construction area responsible for objectionable appearance eliminated.

**3.1.3.8 Embankment and subgrade around structures:** To avoid interference with the construction of abutments, wing walls or return walls of culvert/bridge structures, the Contractor shall, at points to be determined by the Engineer suspend work on embankment forming approaches to such structures, until such time as the construction of the latter is sufficiently advanced to permit the completion of approaches without the risk of damage to the structure.

Unless directed otherwise, the filling around culverts, bridges and other structures up to a distance of twice the height of the road from the back of the abutment shall be carried out independent of the work on the main embankment. The fill material shall not be placed against any abutment or wing wall, unless permission has been given by the Engineer but in any case not until the concrete or masonry has been in position for 14 days. The embankment and subgrade shall be brought up simultaneously in equal layers on each side of the structure to avoid displacement and unequal pressure. The sequence of work in this regard shall be got approved from the Engineer.

The material used for backfill shall not be an organic soil or highly plastic clay having plasticity index and liquid limit more than 20 and 40 respectively when tested according to IS: 2720 (Part 5). Filling behind abutments and wing walls for all

structures shall conform to the general guidelines given in Appendix 6 of IRC: 78 (Standard Specifications and Code of Practice for Road Bridges-Section VII) in respect of the type of material, the extent of backfill, its laying and compaction etc. The fill material shall be deposited in horizontal layers in loose thickness and compacted thoroughly to the requirements of Table 3.2.

Where the provision of any filter medium is specified behind the abutment, the same shall be laid in layers simultaneously with the laying of fill material. The material used for filter shall conform to the requirements for filter medium spelt out in Table 3.3. Unless otherwise specified in the Contract.

Where it may be impracticable to use conventional rollers, the compaction shall be carried out by appropriate mechanical means such as small vibratory roller, plate compactor or power rammer. Care shall be taken to see that the compaction equipment does not hit or come too close to any structural member so as to cause any damage to them or excessive pressure against the structure.

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

3.1.3.10 **Earthwork for high embankment:** In the case of high embankments, the Contractor shall normally use the material from the specified borrow area. In case he desires to use different material for his own convenience, he shall have to carry out necessary soil investigations and redesign the high embankment at his own cost. The Contractor shall then furnish the soil test data and design of high embankment for approval of the Engineer, who reserves the right to accept or reject it.

If necessary, stage construction of fills and any controlled rates of filling shall be carried out in accordance with the Contract including installation of instruments and its monitoring.

### 3.1.4 **Plying of Traffic**

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

### 3.1.5 **Surface Finish and Quality Control of Work**

The surface finish of construction of subgrade shall conform to the requirements of Table 3.26. Control on the quality of materials and works shall be exercised in accordance with Clause 3.15.

### 3.1.6 **Subgrade Strength**

3.1.6.1 It shall be ensured prior to actual execution that the borrow area material to be used in the subgrade satisfied the requirements of design CBR.

3.1.6.2 Subgrade shall be compacted and finished to the design strength consistent with other physical requirements. The actual laboratory CBR values of constructed subgrade shall be determined on undisturbed samples cut out from the compacted subgrade in CBR mould fitted with cutting saw or on remoulded samples, compacted to the field density at the field moisture content.

### 3.1.7 Measurements for Payment

Earth embankment/subgrade construction shall be measured separately by taking cross sections at intervals in the original position before the work starts and after its completion and computing the volumes of earthwork in cubic metres by the method of average end areas.

The measurement of fill material from borrow areas shall be the difference between the net quantities of compacted fill and the net quantities of suitable material brought from roadway and drainage excavation. For this purpose, it shall be assumed that one cu.m. of suitable material brought to site from road and drainage excavation form one cu.m. of compacted fill and all building or shrinkage shall be ignored.

Construction of embankment under water shall be measured in cu.m.

Construction of high embankment with specified material and in specified manner shall be measured in cu.m.

Stripping including storing and reapplication of topsoil shall be measured in cu.m.

Work involving loosening and recompacting of ground supporting embankment/subgrade shall be measured in cu.m.

Removal of unsuitable material at embankment/subgrade foundation and replacement with suitable material shall be measure in cu.m.

Filter medium and backfill material behind abutments, wing walls and other retaining structures shall be measured as finished work in position in cu.m.

### 3.1.8 Rates

3.1.8.1 The Contract unit rates for the items of embankment and subgrade construction shall be payment in full for carrying out the required operations including full compensation for:

- (i) Cost of arrangement of land as a source of supply of material of required quantity for construction unless provided otherwise in the Contract;
- (ii) Setting out;
- (iii) Compacting ground supporting embankment/subgrade except where removal and replacement of unsuitable material or loosening and recompacting is involved.
- (iv) Scarifying or cutting continuous horizontal benches 300 mm wide on side slopes of existing embankment and subgrade as applicable.
- (v) Cost of watering or drying of material in borrow areas and/or embankment and subgrade during construction as required.
- (vi) Spreading in layers, bringing to appropriate moisture content and compacting to Specification requirements;
- (vii) Shaping and dressing top and slopes of the embankment and subgrade including rounding of corners;
- (viii) Restricted working at sites of structures;
- (ix) Working on narrow width of embankment and subgrade;
- (x) Excavation in all soils from borrow pits/designated borrow areas including clearing and grubbing and transporting the material to embankment and subgrade site with all lifts and leads unless otherwise provided for in the Contract;

- (xi) All labour, materials, tools, equipment and incidentals necessary to complete the work to the Specifications;
- (xii) Dewatering; and
- (xiii) Keeping the embankment/completed formation free of water.

## **3.2 SURFACE/SUB SURFACE DRAINS**

### **3.2.1 Scope**

This work shall consist of constructing surface and / or sub-surface drains in accordance with requirements of these specifications and to the lines, grades, dimensions and other particulars shown on the drawings or as directed by the Engineer. Schedule of work shall be so arranged that the drains are completed in proper sequence with road works to ensure that no excavation of the completed road works is necessary subsequently or any damage is caused to these works due to lack of drainage.

### **3.2.2 Surface Drains**

Surface drains shall be excavated to the specified lines, grades, levels and dimensions as shown in drawings. The excavated material shall be removed from the area adjoining the drains and if found suitable, utilized in embankment / subgrade construction. All unsuitable material shall be disposed of as directed.

The excavated bed and sides of the drains shall be dressed to bring these in close conformity with the specified dimensions, levels and slopes.

Where so indicated, drains shall be lined or turfed with suitable materials in accordance with details on the drawings.

All works on drain construction shall be planned and executed in proper sequence with other works as approved by the engineer, with a view to ensuring adequate drainage for the area and minimizing erosion / sedimentation.

The Special Specification for Storm Water Drainage also shall be referred to.

### **3.2.3 Sub-surface Drains**

**3.2.3.1 Scope:** Sub-surface drains shall be of close-jointed perforated pipes, open-jointed unperforated pipes, surrounded by granular material laid in a trench or aggregate drains to drain the pavement courses or sub-surface drains designed using Geosynthetic material and approved by the Engineer.

#### **3.2.3.2 Materials**

**A. Pipe:** Perforated pipes for the drains may be of metal / asbestos cement/ cement concrete / PVC, and unperforated pipes of vitrified clay / cement concrete / asbestos cement. The type, size and grade of the pipe to be used shall be as specified in the contract. In no case, however, shall the internal diameter of the pipe be less than 100mm. Holes for perforated pipes shall be on one half of the circumference only and conform to the spacing indicated on the drawings. Size of the holes shall not ordinarily be greater than half of D85 size of the material surrounding the pipe, subject to minimum 3mm and maximum 6mm. D85 stands for the size of the sieve that allows 85% of the material to pass through it.

**B. Backfill material:** Backfill material shall consist of sound, tough, hard, durable particles of free draining sand-gravel material or crushed stone and shall be free of organic material, clay balls or other deleterious matter. Unless the contract specifies any particular gradings for the backfill material or requires these to be designed on inverted filter criteria for filtration and permeability to the approval of the engineer, the backfill material shall be provided on the following lines:

- i. Where the soil met with in the trench is of fine grained type (e.g., silt, clay or a mixture thereof), the backfill material shall conform to Class I grading set out in Table 3.3.
- ii. Where the soil met with in the trench is of coarse silt to medium sand or sandy type, the backfill material shall correspond to Class II grading of Table 3.3
- iii. Where the soil met with in the trench is of gravelly sand, the backfill material shall correspond to Class III grading of Table 3.3.

Thickness of backfill material around the pipe shall be as shown on the drawings subject to being at least 150mm around in all cases.

**TABLE 3.3: Grading Requirements for Filter Material**

Sieve designation	Per cent passing by weight		
	Class I	Class II	Class III
53 mm	-	-	100
45 mm	-	-	97-100
26.5 mm	-	100	-
22.4 mm	-	95-100	58-10
11.2 mm	100	48-100	20-60
5.6 mm	92-100	28-54	4-32
2.8 mm	83-100	20-35	0-10
1.4 mm	59-96	-	0-5
710 micron	35-80	6-18	-
355 micron	14-40	2-9	-
180 micron	3-15	-	-
90 micron	0-5	0-4	0-3

3.2.3.3 **Trench Excavation:** Trench for sub-surface drain shall be excavated to the specified lines, grades and dimensions shown in the drawings provided that width of trench at pipe level shall not be less than 450mm. The excavation shall begin at the outlet end of the drain and proceed towards the upper end. Where unsuitable material is met with at the trench bed, the same shall be removed to such depth as directed by the engineer and backfilled with approved material which shall be thoroughly compacted to the specified degree.

3.2.3.4 **Laying of pipe and Backfilling:** Laying of pipe in the trench shall be started at the outlet end and shall proceed towards the upper end, true to lines and grade specified. Unless otherwise provided, longitudinal gradient of the pipe shall not be less than 1 in 100.

Before placing the pipe, backfill material of the required grading(s) shall be laid for full width of the trench bed and compacted to a minimum thickness of 150mm or as shown on the drawings. The pipe shall then be embedded firmly on the bed.

Perforated pipes, unless otherwise specified, shall be placed with their perforations down to minimize clogging. The pipe sections shall be joined securely with appropriate coupling fittings or bands.

Non-perforated pipes shall be laid as close as possible with the open joints wrapped with suitable pervious material (like double layer of Hessian, suitable Geosynthetic material of not less than 150mm width) to permit entry of water but prevent fines entering the pipes. In the case of non-perforated pipes with bell end, the bell shall face upgrade.

Upgrade end sections of the pipe installation shall be tightly closed by means of concrete plugs or plugs fabricated from the same material as the pipe and securely held in place to prevent entry of soil materials.

After the pipe installation has been completed and approved, backfill material of the required grading(s) shall be placed over the pipe to the required level in horizontal layers not exceeding 150mm in thickness and thoroughly compacted. The minimum thickness of material above the top of the pipe shall be 300mm.

Unless otherwise provided, sub-surface drains not located below the road pavement shall be sealed at the top by means of 150mm thick layer of compacted clay so as to prevent percolation of surface water under the road layers.

**3.2.3.5 Use of Geosynthetic in laying of pipe and backfilling:** After excavating the trench for subsurface drain, the filter fabric shall be placed, the pipe installed and the trench backfilled with permeable material according to dimensions and details shown on the plans. Surfaces to receive filter fabric prior to placing shall be free of loose or extraneous material and sharp objects that may damage the filter fabric during installation. Adjacent rolls of the fabric shall be overlapped a minimum of 450mm. The preceding roll shall overlap the following roll in the direction the material is being spread.

Damage to the fabric resulting from Contractor's vehicles, equipment or operations shall be replaced or repaired by the contractor at his expense.

**3.2.3.6 Drain outlet:** The outlet for a sub-drain shall not be under water or plugged with debris but should be a free outlet discharging into a stream, culvert or open protected with grate or screen. For a length of 500mm from the outlet end, the trench for pipe shall not be provided with granular material but backfilled with excavated soil and thoroughly compacted so as to stop water directly percolating from the backfill material around the pipe. The pipe in this section shall not have any perforations.

Trenches for aggregate drains shall be excavated to a minimum width of 300mm and to the depth shown on the plans or ordered by the engineer. The bottom of the trench shall be sloped to drain and shall be free from loose particles of soil. The trench shall be excavated so as to expose clearly the granular pavement courses to be drained.

Aggregate for the drains shall be durable gravel, stone or slag and shall be free from vegetable matter and other deleterious substances.

### **3.2.4 Measurement of Payment**

Measurement for surface and sub-surface drains shall be per running metre length of the drain. Disposal of surplus material beyond 1000 m shall be measured in cu.m.



**3.2.5 Rates**

The Contract unit rates for surface and subsurface drains shall be payment in full for all items such as excavation, dressing the sides and bottom; providing lining, turving, pitching, masonry, concrete and plastering; providing, laying and jointing pipes; providing, laying and compacting backfill and bed of granular material; providing, fixing and painting of cover etc. including full compensation for all materials, labour, tools, equipment and other incidentals to complete the work as shown on drawings with all leads and lifts except for removal of unsuitable material for which the lead shall be 1000 m. Provision of inlets, gratings, sumps, outlet pipes, bedding, disburers etc. wherever required shall be incidental to construction of drain. The Contract unit rate for disposal of surplus and unsuitable material beyond the initial 1000 m lead shall be full compensation for labour, tools, equipment and incidentals necessary on account of the additional haul.

**3.3 GRANULAR SUB-BASE**

**3.3.1 Scope**

This work shall consist of laying and compacting well-graded material on prepared subgrade in accordance with the requirements of these Specifications. The material shall be laid in one or more layers as sub-base or lower sub-base and upper sub-base (termed as sub-base hereinafter) as necessary according to lines, grades and cross-sections shown on the drawings or as directed by the Engineer.

**3.3.2 Materials**

3.3.2.1 The material to be used for the work shall be natural sand, moorum, gravel, crushed stone, Jhama brick aggregate or combination thereof depending upon the grading required. Materials like crushed slag, crushed concrete, brick metal and kankar may be allowed only with the specific approval of the Engineer. The material shall be free from organic or other deleterious constituents and conform to one of the three gradings given in Table 3.4.

3.3.2.2 While the gradings in Table 3.4 are in respect of close-graded granular sub-base materials, one each for maximum particle size of 75 mm, 53 mm and 26.5 mm.

3.3.2.3 **Physical requirements:** The material shall have a 10 per cent fines value of 50 kN or more (for sample in soaked condition) when tested in compliance with BS: 812 (Part 111). The water absorption value of the coarse aggregate shall be determined as per IS: 2386 (Part 3); if this value is greater than 2 per cent, the soundness test shall be carried out on the material delivered to site as per IS: 383. For Grading II and III materials, the CBR shall be determined at the density and moisture content likely to be developed in equilibrium conditions which shall be taken as being the density relating to a uniform air voids content of 5 per cent.

**TABLE 3.4: Grading for Close-Graded Granular Sub-Base Materials**

IS Sieve Designation	Per cent by weight passing the IS sieve		
	Grading I	Grading II	Grading III
75.0 mm	100	-	-
53.0 mm	80-100	100	-
26.5 mm	55-90	70-100	100

IS Sieve Designation	Per cent by weight passing the IS sieve		
	Grading I	Grading II	Grading III
9.50 mm	35-65	50-80	65-95
4.75 mm	25-55	40-65	50-80
2.36 mm	20-40	30-50	40-65
0.425 mm	10–25	15–25	20–35
0.075 mm	3-10	3-10	3-10
CBR value (Minimum)	30	25	20

### 3.3.3 Strength of sub-base

It shall be ensured prior to actual execution that the material to be used in the sub-base satisfies the requirements of CBR and other physical requirements when compacted and finished.

When directed by the Engineer, this shall be verified by performing CBR tests in the laboratory as required on specimens remoulded at field dry density and moisture content any other tests for the “quality” of materials, as may be necessary.

### 3.3.4 Construction Operations

**3.3.4.1 Preparation of subgrade:** Immediately prior to the laying of sub-base, the subgrade already finished to Clause 3.1 shall be prepared by removing all vegetation and other extraneous matter, lightly sprinkled with water if necessary and rolled with two passes of 80 – 100 kN smooth wheeled roller.

**3.3.4.2 Spreading and Compacting:** The sub-base material of grading specified in the Contract shall be spread on the prepared subgrade with the help of a motor grader of adequate capacity, its blade having hydraulic controls suitable for initial adjustment and for maintaining the required slope and grade during the operation or other means as approved by the Engineer.

When the sub-base material consists of combination of materials mentioned in Clause 3.3.2, mixing shall be done mechanically by the mix-in-place method.

Manual mixing shall be permitted only where the width of laying is not adequate for mechanical operations, as in small-sized jobs. The equipment used for mix-in-place construction shall be a rotavator or similar approved equipment capable of mixing the material to the desired degree. If so desired by the Engineer, trial runs with the equipment shall be carried out to establish its suitability for the work.

Moisture content of the loose material shall be checked in accordance with IS: 2720 (Part 2) and suitably adjusted by sprinkling additional water from a truck mounted or trailer mounted water tank and suitable for applying water uniformly and at controlled quantities to variable widths of surface or other means approved by the Engineer so that, at the time of compaction, it is from 1 per cent above to 2 per cent below the optimum moisture content corresponding to IS: 2720 (Part 8). While adding water, due allowance shall be made for evaporation losses. After water has been added, the material shall be processed by mechanical or other approved means like disc harrows, rotavators until the layer is uniformly wet.

Immediately thereafter, rolling shall start. If the thickness of the compacted layer does not exceed 100 mm, a smooth wheeled roller of 80 to 100 kN weight may be used. For a compacted single layer upto 225 mm the compaction shall be done with the

help of a vibratory roller of minimum 80 to 100 kN static weight with plain drum or pad foot-drum or heavy pneumatic tyred roller of minimum 200 to 300 kN weight having a minimum tyre pressure of 0.7 MN/m<sup>2</sup> or equivalent capacity roller capable of achieving the required compaction. Rolling shall commence at the lower edge and proceed towards the upper edge longitudinally for stretches of unidirectional crossfall and super-elevation, and shall commence at the edges and progress towards the centre for stretches having crossfall on both sides.

Each pass of the roller shall uniformly overlap not less than one-third of the track made in the preceding pass. During rolling, the grade and crossfall (camber) shall be checked and any high spots or depressions, which become apparent, corrected by removing or adding fresh material. The speed of the roller shall not exceed 5 km per hour.

Rolling shall be continued till the density achieved is at least 98 per cent of the maximum dry density for the material determined as per IS: 2720 (Part 8). The surface of any layer of material on completion of compaction shall be well closed, free from movement under compaction equipment and from compaction planes, ridges, cracks or loose material. All loose, segregated or otherwise defective areas shall be made good to the full thickness of layer and re-compacted.

### **3.3.5 Surface Finish and Quality Control of Work**

The surface finish of construction shall conform to the requirements of Clause 3.15.

Control on the quality of materials and works shall be exercised by the Engineer in accordance with Section 3.15.

### **3.3.6 Arrangements for Traffic**

During the period of construction, arrangement of traffic diversions shall be maintained as per the direction of Engineer.

### **3.3.7 Measurements for Payment**

Granular sub-base shall be measured as finished work in position in cubic metres.

The protection of edges of granular sub-base extended over the full formation as shown in the drawing shall be considered incidental to the work of providing granular sub-base and as such no extra payment shall be made for the same.

### **3.3.8 Rate**

The Contract unit rate for granular sub-base shall be payment in full for carrying out the required operations including full compensation for:

- (i) making arrangements for traffic diversions. Except for initial treatment to verges, shoulders and construction of diversions;
- (ii) furnishing all materials to be incorporated in the work including all royalties, fees, rents where necessary and all leads and lifts;
- (iii) all labour, tools, equipment and incidentals to complete the work to the Specifications;
- (iv) carrying out the work in part widths of road where directed;
- (v) carrying out the required tests for quality control and
- (vi) multiple handling of materials

## **3.4 WATER BOUND MACADAM**

### **3.4.1 Scope**

This work shall consist of clean, crushed aggregates mechanically interlocked by rolling and bonding together with screening, binding material where necessary and water laid on a properly prepared subgrade/sub-base/base or existing pavement, as the case may be and finished in accordance with the requirements of these Specifications and in close conformity with the lines, grades, cross-sections and thickness as per approved plans or as directed by the Engineer.

It is, however, not desirable to lay water bound macadam on an existing thin black topped surface without providing adequate drainage facility for water that would get accumulated at the interface of existing bituminous surface and water bound macadam.

### 3.4.2 Materials

#### 3.4.2.1 Aggregates

**3.4.2.1.1 Physical requirements:** Coarse aggregates shall be either crushed or broken stone, crushed slag, overburnt (Jhama) brick aggregate or any other naturally occurring aggregates such as kankar and laterite of suitable quality. Material other than crushed or broken stone and crushed slag shall be used in sub-base courses only. If crushed gravel/shingle is used, not less than 90 per cent by weight of the gravel, shingle pieces retained on 4.75 mm sieve shall have at least two fractured faces. The aggregates shall conform to the physical requirements set forth in **Table 3.5**. The type and size range of the aggregate shall be specified in the Contract or shall be as specified by the Engineer. If the water adsorption value of the coarse aggregate is greater than 2 percent, the soundness test shall be carried out on the material delivered to site as per IS: 2386 (Part 5)

**3.4.2.1.2 Crushed or broken Stone:** The crushed or broken stone shall be hard, durable and free from excess flat, elongated, soft and disintegrated particles, dirt and other deleterious material.

**TABLE 3.5: Physical Requirements of Coarse Aggregates for Water Bound Macadam for Sub-Base/Base Courses**

Test	Test Method	Requirements
1. * Los Angeles Abrasion value or *Aggregate Impact value	IS: 2386 (Part-4)	40 per cent (Max.)
	IS: 2386 (Part-4) or IS: 5640	30 per cent (Max.)
2. Combined Flakiness and Elongation indices (Total)	IS: 2386 (Part – I)	30 per cent (Max.)**

\* Aggregate may satisfy requirements of either of the two tests.

\*\* Aggregates like brick metal, kankar, laterite etc. Which get softened in presence of water shall tested for impact value under wet conditions in accordance with IS: 5640

\*\*\* The requirement of flakiness index and elongation index shall be enforced only in the case of crushed broken stone and crushed slag

#### 3.4.2.1.3 Crushed or broken Stone:

Crushed slag shall be made from air-cooled blast furnace slag. It shall be of angular shape, reasonably uniform in quality and density and generally free from thin, elongated and soft pieces, dirt or other deleterious materials. The weight of crushed slag shall not be less than 11.2 kN per m<sup>3</sup> and the percentage of glossy material shall not be more than 20. It should also comply with the following requirements:

1. Chemical stability : To comply with requirements of appendix of BS:1047
2. Sulphur content : Maximum 2 per cent
3. Water absorption : Maximum 10 per cent

**3.4.2.1.4 Overburnt (Jhama) brick aggregates:**

Jhama brick aggregates shall be made from overburnt bricks or brick bats and be free from dust and other objectionable and deleterious materials.

**3.4.2.1.5 Grading requirements:**

The coarse aggregates shall conform to one of the Grading given in Table 3.6 as specified, provided, however, the use of Grading No. 1 shall be restricted to sub-base courses only.

**TABLE 3.6: Grading Requirements of Aggregates for Wet Bound Macadam**

Grading No.	Size Range	IS Sieve Designation	Per cent by weight passing
1.	90 mm to 45 mm	125 mm	100
		90 mm	90-100
		63 mm	25-60
		45 mm	0-15
		22.4 mm	0-5
2.	63 mm to 45 mm	90 mm	100
		63 mm	90-100
		53 mm	25-75
		45 mm	0-15
		22.4 mm	0-5
3.	53 mm to 22.4 mm	63 mm	100
		53 mm	95-100
		45 mm	65-90
		22.4 mm	0-10
		11.2 mm	0-5

*Note: The compacted thickness for a layer with Grading 1 shall be 100 mm while for layer with other Gradings i.e., 2 & 3, it shall be 75 mm.*

**3.4.2.1.6 Screenings:**

Screenings to fill voids in the coarse aggregate shall generally consist of the same material as the coarse aggregate. However, where permitted, predominantly non-

plastic material such as moorum or gravel (Other than rounded borne material) may be used for this purpose provided liquid limit and plasticity index of such material are below 20 and 6 respectively and fraction passing 75 micron sieve does not exceed 10 per cent.

Screenings shall conform to the grading set forth in Table 3.6.1. The consolidated details of quantity of screenings required for various grades of stone aggregates are given in **Table 3.6.2**. The table also gives the quantities of materials (loose) required for 10 m<sup>2</sup> for sub-base/base compacted thickness of 100/75 mm

The use of screenings shall be omitted in the case of soft aggregates such as brick metal, kankar, laterites, etc. As they are likely to get crushed to a certain extent under rollers.

**Table 3.6.1: Grading for Screenings**

Grading Classification	Size of Screenings	IS Sieve Designation	Percent by weight passing the IS Sieve
A	13.2 mm	13.2 mm	100
		11.2 mm	95-100
		5.6 mm	15-35
		180 micron	0-10
B	11.2 mm	11.2 mm	100
		5.6 mm	90-100
		180 mm	15-35

**Table 3.6.2: Approximate Quantities of Coarse Aggregates and Screenings Required for 100/75 mm Compacted Thickness of Water Bound Macadam (WBM) Sub-Base /Base Course for 10m<sup>2</sup> Area**

Classification	Size Range	Compacted thickness	Loose Qty.	Screenings			
				Stone Screening		Crushable Type such as Moorum or Gravel	
				Grading Classification & size	For. WBM Sub-base/base course (Loose quantity)	Grading Classification & size	Loose Qty.
Grading 1	90 mm to 45 mm	100 mm	1.21 to 1.43 m <sup>3</sup>	Type A 13.2 mm	0.27 to 0.30 m <sup>3</sup>	Not uniform	0.30 to 0.32 m <sup>3</sup>
Grading 2	63 mm to 45 mm	75 mm	0.91 to 1.07 m <sup>3</sup>	Type A 13.2 mm	0.12 to 0.15 m <sup>3</sup>	-do-	0.22 to 0.24 m <sup>3</sup>
-do-	-do-	-do-	-do-	Type B 11.2 mm	0.20 to 0.22 m <sup>3</sup>	-do-	-do-
Grading 3	53 mm to 22.4 mm	75 mm	-do-	-do-	0.18 to 0.21 m <sup>3</sup>	-do-	-do-

### 3.4.2.1.7 Binding material

Binding material to be used for water bound macadam as a filler material meant for preventing ravelling, shall comprise of a suitable material approved by the Engineer having a Plasticity Index (PI) value of less than 6 as determined in accordance with IS: 2720 (Part-5).

The quantity of binding material where it is to be used, will depend on the type of screenings. Generally, the quantity required for 75 mm compacted thickness of water bound macadam will be 0.06-0.09 m<sup>3</sup>/10m<sup>2</sup> and 0.08-0.10m<sup>3</sup>/10m<sup>2</sup> for 100 mm compacted thickness.

The above mentioned quantities should be taken as a guide only, for estimation of quantities of construction etc.

Application of binding materials may not be necessary when the screenings used are of crushable type such as moorum or gravel.

### 3.4.3 Construction Operations

**3.4.3.1 Preparation of base:** The surface of the subgrade/sub-base/base to receive the water bound macadam course shall be prepared to the specified lines and crossfall (camber) and made free of dust and other extraneous material. Any ruts or soft yielding places shall be corrected in an approved manner and rolled until firm surface is obtained if necessary by sprinkling water. Any sub-base/base/surface irregularities, where predominant, shall be made good by providing appropriate type of profile corrective course (leveling course) to **Clause 501** of these Specifications.

As far as possible, laying water bound macadam course over an existing thick bituminous layer may be avoided since it will cause problems of internal drainage of the pavement at the interface of two courses. It is desirable to completely pick out the existing thin bituminous weaning course where water bound macadam is proposed to be laid over it. However, where the intensity of rain is low and the interface drainage facility is efficient, water bound macadam can be laid over the existing thin bituminous surface by cutting 50 mm x 50 mm furrows at an angle of 45 degrees to the centre line of the pavement at one m intervals in the existing road. The directions and depth of furrows shall be such that they provide adequate bondage and also serve to drain water to the existing granular base course beneath the existing thin bituminous surface.

**3.4.3.2 Inverted Choke:** If water bound macadam is to be laid directly over the subgrade, without any other intervening pavement course, a 25 mm course of screenings (Grading B) or coarse sand shall be spread on the prepared subgrade before application of the aggregates is taken up. In case of a fine sand or silty or clayey subgrade, it is advisable to lay 100 mm insulating layer of screening or coarse sand on top of fine grained soil, the gradation of which will depend upon whether it is intended to act as a drainage layer as well. As a preferred alternative to inverted choke, appropriate geosynthetics performing functions of separation and drainage may be used over the prepared subgrade as directed by the Engineer. **Section 700** of MoST specifications for Road and Bridge Works (IV Revision) shall be applicable for use of Geosynthetics.

**3.4.3.3 Spreading coarse aggregates:** The coarse aggregates shall be spread uniformly and evenly upon the prepared subgrade/sub-base/base to proper profile by using templates places across the road about 6m apart, in such quantities that the thickness of each

compacted layer is not more than 100 mm for Grading 1 and 75 mm for Grading 2 and 3, as specified in **Clause 3.4.2.1.5**. Wherever possible, approved mechanical devices such as aggregate spreader shall be used to spread the aggregates uniformly so as to minimise the need for manual rectification afterwards. Aggregates placed at locations which are inaccessible to the spreading equipment, may be spread in one of more layers by any approved means so as to achieve the specified results.

The spreading shall be done from stockpiles along the side of the roadway or directly from vehicles. No segregation of large or fine aggregates shall be allowed and the coarse aggregate as spread shall be uniform gradation with no pockets of fine material.

The surface of the aggregates spread shall be carefully checked with templates and all high or low spots remedied by removing or adding aggregates as may be required. The surface shall be checked frequently with a straight edge while spreading and rolling so as to ensure a finished surface as per approved Drawings.

The coarse aggregates shall not normally be spread more than 3 days in advance of the subsequent construction operations.

**3.4.3.4 Rolling:** Immediately following the spreading of the coarse aggregate, rolling shall be started with three wheeled power rollers of 80 to 100 kN capacity or tandem or vibratory rollers of 80 to 100 kN static weight. The type of roller to be used shall be approved by the Engineer based on trial run.

Except on superelevated portions where the rolling shall proceed from inner edge to the outer, rolling shall begin from the edges gradually progressing towards the centre. First the edge/edges shall be compacted with roller running forward and backward. The roller shall then move inward parallel to the centre line of the road, in successive passes uniformly lapping preceding tracks by at least one half width.

Rolling shall be discontinued when the aggregates are partially compacted with sufficient void space in them to permit application of screenings. However, where screenings are not to be applied, as in the case of crushed aggregates like brick metal, laterite and kankar, compaction shall be continued until the aggregates are thoroughly keyed. During rolling, slight sprinkling of water may be done, if necessary. Rolling shall not be done when the subgrade is soft or yielding or when it causes a wave-like motion in the subgrade or subbase course.

The rolled surface shall be checked transversely and longitudinally, with templates and any irregularities corrected by loosening the surface, adding or removing necessary amount of aggregates and re-rolling until the entire surface conforms to desired crossfall (camber) and grade. In no case shall the use of screenings be permitted to make up depressions.

Material which gets crushed excessively during compaction or becomes segregated shall be removed and replaced with suitable aggregates.

It shall be ensured that shoulders are built up simultaneously along with water bound macadam courses as per specification.

**3.4.4 Application of Screening:** After the coarse aggregate has been rolled to **Clause 3.4.3.4**, screenings to completely fill the interstices shall be applied gradually over the surface. These shall not be damp or wet at the time of application. Dry rolling shall be done while the



screening are being spread so that vibrations of the roller cause them to settle into the voids of the coarse aggregate. The screenings shall not be dumped in piles but be spread uniformly in successive thin layers either by the spreading motions of hand shovels or by mechanical spreaders, or directly from tipper with suitable grit spreading arrangement. Tipper operating for spreading the screenings shall be so driven as not to disturb the coarse aggregate.

The screenings shall be applied at a slow and uniform rate (in three or more applications) so as to ensure filling of all voids. This shall be accompanied by dry rolling and brooming with mechanical brooms, hand brooms or both. In no case shall the screenings be applied so fast and thick as to form cakes or ridges on the surface in such a manner as would prevent filling of voids or prevent the direct bearing of the roller on the coarse aggregate. These operations shall continue until no more screenings can be forced into the voids of the coarse aggregate.

The spreading, rolling, and brooming of screenings shall be carried out in only such lengths of the road which could be completed within one day's operation

#### **3.4.5 Sprinkling of water and grouting**

After the screenings have been applied, the surface be copiously sprinkled with water, swept and rolled. Hand brooms shall be used to sweep the wet screenings into voids and to distribute them evenly. The sprinkling, sweeping and rolling operation shall be continued, with additional screenings applied as necessary until the coarse aggregate has been thoroughly keyed, well-bonded and firmly set in its full depth and a grout has been formed of screenings. Care shall be taken to see that the base or subgrade does not get damaged due to the addition of excessive quantities of water during construction.

In case of lime treated soil sub-base, construction of water bound macadam on top of it can cause excessive water to flow down to the lime treated sub-base before it has picked up enough strength (is still "green") and thus cause damage to the sub-base layer. The laying of water bound macadam layer in such cases shall be done after the sub-base attains adequate strength, as directed by the Engineer.

#### **3.4.6 Application of Binding Material**

After the application of screenings in accordance with **Clauses 3.4.4 and 3.4.5** the binding material where it is required to be used (**Clause 3.4.2.1.7**) shall be applied successively in two or more thin layers at a slow and uniform rate. After each application, the surface shall be copiously sprinkled with water, the resulting slurry swept in with hand brooms, or mechanical brooms to fill the voids properly, and rolled during which water shall be applied to the wheels of the rollers if necessary to wash down the binding material sticking to them. These operations shall continue until the resulting slurry after filling of voids, forms a wave ahead of the wheels of the moving roller.

#### **3.4.7 Setting and Drying**

After the final compaction of water bound macadam course, the pavement shall be allowed to dry overnight. Next morning hungry spots shall be filled with screenings or binding material as directed, lightly sprinkled with water if necessary and rolled. No traffic shall be allowed on the road until the macadam has set. The Engineer shall have the discretion to stop hauling traffic from using the completed water bound macadam course, if in his opinion it would cause excessive damage to the surface.

The compacted water bound macadam course should be allowed to completely dry and set before the next pavement course is laid over it

#### **3.4.8 Surface Finish and Quality Control of Work**

The surface finish of construction shall conform to the requirements of Section 902 of MoST Specifications for Road and Bridge Works (IV Revision).

Control on the quality of materials and works shall be exercised by the Engineer in accordance with Section 900 of MoST Specifications for Road and Bridge Works (IV Revision).

The water bound macadam work shall not be carried out when the atmospheric temperature is less than 0 degree centigrade in the shade.

#### **3.4.9 Reconstruction of Defective macadam**

The finished surface of water bound macadam shall conform to the tolerance of surface regularity as prescribed in Section 902 of MoST Specifications for Road and Bridge Works (IV Revision). However, where the surface irregularity of the course exceeds the tolerances or where the course is otherwise defective due to subgrade soil mixing with the aggregates, the course to its full thickness shall be scarified over the affected area, reshaped with added material or removed and replaced with fresh material as applicable and recompacted. In no case shall depressions be filled up with screenings or binding material.

#### **3.4.10 Arrangement for Traffic**

During the period of construction, the arrangement of traffic shall be done as per MoRT&H clause 112.

#### **3.4.11 Measurements for Payment**

Water bound macadam shall be measured as finished work in position in cubic metres.

#### **3.4.12 Rate**

The Contract unit rate for water bound macadam sub-base/base course shall be payable in full for carrying out the required operations including full compensation for all components listed in **Clause 3.3.8** including arrangement of water used in the work as approved by the Engineer.

### **3.5 CEMENT CONCRETE KERB AND KERB WITH CHANNEL**

#### **3.5.1 Scope**

This work shall consist of constructing cement concrete kerbs and kerbs with channel in the central median and/or along the footpaths or separators in conformity with the lines, levels and dimensions as specified in the drawings.

#### **3.5.2 Materials**

Kerbs and kerb with channel shall be provided in cement concrete of Grade M20 in accordance with the Specifications.

#### **3.5.3 Type of Construction**

These shall be cast-in-situ construction with suitable kerb casting machine in all situations except at locations where continuous casting with equipment is not practicable. In those situations, precast concrete blocks shall be used.

#### **3.5.4 Equipment**

A continuous kerb casting equipment of adequate capacity and controls, capable of laying the kerbs in required cross-sections and producing a well-compacted mass of concrete free of voids and honeycombs, shall be used.

### **3.5.5 Construction Operations**

- 3.5.5.1 Kerb shall be laid on firm foundation of minimum 150 mm thickness of cement concrete of M10 grade cast in-situ or one extended width and pavement. The foundation shall have a projection of 50 mm beyond the kerb stone. Before laying the foundation of lean concrete, the base shall be levelled and slightly watered to make it damp.
- 3.5.5.2 In the median lengths. In the portions where footpath is provided and/or the slope of the carriageway is towards median (as in case of super elevated portions), there shall be sufficient gap/recess left in the kerb to facilitate portions in the straight reaches, the kerb shall be cast in continuous drainage openings.
- 3.5.5.3 After laying the kerbs and just prior to hardening of the concrete, saw cut grooves shall be provided at 5 m intervals or as specified by the Engineer.
- 3.5.5.4 Kerbs on the drainage ends such as along the footpath or the median in super elevated portions shall be cast with monolithic concrete channels as indicated in drawings. The slope of the channel towards drainage pipes shall be ensured for efficient drainage of the road surface.
- 3.5.5.5 Vertical and horizontal tolerances with respect to true line and level shall be  $\pm 6$  mm.

### **3.5.6 Measurements for Payment**

Cement concrete kerb/kerb with channel shall be measured in linear metre for the complete item of work.

Foundation of kerb, where separately provided shall be measured in linear metre for complete item of work.

### **3.5.7 Rates**

The Contract unit rates for cement concrete kerb/kerb with channel and foundation for kerb shall be payment in full compensation for furnishing all materials, labour, tools, equipment for construction and other incidental cost necessary to complete the work.

## **3.6 FOOTPATHS AND SEPARATORS**

### **3.6.1 Scope**

The work shall consist of constructing footpaths and/or separators at locations as specified in the drawings or as directed by the Engineer. The lines, levels and dimensions shall be as per the drawings. The scope of the work shall include provision of all drainage arrangements as shown in the drawings or as directed.

### **3.6.2 Materials**

The footpaths and separators shall be constructed with any of the following types:

- a) Cast-in-situ cement concrete of Grade M20 as per the Specifications.
- b) Precast cement concrete blocks/tiles of Grade M20 as per the Specifications. The minimum thickness of the cement concrete block/tile shall be 25 mm and minimum size shall be 300 mm  $\times$  300 mm.
- c) Natural stone slab cut and dressed from stone of good and sound quality, uniform in texture, free from defects and at least equal to a sample submitted by the Contractor and approved by the Engineer. The minimum thickness of the natural stone slab shall be 25 mm and minimum size shall be 300 mm  $\times$  300 mm.

### 3.6.3 Construction Operations

- 3.6.3.1 Drainage pipes below the footpath originating from the kerbs shall be first laid in the required slope and connected to the drains/sumps/storm water drain/drainage chutes as per provisions of the drawings, or as specified.
- 3.6.3.2 Portion on back side of kerbs shall be filled and compacted with granular sub-base material as per Clause 3.3 of the Specifications in specified thickness.
- 3.6.3.3 The base shall be prepared and finished to the required lines, levels and dimensions as indicated in the drawings with the following:
- a) Minimum 150 mm thick, compacted granular sub-base material as per Clause 3.3 of the Specifications.
  - b) Minimum 25 mm thick cement concrete of Grade M 15.
- Over the prepared base, precast concrete blocks/tiles/natural stone slabs and/or cast-in-situ slab shall be set/laid as described in Clauses 3.6.3.4 and 3.6.3.5.
- 3.6.3.4 Precast cement concrete blocks/tiles/natural stone slab: The blocks/tiles/slabs shall be set on a layer of average 12 mm thick cement sand mortar (1:3) laid on prepared base in such a way that there is no rocking. The gaps between the blocks/tiles/slabs shall not be more than 12 mm and shall be filled with cement-sand mortar (1:3).
- 3.6.3.5 Cast-in-situ cement concrete: The minimum thickness of the cement concrete shall be 25 mm and it shall be cast on the prepared base in panels of specified size in a staggered manner. Construction joints shall be provided as directed.

### 3.6.4 Measurements for Payment

Footpaths and separators shall be measured in sq.metre between inside of kerbs.

### 3.6.5 Rates

Contract unit rates shall be inclusive of full compensation of all labour, materials, tools, equipment and incidentals to construction of footpaths. Cost of providing pipes and arrangement for their discharge into appropriate drainage channels shall be incidental to the construction of footpaths.

## 3.7 PRIME COAT OVER GRANULAR BASE

### 3.7.1 Scope

This work shall consist of the application of a single coat of low viscosity liquid bituminous material to a porous granular surface preparatory to the superimposition of bituminous treatment or mix.

### 3.7.2 Materials

- 3.7.2.1 **Primer:** The choice of a bituminous primer shall depend upon the porosity characteristics of the surface to be primed as classified in IRC:16. These are:
- i) Surfaces of low porosity; such as wet mix macadam and water bound macadam,
  - ii) Surfaces of medium porosity; such as cement stabilized soil base,
  - iii) Surface of high porosity; such as a gravel base.
- 3.7.2.2 **Primer viscosity:** The type and viscosity of the primer shall comply with the requirements of IS 8887, as sampled and tested for bituminous primer in accordance with these standards. Guidance on viscosity and rate of spray is given in Table 3.7.

**TABLE 3.7: Viscosity Requirement and Quantity of Liquid Bituminous Primer**

Type of surface	Kinematic Viscosity of Primer at 60°C (Centistokes)	Quantity of Liquid Bituminous Material per 10 Sq.m. (kg)
Low porosity	30 - 60	6 to 9
Medium porosity	70 – 140	9 to 12
High porosity	250 – 500	12 to 15

**3.7.2.3 Choice of primer:** The primer shall be bitumen emulsion, complying with IS 8887 of a type and grade as specified in the Contract or as directed by the Engineer. The use of medium curing cutback as per IS 217 shall be restricted only for sites at sub-zero temperatures or for emergency applications as directed by the Engineer.

### 3.7.3 Weather and Seasonal Limitations

Bituminous primer shall not be applied to a wet surface (see 3.7.4.2) or during a dust storm or when the weather is foggy, rainy or windy or when the temperature in the shade is less than 10°C. Surfaces which are to receive emulsion primer should be damp, but no free or standing water shall be present.

### 3.7.4 Construction

**3.7.4.1 Equipment:** The primer distributor shall be a self-propelled or towed bitumen pressure sprayer equipped for spraying the material uniformly at specified rates and temperatures. Hand spraying of small area, inaccessible to the distributor, or in narrow strips shall be sprayed with a pressure hand sprayer, or as directed by the Engineer.

**3.7.4.2 Preparation of road surface:** The surface to be primed shall be prepared in accordance with Table 3.26 as appropriate. Immediately prior to applying the primer the surface shall be carefully swept clean of dust and loose particles, care being taken not to disturb the interlocked aggregate. This is best achieved when the surface layer is slightly moist (lightly sprayed with water and the surface allowed to dry) and the surface should be kept moist until the primer is applied.

**3.7.4.3 Application of bituminous primer:** The viscosity and rate of application of the primer shall be as specified in the Contract, or as determined by site trials carried out as directed by the Engineer. The bituminous primer shall be sprayed uniformly. The method for application of the primer will depend on the type of equipment to be used, size of nozzles, pressure at the spray bard and speed of forward movement. The Contractor shall demonstrate at a spraying trial, that the equipment and method to be used is capable of producing a uniform spray, within the tolerances specified.

**3.7.4.4 Curing of primer and opening to traffic:** A primed surface shall be allowed to cure for at least 24 hours or such other period as is found to be necessary to allow all the volatiles to evaporate before any subsequent surface treatment or mix is laid. Any unabsorbed primer shall first be blotted with an application of sand, using the minimum quantity possible. A primed surface shall not be opened to traffic other than that necessary to lay the next course. A very thin layer of clean sand may be applied to the surface of the primer, to prevent the primer picking up under the wheels of the paver and the trucks delivering bituminous material to the paver.

**3.7.4.5 Tack coat:** Over the primed surface, a tack coat should be applied in accordance with Clause 3.8 if required and directed by the Engineer.

### 3.7.5 Quality Control of Work

For control of the quality of materials supplied and the works carried out, the relevant provisions of Section 3.15 shall apply.

### **3.7.6 Arrangements for Traffic**

During construction operations, arrangements for traffic diversion shall be made in accordance with the direction of the Engineer.

### **3.7.7 Measurement for Payment**

Prime coat shall be measured in terms of surface area of application in square metres.

### **3.7.8 Rate**

The contract unit rate for prime coat as described in Clause 3.7.7 shall be payment in full for carrying out the required operations including full compensation for all components listed in Clause 3.7.4 and as applicable to the work specified in these Specifications. Payment shall be made on the basis of the provision of prime coat at an application rate of 0.6 kg per square metre, with adjustment, plus or minus, for the variation between this amount and the actual amount approved by the Engineer after the preliminary trials referred to in Clause 3.7.4.3.

## **3.8 TACK COAT**

### **3.8.1 Scope**

This work shall consist of the application of a single coat of low viscosity liquid bituminous material to an existing bituminous road surface preparatory to the superimposition of a bituminous mix, when specified in the Contract or instructed by the Engineer.

### **3.8.2 Materials**

3.8.2.1 **Binder:** The binder used for tack coat shall be bitumen emulsion complying with IS 8887 of a type and grade as specified in the Contract or as directed by the Engineer. The use of cutback bitumen as per IS 217 shall be restricted only for sites at sub-zero temperatures or for emergency applications as directed by the Engineer.

### **3.8.3 Weather and Seasonal Limitations**

Bituminous material shall not be applied to a wet surface or during a dust storm or when the weather is foggy, rainy or windy or when the temperature in the shade is less than 10°C. Where the tack coat is of cutback bitumen, the surface shall be dry.

### **3.8.4 Construction**

3.8.4.1 **Equipment:** The tack coat distributor shall be a self-propelled or towed bitumen pressure sprayer, equipped for spraying the material uniformly at a specified rate. Hand spraying of small areas, inaccessible to the distributor, or in narrow strips, shall be sprayed with a pressure hand sprayer, or as directed by the Engineer.

3.8.4.2 **Preparation of base:** The surface on which the tack coat is to be applied shall be clean and free from dust, dirt, and any extraneous material, and be otherwise prepared in accordance with the requirements of Clause 3.15 as appropriate. Immediately before the application of the tack coat, the surface shall be swept clean with a mechanical broom, and high pressure air jet, or by other means as directed by the Engineer.

3.8.4.3 **Application of tack coat:** The application of tack coat shall be at the rate specified in the Contract, and shall be applied uniformly. If rate of application of Tack Coat is not specified in the contract then it shall be at the rate specified in Table 3.8. The normal range of spraying temperature for a bituminous emulsion shall be 20°C to 70°C and for cutback, 50°C to 80°C if RC-70 is used. The method of application of the tack coat will depend on the type of equipment to be used, size of nozzles, pressure at the spray bar, and speed of forward movement. The Contractor shall demonstrate at a spraying trial, that the equipment and method to be used is capable of producing a uniform spray, within the tolerances specified.

**TABLE 3.8: Rate of Application of Tack Coat**

Type of Surface	Quantity of liquid bituminous material in Kg per sq.m. area
i) Normal bituminous surfaces	0.20 to 0.25
ii) Dry and hungry bituminous surfaces	0.25 to 0.30
iii) Granular surfaces treated with primer	0.25 to 0.30
iv) Non bituminous surfaces	
a) Granular base (not primed)	0.35 to 0.40
b) Cement concrete pavement	0.30 to 0.35

Where the material to receive an overlay is a freshly laid bituminous layer, that has not been subjected to traffic, or contaminated by dust, a tack coat is not mandatory where the overlay is completed within two days.

**3.8.4.4 Curing of tack coat:** The tack coat shall be left to cure until all the volatiles have evaporated before any subsequent construction is started. No plant or vehicles shall be allowed on the tack coat other than those essential for the construction.

### 3.8.5 Quality Control of Work

For control of the quality of materials supplied and the works carried out, the relevant provisions of Section 3.15 shall apply.

### 3.8.6 Arrangements for Traffic

During the period of construction, arrangements for traffic diversion shall be made as directed.

### 3.8.7 Measurement for Payment

Tack coat shall be measured in terms of surface area of application in square metres.

### 3.8.8 Rate

The contract unit rate for tack coat shall be payment in full for carrying out the required operations including for all components listed in Clause 3.8.4 and as applicable to the work specified in these Specifications. The rate shall cover the provision of tack coat at 0.2 kg per square metre, with the provision that the variance in actual quantity of bitumen used will be assessed and the payment adjusted accordingly.

## 3.9 BITUMINOUS MACADAM

### 3.9.1 Scope

This work shall consist of construction in a single course having 50 mm to 100 mm thickness or in multiple courses of compacted crushed aggregates premixed with a bituminous binder on a previously prepared base to the requirements of these Specifications. Bituminous macadam is more open graded than the dense graded bituminous materials described in Clauses 3.10, 3.11, 3.12.

### 3.9.2 Materials

**3.9.2.1 Bitumen:** The bitumen shall be paving bitumen of Penetration Grade complying with Indian Standard Specifications for “Paving Bitumen” IS: 73, and of the penetration indicated in Table 3.10.

**3.9.2.2 Coarse aggregates:** The coarse aggregates shall consist of crushed rock, crushed gravel or other hard material retained on the 2.36 mm sieve. They shall be clean, hard, durable, of

cubical shape, free from dust and soft or friable matter, organic or other deleterious matter. Where the Contractor's selected source of aggregates have poor affinity for bitumen, as a condition for the approval of that source, the bitumen shall be treated with approved anti-stripping agents, as per the manufacturer's recommendations, without additional payment. Before approval of the source, the aggregates shall be tested for stripping.

The aggregates shall satisfy the physical requirements set forth in Table 3.9.

Where crushed gravel is proposed for use as aggregate, not less than 90% by weight of the crushed material retained on the 4.75 mm sieve shall have at least two fractured faces.

- 3.9.2.3 **Fine aggregates:** Fine aggregates shall consist of crushed or naturally occurring mineral material, or a combination of the two, passing 2.36mm sieve and retained on the 75 micron sieve. They shall be clean, hard, durable, dry and free from dust, and soft or friable matter, organic or other deleterious matter.

**TABLE 3.9: Physical Requirements for Coarse Aggregates for Bituminous Macadam**

Property	Test	Specification
Cleanliness	Grain size analysis <sup>1</sup>	Max 5% passing 0.075mm sieve
Particle shape	Flakiness and Elongation Index (Combined) <sup>2</sup>	Max 30%
Strength*	Los Angeles Abrasion Value <sup>3</sup>	Max 40%
	Aggregate Impact Value <sup>3</sup>	Max 30%
Durability	Soundness: <sup>4</sup>	
	Sodium Sulphate	Max 12%
	Magnesium Sulphate	Max 18%
Water Absorption	Water absorption <sup>5</sup>	Max 2%
Stripping	Coating and Stripping of Bitumen Aggregate Mixtures <sup>6</sup>	Minimum retained coating 95%
Water Sensitivity <sup>7</sup>	Retained Tensile Strength	Min 80%

Notes: 1. IS: 2386 Part 1

4. IS: 2386 Part 5

2. IS: 2386 Part I

5. IS: 2386 Part 3

(the elongation test to be done only on non-flaky aggregate in the sample)

3. IS: 2386 Part 4\*

6. IS: 6241

7. The water sensitivity test is only to be carried out if the minimum retained coating in the stripping test is less than 95%.

\*Aggregate may satisfy requirements of either of these two tests.

- 3.9.2.4 **Aggregate grading and binder content:** When tested in accordance with IS: 2386 Part I (wet sieving method), the combined aggregate grading for the particular mixture shall fall within the limits shown in Table 3.10 for the grading specified in the Contract. The type and quantity of bitumen, and appropriate thickness, are also indicated for each mixture type.

- 3.9.2.5 **Proportioning of material:** The aggregates shall be proportioned and blended to produce a uniform mixture complying with the requirements of Table 3.10. The binder content shall be



within a tolerance of  $\pm 0.3$  per cent by weight of total mixture when individual specimens are taken for quality control tests in accordance with the provisions of Table 3.28.

### 3.9.3 Construction Operations

3.9.3.1 **Weather and seasonal limitations:** Laying shall be suspended while free-standing water is present on the surface to be covered, or during fog, rain and dust storms or when the surrounding temperature is below 10°C or when wind speed exceed 40 km/hr at 2m height.

**TABLE 3.10: Composition of Bituminous Macadam**

Mix designation Nominal aggregate size Layer thickness IS Sieve (mm)	Grading 1 40 mm 80 - 100 mm Cumulative % by weight of total aggregate passing	Grading 2 19 mm 50 - 75 mm
45	100	
37.5	90 – 100	
26.5	75 – 100	100
19	-	90 – 100
13.2	35 – 61	56 – 88
4.75	13 – 22	16 – 36
2.36	4 – 19	4 – 19
0.3	2 – 10	2- 10
0.075	0 – 8	0 – 8
Bitumen content, % by weight of total mixture <sup>1</sup>	3.1 – 3.4	3.3 – 3.5
Bitumen grade	35 to 90	35 to 90

Notes: 1. Appropriate bitumen contents for conditions in cooler areas of India may be up to 0.5% higher subject to the approval of the Engineer.

3.9.3.2 **Preparation of the base:** The base on which bituminous macadam is to be laid shall be prepared, shaped and compacted to the required profile in accordance with Clause 3.15 as appropriate, and a prime coat, shall be applied in accordance with Clause 3.7 where specified, or as directed by the Engineer.

3.9.3.3 **Tack coat:** A tack coat in accordance with Clause 3.8 shall be applied as required by the Contract documents, or as directed by the Engineer.

3.9.3.4 **Preparation and transportation of the mixture:** The bituminous mix materials shall be prepared in a hot mix plant of adequate capacity and capable of yielding a mix of proper and uniform quality and shall be transported to site in clean insulated vehicles and shall be covered while in transit or awaiting tipping.

3.9.3.5 **Spreading:** Except in areas where paver cannot access bituminous materials shall be spread, levelled and tamped by an approved self-propelled paving machines. The materials shall be supplied continuously to the paver and laid without delay.

**TABLE 3.11: Manufacturing and Rolling Temperatures**

Bitumen Penetration	Bitumen Mixing (°C)	Aggregate Mixing (°C)	Mixed Material (°C)	Rolling (°C)	Laying (°C)
35	160 – 170	160 – 175	170 Maximum	100 Minimum	130 Minimum
65	150 – 165	150 -170	165 Maximum	90 Minimum	125 Minimum
90	140 – 160	140 -165	155 Maximum	80 Minimum	115 Minimum

**3.9.3.6 Rolling:** Compaction shall be carried out 8 to 10 kN static or vibratory roller or pneumatic roller at temperature specified in Table 3.11.

Rolling shall be continued until the specified density is achieved, or where no density is specified, until there is no further movement under the roller. The required frequency of testing is defined in Clause 3.15.

### 3.9.4 Surface Finish and Quality Control of Work

The surface finish of the completed construction shall conform to the requirements of Table 3.26. For control of the quality of materials supplied and the works carried out, the relevant provisions of Clause 3.15 shall apply.

### 3.9.5 Protection of the Layer

The bituminous macadam shall be covered with either the next pavement course or wearing course, as the case may be, within a maximum of forty-eight hours. If there is to be any delay, the course shall be covered by a seal coat before opening to any traffic. The seal coat in such cases shall be considered incidental to the work and shall not be paid for separately.

### 3.9.6 Arrangements for Traffic

During the period of construction, arrangements for traffic diversions shall be made as directed.

### 3.9.7 Measurement for Payment

Bituminous macadam shall be measured as finished work in cubic metres, or by weight in metric tones, where used as regulating course, or square metres at the specified thickness as indicated in the Contract or shown on the drawings, or as otherwise directed by the Engineer.

### 3.9.8 Rate

The contract unit rate for bituminous macadam shall be payment in full for carrying out the required operations as specified.

## 3.10 DENSE GRADED BITUMINOUS MACADAM

### 3.10.1 Scope

This clause specifies the construction of Dense Graded Bituminous Macadam, (DBM), for use mainly, but not exclusively, in base/binder and profile corrective courses. DBM is also intended for use as road base material. This work shall consist of construction in a single or multiple layers of DBM on a previously prepared base or sub-base. The thickness of a single layer shall be 50 mm to 100 mm.

### 3.10.2 Materials

**3.10.2.1 Bitumen:** The bitumen shall be paving bitumen of Penetration Grade complying with Indian Standard Specifications for “Paving Bitumen” IS: 73, and of the penetration indicated in Table 3.14 for dense bitumen macadam, or as otherwise specified in the Contract.

**3.10.2.2 Coarse aggregates:** The coarse aggregates shall consist of crushed rock, crushed gravel or other hard material retained on the 2.36 mm sieve. They shall be clean, hard, durable, of cubical shape, free from dust and soft or friable matter, organic or other deleterious substances. Where the Contractor's selected source of aggregates have poor affinity for bitumen, as a condition for the approval of that source, the bitumen shall be treated with an approved anti-stripping agent, as per the manufacturer's recommendations, without additional payment. Before approval of the source, the aggregates shall be tested for stripping. The aggregates shall satisfy the physical requirements specified in Table 3.12, for dense bituminous macadam.

Where crushed gravel is proposed for use as aggregate, not less than 90% by weight of the crushed material retained on the 4.75 mm sieve shall have at least two fractured faces.

**3.10.2.3 Fine aggregates:** Fine aggregates shall consist of crushed or naturally occurring mineral material, or a combination of the two, passing the 2.36mm sieve and retained on the 75 micron sieve. They shall be clean, hard, durable, dry and free from dust, and soft or friable matter, organic or other deleterious matter.

The fine aggregate shall have a sand equivalent value of not less than 50 when tested in accordance with the requirement of IS: 2720 (Part 37).

The plasticity index of the fraction passing the 0.425 mm sieve shall not exceed 4. When tested in accordance with IS: 2720 (Part 5).

**TABLE 3.12: Physical Requirements for Coarse Aggregate for Dense Graded Bituminous Macadam**

Property	Test	Specification
Cleanliness (dust)	Grain size analysis <sup>1</sup>	Max 5% passing 0.075mm sieve
Particle shape	Flakiness and Elongation Index (Combined) <sup>2</sup>	Max 30%
Strength*	Los Angeles Abrasion Value <sup>3</sup>	Max 35%
	Aggregate Impact Value <sup>4</sup>	Max 27%
Durability	Soundness: <sup>5</sup>	
	Sodium Sulphate	Max 12%
	Magnesium Sulphate	Max 18%
Water Absorption	Water absorption <sup>6</sup>	Max 2%
Stripping	Coating and Stripping of Bitumen	Minimum retained coating 95%
	Aggregate Mixtures <sup>7</sup>	
Water Sensitivity**	Retained Tensile Strength <sup>8</sup>	Min 80%

Notes: 1. IS: 2386 Part 1

5. IS: 2386 Part 5

2. IS: 2386 Part I

6. IS: 2386 Part 3

(the elongation test to be done only on non-flaky aggregate in the sample)

3. IS: 2386 Part 4\*

7. IS: 6241

4. IS: 2386 Part 4%

8. AASHTO T283\*\*

\* Aggregate may satisfy requirements of either of these two tests.

\*\* The water sensitivity test is only required if the minimum retained coating in the stripping test is less than 95%.

**3.10.2.4 Filler:** Filler shall consist of finely divided mineral matter such as rock dust, hydrated lime or cement approved by the Engineer.

The filler shall be graded within the limits indicated in Table 3.13.

**TABLE 3.13: Graded Requirements for Mineral Filler**

IS Sieve (mm)	Cumulative per cent passing by weight of total aggregate
0.6	100
0.3	95 – 100
0.075	85 – 100

The filler shall be free from organic impurities and have a Plasticity Index not greater than 4. The Plasticity Index requirement shall not apply if filler is cement or lime. When the coarse aggregate is gravel, 2 per cent by weight of total aggregate, shall be Portland cement or hydrated lime and the percentage of fine aggregate reduced accordingly. Cement or hydrated lime is not required when the limestone aggregate is used. Where the aggregates fail to meet the requirements of the water sensitivity test in Table 3.12, then 2 per cent by total weight of aggregate, of hydrated lime shall be added without additional cost.

**3.10.2.5 Aggregate grading and binder content:** When tested in accordance with IS: 2386 Part I (wet sieving method), the combined grading of the coarse and fine aggregates and added filler for the particular mixture shall fall within the limits shown in Table 3.14, for dense bituminous macadam grading 1 or 2 as specified in the Contract. The type and quantity of bitumen, and appropriate thickness, are also indicated for each mixture type.

**TABLE 3.14: Composition of Dense Graded Bituminous Macadam Pavement Layers**

Grading	1	2
Nominal aggregate size	40 mm	25 mm
Layer Thickness	80 – 100 mm	50 – 75 mm
IS Sieve <sup>1</sup> (mm)	Cumulative % by weight of total aggregate passing	
45	100	
37.5	95 – 100	100
26.5	63 – 93	90 – 100
19	-	71 – 95
13.2	55 – 75	56 – 80
9.5	-	-
4.75	38 – 54	38 – 54
2.36	28 – 42	28 – 42
1.18	-	-
0.6	-	-

0.3	7 – 21	7 – 21
0.15	-	-
0.075	2 – 8	2 – 8
Bitumen content % by mass of total mix <sup>2</sup>	Min 4.0	Min 4.5
Bitumen grade (pen)	65 or 90	65 or 90

**Notes:** 1. The combined aggregate grading shall not vary from the low limit on one sieve to the high limit on the adjacent sieve.

2. Determined by the Marshall method.

### 3.10.3 Mixture Design

3.10.3.1 **Requirement for the mixture:** Apart from conformity with the grading and quality requirements for individual ingredients, the mixture shall meet the requirements set out in Table 3.15.

**TABLE 3.15: Requirements for Dense Graded Bituminous Macadam**

Minimum stability (kN at 60°C)	9.0
Minimum flow (mm)	2
Maximum flow (mm)	4
Compaction level (Number of blows)	75 blows on each of the two faces of the specimen
Per cent air voids	3 – 6
Per cent voids in mineral aggregate (VMA)	See Table 3.16 below
Per cent voids filled with bitumen (VFB)	65 -75

The requirements for minimum per cent voids in mineral aggregate (VMA) are set out in Table 3.16.

**TABLE 3.16: Minimum Per cent Voids in Mineral Aggregate (VMA)**

Nominal Maximum Particle Size <sup>1</sup> (mm)	Minimum VMA, Per cent Related to Design Air Voids, Per cent <sup>2</sup>		
	3.0	4.0	5.0
9.5	14.0	15.0	16.0
12.5	13.0	14.0	15.0
19.0	12.0	13.0	14.0
25.0	11.0	12.0	13.0
37.5	10.0	11.0	12.0

**Notes:** 1. The nominal maximum particle size is one size larger than the first sieve to retain more than 10 per cent.

2. Interpolate minimum voids in the mineral aggregate (VMA) for design air voids values between those listed.

**3.10.3.2 Binder Content:** The binder content shall be optimized to achieve the requirements of the mixture set out in Table 3.15 and the traffic volume specified in the Contract. The Marshall method for determining the optimum binder content shall be adopted as described in The Asphalt Institute Manual MS-2, replacing the aggregates retained on the 26.5 mm sieve by the aggregates passing the 26.5 mm sieve and retained on the 22.4 mm sieve, where approved by the Engineer.

Where 40 mm dense bituminous macadam mixture is specified, the modified Marshall method described in MS-2 shall be used. This method requires modified equipment and procedures; particularly the minimum stability values in Table 3.15 shall be multiplied by 2.25, and the minimum flow shall be 3 mm.

**3.10.3.3 Job mix formula:** The Contractor shall inform the Engineer in writing at least 20 days before the start of the work, of the job mix formula proposed for use in the works, and shall give the following details:

- i) Source and location of all materials;
- ii) Proportions of all materials expressed as follows where each is applicable:
  - a) Binder type, and percentage by weight of total mixture;
  - b) Coarse aggregate/Fine aggregate/Mineral filler as percentage by weight of total aggregate including mineral filler;
- iii) A single definite percentage passing each sieve for the mixed aggregate;
- iv) The individual gradings of the individual aggregate fractions, and the proportion of each in the combined grading.
- v) The results of tests enumerated in Table 3.15 as obtained by the Contractor;
- vi) Where the mixer is a batch mixer, the individual weights of each type of aggregate, and binder per batch.
- vii) Test results of physical characteristics of aggregates to be used;
- viii) Mixing temperature and compacting temperature.

While establishing the job mix formula, the Contractor shall ensure that it is based on a correct and truly representative sample of the materials that will actually be used in the work and that the mixture and its different ingredients satisfy the physical and strength requirements of these Specifications.

Approval of the job mix formula shall be based on independent testing by the Engineer for which samples of all ingredients of the mix shall be furnished by the Contractor as required by the Engineer.

The approved job mix formula shall remain effective unless and until a revised Job Mix Formula is approved. Should a change in the source of materials be proposed, a new job mix formula shall be forwarded to the Engineer for approval before the placing of the material.

**3.10.3.4 Plant trials – permissible variation in job mix formula:** Once the laboratory job mix formula is approved, the Contractor shall carry out plant trials at the mixer to establish that the plant can be set up to produce a uniform mix conforming to the approved job mix formula. The permissible variations of the individual percentage of the various ingredients in the actual mix from the job mix formula to be used shall be within the limits as specified in Table 3.17. These variations are intended to apply to individual specimens taken for quality control tests in accordance with Section 900.

**TABLE 3.17: Permissible Variations form the Job Mix Formula**

Description	Permissible variation	
	Base/binder course	Wearing course
Aggregate passing 19mm sieve or larger	±8%	±7%
Aggregate passing 13.2mm, 9.5 mm	±7%	±6%
Aggregate passing 4.75 mm	±6%	±5%
Aggregate passing 2.36mm, 1.18mm, 0.6mm	±5%	±4%
Aggregate passing 0.3mm, 0.15mm	±4%	±3%
Aggregate passing 0.075mm	±2%	±1.5%
Binder content	±0.3%	±0.3%
Mixing temperature	±10°C	±10°C

Once the plant trials have demonstrated the capability of the plant, and the trials are approved, the laying operation may commence. Over the period of the first month of production for laying on the works, the Engineer shall require additional testing of the product to establish the reliability and consistency of the plant.

**3.10.3.5 Laying Trials:** Once the plant trials have been successfully completed and approved, the Contractor shall carry out laying trials, to demonstrate that the proposed mix can be successfully laid, and compacted all in accordance with the specifications. The laying trial shall be carried out on a suitable area which is not to form part of the works, unless specifically approved in writing, by the Engineer. The area of the laying trials shall be a minimum of 100 sq.m. of construction similar to that of the project road, and it shall be in all respects, particularly compaction, the same as the project construction, on which the bituminous material is to be laid.

The Contractor shall previously inform the Engineer of the proposed method for laying and compacting the material. The plant trials shall then establish if the proposed laying plant, compaction plant, and methodology is capable of producing satisfactory results. The density of the finished paving layer shall be determined by taking cores, no sooner than 24 hours after laying, or by other approved method.

Once the laying trials have been approved, the same plant and methodology shall be applied to the laying of the material on the project, and no variation of either shall be acceptable, unless approved in writing by the Engineer, who may at his discretion require further laying trials.

### 3.10.4 Construction Operations

**3.10.4.1 Weather and seasonal limitations:** The provisions of Clause 3.9.3.1 shall apply.

**3.10.4.2 Preparation of base:** The base on which Dense Graded Bituminous Material is to be laid shall be prepared in accordance with Clause 3.15 as appropriate, or as directed by the Engineer. The surface shall be thoroughly swept clean by a mechanical broom, and the dust removed by compressed air. In locations where mechanical broom cannot access, other approved methods shall be used as directed by the Engineer.

**3.10.4.3 Geosynthetics:** Where Geosynthetics are specified in the Contract this shall be as directed by the Engineer.

**3.10.4.4 Stress absorbing layer:** Where a stress absorbing layer is specified in the Contract, this shall be applied as directed by the Engineer.

**3.10.4.5 Prime coat:** Where the material on which the dense bituminous macadam is to be laid is other than a bitumen bound layer, a prime coat shall be applied, as specified, in accordance with the provisions of Clause 3.7, or as directed by the Engineer.

3.10.4.6 **Tack coat:** Where the material on which the dense bituminous macadam is to be placed is a bitumen bound surface, a tack coat shall be applied as specified, in accordance with the provisions of Clause 3.8 or as directed by the Engineer.

3.10.4.7 **Mixing and transportation of the mixture:** The provisions as specified in Clause 3.9.3.4 shall apply.

3.10.4.8 **Spreading:** The provisions of Clause 3.9.3.5 Shall apply

3.10.4.9 **Rolling:** The general provisions of Clause 3.9.3.6 shall apply, as modified by the approved laying trails. The compaction process shall be carried out by the same plant, and using the same method, as approved in the laying trials, which may be varied only with the express approval of the Engineer in writing.

### **3.10.5 Opening to Traffic**

The newly laid surface shall not be open to traffic for at least 24 hrs after laying and completion of compaction, without the express approval of the Engineer in writing.

### **3.10.6 Surface Finish and Quality Control of Work**

The surface finish of the completed construction shall conform to the requirements of Clause 3.15. All materials and workmanship shall comply with the provisions set out in Clause 3.15 of this Specification.

### **3.10.7 Arrangements for Traffic**

During the period of construction, arrangements for traffic diversion shall be made in accordance with the direction of the Engineer.

### **3.10.8 Measurement for Payment**

Dense Graded Bituminous Materials shall be measured as finished work either in cubic metres, tons or by the square metre at a specified thickness as detailed on the Contract drawings, or documents, or as directed by the Engineer.

### **3.10.9 Rate**

The contract unit rate for Dense Graded Bituminous Macadam shall be payment in full for carrying out the all required operations as specified, and shall include, the provision of bitumen, at 4.25 per cent by weight of the total mixture.

The variance in actual percentage of bitumen used will be assessed and the payment adjusted, up or down, accordingly.

## **3.11 SEMI-DENSE BITUMINOUS CONCRETE**

### **3.11.1 Scope**

This clause specifies the construction of Semi Dense Bituminous Concrete, for use in wearing/binder and profile corrective courses. This work shall consist of construction in a single or multiple layers of semi dense bituminous concrete on a previously prepared bituminous bound surface. A single layer shall be 25 mm to 100 mm in thickness.

### **3.11.2 Materials**

3.11.2.1 **Bitumen:** The bitumen shall be paving bitumen of Penetration grade complying with Indian Standard Specification for Paving Bitumen, IS: 73 and of the penetration indicated in Table 3.19, for semi dense bituminous concrete, or as otherwise specified in the Contract.



3.11.2.2 **Coarse aggregates:** The coarse aggregates shall be generally as specified in Clause 3.10.2.2 except that the aggregates shall satisfy the physical requirements of Table 3.18.

3.11.2.3 **Fine aggregates:** The fine aggregates shall be all as specified in Clause 3.10.2.3.

3.11.2.4 **Filler:** Filler shall be generally as specified in Clause 3.10.2.4. Where the aggregates fail to meet the requirements of the water sensitivity test in Table 3.18 then 2 per cent by total weight of aggregate of hydrated lime shall be added without additional cost.

3.11.2.5 **Aggregate grading and binder content:** When tested in accordance with IS: 2386 Part I (Wet sieving method), the combined grading of the coarse and fine aggregates and added filler shall fall within the limits shown in Table 3.19 for gradings 1 or 2 as specified in the Contract.

### 3.11.3 Mixture Design

3.11.3.1 **Requirements for the mixture:** Apart from conformity with the grading and quality requirements of individual ingredients the mixture shall meet the requirements set out in Table 3.20.

**TABLE 3.18: Physical Requirements for Coarse Aggregate for Semi Dense Bituminous Concrete Pavement Layers**

Property	Test	Specification
Cleanliness (dust)	Grain size analysis <sup>1</sup>	Max 5% passing 0.075mm sieve
Particle shape	Flakiness and Elongation Index (Combined) <sup>2</sup>	Max 30%
Strength*	Los Angeles Abrasion Value <sup>3</sup>	Max 35%
	Aggregate Impact Value <sup>4</sup>	Max 27%
Polishing Durability	Polished Stone Value <sup>5</sup>	Min 55
	Soundness: <sup>6</sup> Sodium Sulphate	Max 12%
	Magnesium Sulphate	Max 18%
Water Absorption	Water absorption <sup>7</sup>	Max 2%
Stripping	Coating and Stripping of Bitumen Aggregate Mixtures <sup>9</sup>	Minimum retained coating 95%
Water Sensitivity **	Retained Tensile Strength <sup>8</sup>	Min 80%

Notes: 1. IS: 2386 Part 1

6. IS: 2386 Part 5

2. IS: 2386 Part I

7. IS: 2386 Part 3

(the elongation test to be done only on non-flaky aggregate in the sample)

3. IS: 2386 Part 4\*

8. AASHTO T283\*\*

4. IS: 2386 Part 4%

9. IS: 6241

5. BS: 812 Part 114

\* Aggregate may satisfy requirements of either of these two tests.

\*\* The water sensitivity test is only required if the minimum retained coating in the stripping test is less than 95%.

The requirements for minimum per cent voids in mineral aggregate (VMA) are set out in Table 3.16.

**3.11.3.2 Binder content:** The binder content shall be optimized to achieve the requirements of the mixture set out in Table 3.20 and the traffic volume as specified in the Contract. The Marshall method for determining the optimum binder content shall be adopted as described in the Asphalt Institute Manual MS-2, replacing the aggregates retained on the 26.5 mm sieve and retained on the 22.4 mm sieve, where approved by the Engineer.

**TABLE 3.19: Composition of Semi Dense Bituminous Concrete Pavement Layers**

Grading	1	2
Nominal aggregate size	13 mm	10 mm
Layer Thickness	35 – 40 mm	25 – 30 mm
IS Sieve <sup>1</sup> (mm)	Cumulative % by weight of total aggregate passing	
45		
37.5		
26.5		
19	100	
13.2	90 – 100	100
9.5	70 - 90	90 - 100
4.75	35 – 51	35 – 51
2.36	24 – 39	24 – 39
1.18	15 - 30	15 - 30
0.6	-	-
0.3	9 – 19	9 – 19
0.15	-	-
0.075	3 – 8	3 – 8
Bitumen content % by mass of total mix <sup>2</sup>	Min 4.5	Min 5.0
Bitumen grade (pen)	65*	65*

**Notes:** 1. The combined aggregate grading shall not vary from the low limit on one sieve to the high limit on the adjacent sieve.

2. Determined by the Marshall method.

\* Only in exceptional circumstances, 80/100 penetration grade may be used, as approved by the Engineer.

**TABLE 3.20: Requirements for Semi Dense Bituminous Pavement Layers**

Minimum stability (kN at 60°C)	8.2
Minimum flow (mm)	2
Maximum flow (mm)	4

Compaction level (Number of blows	75 blows on each of the two faces of the specimen
Per cent air voids	3 – 5
Per cent voids in mineral aggregate (VMA)	See Table 3.16
Per cent voids filled with bitumen (VFB)	65 -78

**3.11.3.3 Job mix formula:** The procedure for formulating the job mix formula shall be generally as specified in Clause 3.10.3.3 and the results of tests enumerated in Table 3.20 as obtained by the Contractors.

**3.11.3.4 Plant trials – permissible variation in job mix formula:** The requirements for plant trials shall be all as specified in Clause 3.10.3.4 and permissible limits for variation as shown in Table 3.17.

**3.11.3.5 Laying trials:** The requirements for laying trials shall be all as specified in Clause 3.10.3.5.

### **3.11.4 Construction Operations**

**3.11.4.1 Weather and seasonal limitations:** The provisions of Clause 3.9.3.1 shall apply.

**3.11.4.2 Preparation of base:** The surface on which the Semi Dense Bituminous material is to be laid shall be prepared in accordance with Clause 3.15 as appropriate, or as directed by the Engineer. The surface shall be thoroughly swept clean by mechanical broom and dust removed by compressed air. In locations where a mechanical broom cannot access, other approved methods shall be used as directed by the Engineer.

**3.11.4.3 Tack coat:** Where specified in the Contract, or otherwise required by the Engineer, a tack coat shall be applied in accordance with the requirements of Clause 3.8.

**3.11.4.4 Mixing and transportation of the mixture:** The provisions as specified in Clause 3.9.3.4 shall apply.

**3.11.4.5 Spreading:** The general provisions of Clause 3.9.3.5 shall apply.

**3.11.4.6 Rolling:** The general provisions of Clause 3.9.3.6 shall apply, as modified by the approved laying trials. The compaction process shall be carried out by the same plant, and using the same method, as approved in the laying trials, which may be varied only with the express approval of the Engineer in writing.

### **3.11.5 Opening to Traffic**

The newly laid surface shall not be open to traffic for at least 24 hours after laying and the completion of compaction, without the express approval of the Engineer in writing.

### **3.11.6 Surface Finish and Quality Control**

The surface finish of the completed construction shall conform to the requirements of Clause 3.15. All materials and workmanship shall comply with the provisions set out in Clause 3.15 of this Specification.

### **3.11.7 Arrangements for Traffic**

During the period of construction, arrangements for traffic diversion shall be made as directed by the Engineer.

### **3.11.8 Measurement for Payment**

The measurement shall be all as specified in Clause 3.10.8.

### **3.11.9 Rate**

The contract unit rate shall be all as specified in Clause 3.10.9, except that the rate shall include the provision of bitumen at 4.75 per cent, by weight of total mixture. The variance in actual percentage of bitumen used will be assessed and the payment adjusted up or down, accordingly.

### 3.12 BITUMINOUS CONCRETE

#### 3.12.1 Scope

This clause specifies the construction of Bituminous Concrete, for use in wearing and profile corrective courses. This work shall consist of construction in a single or multiple layers of bituminous concrete on a previously prepared bituminous bound surface. A single layers shall be 25 mm to 100 mm in thickness.

#### 3.12.2 Materials

3.12.2.1 **Bitumen:** The bitumen shall be paving bitumen of Penetration grade complying with Indian Standard Specification for Paving Bitumen, IS: 73 and of the penetration indicated in Table 3.22, for bituminous concrete, or as otherwise specified in the Contract.

3.12.2.2 **Coarse aggregates:** The coarse aggregates shall be generally as specified in Clause 3.10.2.2 except that the aggregates shall satisfy the physical requirements of Table 3.21.

3.12.2.3 **Fine aggregates:** The fine aggregates shall be all as specified in Clause 3.10.2.3.

3.12.2.4 **Filler:** Filler shall be generally as specified in Clause 3.10.2.4. Where the aggregates fail to meet the requirements of the water sensitivity test in Table 3.21 then 2 per cent by total weight of aggregate of hydrated lime shall be added without additional cost.

3.12.2.5 **Aggregate grading and binder content:** When tested in accordance with IS: 2386 Part I (Wet grading method), the combined grading of the coarse and fine aggregates and added filler shall fall within the limits shown in Table 3.22 for gradings 1 or 2 as specified in the Contract.

#### 3.12.3 Mixture Design

3.12.3.1 **Requirements for the mixture:** Apart from conformity with the grading and quality requirements of individual ingredients the mixture shall meet the requirements set out in Table 3.23.

The requirements for minimum per cent voids in mineral aggregate (VMA) are set out in Table 3.16.

3.12.3.2 **Binder content:** The binder content shall be optimized to achieve the requirements of the mixture set out in Table 3.23 and the traffic volume as specified in the Contract. The Marshall method for determining the optimum binder content shall be adopted as described in the Asphalt Institute Manual MS-2, replacing the aggregates retained on the 26.5 mm sieve and retained on the 22.4 mm sieve, where approved by the Engineer.

**TABLE 3.21: Physical Requirements for Coarse Aggregate for Bituminous Concrete Pavement Layers**

Property	Test	Specification
Cleanliness (dust)	Grain size analysis <sup>1</sup>	Max 5% passing 0.075mm sieve
Particle shape	Flakiness and Elongation Index (Combined) <sup>2</sup>	Max 30% (Combined) <sup>2</sup>

Strength*	Los Angeles Abrasion Value <sup>3</sup>	Max 30%
	Aggregate Impact Value <sup>4</sup>	Max 24%
Polishing Durability	Polished Stone Value <sup>5</sup>	Min 55
	Soundness: <sup>6</sup>	
	Sodium Sulphate	Max 12%
	Magnesium Sulphate	Max 18%
Water Absorption	Water absorption <sup>7</sup>	Max 2%
Stripping	Coating and Stripping of Bitumen Aggregate Mixtures <sup>9</sup>	Minimum retained coating 95%
Water Sensitivity**	Retained Tensile Strength <sup>8</sup>	Min 80%

**3.12.3.3 Job mix formula:** The procedure for formulating the job mix formula shall be generally as specified in Clause 3.10.3.3 and the results of tests enumerated in Table 3.23 as obtained by the Contractors.

**3.12.3.4 Plant trials – permissible variation in job mix formula:** The requirements for plant trials shall be all as specified in Clause 3.10.3.4 and permissible limits for variation as shown in Table 3.17.

**3.12.3.5 Laying trials:** The requirements for laying trials shall be all as specified in Clause 3.10.3.5.

### 3.12.4 Construction Operations

**3.12.4.1 Weather and seasonal limitations:** The provisions of Clause 3.9.3.1 shall apply.

**TABLE 3.22: Composition of Bituminous Concrete Pavement Layers**

Grading	1	2
Nominal aggregate size	19 mm	13 mm
Layer Thickness	50 – 65 mm	30 – 45 mm
IS Sieve <sup>1</sup> (mm)	Cumulative % by weight of total aggregate passing	
45		
37.5		
26.5	100	
19	79 – 100	100
13.2	59 – 79	79 – 100
9.5	52 – 72	70 - 88
4.75	35 – 55	53 – 71
2.36	28 – 44	42 – 58
1.18	20 - 34	34 - 48
0.6	15 - 27	26 - 38
0.3	10 - 20	18 - 28

0.15	5 - 13	12-20
0.075	2 – 8	4 – 10
Bitumen content % by mass of total mix <sup>2</sup>	5.0 – 6.0	5.0 – 7.0
Bitumen grade (pen)	65	65

- Notes:**
1. The combined aggregate grading shall not vary from the low limit on one sieve to the high limit on the adjacent sieve.
  2. Determined by the Marshall method.

**TABLE 3.23: Requirements for Bituminous Pavement Layers**

Minimum stability (kN at 60°C)	9.0
Minimum flow (mm)	2
Maximum flow (mm)	4
Compaction level (Number of blows)	75 blows on each of the two faces of the specimen
Per cent air voids	3 – 6
Per cent voids in mineral aggregate (VMA)	See Table 3.16
Per cent voids filled with bitumen (VFB)	65 -75
Loss of stability on immersion in water at 60°C (ASTM D 1075)	Min. 75 per cent retained strength

**3.12.4.2Preparation of base:** The surface on which the Bituminous concrete is to be laid shall be prepared in accordance with Clause 3.15 as appropriate, or as directed by the Engineer. The surface shall be thoroughly swept clean by mechanical broom and dust removed by compressed air. In locations where a mechanical broom cannot access, other approved methods shall be used as directed by the Engineer.

**3.12.4.3Tack coat:** Where specified in the Contract, or otherwise required by the Engineer, a tack coat shall be applied in accordance with the requirements of Clause 3.8.

**3.12.4.4Mixing and transportation of the mixture:** The provisions as specified in Clause 3.9.3.4 shall apply.

**3.12.4.5Spreading:** The general provisions of Clause 3.9.3.5 shall apply.

**3.12.4.6Rolling:** The general provisions of Clause 3.9.3.6 shall apply, as modified by the approved laying trials.

**3.12.5 Opening to Traffic**

The newly laid surface shall not be open to traffic for at least 24 hours after laying and the completion of compaction, without the express approval of the Engineer in writing.

**3.12.6 Surface Finish and Quality Control**

The surface finish of the completed construction shall conform to the requirements of Clause 3.15. All materials and workmanship shall comply with the provisions set out in Clause 3.15 of this Specification.

**3.12.7 Arrangements for Traffic**

During the period of construction, arrangements for traffic diversion shall be made as directed by the Engineer.

### **3.12.8 Measurement for Payment**

The measurement shall be all as specified in Clause 3.10.8.

### **3.12.9 Rate**

The contract unit rate shall be all as specified in Clause 3.10.9 except that the rate shall include the provision of bitumen at 5.0 per cent, by weight of total mixture. The variance in actual percentage of bitumen used will be assessed and the payment adjusted up or down, accordingly.

## **3.13 TRAFFIC SIGNS**

### **3.13.1 General**

3.13.1.1 The colour, configuration, size and location of all traffic signs shall be in accordance with the Code of Practice for Road Signs, IRC: 67 or as shown on the drawings. In the absence of any details or for any missing details, the signs shall be provided as directed by the Engineer.

3.13.1.2 The signs shall be either reflectorised or non-reflectorised as shown on the drawing or as directed by the Engineer. When they are of reflectorised type, they shall be of retro-reflectorised type and made of encapsulated lens type reflective sheeting vide Clause 3.13.3, fixed over aluminium sheeting as per these Specifications.

3.13.1.3 In general, cautionary and mandatory signs shall be fabricated through process of screen printing. In regard to informatory signs with inscriptions, either the message could be printed over the reflective sheeting, or cut letters of non-reflective black sheeting used for the purpose which must be bonded well on the base sheeting as directed by the Engineer.

### **3.13.2 Materials**

The various materials and fabrication of the traffic signs shall conform to the following requirements:

**3.13.2.1 Concrete:** Concrete shall be of the grade shown on the Contract drawings or otherwise as directed by the Engineer.

**3.13.2.2 Reinforcing steel:** Reinforcing steel shall conform to the requirement of IS: 1786 unless otherwise shown on the drawing.

**3.13.2.3 Bolts, nuts, washers:** High strength bolts shall conform to IS: 1367 whereas precision bolts, nuts, etc., shall conform to IS: 1364.

**3.13.2.4 Plates and supports:** Plates and support sections for the sign posts shall conform to IS: 226 and IS: 2062 or any other relevant IS Specifications.

**3.13.2.5 Aluminium:** Aluminium sheets used for sign boards shall be of smooth, hard and corrosion resistant aluminium alloy conforming to IS: 736-Material designation 24345 or 1900.

3.13.2.6 Signs with a maximum side dimension not exceeding 600 mm shall not be less than 1.5 mm thick. All others shall be at least 2 mm thick. The thickness of the sheet shall be related to the size of the sign and its support and shall be such that it does not bend or deform under the prevailing wind and other loads.

3.13.2.7 In respect of sign sizes not covered by IRC: 67, the structural details (thickness, etc.) shall be as per the approved drawings.

### **3.13.3 Traffic Signs Having Retro-reflective Sheeting**

3.13.3.1 **General requirements:** The retro-reflective sheeting used on the sign shall consist of the white or coloured sheeting having a smooth outer surface which has the property of retro-reflection over its entire surface. It shall be weather-resistant and show colour fastness. It shall

be new and unused and shall show no evidence of cracking, scaling, pitting, blistering, edge lifting or curling and shall have negligible shrinkage or expansion. A certificate of having tested the sheeting for these properties in an unprotected outdoor exposure facing the sun for two years and its having passed these tests shall be obtained from a reputed laboratory, by the manufacturer of the sheeting. The reflective sheeting shall be either of Engineering Grade material with enclosed lens or of High Intensity Grade with encapsulated lens. The type of the sheeting to be used would depend upon the type, functional hierarchy and importance of the road.

**3.13.3.2 High intensity grade sheeting:** This sheeting shall be of encapsulated lens type consisting of spherical glass lens, elements adhered to a synthetic resin and encapsulated by a flexible, transparent water-proof plastic having a smooth surface.

**3.13.3.3 Engineering grade sheeting:** This sheeting shall be of enclosed lens type consisting of microscopic lens elements embedded beneath the surface of a smooth, flexible, transparent, water-proof plastic, resulting in a non-exposed lens optical reflecting system.

**3.13.3.4 Messages/borders:** The messages (legends, letters, numerals etc.) and borders shall either be screen-printed or of cut-outs. Screen printing shall be processed and finished with materials and in a manner specified by the sheeting manufacturer. Cut-outs shall be of materials as specified by the sheeting manufacturer and shall be bonded with the sheeting in the manner specified by the manufacturer.

**3.13.3.5 Cut-out messages and borders,** wherever used, shall be made out of retro-reflective sheeting (as per Clause 3.13.3.2 or 3.13.3.3 as applicable), except those in black which shall be of non-reflective sheeting.

**3.13.3.6 Colour:** Unless otherwise specified, the general colour scheme shall be as stipulated in IS: 5 “Colour for Ready Mixed Paints”, viz.

Blue	-	IS	Colour	No. 166: French Blue
Red	-	IS	Colour	No. 537: Signal Red
Green	-	IS	Colour	No. 284: India Green
Orange	-	IS	Colour	No. 591: Deep Orange

The Colours shall be durable and uniform in acceptable hue when viewed in day light or under normal headlights at night.

**3.13.3.7 Adhesives:** The sheeting shall either have a pressure-sensitive adhesive of the aggressive-tack type requiring no heat, solvent or other preparation for adhesion to a smooth clean surface, or a tack free adhesive activated by heat, applied in a heat-vacuum applicator, in a manner recommended by the sheeting manufacturer. The adhesive shall be protected by an easily removable liner (removable by peeling without soaking in water or other solvent) and shall be suitable for the type of material of the base plate used for the sign. The adhesive shall form a durable bond to smooth, corrosion and weather resistant surface of the base plate such that it shall not be possible to remove the sheeting from the sign base in the piece by use of sharp instrument. In case of pressure-sensitive adhesive sheeting, the sheeting shall be applied in accordance with the manufacturer’s Specifications. Sheetings with adhesives requiring use of solvents or other preparation for adhesive shall be applied strictly in accordance with the manufacturer’s instructions.

**3.13.3.8 Refurbishment:** Where existing signs are specified for refurbishment, the sheeting shall have a semi-rigid aluminium backing pre-coated with aggressive-tack type pressure sensitive adhesive. The adhesive shall be suitable for the type of material used for the sign and should thoroughly bond with that material.

**3.13.3.9 Fabrication:**



- 3.13.3.9.1 Surface to be reflectorised shall be effectively prepared to receive the retro-reflective sheeting. The aluminium sheeting shall be de-greased either by acid or hot alkaline etching and all scale/dust removed to obtain a smooth plain surface before the application of retro-reflective sheeting. If the surface is rough, approved surface primer may be used. After cleaning, metal shall not be handled, except by suitable device or clean canvas gloves, between all cleaning and preparation operation and application of reflective sheeting/primer. There shall be no opportunity for metal to come in contact with grease, oil or other contaminants prior to the application of retro-reflective sheeting.
- 3.13.3.9.2 Complete sheets of the material shall be used on the signs except where it is unavoidable; at splices, sheeting with pressure sensitive adhesives shall be overlapped not less than 5 mm. Sheeting with heat-activated adhesives may be spliced with an overlap not less than 5 mm or butted with a gap not exceeding 0.75 mm. Where screen printing with transparent colours is proposed, only butt jointing shall be used. The material shall cover the sign surface evenly and shall be free from twists, cracks and folds. Cut-outs to produce legends and borders shall be bonded with the sheeting in the manner specified by the manufacturer.
- 3.13.3.10 **Warranty and durability:** The contractor shall obtain from the manufacturer a seven-year warranty for satisfactory field performance including stipulated retro-reflectance of the retro-reflective sheeting of high intensity grade and a five year warranty for the adhesive sheeting of engineering grade and submit the same to the Engineer. In addition, a seven year and a five year warranty for satisfactory in-field performance of the finished sign with retro-reflective sheeting of high intensity grade and engineering grade respectively, inclusive of the screen printed or cut out letters/legends and their bonding to the retro-reflective sheeting shall be obtained from the Contractor/supplier and passed on to the Engineer. The Contractor/supplier shall also furnish a certification that the signs and materials supplied against the assigned work meets all the stipulated requirements and carry the stipulated warranty.

Processed and applied in accordance with recommended procedures, the reflective material shall be weather resistant and, following cleaning, shall show no appreciable discolouration, cracking, blistering or dimensional change and shall not have less than 50 per cent of the specified minimum reflective intensity values when subjected to accelerated weathering for 1000 hours, using type E or EH Weatherometer (AASHTO Designation M 268).

### 3.13.4 Installation

- 3.13.4.1 Sign posts, their foundations and sign mountings shall be so constructed as to hold these in a proper and permanent position against the normal storm wind loads or displacement by vandalism. Normally, signs with an area upto 0.9 sq.m shall be mounted on a single post, and for greater area two or more supports shall be provided. Sign supports may be of mild steel, reinforced concrete or galvanized iron (G.I). Post-end(s) shall be firmly fixed to the ground by means of properly designed foundation. The work of foundation shall conform to relevant Specifications as specified.
- 3.13.4.2 All Components of signs and supports, other than the reflective portion and G.I. posts shall be thoroughly descaled, cleaned, primed and painted with two coats of epoxy paint. Any part of mild steel (M.S.) post below ground shall be painted with three coats of red lead paint.
- 3.13.4.3 The signs shall be fixed to the posts by welding in the case of steel posts and by bolts and washers of suitable size in the case of reinforced concrete or G.I. posts. After the nuts have been tightened, the tails of the bolts shall be furred over with a hammer to prevent removal.

### 3.13.5 Measurements for Payment

The measurement of standard cautionary, mandatory and information signs shall be in numbers of different types of signs supplied and fixed, while for direction and place identification signs, these shall be measured by area in square metres.

**3.13.6 Rate**

The Contract unit rate shall be payment in full for the cost of making the road sign, including all materials, installing it at the site and incidentals to complete the work in accordance with the Specifications.

**3.14 ROAD MARKINGS**

**3.14.1 General**

The colour, width and layout of road markings shall be in accordance with the Code of Practice for Road Markings with paints, IRC: 35, and as specified in the drawings or as directed by the Engineer.

**3.14.2 Materials**

Road markings shall be of hot applied thermoplastic compound, or reflectorised paint as specified in the item and the material shall meet the requirements as specified below.

**3.14.3 Hot Applied Thermoplastic Road Marking**

**3.14.3.1 General:**

- i) The work under this section consists of marking traffic stripes using a thermoplastic compound meeting the requirements specified herein.
- ii) The thermoplastic compound shall be screeded/extruded on to the pavement surface in a molten state by suitable machine capable of controlled preparation and laying with surface application of glass beads at a specific rate. Upon cooling to ambient pavement temperature, it shall produce an adherent pavement marking of specified thickness and width and capable of resisting deformation by traffic.
- iii) The colour of the compound shall be white or yellow (IS colour No. 356) as specified in the drawings or as directed by the Engineer.
- iv) Where the compound is to be applied to cement concrete pavement, a sealing primer as recommended by the manufacturer, shall be applied to the pavement in advance of placing of the stripes to ensure proper bonding of the compound. On new concrete surface any laitance and/or curing compound shall be removed before the markings are applied.

**3.14.3.2 Thermoplastic Material**

**3.14.3.2.1 General:** The thermoplastic material shall be homogeneously composed of aggregate, pigment, resins and glass reflectorizing beads.

**3.14.3.2.2 Requirements:**

- i) **Composition:** The pigment, beads, and aggregate shall be uniformly dispersed in the resin. The material shall be free from all skins, dirt and foreign objects and shall comply with requirements indicated in Table 3.24.

**TABLE 3.24: Proportions of Constituents of Marking Material (Percentage by weight)**

Component	White	Yellow
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Binder	18.0 min.	18.0 min.
Glass Beads	30-40	30-40
Titanium Dioxide	10.0 min.	-
Calcium Carbonate and Inert Fillers	42.0 max.	See Note
Yellow Pigments	-	

Note: Amount of yellow pigment, calcium carbonate and inert fillers shall be at the option of the manufacturer, provided all other requirements of this Specification are met.

- ii) **Properties:** The properties of thermoplastic material, when tested in accordance with ASTM D36/BS-3262 (Part I), shall be as below:
  - a) **Luminance:**
    - White: Daylight luminance at 45 degrees-65 per cent min. as per AASHTO M 249.
    - Yellow: Daylight luminance at 45 degrees 45 per cent min. as per AASHTO M 249.
  - b) **Drying time:** When applied at a temperature specified by the manufacturer and to the required thickness, the material shall set to bear traffic in not more than 15 minutes.
  - c) **Skid resistance:** not less than 45 as per BS 6044.
  - d) **Cracking resistance at low temperature:** The material shall show no cracks on application to concrete blocks.
  - e) **Softening point:** 102.5 ±9.5% C as per ASTM D 36.
  - f) **Flow resistance:** Not more than 25 per cent as per AASHTO M 249.
  - g) **Yellowness index (for white thermoplastic paint):** not more than 0.12 as per AASHTO M 249
- iii) **Storage life:** The material shall meet the requirements of these Specifications for a period of one year. The thermoplastic material must also melt uniformly with no evidence of skins or unmelted particles for the one year storage period. Any material not meeting the above requirements shall be replaced by the manufacturer/supplier/Contractor.
- iv) **Reflectorisation:** Shall be achieved by incorporation of beads, the grading and other properties of the beads shall be as specified in Clause 3.14.4.3.
- v) **Marking:** Each container of the thermoplastic material shall be clearly and indelibly marked with the following information:
  1. The name, trade mark or other means of identification of manufacturer
  2. Batch number
  3. Date of manufacture
  4. Colour (white or yellow)
  5. Maximum application temperature and maximum safe heating temperature.

- vi) **Sampling and testing:** The thermoplastic material shall be sampled and tested in accordance with the appropriate ASTM/BS method. The Contractor shall furnish to the Employer a copy of certified test reports from the manufacturers of the thermoplastic material showing results of all tests specified herein and shall certify that the material meets all requirements of this Specification.

**3.14.3.3 Reflectorisng glass beads**

3.14.3.3.1 **General:** This Specification covers two types of glass beads to be used for the production of reflectorised pavement markings.

Type 1 beads are those which are a constituent of the basic thermoplastic compound vide Table 3.24 and Type 2 beads are those which are to be sprayed on the surface vide Clause 3.14.6.3.

3.14.3.3.2 The glass beads shall be transparent, colourless and free from milkiness, dark particles and excessive air inclusions.

These shall conform to the requirements spelt out in Clause 3.14.4.3.3

**3.14.3.3.3 Specific requirements**

- A. **Gradation:** The glass beads shall meet the gradation requirements for the two types as given in Table 3.25.

**TABLE 3.25: Gradation Requirements for Glass Beads**

Sieve Size	Per cent retained	
	Type 1	Type 2
1.18 mm	0 to 3	-
850 micron	5 to 20	0 to 5
600 micron	-	5 to 20
425 micron	65 to 95	-
300 micron	-	30 to 75
180 micron	0 to 10	10 to 30
Below 180 micron	0	0 to 15

- B. **Roundness:** The glass beads shall have a minimum of 70 per cent true spheres.
- C. **Refractive index:** The glass beads shall have a minimum refractive index of 1.50.
- D. **Free flowing properties:** The glass beads shall be free of hard lumps and clusters and shall dispense readily under any conditions suitable for paint striping. They shall pass the free flow-test.

3.14.3.3.4 **Test methods:** The specific requirements shall be tested with the following methods:

- i) **Free-flow test:** Spread 100 grams of beads evenly in a 100 mm diameter glass dish. Place the dish in a 250 mm inside diameter disiccator which is filled within 25 mm of the top of a desiccator plate with sulphuric acid water

solution (specific gravity 1.10). Cover the desiccator and let it stand for 4 hours at 20 to 29 degree C. Remove sample from desiccator, transfer beads to a pan and inspect for lumps or clusters. Then pour beads into a clean, dry glass funnel having a 100 mm stem and 6 mm orifice. If necessary, initiate flow by lightly tapping the funnel. The glass spheres shall be essentially free of lumps and clusters and shall flow freely through the funnel.

- ii) The requirements of gradation, roundness and refractive index of glass beads and the amount of glass beads in the compound shall be tested as per BS 6088 and BS 3262 (Part I).
- iii) The Contractor shall furnish to the Employer a copy of certified test reports from the manufacturer of glass beads obtained from a reputed laboratory showing results of all tests specified herein and shall certify that the material meets all requirements of this Specification. However, if so required, these tests may be carried out as directed by the Engineer.

#### **3.14.3.4 Application properties of thermoplastic material**

3.14.3.4.1 The thermoplastic material shall readily get screeded/extruded at temperatures specified by the manufacturers for respective method of application to produce a line of specified thickness which shall be continuous and uniform in shape having clear and sharp edges.

3.14.3.4.2 The material upon heating to application temperatures, shall not exclude fumes, which are toxic, obnoxious or injurious to persons or property.

#### **3.14.3.5 Preparation:**

- i) The material shall be melted in accordance with the manufacturer's instructions in a heater fitted with a mechanical stirrer to give a smooth consistency to the thermoplastic material to avoid local overheating. The temperature of the mass shall be within the range specified by the manufacturer, and shall on no account be allowed to exceed the maximum temperature stated by the manufacturer. The molten material should be used as expeditiously as possible and for thermoplastic material which has natural binders or is otherwise sensitive to prolonged heating, the material shall not be maintained in a molten condition for more than 4 hours.
- ii) After transfer to the laying equipment, the material shall be maintained within the temperature range specified by the manufacturer for achieving the desired consistency for laying.

#### **3.14.3.6 Properties of finished road marking:**

- a) The stripe shall not be slippery when wet.
- b) The marking shall not shift from the pavement in freezing weather.
- c) After application and proper drying, the stripe shall show no appreciable deformation or discolouration under traffic and under road temperatures upto 60°C.
- d) The marking shall not deteriorate by contact with sodium chloride, calcium chloride or oil drippings from traffic.
- e) The stripe or marking shall maintain its original dimensions and position. Cold ductility of the material shall be such as to permit normal movement with the road surface without chopping or cracking.

- f) The colour of yellow marking shall conform to IS Colour No. 356 as given in IS: 164.

#### **3.14.4 Reflectorised Paint**

Reflectorised paint, if used, shall conform to the Specification by the manufacturers and approved by the Engineer. Reflectorising glass beads for reflectorising paints where used shall conform to the requirement of Clause 3.14.4.3.

#### **3.14.5 Application**

3.14.5.1 Marking shall be done by machine. For locations where painting cannot be done by machine, approved manual methods shall be used with prior approval of the Engineer. The Contractor shall maintain control over traffic while painting operations are in progress so as to cause minimum inconvenience to traffic compatible with protecting the workmen.

3.14.5.2 The thermoplastic material shall be applied hot either by screeding or extrusion process. After transfer to the laying apparatus, the material shall be laid at a temperature within the range specified by the manufacturer for the particular method of laying being used. The paint shall be applied using a screed or extrusion machine.

3.14.5.3 The pavement temperature shall not be less than 10°C during application. All surfaces to be marked shall be thoroughly cleaned of all dust, dirt, grease, oil and all other foreign matter before application of the paint.

The material, when formed into traffic stripes, must be readily renewable by placing an overlay of new material directly over an old line of compatible material. Such new material shall so bond itself to the old line that no splitting or separation takes place.

Thermoplastic paint shall be applied in intermittent or continuous lines of uniform thickness of at least 2.5 mm unless specified otherwise. Where arrows or letters are to be provided, thermoplastic compound may be hand-sprayed. In addition to the beads included in the material, a further quantity of glass beads of Type 2, conforming to the above noted Specification shall be sprayed uniformly into a mono-layer on to the hot paint line in quick succession of the paint spraying operation. The glass beads shall be applied at the rate of 250 grams per square metre area.

3.14.5.4 The minimum thickness specified is exclusive of surface applied glass beads. The method of thickness measurement shall be in accordance with Appendices B and C of BS – 3262 (Part 3).

3.14.5.5 The finished lines shall be free from ruggedness on sides and ends and be parallel to the general alignment of the carriageway. The upper surface of the lines shall be level, uniform and free from streaks.

#### **3.14.6 Measurements for Payment**

3.14.6.1 The painted markings shall be measured in sq.metres of actual area marked (excluding the gaps, if any).

3.14.6.2 In respect of markings like directional arrows and lettering, etc., the measurement shall be by numbers.

#### **3.14.7 Rate**

The Contract unit rate for road markings shall be payment in full compensation for furnishing all labour, materials, tools, equipment, including all incidental costs necessary for carrying out the work at the site conforming to these Specifications complete as per the approved drawing(s) or as directed by the Engineer and all other incidental costs necessary to complete the work to these Specifications.

### **3.15 QUALITY CONTROL TESTS DURING CONSTRUCTION**

### 3.15.1 General

The materials supplied and the works carried out by the Contractor shall conform to the specifications prescribed in the following Clauses.

For ensuring the requisite quality of construction, the materials and works shall be subjected to quality control tests, as described hereinafter. The testing frequencies set forth are the desirable minimum and the Engineer shall have the full authority to carry out additional tests as frequently as he may deem necessary, to satisfy himself that the materials and works comply with the appropriate specifications. However, the number of tests recommended in Tables 3.27 and 3.28 may be reduced at the discretion of the Engineer if it is felt that consistency in the quality of material can still be maintained with the reduced number of tests.

Test procedures for the various quality control tests are indicated in the respective Sections of these Specifications or for certain tests within this Section. Where no specific testing procedure is mentioned, the tests shall be carried out as per the prevalent accepted engineering practice to the directions of the Engineer.

There shall not be any separate item in the Boq for the measures for quality control; the rates for measurable items are deemed to include the cost of all the measures advised in the sub clauses of 3.15

### 3.15.2 Surface Levels

The levels of the subgrade and different pavement courses as constructed, shall not vary from those calculated with reference to the longitudinal and cross-profile of the rod shown on the drawings or as directed by the Engineer beyond the tolerances mentioned in Table 3.26.

**TABLE 3.26: Tolerances in Surface Levels**

1.	Subgrade	+ 20 mm - 25 mm
2.	Sub-base + 10 mm a) Flexible pavement b) Concrete pavement [Dry lean concrete or Rolled concrete]	- 20 mm + 6 mm - 10 mm
3.	Base-course for flexible pavement a) Bituminous course  b) Other-than bituminous i) Machine laid  ii) Manually laid	+ 6 mm - 6 mm  + 10 mm - 10 mm  + 15 mm - 15 mm
4.	Wearing course for flexible pavement a) Machine laid	+ 6 mm

	b) Manually laid	- 6 mm + 10 mm - 10 mm
5.	Cement concrete pavement	+ 5 mm - 6 mm*

\* This may not exceed – 8 mm at 0 – 30 cm from the edges.

### 3.15.3 Tests on Earthwork for Embankment, Subgrade Construction and Cut Formation/Fill Formation

**3.15.3.1 Borrow material:** Grid the borrow area at 25 m c/c (or closer, if the variability is high) to full depth of proposed working. These pits should be logged and plotted for proper identification of suitable sources of material. The following tests on representative samples shall be carried out:

- a) Sand Content [IS: 2720 (Part-4)]: 2 tests per 3000 cubic metres of soil.
- b) Plasticity Test [IS: 2720 (Part-5)]: Each type to be tested, 2 tests per 3000 cub.metres of soil.
- c) Density Test [IS: 2720 (Part 8)]: Each soil type to be tested, 2 tests per 3000 cubic metres of soil.
- d) Deleterious Content Test [IS: 2720 (Part 27)]: As and when required by the Engineer.
- e) Moisture Content Test [IS: 2720 (Part-2)]: One test for every 250 cubic metres of soil.
- f) CBR Test on materials to be incorporated in the subgrade on soaked/unsaturated samples [IS: 2720 (part 16)]: one CBR test for every 3000 cu.m. atleast or closer as and when required by the Engineer.

**3.15.3.2 Compaction Control:** Control shall be exercised on each layer by taking at least one measurement of density for each 1000 square metres of compacted area, or closer as required to yield the minimum number of test results for evaluating a day's work on statistical basis. The determination of density shall be in accordance with IS: 2720 (Part-28). Test locations shall be chosen only through random sampling techniques. Control shall not be based on the result of anyone test but on the mean value of a set of 5-10 density determinations. The number of tests in one set of measurements shall be 6 (if non-destructive tests are carried out, the number of tests shall be doubled) as long as it is felt that sufficient control over borrow material and the method of compaction is being exercised. If considerable variations are observed between individual density results, the minimum number of tests in one set of measurement shall be increased to 10. The acceptance criteria shall be subject to the condition that the mean density is not less than the specified density plus:

$$\left[ 1.65 - \frac{1.65}{(\text{No. of Samples})^{0.5}} \right] \text{times the standard deviation}$$

However, for earthwork in shoulders and median (earthen) and in the subgrade, at least one density measurement shall be taken for every 500 square metres for the compacted area provided further that the number of tests in each set of measurements shall be atleast 10. In other respects, the control shall be similar to the described earlier.



**3.15.3.3 Cut formation:** Tests for the density requirements of cut formation shall be carried out in accordance with Clause 3.15.3.2.

**3.15.4 Tests on Sub-bases and Bases (excluding bitumen bound bases)**

The tests and their frequencies for the different types of bases and sub-bases shall be as given in Table 3.27. The evaluation of density results and acceptance criteria for compaction control shall be on lines similar to those set out in Clause 3.15.3.2

**3.15.4.1 Acceptance criteria:** The acceptance criteria for tests on the strength of cement/lime stabilized soil and distribution of stabilizer content shall be subject to the condition that the mean value is not less than the specified value plus:

$$\left[ 1.65 - \frac{1.65}{(\text{No. of Samples})^{0.5}} \right] \text{times the standard deviation}$$

**TABLE 3.27: Control Tests and Their Minimum Frequency for Sub-bases and Bases (Excluding Bitumen Bound Bases)**

Sl. No.	Type of Construction	Test	Frequency (min.)
1.	Granular	i) Gradation ii) Atterberg limits iii) Moisture content prior to compaction iv) Density of compacted layer v) Deleterious constituents vi) C.B.R.	One test per 200 m <sup>3</sup> One test per 200 m <sup>3</sup> One test per 250 m <sup>3</sup> One test per 500 m <sup>3</sup> As required As required
2.	Wet Bound Macadam	i) Aggregate impact Value ii) Grading iii) Flakiness and Elongation Index iv) Atterberg limits of portion of aggregate passing 425 micron sieve v) Density of compacted layer.	One test per 200 m <sup>3</sup> of aggregate One test per 100 m <sup>3</sup> of aggregate One test per 200 m <sup>3</sup> of aggregate One test per 100 m <sup>3</sup> of aggregate One test per 500 m <sup>3</sup>

**3.15.5 Tests on Bituminous Construction**

**3.15.5.1 Tests and frequency:** The tests and their minimum frequencies for the different types of bituminous works shall be as given in Table 3.28. The Engineer may direct additional testing as required.

**3.15.5.2 Acceptance criteria:** The acceptance criteria for tests on density and Marshall stability shall be subject to the condition that the mean value is not less than the specified value plus:

$$\left[ 1.65 - \frac{1.65}{(\text{No. of Samples})^{0.5}} \right] \text{times the standard deviation}$$

**TABLE 3.28: Control Tests for Bituminous works, and their Minimum Frequency**

Sl. No.	Type of Construction	Test	Frequency (min.)
1.	Prime Coat/Tack Coat/Fog Spray	i) Quality of binder  ii) Binder temperature for application  iii) Rate of spread of Binder	Number of samples per lot and tests as per IS: 73, IS: 217 and IS: 8887 as applicable.  At regular close intervals.  One test per 500m <sup>2</sup> and not less than two tests per day.
2.	Bituminous Macadam	i) Quality of binder  ii) Aggregate Impact Value/Los Angeles Abrasion Value  iii) Flakiness Index and Elongation Index  iv) Stripping Value     v) Water sensitivity of mix     vi) Grading of aggregates    vii) Water absorption of aggregates    viii) Soundness (Magnesium and Sodium Sulphate)    ix) Percentage of fractured	Number of samples per lot and tests as per IS: 73, IS: 217 and IS: 8887 as applicable.  One test per 50 m <sup>3</sup> of aggregate  One test per 50 m <sup>3</sup> of aggregate  Initially one set of 3 representative specimens for each source of supply. Subsequently when warranted by changes in the quality of aggregates  Initially one set of 3 representative specimens for each source of supply. Subsequently when warranted by changes in the quality of aggregates  Two tests per day per plant both on the individual constituents and mixed aggregates from the dryer  Initially one set of 3 representative specimens for each source of supply. Subsequently when warranted by changes in the quality of aggregates  Initially, one determination by each method for each source of supply, then as warranted by change in the quality of the aggregates.  When gravel is used, one test per 50m <sup>3</sup> of aggregate  Periodic, subject to minimum

		<p>faces</p> <p>x) Binder content and aggregate grading</p> <p>xi) Control of temperature of binder and aggregate for mixing and of the mix at the time of laying and rolling</p> <p>xii) Rate of spread of mixed material</p> <p>xiii) Density of Compacted layer</p>	<p>to two tests per day per plant</p> <p>At regular close intervals</p> <p>Regular control through checks of layer thickness</p> <p>One test per 250m<sup>2</sup> of area</p>
3.	Dense Bituminous Macadam/Semi Dense Bituminous Concrete/Bituminous Concrete	<p>i) Quality of binder</p> <p>ii) Aggregate Impact Value/Los Angeles Abrasion Value</p> <p>iii) Flakiness Index and Elongation Index</p> <p>iv) Stripping Value</p> <p>v) Soundness (Magnesium and Sodium Sulphate)</p> <p>vi) Water absorption of aggregates</p> <p>vii) Sand equivalent test</p> <p>viii) Plasticity Index</p> <p>ix) Polished stone value</p> <p>x) Percentage of fractured faces</p> <p>xi) Mix grading</p>	<p>Number of samples per lot and tests as per IS: 73, IS: 217 and IS: 8887 as applicable.</p> <p>One test per 50 m<sup>3</sup> of aggregate</p> <p>One test per 50 m<sup>3</sup> of aggregate</p> <p>Initially one set of 3 representative specimens for each source of supply. Subsequently when warranted by changes in the quality of aggregates</p> <p>Initially one set of 3 representative specimens for each source of supply. Subsequently when warranted by changes in the quality of aggregates</p> <p>Initially one set of 3 representative specimens for each source of supply. Subsequently when warranted by changes in the quality of aggregates</p> <p>As required</p> <p>As required</p> <p>As required, for Semi Dense Bituminous Concrete/Bituminous Concrete</p> <p>When gravel is used, one test per 50m<sup>3</sup> of aggregate</p> <p>One set of tests on individual constituents and mixed aggregate from the dryer for each 400 tonnes of mix subject</p>

			to a minimum of two tests per plant per day
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**3.15.6 Measurement for payment**

There shall not be a separate item in the Bill of Quantities, for the measures for quality control; the rates for measurable items in the Contract are deemed to include the cost of all the tests advised at specified frequencies, in the sub clauses of Clause 3.15

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## GENERAL TECHNICAL SPECIFICATION FOR PLUMBING WORK

### 1.0 GENERAL:

- 1.1 The work shall be carried out in the accordance with the drawings and design as would be issued to the Contractor by the Design Consultant duly signed and stamped by him. The Contractor shall not take cognizance of any drawings, designs, specifications etc. **not** bearing Design Consultant signature and stamp. Similarly the Contractor shall not take cognizance of instructions given by any other Authority except the instructions given by the Client's Representative in writing.
- 1.2 The work shall be executed and measured as per metric dimensions given in the Bill of Quantities, drawings etc.
- 1.3 The Contractor shall acquaint himself fully with the partial provisions for supports that may or may not be available in the structure and if are available then utilize them to the extent possible. In any case the Contractor shall provide all the supports regardless of provisions that they have been already made. Nothing extra shall be payable for situations where insert plates (for supports) are not available or are not useful.
- 1.4 Shop coats of paint that may be damaged during shipment or erection shall be cleaned off with mineral spirits, wire brushed and spot primed over the affected areas, then coated with paint to match the finish over the adjoining shop painted surface.
- 1.5 The Contractor shall protect / handle the material carefully and if any damage occurs while handling by the Contractor then the sole responsibility shall be of the Contractor. Such damages shall be rectified/recovered by the Contractor at no extra cost whatsoever.
- 1.6 The Contractor shall, within twenty one (21) days of receipt of the Notice of Award for the Project, where applicable, complete the submission of shop drawings to the Client's Representative for approval by the Design Consultants in order to conform to the contract schedule.

### 1.7 MEASUREMENTS:

All measurements shall be taken in accordance with relevant IS codes, unless otherwise specified.

### 2.0 APPLICABLE CODES AND STANDARDS:

All equipment, supply, erection, testing and commissioning shall comply with the requirements of Indian Standards and code of practice given below as amended up to the date of submission of Tender. All equipment and material being supplied shall meet the requirements of BIS and other relevant standard and codes.

#### Plumbing Works:

Vitreous Chinaware	-	IS: 2556 - 1974 (Part - I)
	-	IS: 2556 - 1981 (Part - II)
	-	IS: 2556 - 2556 (Part - III)
Ball Valve	-	IS: 1703 - 1977
Cistern Brackets	-	IS: 775 - 1970
Toilet Seat Cover	-	IS: 2548 - 1983
Vitreous China Cistern	-	IS: 2326 - 1987
Sand Cast Iron Pipes and Fittings	-	IS: 1729 - 1979
Spun Cast Iron Pipes and Fittings	-	IS: 3989 - 1984
GI Pipes	-	IS: 1239 - 1979
Galvanizing for GI Pipes	-	IS: 4736 - 1986
Pipe Threads	-	IS: 554 - 1985
Milleable Iron Fittings	-	IS: 1879 - 1987
Cast Iron Sluice Valves	-	IS: 780 - 1984
Full Way Valves	-	IS: 778 - 1984

Brass Ferrule	-	IS: 2692 - 1978
Stone Ware Gully Trap	-	IS: 651 - 1980
RCC Pipes	-	IS: 458 - 1971
Cast Iron Class LA Pipes	-	IS: 1536 - 1989
Cast (Spun) Iron Fittings	-	IS: 1538 - 1976
Pig Lead	-	IS: 782 - 1966
Induction Motors	-	IS: 4691
Code for Measurements	-	IS: 1200
UPVC Pipes and Fittings	-	IS: 4984
Specification for Caulking Lead	-	IS: 782
Code of Practice for laying of concrete	-	IS: 783

### **3.0 QUALITY ASSURANCE AND QUALITY CONTROL:**

- 3.1 The work shall conform to high standard of design and workmanship, shall be structurally sound and aesthetically pleasing. Quality standards prescribed shall form the backbone for the quality assurance and quality control system.
- 3.2 At the site, the Contractor shall arrange the materials and their stacking/ storage in appropriate manner to ensure the quality. Contractor shall provide equipment and manpower to test continuously the quality of material, assemblies etc. as directed by the Client's Representative. The test shall be conducted continuously and the result of tests maintained. In addition the Contractor shall keep appropriate tools and equipment for checking alignments, levels, slopes and evenness of surface.
- 3.3 The Client's Representative shall be free to carry out such tests as may be decided by him at this sole direction, from time to time, in addition to those specified in this Document. The Contractor shall provide the samples and labour for collecting the samples. Nothing extra shall be payable to the Contractor for samples or for the collection of the samples.
- 3.4 The test shall be conducted at Standard Laboratory selected by Client's Representative. Contractor shall keep the necessary testing equipment such as hydraulic testing machine, smoke testing machine, gauges and other necessary equipment required.
- 3.5 The Client's Representative shall transport the samples to the laboratory.
- 3.6 Testing charges shall be borne by the Client's Representative.
- 3.7 Testing may be witnessed by the Contractor or his Authorised Representative. Whether witnessed by the Contractor or not, the test results shall be binding on the Contractor.

### **4.0 SANITARY FIXTURES & C.P. FITTINGS:**

#### **4.1 SCOPE**

- 4.1.1 Work under this section shall consist of transportation, furnishing, installation, testing and commissioning and all labour as necessary as required to completely install all sanitary fixtures, brass and chromium plated fittings and accessories as required by the drawings and specified hereinafter or given in the Bill of Quantities.

#### **4.2 GENERAL REQUIREMENTS**

- 4.2.1 All fixtures and fittings shall be fixed with all such accessories as are required to complete the item in working condition whether specifically mentioned or not in the Bill of Quantities, specifications, drawings or not.
- 4.2.2 All fixtures and accessories shall be fixed in accordance with a set pattern matching the tiles or interior finish as per architectural design requirements. Wherever necessary the fittings shall be centered to dimensions and pattern desired.



- 4.2.3 Fixing screws shall be half round head chromium plated brass with C.P. washers wherever required as per directions of Client's Representative.
- 4.2.4 All fittings and fixtures shall be fixed in a neat workmanlike manner true to levels and heights shown on the drawings & in accordance with the manufacturer's recommendations. Care shall be taken to fix all inlet and outlet pipes at correct positions. Faulty locations shall be made good and any damage to the finished floor, wall or ceiling surfaces shall be made good at Contractor's cost.
- 4.2.5 All fixtures of the similar materials shall be by the same manufacturers.
- 4.2.6 All fitting shall be of the chromium plated materials.
- 4.2.7 Without restricting to the generally of the foregoing the sanitary fixtures shall include all sanitary fixtures, C.P. fittings and accessories etc. necessary and required for the building.
- 4.2.8 Whether specifically mentioned or not all fixtures and appliances shall be provided with approved fixing devices, nuts, bolts, screws, and hangers as required. These supports shall have the necessary adjustment to allow for irregularities in the building area construction.
- 4.2.9 For the installation of the CP fittings, Teflon tape shall be used.

### **4.3 EUROPEAN W.C.**

- 4.3.1 European W.C. of glazed vitreous china shall be wash down, single or double symphonic type, floor or wall mounted set, flushed by means of flush valve as specified in Bill of Quantities. Flush pipe / bend shall be connected to the W.C. by means of suitable rubber adopter. Wall hung W.C. shall be supported by C.I. floor mounted chair.
- 4.3.2 Each W.C. seat cover shall be so fixed that it remains absolutely stationary in vertical position without falling down on the W.C. Seat cover shall be of white solid plastic, elongated open front with heavy duty hinges. Exposed fixture trims shall be Chrome plated, and trims of similar function shall be by the same manufacturer.
- 4.3.3 Flush valves shall be of the best approved quality procurable with C.P. control valve and C.P. flush pipe.
- 4.3.4 The flush pipe/bend shall be connected to the WC by means of a suitable rubber adopter.
- 4.3.5 Alternatively if flushing cistern to be used shall conform to the requirements of IS: 774-1971. High level cisterns shall be of cast iron unless otherwise specified. Low level cistern shall be of the same material as the water closet or as instructed by the Owner/Architect/ Consultant. The cisterns shall be mosquito proof & shall fulfill the requirements of the local Authority.
- 4.3.6 The levels of the WC should be checked by placing spirit level on the W.C. W.C. should be tested on completion of fixing by putting small paper balls and flushing out. If all the paper balls are not flushed out. The fixing will have to be rectified / re-aligned.

### **4.4 KITCHEN / PANTRY SINKS**

- 4.4.1 Sinks shall be of stainless steel material as specified in the Bill of Quantities/Drawings.
- 4.4.2 Each sink shall be provided with R. S. brackets and clips and securely fixed. Counter top sinks shall be fixed with suitable angle iron clips or brackets as recommended by the manufacturer. Each sink shall be provided with 40 mm dia Chromium Plated waste with chain and plug or P.V.C. waste with Escutcheon plates. Fixing shall be done as directed by Client's Representative.
- 4.4.3 Supply fittings for sinks shall be mixing fittings or C.P. taps, angle cocks etc. all as specified in the Bill of Quantities/Drawings.

### **4.5 WASH BASINS**

- 4.5.1 Wash basin shall be of white vitreous china of best quality manufactured by an approved firm and sizes as specified in the Bill of Quantities.
- 4.5.2 Wash basin shall be of under counter drop in type shall be supported on a pair of rolled steel brackets of approved design and shall be mounted on a countertop. So that rim and basin bowl is exposed from top.
- 4.5.3 Wash basin shall be provided with single lever mixer with chain and rubber plug, chromium plated brass bottle trap of approved quality, design and make where hot water required. Single tap where hot water is not required.
- 4.5.4 Wash basin shall be fixed at proper location and height and truly horizontal as shown on drawing or as directed by Client's Representative.

#### **4.6 HOSE BIBB'S**

- 4.6.1 Hose Bib of Chromium Plate tap is draw off tap with horizontal inlet and free outlet knurling on outer face to fix the hose pipe. Hose bib shall be of specified size and shall be of screw down type and shall conform to IS: 781-1984. The closing device shall work by means of a disc carrying a renewable non-metallic washer which shuts against the water pressure on a seating at right angle to the axis of the threaded spindle which operate it. The handle shall be either crutch or butterfly type securely

#### **4.7 URINALS**

Half stall wall hung urinals of glazed vitreous china shall be provided with 15mm dia, C.P. brass spreader, 32mm dia C.P. domical waste and C.P. cast brass bottle trap with pipe and wall flange and shall fixed to wall by one C.I. bracket and two C.I. clips as recommended by manufacturers complete as directed by the Client's Representative.

Urinals shall be flushed by means of "NO-TOUCH" infrared operated flush valves.

Waste pipes for urinals shall be any one of the given material as directed by the Client's Representative:

- a) G.I. Pipes
- b) Rigid PVC/High density polyethylene.

Waste pipes may be exposed on wall or concealed in chase as directed by the Client's Representative.

#### **4.8 BATH TUB**

Bath tub & panel shall be white enameled cast iron or pressed steel as specified in the Bill of Quantities of guaranteed quality and specifications.

Each bath tub shall be provided with 40mm dia CP brass waste with 32mm C.P. brass overflow, 40mm dia cast brass overflow-cum-waste trap with pop-up waste assembly.

Bath tub shall be provided with four Nos. C.P. brass concealed stop cocks, bath spout and overhead shower or as specified in the Bill of Quantities.

Bath tubs shall be fixed true to level firmly fixed to another or supports provided by the manufacturer. Edges touching the wall shall be slightly recessed in the wall finishing so as ensuring water tightness. The fixing shall be perfectly done so that the wall behind does not tend to get damp or patchy.

Contractor shall during the entire period of installation and afterwards protect the bathtub by providing suitable cover or any other protection so as to absolutely prevent any damage to the bathtub until handing over.

#### **4.9 MEASUREMENTS**

- 4.9.1 Rate for providing and fixing of sanitary fixtures, accessories, urinal partitions shall include all items and operations stated in the respective specifications and Bill of Quantities, and nothing extra is payable.

4.9.2 Rates for all items under specifications para above shall be inclusive of cutting holes and chases and making good the same, C.P. screws, nuts, bolts and any fixing arrangement required.

## **5.0 WATER SUPPLY:**

### **5.1 SCOPE**

5.1.1 Work under this section consists of furnishing all labour, materials equipment and appliances necessary and required to completely install the water supply system as required by the drawings, specified hereinafter and given in the bill of quantities.

5.1.2 Without restricting to the generality of the foregoing, the water supply system shall include the following:-

- i. Pipe protection & painting.
- ii. Connections to all plumbing fixtures, tanks, pump etc.
- iii. Providing hot water pipe lines and supply point with isolation valves, wherever required.
- iv. Control valves, masonry chambers and other appurtenances.
- v. Connections to all plumbing fixtures, tanks and appliances.
- vi. Excavation and refilling of pipe trenches, wherever necessary.
- vii. Internal galvanized water supply piping inside the toilets shaft/plant room/terrace.
- viii. Testing all line and fixtures as specified.

### **5.2 GENERAL REQUIREMENTS:**

5.2.1 All materials shall be new of the best quality and shall be furnished, delivered, erected, connected and finished in every detail conforming to specifications and subject to the approval of Client's Representative.

5.2.2 Pipes and fittings shall be fixed truly vertical, horizontal or in slopes as required in a neat workmanlike manner.

5.2.3 Short or long bends shall be used on all main pipe lines as far as possible. Use of elbows shall be restricted for short connections.

As far as possible all bends shall be formed by means of hydraulic pipe bending machine for pipes up to 65mm dia.

5.2.4 Pipes shall be fixed in a manner as to provide easy accessibility for repair and maintenance and shall not cause obstruction in shafts, passages etc. and shall be selected and arranged so as to fit properly into the allocated building space.

5.2.5 Pipes shall be securely fixed to walls by suitable clamps at intervals specified.

5.2.6 Valves and other appurtenances shall be located to provide easy accessibility for operation, maintenance and repairs.

5.2.7 Connection between dissimilar materials.

5.2.8 All G.I. pipes jointing shall be with white lead and spun yarn.

5.2.9 Drawings illustrating block out and penetration of pipes in the wall/floor/slab.

5.2.10 UNIONS:

Contractor shall provide adequate no. of unions on all pipes to enable dismantling later and for servicing. Union shall be provided near each gunmetal valve.

### **5.3 INTERNAL WORKS**

#### **5.3.1 MATERIALS:**

##### **5.3.1.1 G.I. PIPES**

- i. The pipes shall be galvanised mild steel threaded pipes conforming to the requirement of IS: 1239 Part-I for heavy grade upto 150mm dia and IS: 3589 for pipes above 150mm dia. They shall be of the dia (nominal bore) specified in the description of the item. Galvanising shall conform to IS: 4736.
- ii. The pipes shall be clearly finished, well galvanised in and out and free from cracks, surface flow, laminations and other defects. All screw threads shall be clean and well cut. The ends shall be cut cleanly and square with axis of the tube.
- iii. All screw tubes shall have pipe threads conforming to the requirements of IS: 544-1955 (or revised).

##### **5.3.1.2 G.I. FITTINGS**

- i. All fittings shall be conforming to IS: 1239 Part II (or as revised). All fittings shall have manufacturer's trade mark stamped on it. Fittings in G.I. pipe lines shall include elbows, tees, bends, reducers, nipples, union, G.I. Clamps / Steel structural supports of approved design, nuts, bolts, washers, etc. All fittings shall be tested at manufacturer's works. Contractors may be required to produce certificate to this effect from the manufacturers.
- ii. The fittings shall have screw threads at the ends conforming to the requirements of IS: 544-1955 (or revised). Female threads on fittings shall be parallel and male threads (except on running nipples and collars of unions) shall be tapered.

##### **5.3.1.3 CUTTING AND JOINTING:**

- i) The pipes and fittings shall be inspected at site before use to ascertain that they conform the specification given in para no. 5.3.1.1 above. The defective pipes shall be rejected. Where the pipes have to be cut or re-threaded, the ends shall be carefully filled out so that no obstruction to bore is offered. The end of the pipes shall then be threaded conforming to the requirements of IS: 544-1955 with pipe dies and taps carefully in such a manner as will not result in slackness of joints when the two pieces are screwed together. The taps and dies shall be used only for straightening screw threads which have become bend or damaged and shall not be used for turning of the threads so as to make them slack, as the later procedure may not result in water tight joint.
- ii) The screw threads of pipes and fittings shall be protected from damage until they are fitted.
- iii) The pipes shall be cleaned and cleared of all foreign matter before being laid. In jointing the pipes, the inside of the socket and the screwed end of the pipes shall be oiled and rubbed over with white lead and a few turns of spun yarn wrapped round the screwed end of the pipe. The end shall then be screwed in the socket. Care should be taken that all pipes and fitting are properly jointed so as to make the joints completely water tight and pipes are kept at all times free dust and dirt during the fixing. Burr from the joint shall be removed after laying. The open ends of the pipes shall be temporarily plugged to prevent access of water, solid or any other foreign matter.

#### **5.3.2 INSTALLATION OF G.I.:**

Tender drawings indicate schematically the size and location of pipes. The Contractor on the award of the work, shall prepare detailed coordinated with other trades working drawings, showing the cross-section, longitudinal sections, details of fittings, locations of isolating and control valves, drain valves and all pipe support, structural supports. He must keep in view the specific openings in buildings and other structures through which pipes are designed to pass.

- i. Piping shall be properly supported on or suspended from connection clamps, hangers as specified and as required. Install pipes in a manner to avoid strain on equipments connections. The Contractor shall adequately design all the brackets, saddles, anchors, clamps and hangers, and be responsible for their structural sufficiency.
- ii. Pipe supports shall be of steel, adjustable for height and primer coated with rust preventive paint

and finish coated back. Where pipe and clamps are of dissimilar materials a dielectric fitting shall be provided in between. Spacing of pipe supports shall not exceed the following:

<b>Pipe Size</b>	<b>Spacing between Supports</b>
Upto 12 mm	1.5 meter
15 to 25 mm	2.0 meter
32 to 150 mm	2.0 meter
150 mm and over	2.5 meter

- iii. Vertical risers shall be parallel to walls and column lines and shall be straight and plumb. Risers passing from floor to floor shall be supported at each floor by clamps or collars steel structural supports attached to pipe and with a 15 mm thick rubber pad or any resilient material. Where pipes pass through the terrace floor, suitable flashing shall be provided to prevent water leakage. Risers shall have a suitable clean out at the lowest point and air vent at the highest point.
- iv. Pipe sleeves, 50 mm larger diameter than pipes, and 50mm above F.F.L. Shall be provided wherever pipes pass through walls and slabs, and annular space filled with fire proof materials like putty, fire seal etc.
- v. All pipe work shall be carried out in workmen like manner, causing minimum disturbance to the existing services, buildings, roads and structure. The entire piping work shall be organized in consultation also coordinated with other Contractors work so that particular area work shall be carried out in one stretch.
- vi. Cut outs in the floor slab for installing the various pipes are indicated in the drawings. Contractor shall carefully examine the cut outs provided and clearly point out wherever the cut outs shown in the drawings, do not meet with the requirements.
- vii. The Contractor shall make sure that the clamps, steel structural supports, brackets, clamp saddles and hangers provided for pipe supports are adequate. Piping layout shall take due care for expansion and contraction in pipes, and include expansion joints where required.
- viii. All pipes shall be accurately cut to the required sizes in accordance with relevant BIS codes and burrs removed before laying. Open ends of the piping shall be closed as the pipe is installed to avoid entrance of foreign matter. Where reducers are to be made in horizontal runs, eccentric reducers shall be used for the piping to drain freely. In other locations, concentric reducers may be used.
- ix. All buried pipes shall be cleaned and coated with zinc chromate primer and bitumen paint, then wrapped with bitumen faced hesian.
- x. In case the pipe is embedded in walls or floors, it should be painted with two coats of anti corrosive bitumastic paint of approved quality, covered with one layer of fiberglass tissue and finally painted with one coat of bitumen paint. The pipe should not come in contact with cement mortar or cement concrete as the pipe will be affected by cement. Under the floors, the pipes shall be laid in layer of filling under concrete floors.
- xi. For pipes 15mm to 25mm dia, the holes in the walls and floors shall be made by drilling with chisel or jumper and not by dismantling the brick work or concrete. However, for bigger dimension pipes the holes shall be carefully made of the smallest size as directed by the Client's Representative. After fixing the pipes the holes shall be made good with cement mortar 1:3 (1 cement: 3 coarse sand) properly finished to match the adjacent surface.
- xii. All pipes above ground shall be painted with one coat of red lead and two coats of synthetic enamel paint of approved shade and quality. Pipes shall be painted to standard colour code/or as specified by the Client's Representative.
- xiii. Springing or forcing pipe into place will not be permitted. Protect piping at all times from dirt and moisture. During storage at construction site, keep end plugged to prevent dirt and moisture entering.
- xiv. Carefully grade all pipes to eliminate traps and pockets. Where air pockets or water traps can not

be avoided provide means of drainage with valved hose connection for water traps and valved automatic air vents for air pockets.

- xv. Below grade piping shall be installed in such a manner that it does not appear directly on ground.
- xvi. Any location where pipes/valves through or closed to basement walls shall be protected from direct contact of concrete block.
- xvii. Pipes passing through building walls shall be protect by cast iron sleeves large enough to permit changes size eccentric fittings shall be used except where branch pipes connect into mains and in domestic system.

### 5.3.3 INSULATION:

- All the Hot Water supply & Hot Water return pipe shall be insulated in the manner specified hereinafter.
- Insulating material shall be rigid performed sections of mineral/rock wool with a “K” value of not more than 0.036 W/MK at 100 Deg. C mean temperature and of density 140 Kg/Cu.m
- No insulation shall be applied until the pipe is satisfactorily pressure tested.
- Pipes shall be insulated with rigid performed pipe sections of the following thickness:

Pipe Diameter (mm)	Thickness (Mineral Wool) mm
80-150	50

- Pipe insulation shall be applied as follows:
- Pipe shall be thoroughly cleaned with wire brush and rendered free from all rust and grease and applied with two coats of anti-rust paint.
- Pipes in Shaft:
  - i) Fix rigid performed sections of insulation with adhesive between all points (transverse and circumferential).
  - ii) The insulation shall be tied with GI chicken wire mesh.
  - iii) The insulation shall be provided with 24 gauge aluminium cladding screwed at the joints with cadmium coated self tapping screws. Joints shall be overlapped minimum 12mm wide.
- Pipes exposed to weather:
  - i) Same as (b) (i) to (ii)
  - ii) Provide polythene based hessian (500 gauges) overlapping 100mm on all joints (transverse and circumferential) and stitched at the joints.
  - iii) The hessian shall be covered with 15mm x 20mm hexagonal chicken wire mesh.
  - iv) Over the wire mesh the surface shall be covered with two layers of tarfelt grade-II and type-II with bitumen between layer overlapping 100mm on all joints (transverse & circumferential).
  - v) Over the second layer of tarfelt final coat of hot bitumen not less than 6mm thick shall be applied.
  - vi) Over the final layer of tarfelt and hot bitumen coat aluminium cladding shall be provided with 24 gauge aluminium shut screwed at the joints with cadmium coated self-tapings screws. Joints shall be overlapped minimum 25mm wide.
- d) Pipes Buried Underground:

- i) Rigid pipe sections of insulation shall be fixed tightly to the surface taking care to seal all joints with 50mm wide aluminium adhesive tape (transverse and circumferential).
- ii) The insulation shall be tied with aluminium band not less than 6mm width and 24 gauge 4 bands per meter or equivalent plastic band using G.I. sheet clamp crimped at the joints.
- iii) Wrap the insulation with polythene sheet 400 gauges. Polythene sheet shall be tied with 6mm, 24 gauge, aluminium band 4 bands per meter or equivalent plastic tape using GI sheet clamp crimped at the joint.
- iv) The polythene surface shall be covered with two layers of tarfelt grade – II, type – II with bitumen between layers overlapped 100mm on all joints (transverse and circumferential).
- v) Over the second layer of tarfelt final coat of hot bitumen not less than 6mm thick shall be applied.

#### **5.3.4 TESTING:**

After laying and jointing, the pipes and fittings shall be inspected under working condition of pressure and flow. Any joint found leaking shall be redone and all leaking pipes removed and replaced without extra cost. Use of any compound or stop leak compound will not permit.

The pipes and fittings after they are laid shall be tested to hydraulic pressure of 1.5 times the working pressure or 7.5 Kg/Sq.cm whichever is more. The pipes shall be slowly and carefully charged with water allowing all air to escape and avoiding all shock or water hammer. The draw of taps and stop cocks shall then be closed and specified hydraulic pressure shall be applied gradually. Pressure gauge must be accurate and preferably should have been recalibrated before the test. The test pump having been stopped, the test pressure should be maintained without loss for at least two hours. The pipes and fittings shall be tested in sections as the work of laying proceeds, having the joints exposed for inspection during the testing.

#### **5.3.5 PAINTING:**

The pipes shall be finally provided with synthetic enamel paint of approved quality for exposed pipes after the Hydrostatic test pressure. The cost of such painting should be included to the Contractor's quote.

#### **5.3.6 MEASUREMENTS:**

The length above ground shall be measured in running meter correct to a cm for the finished work, which shall include G.I. pipe and G.I. fittings such as bends, tees, elbows, reducers, crosses, plugs, sockets, nipples and nuts, unions etc... Deductions for length of valves shall be made. Rate quoted shall be inclusive of all fittings, clamps, cutting holes chased and making good the same and all items mentioned in the specifications and Bill of Quantities.

### **5.4 EXTERNAL WORKS:**

#### **5.4.1 MATERIALS:**

##### **5.4.1.1 G.I. PIPES**

- i. The pipes shall be galvanised mild steel threaded pipes conforming to the requirement of IS: 1239 Part-I for heavy grade upto 150mm dia and IS: 3589 for pipes above 150mm dia. They shall be of the dia (nominal bore) specified in the description of the item. Galvanising shall conform to IS: 4736.
- ii. The pipes shall be clearly finished, well galvanised in and out and free from cracks, surface flow, laminations and other defects. All screw threads shall be clean and well cut. The ends shall be cut cleanly and square with axis of the tube.
- iii. All screw tubes shall have pipe threads conforming to the requirements of IS: 544-1955 (or revised).

##### **5.4.1.2 G.I. FITTINGS**

- i. All fittings shall be conforming to IS: 1239 Part II (or as revised). All fittings shall have manufacturer's trade mark stamped on it. Fittings in G.I. pipe lines shall include elbows, tees, bends, reducers, nipples, union, G.I. Clamps / Steel structural supports of approved design, nuts, bolts, washers, etc. All fittings shall be tested at manufacturer's works. Contractors may be required to produce certificate to this effect from the manufacturers.
- ii. The fittings shall have screw threads at the ends conforming to the requirements of IS: 544-1955 (or revised). Female threads on fittings shall be parallel and male threads (except on running nipples and collars of unions) shall be tapered.
- iii. Contractor shall provide adequate number of unions on all pipes to enable dismantling later. Unions shall be provided near each gunmetal valve, stop cocks, or check valves and on straight runs as necessary at appropriate locations as required and/or directed by Client's Representative.

#### 5.4.1.3 CUTTING AND JOINTING:

- i) The pipes and fittings shall be inspected at site before use to ascertain that they conform the specification given in para no. 5.4.1.1 above. The defective pipes shall be rejected. Where the pipes have to be cut or re-threaded, the ends shall be carefully filled out so that no obstruction to bore is offered. The end of the pipes shall then be threaded conforming to the requirements of IS: 544-1955 with pipe dies and taps carefully in such a manner as will not result in slackness of joints when the two pieces are screwed together. The taps and dies shall be used only for straightening screw threads which have become bend or damaged and shall not be used for turning of the threads so as to make them slack, as the later procedure may not result in water tight joint.
- ii) The screw threads of pipes and fittings shall be protected from damage until they are fitted.
- iii) The pipes shall be cleaned and cleared of all foreign matter before being laid. In jointing the pipes, the inside of the socket and the screwed end of the pipes shall be oiled and rubbed over with white lead and a few turns of spun yarn wrapped round the screwed end of the pipe. The end shall then be screwed in the socket. Care should be taken that all pipes and fitting are properly jointed so as to make the joints completely water tight and pipes are kept at all times free dust and dirt during the fixing. Burr from the joint shall be removed after laying. The open ends of the pipes shall be temporarily plugged to prevent access of water, solid or any other foreign matter.

#### 5.4.1.4 INSTALLATION:

##### i) Trenches :

The galvanised iron pipes and fittings shall be laid in trenches. The widths and depths of the trenches for different diameters of the pipes shall be as in Table below:-

<b>Dia of pipe</b>	<b>Width of trench</b>	<b>Depth of trench</b>
15 mm to 50 mm	30 cm	60 cm
65 mm to 150 mm	45 cm	75 cm

At joints the trench width shall be widened where necessary. All G.I. / C.I. pipes below ground in trenches minimum cover over pipes shall be 60cm. Cover shall be measured from top of pipe to the surface of ground. The bed of the trench if in soft or made up earth, shall be well watered and rammed before laying the pipes and depressions if any shall be properly filled with earth and consolidated in 20cm layers.

If the trench bottom is extremely hard and rocky or loose stony soil, the trench shall be excavated at least 150mm below the trench grade. Rocks, Stone or other hard substances from the bottom of the trench brought back the required grade by filling with selected fine earth or sand and compacted so as to provide smooth bedding for the pipe. When excavation required blasting operation, it shall be ensured that no pipes have be stacked in the vicinity and completed pipe in the vicinity has already been covered before starting of blasting operations; this is necessary to prevent damage to the exposed pipe in the vicinity by falling stone as result of blasting.

After the excavation of the trench is completed, hollows shall be cut at the required position to receive the socket of the pipes and these hollows shall be of sufficient depth to ensure that the barrel of the pipes shall rest throughout their entire length on the solid ground and that sufficient spaces left for



jointing the under side of the pipe joint. These socket holes shall be refilled with sand after jointing the pipe.

Roots of tree within distance of about 0.5 meter from the side of the pipe line shall be removed or killed.

The excavated materials shall be placed within 1 meter or half of the depth of the trench, whichever is greater, from the edge of the trench. The material excavated shall be separated and stacked so that in refilling they may be re-laid and completed the same order to satisfaction of the Client's Representative.

The filling shall be done in layers not exceeding 15mm in depth. Each layer shall be watered, rammed and consolidated. Ramming shall be done with iron rammers where possible and with blunt end of the crow brass where rammers can not be used. Special care shall be taken to ensure that no damage is caused to the pipes, drains, masonry or concrete in the trenches.

Filling in trenches shall be commenced soon after the joints of pipes, cables; conduits etc. have been tested and approved by Client's Representative. The space around the pipes shall be cleared of all debris where the trenches are excavated in hard/soft soil. The filling shall be done with earth on the sides and tops of pipes in layers not exceeding 15mm in depth. Each layer shall be watered rammed and consolidated. The clods and lumps of earth exceeding 8cm in any direction shall be broken or removed before the excavated earth is used for filling. Generally no test is done to determine the instrument diversity of filled earth but on the discretion of Client's Representative the 95 proctor's compaction test may be done to ensure the in situ density after filling. Consolidation is removal of water from the pores and compaction is the explosion of air from the pores. In case of refilling consolidation places most important role as the watering of the each layer is being done properly. If required by the Client's Representative proctors needle may also be used for the proper checking of the refilling items of in situ density.

**ii) Pipe Protection:**

For underground G.I. pipes following treatment will be given:

Coat of hot bitumen R 85/25

- a) Wrapping of fiberglass tissue.
- b) Coat of hot bitumen R 85/25 over fiberglass tissue.

The pipes shall be laid on a layer of 7.5 cm sand and filled upto 15 cm above the pipes. The remaining portion of the trench shall then be filled with excavated earth. The surplus earth shall be disposed off as directed.

**iii) Jointing :**

The pipes shall be cleaned and cleared of all foreign matter before being laid. In jointing the pipes, the inside of the socket and the screwed end of the pipes shall be oiled and rubbed over with white lead and a few turns of spun yarn wrapped around the screwed end of the pipes. The end shall then be screwed in the socket, tee etc with the pipe wrench. Care shall be taken that all pipes and fittings are properly jointed so as to make the joints completely water tight and pipes are kept at all times free from dust and dirt during fixing. Burr from the joints shall be removed after screwing. After laying, the ends of the pipes shall be temporarily plugged to prevent access of water, soil or any other foreign matter.

**iv) Thrust Blocks :**

In case of bigger pipes (80 mm dia and above), thrust blocks of cement concrete 1:2:4 (1 cement: 2 coarse sand: 4 graded stone aggregate of 20 mm nominal size) shall be constructed on all bends as directed by the Client's Representative.

**5.4.1.5 TESTING:**

- i. All external water supply pipes shall be tested by hydrostatic pressure of 1.5 times the working pressure or 7.5 Kg/Sq.cm whichever is more.
- ii. Pressure shall be maintained for a period of at least 180 minutes without any drop in the pressure after fixing at site.

- iii. In addition to the sectional testing carried out during the construction. Contractor shall test the entire installation after connections to the hydropneumatic system or pumping system. He shall rectify all leakages, and shall replace all defective materials in the system. Any damage done due to careless will has to be replaced by the Contractor.
- iv. The initial back fill shall be placed evenly in a layer of about 100mm thick. This shall be properly consolidated and this shall be continued till there is a cushion of at least 300mm of cover over the pipe.
- v. The joint or coupling during the testing of mains shall be left exposed for inspection before cover-up, sufficient back fill shall be placed on the pipe to resist the movement due to pressure while testing. In this way if any error if workmanship will be found shall immediately corrected at a minimum cost.

#### 5.4.1.6 MASONRY CHAMBER:

- i) All masonry chambers for stop cocks, sluice valves and meter etc. shall be built as per supplied drawings.
- ii) The excavation for chambers shall be done true to dimension and level indicated on plans or as directed by the Client's Representative.
- iii) Concrete shall be having cement concrete 1:2:4 (1 cement: 2 fine sand: 4 graded stone aggregate 40mm nominal size).
- iv) Brick shall be in 1<sup>st</sup> class bricks in cement mortar 1:5 (1 cement: 5 fine sand).
- v) Plastering not less than 12mm/15mm thick shall be done in cement mortar 1:3 (1 cement: 3 coarse sand) finished with a floating coat of neat cement for inside plaster and same for outside but with Rough plaster.

#### 5.4.1.7 MEASUREMENTS:

All G.I pipes below ground shall be measured per linear meters (to the nearest cm) and shall be inclusive of all fittings e.g. coupling, tees, bends, elbows, unions, deduction for valves shall be made rate quoted shall be inclusive of all fittings, excavation, back filling and disposal of surplus earth, cutting holes and chase and making good all item mentioned in Bill of Quantities.

All C.I. class (LA) pipes below ground level shall be measured per linear meter (to the nearest cm) and shall be inclusive of all fittings e.g. tees, elbows, bends, deduction for valves shall be made. The portion of the pipe within the collar at the joints shall not be included in the length of the pipe work. Rate quoted shall be inclusive of all fittings, excavation, back filling of surplus earth including consolidation and compaction of earth.

### 5.5 VALVES:

#### 5.5.1 BUTTERFLY VALVES:

All the isolation valve 50cm and above on the equipment and water lines, where specified or shown on drawings shall be wafer type butterfly valves. They shall be designed to fit without gaskets, the water tight seal being obtained by EPDM seat projection at the faces compressed between the flanges. The valves shall be supplied inclusive of M.S. pipe flanges and high tensile steel bolts of dimensions recommended by suppliers of valves. The valves shall comply with following specifications:

- a) Test Pressure : Body 24 Bar, Seat 16 Bar
- b) Valve Component : Material of Construction
  - i) Body : Cast Iron, Gr. FG 260, IS:210
  - ii) Disc : Nylon or Epoxy powder coated high duty iron, Gr, FG 260
  - iii) Stem : Stainless Steel or carbon steel IS: 1570, Part-II.
  - iv) Seat : EPDM

- v) Hand Lever : Cast Iron (Mechanical Memory Stop)
- vi) Bearings : PTFE or Nylon covered S.S. bush bearings at stem and pivot.
- vii) Primary Seal : Reinforced PTEE slide bearings
- viii) Temperature : 80 Degree C (max.)

5.5.2 INSTALLATION:

Valve shall be installed in a manner that allows future removal and service of the valve.

Packing and gasket shall not contain asbestos.

The valve shall be of the same size as the pipe to which they are installing.

Valve above 150mm diameter shall be self locking worm gear type water proof and protory lubricated.

Provide chain operators with chain cleats for all valves more than 2.4 meters above floor.

5.5.3 NON RETURN VALVES:

All non-return valves shall be provided as shown in the drawings conforming to relevant Indian Standards and in accordance with the following specifications.

Size	Construction	Ends
Up to 50 mm.	Gun metal	Screwed
65 mm and above	Gun metal/cast iron	flanged

Non-return valves shall be of approved make. Flap type non-return valve shall be used and tested to 15 Kg. / Sq.cm. pressure.

5.5.4 BALL VALVES (FLOAT VALVE):

The ball valve shall be of high pressure class and shall be confirm to IS: 1703 of sizes as specified. The nominal size of a ball valve shall be that corresponding to the size of the pipe to which it is fixed. The ball shall be of brass or gun metal as specified and the float shall be of polythene sheet. The minimum gauge of copper sheet used for making the float shall be 0.45mm for float upto 115mm dia and 0.55mm for float exceeding 115mm dia and shall be special in shape. The valve shall be constructed to permit replacing without console of the valve body from the valve line and the system shall not blow out under pressure. The jointing of the float shall be made by efficiently burnished, lapped and soldered seam or by bracing. Plastic float may also be used if specified. The body of ball valve when assembled in working conditions with the float immersed to not more than half of its volume shall remain closed against a test pressure of 10.5 Kg/Sq.cm. All ball valves shall be capable of withstanding a pressure of 14 Kg/Sq.cm.

The ball valve shall generally conform to IS specifications No. 1703-1962.

5.5.5 BALL VALVES:

The ball valve shall be of Brass or Gunmetal as specified conforming to IS: 1703. The ball valve shall be as given below:

**High Pressure:**

Indicated by the abbreviation 'HP' for use on mains having pressure. These shall remain closed at a test pressure of 10.5 Kg/Sq.cm.

SL. NO.	NOMINAL SIZE OF BALL VALVE					
	15 mm	20mm	25mm	32mm	40mm	50mm
1. Diameter of spherical float (mm)						
High Pressure	127	152	203	229	254	305

SL. NO.	NOMINAL SIZE OF BALL VALVE					
	15 mm	20mm	25mm	32mm	40mm	50mm
Low Pressure	114	127	178	203	203	254
Minimum weight of ball valve including back nut, body and piston (gms)	283	446	823	1149	1589	1852

The ball valves shall be of following nominal sizes 15mm, 20mm, 25mm, 32mm, 40mm and 50mm. The nominal size shall correspond with the nominal bore of the inlet shanks.

**5.5.6 AIR VALVES:**

Air valves shall be provided in all high points in the system to prevent air locks as shown on the drawings or directed by Client's Representatives.

**5.5.7 TESTING:**

All valves shall be tested while installed in pipe by hydrostatic pressure of 1.5 time of the working pressure 7.5 Kg/Sq.cm which ever is more.

**5.5.8 MEASUREMENTS:**

All valves as mentioned in Bill of Quantities shall be measured by numbers and shall include all items mentioned in the Bill of Quantities.

**5.6 CHLORINATION OF DOMESTIC WATER LINES:**

5.6.1 After the completion of all the hot and cold water service piping, disinfect all the fresh water supply work and water reservoirs using a chlorine solution.

5.6.2 CHLORINATED SYSTEMS SHALL INCLUDE:

- i. Domestic fresh water tanks
- ii. Fire water tanks
- iii. All pipe work systems receiving suction from the above mentioned tanks apart from the fire systems.

5.6.3 Before handover of the system, submit to the consultant copies of the certification of performance and laboratory report (if required)

5.6.4 Under no circumstances the use of any portion of the fresh water system until it is properly disinfected, flushed and certified shall be permitted.

5.6.5 During the Chlorination work the Contractor shall take all necessary precautions to prevent site staff from drinking the system water. Such precautions shall include locking doors to 'wet' areas and providing warning signs in English and Hindi.

**5.7 CPVC PIPES & FITTINGS:**

- i. The pipes and fittings chemically known as Chlorinated Poly Vinyl Chloride [CPVC] shall be produced in Copper Tube Size [CTS] from ½" to 2" with two different standard dimensional ratios – SDR 11 and 13.5. The fittings shall be produced as per SDR 11. All the CPVC pipes and fittings in SDR 11 and SDR 13.5 shall be made from the identical CPVC compound having the same physical properties. Pipes and fitting shall be produced as per SDR 11 & shall meet the requirement of ASTM D 2846 where as the pipes produced with SDR 13.5 shall meet the requirement derived from ASTM F 442, specific to CPVC in Iron Pipe Size[IPS] dimension, which also shall be applied to CPVC pipes in Copper Tube Size[CTS] dimension.

5.7.1. CUTTING AND JOINTING AND INSTALLATION OF CPVC PIPES & FITTINGS:

i. CUTTING:

In order to make a proper and neat joint, the pipe length shall be measured accurately and make a small mark. Ensure that the pipe and fittings are size compatible. It shall be easily cut with a wheel type plastic pipe cutter or hacksaw blade. Cutting tubing as squarely as possible shall provide optimal bonding area within a joint.

ii. DEBURRING / BEVELING:

Burrs and filings shall prevent proper contact between tube and fitting during assembly and should be removed from the outside and inside of the pipe. A pocket knife or file shall be used for this purpose. A slight bevel on the end of the tubing shall ease the entry of the tubing into the fitting socket.

iii. FITTING PREPARATION:

Using a clean, dry rag, wipe dirt and moisture from the fitting sockets and tubing end. The tubing should make contact with the socket wall 1/3 to 2/3 of the way into the fitting socket.

iv. SOLVENT CEMENTS APPLICATION:

Use only CPVC cement or an all – purpose cement conforming to ASTM -493 or joint failure may result. When making a joint, apply a heavy, even coat of cement to the pipe end. Use the same applicator without additional cement to apply a thin coat inside the fitting socket. Too much cement can cause clogged water ways.

v. ASSEMBLY:

Immediately insert the tubing into the fitting socket, rotate the tube ¼ to ½ turn while inserting. This motion will ensure an even distribution of cement within the joint. Properly align the fittings. Hold the assembly for approximately 10 seconds, allowing the joint to set-up.

vi. SET AND CURE TIMES:

Solvent cement set and cure times are a function of pipe size, temperature and relative humidity. Curing time is shorter for drier environments, smaller sizes and higher temperatures. It requires 10 to 20 minutes for perfect joint.

vi. CEMENTING:

- Verify the cement is the same as the pipes and fittings being used.
- Check the temperature where the cementing will take place.
  - Cement takes longer time to set up in cold weather. Be sure to allow extra time for curing. Do not try to speed up the cure by artificial means – this could cause porosity and blisters in the cement film.
  - Solvents evaporate faster in warm weather. Work quickly to avoid the cement setting up before the joint is assembled. Keep the cement as cool as possible. Try to stay out of direct sunlight.
- Keep the lid on cements, cleaner and primers when not in use. Evaporation of the solvent will affect the cement.
- Stir or shake cement before using.
- Use ¾" dauber on small diameter pipes, 1 ½" dauber up through 3" pipe, and a natural bristle brush, swab or roller ½ the pipe diameter on pipes 4" and up.
- Do not mix cleaner or primer with cement.
- Do not use thickened or lumpy cement. It should be like the consistency of syrup or honey.
- Do not handle joints immediately after assembly.
- Do not allow dauber to dry out.
- Maximum temperature allowable for CPVC pipe is 180° F.
- All colored cements, primers and cleaners will have a permanent stain. There is no known cleaning agent.
- Use according to the step outline in ASTM D – 2846, joining of pipe and fittings.

## 5.7.2 TESTING

After laying and jointing, the pipes and fittings shall be inspected under working condition of pressure and flow. Any joint found leaking shall be redone and all leaking pipes removed and replaced without extra cost. Use of any compound or stop leak compound will not permit.

The pipes and fittings after they are laid shall be tested to hydraulic pressure of 1.5 times the working pressure or 7.5 Kg/Sq.cm which ever is more. The pipes shall be slowly and carefully charged with water allowing all air to escape and avoiding all shock or water hammer. The draw of taps and stop cocks shall then be closed and specified hydraulic pressure shall be applied gradually. Pressure gauge must be accurate and preferably should have been recalibrated before the test. The test pump having been stopped, the test pressure should be maintained without loss for at least two hours. The pipes and fittings shall be tested in sections as the work of laying proceeds, having the joints exposed for inspection during the testing.

### 5.7.3 MEASUREMENTS

The length above ground shall be measured in running meter correct to a cm for the finished work, which shall include G.I. pipe and G.I. fittings such as bends, tees, elbows, reducers, crosses, plugs, sockets, nipples and nuts, unions etc... Deductions for length of valves shall be made. Rate quoted shall be inclusive of all fittings, clamps, cutting holes chased and making good the same and all items mentioned in the specifications and Bill of Quantities.

### 5.8 COMPOSITE PIPES & FITTINGS :

- (a) The pipe shall conform to IS 15450 2004 having welded aluminium tube reinforcement between inner & outer polyethylene layers being bonded to aluminium tube by a melt adhesive with welded aluminium tube. The pipe dimensional detail shall be :

Nominal pipe size ID : OD	Equivalent NB size In inch.	Wall thickness in mm	
		Minimum	Maximum
12:16	1/2	1.75	2.00
16:20	3/4	2.00	2.25
20:25	1	2.45	2.70
25:32	1x1/4	2.80	3.20
32:40	1x1/2	3.40	3.80

- (b) The test pressure rating shall be as below :

Nominal pipe size ID : OD	Minimum Burst Pressure in kg per sq.cm
12:16	60
16:20	50
20:25	40
25:32	40
32:40	35

- (c) The internal test pressure rating for fittings shall be as below :

Nominal pipe size ID : OD	Minimum Burst Pressure in kg per sq.cm
12:16	34.30
16:20	26.70
20:25	26.70
25:32	23.00
32:40	22.30

- (d) The fittings shall withstand the following condition & the manufacturer shall submit the test certificate for the following:

Test Temperature : 83 deg Celcius  
 Test Pressure : 3.5 kg per sq.cm.  
 Test duration : 3000 hrs.

- (e) Jointing:

Jointing shall be done by using proper fittings. Prpper tools shall be used for the same

(f) Installation:

The pipe bending shall be done by using proper supports springs, either internal or external. The bending radius shall not be less than 5 times the OD of the pipe.

For concealed piping no supports shall be required but for exposed piping, the spacing of supports shall be as below:

The test pressure rating shall be as below:

Nominal pipe size	Support spacing for horizontal pipe lines	Support spacing for vertical pipe lines
ID : OD	in mtr.	In mtr.
12:16	0.80	1.00
16:20	0.80	1.00
20:25	1.00	1.00
25:32	1.20	1.20
32:40	1.20	1.20

### 5.8.1 INSULATION

5.8.1.1 All the Hot Water supply & Hot Water return pipe shall be insulated in the manner specified hereinafter.

5.8.1.2 Insulating material shall be rigid performed sections of mineral/rock wool with a “K” value of not more than 0.036 W/MK at 100 Deg. C mean temperature and of density 140 Kg/Cu.m

5.8.1.3 No insulation shall be applied until the pipe is satisfactorily pressure tested.

5.8.1.4 Pipes shall be insulated with rigid performed pipe sections of the following thickness:

Pipe Diameter (mm)	Thickness (Mineral Wool) mm
80-150	50

5.8.1.5 Pipe insulation shall be applied as follows OR AS SPECIFIED IN BOQ:

Pipe shall be thoroughly cleaned with wire brush and rendered free from all rust and grease and applied with two coats of anti-rust paint.

#### a) Pipes in Shaft:

- i) Fix rigid performed sections of insulation with adhesive between all points (transverse and circumferential).
- ii) The insulation shall be tied with GI chicken wire mesh.
- iii) The insulation shall be provided with 24 gauge aluminium cladding screwed at the joints with cadmium coated self tapping screws. Joints shall be overlapped minimum 12mm wide.

#### b) Pipes exposed to weather:

- i) Same as (a) (i) to (ii)
- ii) Provide polythene based hessian (500 gauges) overlapping 100mm on all joints (transverse and circumferential) and stitched at the joints.
- iii) The hessian shall be covered with 15mm x 20mm hexagonal chicken wire mesh.
- iv) Over the wire mesh the surface shall be covered with two layers of tarfelt grade-II and type-II with bitumen between layer overlapping 100mm on all joints (transverse & circumferential).
- v) Over the second layer of tarfelt final coat of hot bitumen not less than 6mm thick shall be applied.

- vi) Over the final layer of tarfelt and hot bitumen coat aluminium cladding shall be provided with 24 gauge aluminium shut screwed at the joints with cadmium coated self-tapings screws. Joints shall be overlapped minimum 25mm wide.
- c) **Pipes Buried Underground:**
- i) Rigid pipe sections of insulation shall be fixed tightly to the surface taking care to seal all joints with 50mm wide aluminium adhesive tape (transverse and circumferential).
  - ii) The insulation shall be tied with aluminium band not less than 6mm width and 24 gauge 4 bands per meter or equivalent plastic band using G.I. sheet clamp crimped at the joints.
  - iii) Wrap the insulation with polythene sheet 400 gauges. Polythene sheet shall be tied with 6mm, 24 gauge, aluminium band 4 bands per meter or equivalent plastic tape using GI sheet clamp crimped at the joint.
  - iv) The polythene surface shall be covered with two layers of tarfelt grade – II, type – II with bitumen between layers overlapped 100mm on all joints (transverse and circumferential).
  - v) Over the second layer of tarfelt final coat of hot bitumen not less than 6mm thick shall be applied.

#### 5.8.1.6 TESTING

After laying and jointing, the pipes and fittings shall be inspected under working condition of pressure and flow. Any joint found leaking shall be redone and all leaking pipes removed and replaced without extra cost. Use of any compound or stop leak compound will not permit.

The pipes and fittings after they are laid shall be tested to hydraulic pressure of 1.5 times the working pressure or 7.5 Kg/Sq.cm whichever is more. The pipes shall be slowly and carefully charged with water allowing all air to escape and avoiding all shock or water hammer. The draw of taps and stop cocks shall then be closed and specified hydraulic pressure shall be applied gradually. Pressure gauge must be accurate and preferably should have been recalibrated before the test. The test pump having been stopped, the test pressure should be maintained without loss for at least two hours. The pipes and fittings shall be tested in sections as the work of laying proceeds, having the joints exposed for inspection during the testing.

#### 5.9. Copper Pipes & Fittings

The pipes shall be hard tempered copper pipes and tubes conforming to requirements of BS 2871 Table 'X' Part -1-1971 and the fittings shall conform to BS 864 Part 2.

The fittings shall be as follows:

- a. Internal Solder Ring (ISR) fitting: For pipes from 15 mm to 35 mm dia.
- b. Endex Fittings: For pipes from 42 mm to 54 mm dia.
- c. End brazes Fittings: For pipes from 67 mm dia and above.

Fabricated fittings in NO case shall be allowed. Fittings of all types such as Tees, Crosses, Elbows, Reducers, Unions, Off Sets etc. shall be used on the pipes. Suitable fittings of approved type and make shall be used for jointing copper pipes to GI pipes and for jointing copper pipes to CP fittings etc. shall be used. Use of DZR fitting shall be made for all connections.

Laying; and .Jointing: Of Copper Pipes and Capillary Fittings

The copper" pipes and fittings shall run in wall chase or ceiling or as specified, The fixing shall be done by means of standard pattern holder bat clamps keeping the pipes about 1.5 mm clear of the wall where to be laid on surface. Where it is specified to conceal the pipes, chasing may be adopted. For pipes fixed in the shafts, ducts, etc. there should be sufficient space to work on the pipes with the usual tools. As far as possible, pipes inlays are buried for short distances provided adequate protection is given against damage and where so required special care to be taken at joints. Where directed by the Owner's Site Representative I Architect, pipe sleeves shall be fixed at a place the pipe is passing through a wall or floor for reception of the pipe and allow freedom for expansion and contraction and other movements. In case of pipe is embedded in walls or floors it shall be covered with a protective tape wrapped around the pipes and fittings.

Copper pipes shall be jointed with approved above mentioned fitting conforming to BS 864 Part 2. Care shall be taken to remove any burr from the end of the pipes after cutting. Only fittings of the size



suitable to the pipe shall be used. The ends of the tube shall be cut to the correct size using a tube cutter or a fine blade hacksaw. Care shall be taken to ensure that the ends of the tube are cut perpendicular to the axis of the tube and that the ends remain undamaged and free of burrs. Any burrs remaining shall be removed with a smooth file. Clean the outside surface of the tube that shall go into the fitting. Flux shall be applied on the pipe surface ensuring even and uniform application. Insert the tube into the fittings and push home until the stop is reached. Wipe off excess flux with a soft cloth. Now the assembled joint shall be heated with a blow torch or any similar appliance that emits a clean, blue, soot free flame. The heat shall be turned off once a complete ring of solder has appeared around the mouth of the fitting.

The joint shall be allowed to cool without disturbance.

All copper pipes to G.I. pipe and connection with the valves and faucets shall be with De-zincified Resistance fittings (DZR).

**5.10. ASTM - PVC PIPES & FITTINGS**

5.10.1 SCOPE:

This specification covers the requirements for manufacture, supplying, lowering, laying, jointing, testing and commissioning of ASTM solvent welded PVC pipe with fittings for the conveyance & distribution system for above ground as well as below ground installation with required civil work.

5.10.2 CODES & STANDARDS:

The manufacturing, testing, supplying, jointing and testing at work sites of PVC pipes shall comply with all currently applicable statutes, regulations, standards and codes. in particular, the following standards, unless otherwise specified herein, shall be referred.

5.10.3 MATERIALS

- ASTM D 1785 - Specification for Poly Vinyl Chloride (PVC) Plastic Pipes, SCH 40 & SCH 80.
- ASTM D 2466 - Socket type Vinyl Chloride Plastic Pipe Fittings SCH 40
- ASTM D 2467 - Socket type Vinyl Chloride Plastic Pipe Fittings SCH 80
- ASTM D 2564 - Solvent Cement for Plastic Pipes & Fittings
- ASTM D 2774 - Underground installation of Thermo plastic Pipes

5.10.4 DESIGN

Design of uPVC pipes shall be according to ASTM D-1785 & fittings shall be made according to ASTM D-2467 (for Schedule 80). The pipe shall have socketed solvent welded fittings.

**5.10.5 TRENCHING**

5.10.6 The width of the trench at the crown of the pipe shall be not less than the outside diameter of pipe plus 300 mm to allow proper compaction of the side fills & at a 225 mm above the crown of the pipe. The trench width shall be as below :

NOMINAL PIPE SIZE (IN MM)	TRENCH WIDTH MIN. (IN MM)	TRENCH WIDTH MAX. (IN MM)
110	450	600
160	450	600
200	600	700
225	600	700
250	600	700
315	700	850
355	750	900
400	800	950
450	850	1000

- 5.10.7 The minimum trench depth shall be width plus outer diameter of pipe or 0.75 mtr. above crown of pipe whichever is more.
- 5.10.8 The trench shall be backfilled as soon as possible.
- 5.10.9 The excavated material shall be deposited at a sufficient distance away from the edge of the trench to avoid damage to the pipes through falling stones & debris.
- 5.10.10 Pipe shall be laid with a cover, measured from the top of the pipe to the surface of the ground of not less than 1.2 mtr. under roads
- 5.10.11 The pipe bedding shall be with a granular material & backfilling shall be performed in layer of 6 inch with each layer & shall be sufficiently compacted to 85% to 95% compaction.
- 5.10.12 A mechanical compaction shall be carried out for compacting sand & gravel backfill. Optionally manual compaction shall be carried out.
- 5.10.13 A trench shall be completely filled & backfilling shall be placed & spread in uniform layers to prevent any unfilled spaces or voids. Large rocks, stones, etc. shall be removed. Heavy tampers or rolling equipment shall be used for final backfilling only.

**5.11 PIPE HANDLING & STORAGE :**

- 5.11.1 The pipe shall not be pushed or dragged from the truck bed. Pallets for pipe shall be removed with a fork lift. Loose pipe can be rolled down on timber.
- 5.11.2 The pipe shall be stored in open ground which shall be dry & free from sharp objects.
- 5.11.3 The pipe shall be protected from the sun & shall be in area with proper ventilation.
- 5.11.4 If the pipe shall be stored in racks or it shall be supported throughout its length with the spacing not more than 3 feet.

**5.12 LAYING & JOINTING :**

- 5.12.1 Pipe shall be cut square with the special tool.
- 5.12.2 The inside & outside edges shall be cleaned from any burrs with file or deburring tool.
- 5.12.3 The surface shall be cleaned with a clean dry cloth.
- 5.12.4 With light pressure, pipe should go one third to one half of the way into the fitting socket.
- 5.12.5 Pipes & fittings that are too tight shall not be used. Use an applicator having size equal to one half the pipe diameter.
- 5.12.6 For jointing, full even layer of cement shall be provided on external surface of the pipe & medium layer of cement shall be provided to the inside of a fitting
- 5.12.7 Pipe & fittings shall be assembled & pipe shall give a quarter turn.
- 5.12.8 The piping (for sch. 40) shall be supported by the means of hangers having recommended spacing as below :

NOMINAL PIPE SIZE (MM)	TEMPERATURE IN DEG. C				
	15.5	26.6	37.7	48.8	60
15	4.5 MTR.	4.5 MTR.	4 MTR.	2.5 MTR.	2.5 MTR.
20	5 MTR.	4.5 MTR.	4 MTR.	2.5 MTR.	2.5 MTR.
25	5.5 MTR.	5 MTR.	4.5 MTR.	3 MTR.	2.5 MTR.
32	5.5 MTR.	5.5 MTR.	5 MTR.	3 MTR.	3 MTR.
40	6 MTR.	5.5 MTR.	5 MTR.	3.5 MTR.	3 MTR.
50	6 MTR.	5.5 MTR.	5 MTR.	3.5 MTR.	3 MTR.

63	6.5 MTR.	6 MTR.	5.5 MTR.	4 MTR.	3 MTR.
75	7 MTR.	7 MTR.	6 MTR.	4 MTR.	3.5 MTR.
100	7.5 MTR.	7 MTR.	6.5 MTR.	4.5 MTR.	4 MTR.
150	8.5 MTR.	8 MTR.	7.5 MTR.	5 MTR.	4.5 MTR.

5.12.9 The pipe joint setting & curing time shall be recommended as :

5.12.10 SET TIME :

Temperature	Pipe size	Pipe Size	Pipe Size
Range	15 mm to 32 mm	40 mm to 75 mm	100 & 150 mm
15.5-37.7 deg C	15 minute	30 minute	60 minute
4.4-15.5 deg C	60 minute	120 minute	240 minute

5.12.11 CURE TIME :

Temperature	Pipe size	Pipe Size	Pipe Size
Range	15 mm to 32 mm	40 mm to 75 mm	100 & 150 mm
15.5-37.7 deg C	6 hrs.	12 hrs.	24 hrs.
4.4-15.5 deg C	12 hrs.	24 hrs.	48 hrs.

5.12.12 To compensate the expansion & contraction, suitable means shall be provided by expansion loops with 90 deg elbows / bellows subject to the application for the above ground installation

5.12.13 For underground application, the compensation for expansion & contraction shall be done by anaking the pipe in trench.

### 5.13 TESTING :

5.13.1 The pipe shall be tested with water. Before testing, it shall be properly anchored.

5.13.2 Thrust blocks shall be provided at dead ends, at change in direction & at cahnge in size.

5.13.3 The piping shall be slowly filled with water with velocity not exceeding 1ft./sec.

5.13.4 Vents shall be provided at high points & air shall be release before testing.

5.13.5 All valves & vents shall kept open during testing to release the air.

5.13.6 The piping shall be tested for 125% of design working pressure for one hour maximum

5.13.7 During testing, if any joint is leaking, it shall be cut & replaced.

### 6.0 INTERNAL DRAINAGE (SOIL, WASTE, VENT AND RAIN WATER PIPES):

#### 6.1 SCOPE:

6.1.1 Work under this section shall consist of furnishing all labour, materials, equipment and appliances necessary and required to completely install all soil, waste, vent and rainwater pipes as required by the drawings, specified hereinafter and given in the Bill of Quantities.

6.1.2 Without restricting to the generality of the foregoing, the soil, waste, vent and rainwater pipes system shall include the followings:-

- i. Cast Iron / UPVC vertical and horizontal soil waste and vent pipes, rainwater pipes and fittings, joints clamps and connections to fixtures.
- ii. Floor traps, floor drain clean out plugs, inlet fittings and rainwater roof drain, area/local drains, trench drain...

- iii. Waste pipes connections from all fixtures e.g. wash basins, sinks, kitchen equipment.
- iv. Testing of all pipes.
- v. Connection of main.

**6.2 GENERAL REQUIREMENTS**

- 6.2.1 All materials shall be new of the best quality conforming to specifications and subject to the approval of Client's Representative.
- 6.2.2 Pipes and fittings shall be fixed truly vertical, horizontal or in slopes as required in a neat workmanlike manner.
- 6.2.3 Pipes shall be fixed in a manner as to provide easy accessibility for repair and maintenance and shall not cause obstruction in shafts, passages etc.
- 6.2.4 Pipes shall be securely fixed to walls by suitable clamps at intervals specified.
- 6.2.5 Access doors for fittings and cleanouts shall be so located that they are easily accessible for repair and maintenance.
- 6.2.6 All works shall be executed as directed by Client's Representative.

**6.3 CAST IRON PIPES & FITTINGS**

- 6.3.1 Soil, waste, vent and anti-siphonage pipes shall be cast iron pipes with socket and spigot. All pipes shall be straight and smooth and inside free from irregular bore, blow holes, cracks and other manufacturing defects. Pipes shall be centrifugally spun iron soil pipes conforming to sand cast I.S. 1729-1967.
- 6.3.2 STANDARD WEIGHT DIMENSIONS AND PIG LEAD REQUIRED FOR JOINTS SHALL BE AS FOLLOWS:-

For conforming to I.S. 1729-1967 (sand cast iron soil pipes and fittings)

Diameter Depth	Thickness	Overall	Internal	
		Weight 6'length or 1.83 M	diameter of socket	of lead
50	5	11.41	76	25
75	5	16.52	101	25
100	5	21.67	129	25
150	5	31.91	181	32

- 6.3.3 TOLERANCE  
Acceptable tolerance for pipes to I.S. 1729 shall be as follows:-

- a) Wall thickness -15%
- b) Length ± 20 mm
- c) Weight ± 10%

**6.3.4 FITTINGS**

Fittings shall conform to the corresponding Indian Standard as for pipes. Contractor shall use pipes and fittings of matching specification.  
Access door shall be secured air and water tight with 3mm thick insertion rubber washer and white lead. The bolts shall be lubricated with grease or white lead for easy removal.

**6.3.5 JOINTING:**

All soil, waste and vent pipes including fixture connections between traps and soil pipes shall be jointed with refined pig lead conforming to IS: 27-1977 sufficient sken of jute rope shall be caulked to leave a minimum space for the pig lead as given in **6.3.2** to be poured in. After pouring the lead shall be caulked into the joint with caulking tool and hammer. All surplus lead shall be cut and joint left flush with the rim of the socket neatly.

6.3.6 Vent pipes penetration through roof shall be by means of sleeves. The sleeve will be kept 100mm higher the finish roof level and annular space filled with fire proof materials like putty, fire seal etc.

6.3.7 PIPE, HANGERS, SUPPORT, CLAMP, BRACKE ETC.:

All vertical pipes shall be fixed by M.S. Clamps truly vertical. Branch pipes shall be connected to the stack at the same angle as that of the fittings. No collars shall be used on vertical stacks. Each stack shall be terminated at top with a cowl (terminal guard).

Inclined pipes running along ceiling shall be fixed on M.S. adjustable hangers of special design shown on the drawings or as directed. Pipes shall be laid to uniform slope and the hangers adjusted to the proper levels so that the pipes fully rest on them.

M.S. clamps shall be of standard design and fabricated from M.S. flat 40mm x 3mm x 3mm thick. They shall be painted with two coats of black bitumen paint before fixing.

Structural clamps shall be fabricated from M.S. structural members e.g. rods, angles, channels, flats, as per detailed drawing or as directed. Contractor shall provide all nuts, bolts, welding and paint the clamps with one coat of red oxide. Wooden saddles shall be provided free of cost.

Slotted angle/channel supports on walls shall be provided wherever shown on drawings or as required. Angles/channels shall be fixed to brick walls and bolts embedded in cement concrete blocks and to RCC walls with suitable anchor fasteners. Holes required in RCC walls shall be neatly drilled by electric drills and no manual chiseling will be allowed. The spacing of supports horizontally shall not exceed 1.8 M.

Wherever M.S. clamps are required to be anchored directly to brick walls, concrete slabs, beams or columns, nothing extra shall be payable for clamping arrangement and for making good with cement concrete 1:2:4 (mix 1 cement :2 coarse sand :4 stone aggregate 20mm nominal size) as directed by the Client's Representative.

6.3.8 TESTING:

All pipe work shall be tested before connecting any appliances and then again after connection of appliances. Pipe shall be tested after installation by one of the test given below as directed by the Client's Representative.

Before use at site, all C.I. soil pipes shall be tested by filling up with water for at least 10 minutes at 3 meter head. After filling, pipes shall be struck with a hammer and inspected for blow holes and cracks. All defective pipes shall be rejected and removed from the site within 48 hours.

Water Test:

Pipes shall be tested after installation by filling up the stack with water. All openings and connections shall be suitable plugged. The total head in the stack shall however not 3 M exceed. The level of water in the stack shall not drop within 8 hours. If there is a drop in level of water the leak shall be detected and rectified and test shall be re-conducted until satisfactory result is achieved.

Smoke Test:

Contractor may test all soil and waste stacks by a smoke testing machine. Smoke shall be pumped into the stack after plugging all inlet and outlet connections.

The stack shall then be observed for leakages and all defective pipes and fittings removed or repaired as directed by the Client's Representative.

6.3.9 UPVC PIPES AND FITTINGS (RAIN WATER):

The pipes shall be round and shall be supplied in straight lengths with socketed ends. The internal and external surfaces of pipes shall be smooth, clean, and free from grooving and other defects. The ends shall be cleanly cut and square with the axis of the pipe. The pipes shall be designated by external diameter and shall conform to IS: 4985-1981.

OUTER DIA. (MM)	PRESSURE (KG/CM <sup>2</sup> )	INNER DIA. (MM)	WEIGHT/MT (KG.)
110	4	104.5	1.315
125	4	118.7	1.712

140	4	133.0	2.131
160	4	152.0	2.783
180	4	175.9	3.560
200	2	190.1	4.526
225	4	213.8	5.480

**Fittings:**

Fittings shall be of the same make as that of pipes, injection moulded and shall conform to Indian Standard.

**Laying and Jointing:**

The pipes shall be laid and clamped to wooden plugs fixed above the surface of the wall. Alternatively plastic clamps of suitable designs shall be preferred. Provision shall be made for the effect of thermal movement by not gripping or disturbing the pipe at supports between the anchors for suspended pipes. The supports shall allow the repeated movements to take place without abrasion.

Jointing for UPVC pipes shall be made by means of solvent cement for horizontal lines and 'O' rubber ring for vertical line. The type of joint shall be used as per site conditions/direction of the Client's Representative. Where UPVC pipes are to be used for rain water pipes, the pipe shall be finished with G.I. adopter for insertion in the R.C.C. slab for a water proof joint complete as directed by Client's Representative.

**Supports:**

UPVC pipes require supports at close intervals. Recommended support spacing for unplasticised PVC pipes is 1400 mm for pipes 50 mm dia and above. Pipes shall be aligned properly before fixing them on the wooden plugs with clamps. Even if the wooden plugs are fixed using a plumb line, pipe shall also be checked for its alignment before clamping, piping shall be properly supported on, or suspended from clamps, hangers as specified and as required. The Contractor shall adequately design all the brackets, saddles, anchors, clamps and hangers and be responsible for their structural sufficiency. Pipe supports shall be primer coated with rust preventive paint.

**Repairs:**

While temporary or emergency repairs may be made to the damaged pipes, permanent repairs should be made by replacement of the damaged section. If any split or chip out occurs in the wall of the pipe, a short piece of pipe of sufficient length to cover the damaged portion of the pipe is cut. The sleeve is cut longitudinally and heated sufficiently to soften it so that it may be slipped over the damaged hard pipe.

**Testing:**

All lengths of PVC rain water pipes shall be fully tested for water tightness by means of water test maintained for not less than 30 minutes. All pipes shall be subjected to a test pressure of at least 1.5 meter head of water head. The test pressure shall, however, not exceed 6 meter head at any point. The pipes shall be plugged preferably with standard design plugs with rubber plugs on both ends. The upper end shall, however, be connected to a pipe for filling with water and getting the required head.

**6.3.10 WASTE PIPE FROM APPLIANCES:**

- i) Waste pipe from appliances e.g. wash basins, sinks, urinals, chrome plate where seen water coolers shall be of galvanised steel (heavy class) conforming to IS:1239-1979.
- ii) All pipes shall be fixed in gradient towards the outfalls of drains. Pipes inside a toilet room shall be in chase unless otherwise shown on drawings. Where required pipes may be run at ceiling level in suitable gradient and supported on structural clamps. Spacing for clamps for such pipes shall be as follows:-

	<b>Vertical</b>	
<b>Horizontal</b>		
G.I. Pipes	300 cms	240 cms
P.V.C. Pipes	180 cms	120 cms

#### 6.3.11 PAINTING

Soil, waste vent and rainwater pipes in exposed location, in shafts and pipe spaces shall be thoroughly cleaned to remove dirt, rust and other contamination, and painted with two or more coats of synthetic enamel paint to give an even shade.

Paint shall be of approved quality and shade, where directed pipes shall be painted in accordance with approved pipe colour code.

Waste pipes in chase shall be thoroughly cleaned to remove dirt, rust and other contamination, and painted with two coats of bitumen paint, covered with polythene tape and a final coat of bitumen paint. Exposed pipes shall be painted with two or more coats of synthetic enamel paint.

C.I. soil and waste pipes below ground and covered in cement concrete shall not be painted.

#### 6.3.12 MEASUREMENTS:

C.I. / UPVC/ G.I. waste/soil, waste, vent and rain water pipes shall be measured over all along the center line correct to a centimeter including all fittings along its length. The rate for these pipes shall be inclusive of all fittings, holder bat clamps, lead caulked joint for C.I. and cement joints for UPVC and all other items described in the Bill or Quantities. The portion of the pipe within the collar for C.I./UPVC pipe at the joint shall not be included in the length of the pipe work.

#### 6.4. SWR uPVC PIPES AND FITTINGS:

6.4.1 Soil, waste, vent SWR Ring Fit pipes with socket and spigot. All pipes shall be straight and smooth and inside free from irregular bore, blow holes, cracks and other manufacturing defects. These pipes conform to Indian Standard IS: 4985 – 2000 and are designed to withstand continuous internal hydraulic pressure of 4 Kgf/cm so as to ensure life-long trouble free working. The pipes are provided with an integral rubber ring type socket at one end while the other end is kept plain, smooth and free from burrs. Rubber ring type socket ends provide easy push – fit type jointing. Simultaneously, allowance for thermal expansion can also be provided during installation. Pipes shall be centrifugally spun iron soil pipes conforming to sand cast I.S. 1729-1967.

#### 6.4.2 FITTINGS:

Fittings shall conform to the corresponding Indian Standard as for pipes. Contractor shall use pipes and fittings of matching specification.

Access door shall be secured air and water tight with 3mm thick insertion rubber washer and white lead. The bolts shall be lubricated with grease or white lead for easy removal.

#### 6.4.3 JOINTING:

**Rubber Seal Rings for Joints & Access Doors :** Manufactured in accordance with IS : 5382 for 75 mm / 90 mm / 110 mm sizes. These are made out of natural rubber with a shore 'A' hardness pf 40 x 5. Provide superior resistance to biological attack. Special design of cross section ensures perfect sealing.

**Lubricant:** Available in 100 gms, 250 gms & 500 gms packing. Specially formulated for compatibility with rubber seal as well as PVC. Does not support the growth of bacteria or fungi.

#### 6.4.4 PIPE, HANGERS, SUPPORT, CLAMP, BRACKE ETC.:

##### **Supports:**

UPVC pipes require supports at close intervals. Recommended support spacing for unplasticized PVC pipes is 1400 mm for pipes 50 mm dia and above. Pipes shall be aligned properly before fixing them on the wooden plugs with clamps. Even if the wooden plugs are fixed using a plumb line, pipe shall also be checked for its alignment before clamping, piping shall be properly supported on, or suspended from clamps, hangers as specified and as required. The Contractor shall adequately design all the brackets, saddles, anchors, clamps and hangers and be responsible for their structural sufficiency. Pipe supports shall be primer coated with rust preventive paint.

#### 6.4.5 TESTING:

Before the system is put into use, it should be tested for leakages by air test, hydraulic test or smoke test.

#### 6.5 TRAPS:

#### 6.5.1 NAHANI TRAP OR FLOOR TRAPS:

Nahani traps or floor traps shall be cast iron/ PVC / , deep seal with an effective seal of 50 mm. The trap and waste pipes shall be set in cement concrete blocks firmly supported on the structural floor. The blocks shall be in 1:2:3 mix (1 cement: 2 coarse sand: 4 stone aggregate 20 mm nominal size) mixed with water proof compound and extended to 40 mm below finished floor level. Contractor shall provide all necessary shuttering and centering for the blocks. Size of the block shall be 30 x 30 cms of the required depth. The trap shall be installed at lowest point ensure no pending occurs at perimeters of the drain.

#### 6.6 FLOOR TRAP INLET

Bath room traps and connections shall ensure free and silent flow of discharging water. Where specified, the Contractor shall provide a special type galvanised iron inlet fitting without or with one, two or three inlet sockets to receive the waste pipe. Joint between waste and fitting shall be connected to a C.I. 'P' or 'S' trap with at least 50mm seal (Hopper and traps shall be paid for separately). Floor trap inlet fittings and the trap shall be set in cement concrete blocks.

#### 6.7 C.P./STAINLESS STEEL GRATINGS

Floor and Urinal traps shall be provided with 100-150mm square or round C.P./Stainless steel grating as approved by Client's Representative with rim, of approved design and shape. Minimum thickness shall be 4-5mm or as specified in the Bill of Quantities.

#### 6.8 CLEANOUT PLUGS

Contractor shall provide cast brass cleanout plugs in all horizontal run more than 15 meter length required one cleanout plugs shall be threaded and provided with key holes for opening. Cleanout plugs shall be fixed to the pipe by a G.I. socket and lead caulked joint.

#### 6.9 PIPE SLEEVES

Pipe sleeves 50mm larger diameter than pipes shall be provided wherever pipes pass through walls and slabs and annular space filled with fire proof materials like putty, fire seal etc. All pipes shall be accurately cut to the required sizes in accordance with relevant BIS codes and burs removed before laying. Open ends of the pipe shall be closed as the pipe is installed to avoid entrance of foreign matters. Vertical sleeve shall finish 50mm above finish floor level.

#### 7.0 EXTERNAL DRAINAGE SYSTEM (SEWERAGE AND STORM WATER):

##### 7.1 SCOPE:

- i. Work under this section shall consist of furnishing all labour, materials, equipment and appliances necessary and required to completely install the drainage system as required by the drawings and specified hereinafter or given in the Bill of Quantities.
- ii. Without restricting to the generality of the foregoing, the drainage system shall include:  
Sewer lines including excavations, pipe lines, man holes, drop connections, underground storm water drains, including pipes, man holes, catch basins and open drains, thrust blocks.

##### 7.2 GENERAL REQUIREMENTS:

All materials shall be new of the best quality conforming to specifications and subject to the approval of the Client's Representatives.

Drainage lines shall be laid to the required gradients and profiles.

All drainage work shall be done in accordance with the local municipal bye-laws.

Contractor shall obtain necessary approval and permission for the drainage system from the municipal or any other competent authority and also existing invert levels required to enter sanitary system.

Location of all manholes, catch basins, etc. shall be confirmed by the Client's Representatives before the actual execution of work at site.



All excavation, trenches etc shall be barricaded as per instruction of the Client's Representatives.

All works shall be executed as directed by the Client's Representatives.

### **7.3 TRENCHES FOR PIPE & DRAINS:**

#### **7.3.1 ALIGNMENT AND GRADE:**

The drains are to be laid to alignment and gradients in continuous shown on the drawings but subject to such modifications, as shall be ordered by the Client's Representative from time to time to meet the requirements of the works. No deviations from the line, depths of cutting or gradients of sewers shown in the plans and sections shall be permitted except by the express direction in writing of the Client's Representative.

#### **7.3.2 OPENING OUT TRENCHES:**

In excavating the trenches at the road metaling, pavement kerbing etc. are to be placed on one side and preserved for rein statement when the trench or other excavation shall be filled-up.

Before any road metal is replaced, it shall be carefully shifted. The surface of all trenches and holes shall be restored and maintained to the satisfaction of the Client's Representative. The Contractor shall not cut or break down any live fence or trees in the line of the proposed works but shall tunnel under them unless the Client's Representative shall order to the contrary.

Trench to be excavated to alignment + depth required. Trench to be properly dressed and de-watered. Trench shall be kept free of water at all time. Discharge of water shall be into nearest drainage channel not on the road.

All under ground pipe to be laid open in trench. Pipes to be laid and maintained at required levels and grade during course of work. All joints to be aligned and complete.

Trench shall be of 450mm wide than pipe. Concrete anchors at change in direction for C.I. pipe shall be provided. Pipe shall be rest on cushion in the trench.

The Contractor shall scrub up and clear the surface over the trenches and other excavations of all stumps, roots and all other encumbrances affecting execution of the work and shall remove them from the site to the approval of the Client's Representative.

#### **7.3.3 CONSTRUCTION ACROSS THE ROADS:**

All the pipe line or drain crossing existing road, the road crossing shall be excavated at a time, the second half being commenced after the pipes have been laid in the first half and the trench refilled. Necessary safety measure for traffic as directed shall be adopted. All type of pipes, water mains, cables etc. met within the course of excavation shall be carefully protected and supported. Care shall be taken not to disturb the electrical and communication cable removal of which is necessary shall be arranged by the Client's Representative or the Contractor shall arrange to support and protect them during excavation.

#### **7.3.4 EXCAVATION TO BE TAKEN TO PROPER DEPTH:**

The trenches shall be excavated to such depth and width that the sewers pipe shall rest on cushion so that the inverts may be at the levels given on the section/plan. In bad ground the Client's Representative may order the Contractor to excavate to a greater depth than that shown on the drawings and to fill up the excavation to the level of the sewer with such materials as decided by Client's Representative in writing.

#### **7.3.5 REFILLING:**

The filling shall be done in layers not exceeding 15mm in depth. Each layer shall be watered, rammed and consolidated. Ramming shall be done with iron rammers where possible and with blunt end of the crow brass where rammers can not be used. Special care shall be taken to ensure that no damage is caused to the pipes, drains, masonry or concrete in the trenches.

Filling in trenches shall be commenced soon after the joints of pipes, cables; conduits etc. have been tested and approved by Client's Representative. The space around the pipes shall be cleared of all debris where the trenches are excavated in hard/soft soil. The filling shall be done with earth on the sides and tops of pipes in layers not exceeding 15mm in depth. Each layer shall be watered rammed and consolidated. The clods and lumps of earth exceeding 8cm in any direction shall be broken or

removed before the excavated earth is used for filling. Generally no test is done to determine the instrument diversity of filled earth but on the discretion of Client's Representative the 95 proctor's compaction test may be done to ensure the in situ density after filling. Consolidation is removal of water from the pores and compaction is the explosion of air from the pores. In case of refilling consolidation places most important role as the watering of the each layer is being done properly. If required by the Client's Representative proctors needle may also be used for the proper checking of the refilling items of in situ density.

**7.3.6 CONTRACTOR SHALL RESTORE SETTLEMENT AND DAMAGES:**

The Contractor shall at his own cost make good promptly during the whole period the works are in hand, any settlements that may occur in the surfaces or roads, beams, footpaths, gardens, open spaces etc. Whether public or private caused by his trenches or by his other excavations due to not using the method of compaction as given in clause 7.3.5 and he shall be liable for any accidents caused thereby.

He shall also at his own expense and charges, repair and make good any damage done to the building and other properties.

**7.3.7 DISPOSAL OF SURPLUS SOIL:**

The Contractor shall at his own cost and charge, dispose off from the site all surpluses excavated material not required to be used on the works.

i. The width of excavated trench shall be as per table given below:

<b>Excavation upto</b>	<b>Upto 100 mm Dia. Pipe</b>	<b>Upto 150 mm Dia. pipe</b>
90 cms depth	33 cms	33 cms
90 - 150 cms depth	60 cms	60 cms
150 - 300 cms depth	75 cms	75 cms
300 - 500 cms depth	90 cms	100 cms

**7.3.8 PROTECTION OF EXISTING SERVICES:**

All pipes, water mains, cables etc encountered in the course of excavation shall be carefully protected and supported. In case of any damage caused the same shall be made good at no extra cost failing which necessary works will be carried out by the Clients Representative and contract charged to the Contractor.

**7.4 RCC PIPES:**

7.4.1 All underground storm water drainage pipes and sewer lines where specified (other than those specified cast iron) shall be centrifugally spun RCC pipes NP2 for general and NP3 where road crossing. Pipes shall be true and straight with uniform bore throughout. Cracked, wrapped pipes shall not be used on the work. All pipes shall be tested by the manufacturer and the Contractor shall produce, prior to use on site, a certificate to that effect from the manufacturer.

The pipes shall be with or without reinforcement as required and of the class as specified. These shall conform to IS: 458 - 1971. The reinforced cement concrete pipes shall be manufactured by centrifugal (or spun) process.

All pipes shall be true to shape, straight, perfectly sound and free from cracks and flaws. The external and internal surface of the pipes shall be smooth and hard. The pipes shall be free from defects resulting from imperfect grading of the aggregate mixing or moulding. The pipes shall be R.C.C. light duty, NP2 and NP3 type.

**7.4.2 LAYING:**

R.C.C. spun pipes shall be laid on cements concrete bed or cradles as specified and shown on the detailed drawings. The cradles may be pre-cast and sufficiently cured to prevent cracks and breakage in handling. The invert of the cradles shall be left 12mm below the invert level of the pipe and properly placed on the soil to prevent any disturbance. The pipe shall then be placed on the bed concrete or

cradles and set for the line and gradient by means of sight rails and boning rods, etc. Cradles or concrete bed may be omitted, if directed by the Client's Representatives.

7.4.3 JOINTING (RIGID SPIGOT AND SOCKET JOINT):

Hemp rope soaked in neat cement wash shall be passed round the joint and inserted in it by means of caulking tool. More skein of yarn shall be added and rammed home. Cement mortar with one part of cement and one part of sand and with minimum water content but on no account soft or sloppy, shall be carefully inserted, punched and caulked into the joint and more cement mortar added until the space of the joint has been filled completely with tightly caulked mortar. The joint shall then be finished off neatly outside the socket at an angle of 45 degree.

7.4.4 CURING:

The joint shall be cured for at least seven days.

7.4.5 CEMENT CONCRETE FOR PIPE SUPPORTS:

- a) Unless otherwise directed by the Client's Representative cement concrete for bed, all round or in haunches shall be laid as follows:

	<b>Upto 1.5m depth (5')</b>	<b>Upto 3m depth (10')</b>	<b>Beyond 3m depth (10')</b>
Pipes in open ground (no sub soil water)	all round (1:5:10)	in haunches (1:3:6)	all round (1:5:10)
RCC/C.I. pipes in sub soil water	all round (1:3:6)	in haunches (1:3:6)	in haunches (1:3:6)
RCC/C.I. pipes (in all conditions)	all round (1:3:6)	in haunches (1:3:6)	in haunches (1:3:6)
RCC/C.I pipes under road or building	all round (1:3:6)	all round (1:3:6)	all round (1:3:6)

- b) RCC pipes or CI pipes may be supported on brick masonry or pre-cast RCC or in situ cradles. Cradles shall be as shown on the drawings.
- c) Pipes in loose soil or above ground shall be supported on brick or stone masonry pillars as shown on the drawings.

7.4.6 TESTING:

All lengths of the sewer and drain shall be fully tested for water tightness by means of water head maintained for not less than 30 minutes. Testing shall be carried out from manhole to manhole. All pipes shall be subjected to a test pressure of at least 1.5 meters head of water at the highest point of the section under test. The pipes shall be plugged preferably with standard drain plugs (with rubber rings) on both ends. The upper end shall, however, be connected to a pipe for filling with water and getting the required head.

Permissible drops in water head should not exceed .....

7.4.7 MEASUREMENT:

- a) Excavation:  
Measurement for excavation of pipes trenches shall be made per linear meter.
- b) Trenches shall be measurement between outside walls of manholes at top and the depth shall be the average depth between the two ends to the nearest cm. The rate quoted shall be for a depth upto 1.5 meter or as given in the Bill of Quantities.

Payment for trenches more than 1.5 m in depth shall be made for extra depth as given in the Bill of Quantities and above the rate for depth upto 1.5 m.

- c) RCC pipes shall be measured for the length of the pipe line per linear meter i.e.:

- i. Length between manholes shall be recorded from inside of one manhole to inside of other manhole.
- ii. Length between gully trap and manhole shall be recorded between socket of pipe near gully trap and inside of manhole.

## **7.5 STONEWARE PIPE**

### **a) GENERAL REQUIREMENTS**

7.5.1 All materials shall be new of the best quality conforming to specifications and subject to the approval of the Consultant/ Client/ Architect.

Drainage lines shall be laid to the required gradients and profiles.

7.5.2 All drainage work shall be done in accordance with the local Municipal by-laws.

7.5.3 Contractor shall obtain necessary approval and permission for the drainage system from the Municipal or any other competent authority.

7.5.4 Location of all manholes, catch basins etc. shall be got confirmed by the Consultant/ Client/ Architect before the actual execution of work at site.

7.5.5 All works shall be executed as directed by Consultant/ Client/ Architect.

### **a) ALIGNMENT AND GRADE**

The sewer and storm water drainage pipes shall be laid to alignment and gradient shown on the drawings but subject to such modifications as shall be ordered by the Consultant/ Client/ Architect from time to time to meet the requirements of the works. No deviation from the lines, depth of cutting or gradients of sewers shown on the plans and sections shall be permitted except by the express direction in writing of the Consultant/ Client/ Architect.

### **b) EXCAVATION**

The excavation for sewer works shall be open cutting unless the permission of the Consultant/ Client/ Architect for the ground to be tunneled is obtained in writing. Where sewers have to be constructed along narrow passages, the Consultant/ Client/ Architect may order the excavation to be made partly in tunnel and in such cases the excavated soil shall be brought back later on for refilling the trenches or tunnel.

### **c) OBSTRUCTION OF ROADS**

The contractor shall not occupy or obstruct by his operation more than one half of the width of any road or street and sufficient space shall be then left for public and private transit. He shall remove the materials excavated and bring them back again when the trench is required to be refilled. The contractor shall obtain the consent of the Architect in writing before closing any road to vehicular traffic and the foot walks must be clear at all times.

### **d) EXCAVATION TO BE TAKEN TO PROPER DEPTH**

The trenches shall be excavated to such a depth that the sewer shall rest on concrete as described in the several clauses relating there to and so that the inverts may be at the levels given in the sections. In bad ground, the Consultant/ Client/ Architect may order the contractor to excavate to a greater depth than that shown on the drawings and to fill up excavation to the level of the sewers with the concrete, broken stone, gravel or other materials, the contractor, shall be paid extra at rates laid down for such works in the schedule. If the extra work was ordered by the Consultant/ Client/ Architect in writing, but if the contractor shall excavate the trench to a greater depth than is required without a specific order to that effect in writing of the Consultant/ Client/ Architect the extra depth shall have to be filled up with concrete at the contractor's own cost and charges to the requirements and satisfaction of the Consultant/ Client/ Architect.

### **e) REFILLING**

After the sewer or other works has been laid and proved to be water tight, the trench or other excavation shall be refilled. Utmost care shall be taken in doing this, so that no damage shall be caused to the sewer and other permanent work. The filling in the haunches and upto 75 cms. Above the crown of the sewer shall consist of the finest selected materials placed carefully in 15 cms. Layers and consolidated. After this has been laid, the trench and other excavation shall be refilled in 15 cms. Layers with materials taken from the excavation, each layer being watered to assist in the consolidation, unless the Architect shall otherwise direct.

**f) CONTRACTOR TO RESTORE SETTLEMENT AND DAMAGES**

The contractor shall at his own costs and charges, make good promptly during the whole period for the works in hand, any settlement that may occur in the surfaces of roads, beams, footpaths, gardens, open spaces etc. whether public or private caused by his trenches or by his other excavations and he shall be liable for any accident caused thereby. He shall also, at his own expense and charges, repair and make good any damage done to building and other property. If in the opinion of the Consultant/ Client/ Architect he fails to make good such works with all practicable dispatch, the Consultant/ Client/ Architect shall be at the liberty to get the work done by other means and the expenses thereof shall be paid by the contractor or deducted from any money that may be or become due to him or recovered from him in any other manner according to the law of land.

**g) DISPOSAL OF SURPLUS SOIL**

The contractor shall at his own costs and charges provide places for disposal of all surplus materials not required to be used on the works. As each trench is refilled the surplus soil shall be immediately removed, the surface properly restored and roadways and sides left clear.

**h) TIMBERING OF SEWER AND TRENCHES**

1. The contractor shall at all times support efficiently and effectively the sides of the sewer trenches and other excavations by suitable timbering, piling and sheeting and they shall be closed, timbered in loose or sand strata and below the surface of the sub soil water level.
2. All timbering, sheeting and piling with their walling and supports shall be of adequate dimension and strength and fully braced and strutted so that no risk of collapse or subsidence of the walls of the trench shall take place.
3. The contractor shall be held responsible and will be accountable for the sufficiency of all timbering, sheeting and piling used as also for all damage to persons and property resulting from improper quality, strength, maintaining or removing of the same.

**i) SHORING OF BUILDINGS**

The contractor shall shore up all buildings, walls and other structures, the stability of which is liable to be endangered by the work and shall be fully responsible for all damage to persons or property resulting from any accidents.

**j) REMOVAL OF WATER FROM SEWER, TRENCH ETC.**

1. The contractor shall at all times during the progress of the work keep the trenches and excavations free from water which shall be disposed of by him in a manner as will neither cause injury to the public health nor to the public or private property nor the work completed or in progress nor to the surface of any roads or streets, nor cause any interference with the use of the same by the public.
2. If any excavation is carried out at any point or points to a greater width than the specified cross section of the sewer with its envelope, the full width of the trench shall be filled with concrete by the contractor at his own expense and charges to the requirements of the Consultant/ Client/ Architect.

**k) WIDTH OF TRENCH**

The Consultant/ Client/ Architect shall have power by giving an order in writing to the contractor to increase the maximum width in respect of which payment will be allowed for excavation in trenches for various classes of sewer, manholes and other works in certain lengths to be specifically laid

down by him where on account of bad ground or other unusual conditions, he considers that such increased widths are necessary in view of the site conditions.

**Recommended width of trenches at the bottom of the trench are as follows:**

100 mm dia pipe	55 cms	
150 mm dia pipe	55 cms	
225-250 mm dia pipe		60 cms
300 mm dia pipe	75 cms	

Maximum width of the bed concrete shall be also as above. No additional payment is admissible for widths greater than specified.

**m) SALT GLAZED STONEWARE PIPES:**

Stone ware pipe shall be of first class quality salt glazed and free from rough texture inside and outside and straight. All pipes shall have the manufacturers names marked on it and shall comply to IS 651-1971.

**n) LAYING AND JOINTING OF STONEWARE SALT GLAZED PIPES :**

1. Pipes are liable to be damaged in transit and not with standing tests that may have been made before dispatching each pipe shall be examined carefully on arrival at site. Each pipe shall be rung with a wooden hammer or mallet and those that do not ring true and clear shall be rejected. Sound pipes shall be carefully stacked to prevent damage. All defective pipes should be segregated marked in a conspicuous manner and their use in the works prevented.
2. The pipes shall be laid with sockets leading uphill and should rest on solid and even foundations for the full length of the barrel. Socket holes shall be formed in the foundation sufficiently deep to allow the pipe jointer room to work right round the pipe and as short as practicable to admit the socket and allow the joint to be made.
3. Where pipes are not bedded in concrete the trench bottom shall be left slightly high and carefully bottomed up as pipe laying proceeds so that the pipe barrels rest on firm ground. If excavation has been carried too low it shall be made up with cement concrete at the contractor's cost and charges.
4. If the bottom of the trench consists of rock or very hard ground that cannot be easily excavated to a smooth surface, the pipes shall be laid on cement concrete bed to ensure even bearing.

**o) JOINTING OF PIPES**

1. Tarrd gasket shall first be wrapped round the spigot of each pipe and the spigot shall then be placed into the socket of the pipe previously laid, the pipe shall then adjusted and fixed in its correct positions and the gasket caulked tightly home so as to fill not more than one quarter of the total length of the socket.
2. The remainder of the socket shall be filled with stiff mix of cement mortar (1 cement : 1 clear sharp washed sand). When the socket is filled, a fillet should be formed round the joint with a trowel forming an angle of 45 Degrees with the barrel of the pipe. The mortar shall be mixed as needed  
For immediate use and no mortar shall be beaten up and used after it has begun to set.
3. After the joint has been made, any extraneous material shall be removed from inside of the joint with a suitable scraper or 'badgar'. The newly made joint shall be protected until set from the sun, drying winds, rains or dust. Sacking or other materials which can be kept damp shall be used. The joints shall be exposed and space left all round the pipes for inspection by the Consultant/ Client/ Architect. The inside of the sewer must be left absolutely clear in bore and free from cement mortar or other obstructions throughout its entire length, and shall efficiently drain and discharge.

**p) TESTING**

1. All lengths of the sewer and drain shall be fully tested for water tightness by means of water pressure maintained for not less than 30 minutes. Testing shall be carried out from manhole to manhole. All pipes shall be subjected to a test pressure of atleast 1.5 mtrs. head of water. The test pressure shall, however, not exceed 6 metres head at any point. The pipes shall be plugged preferably with standard design plugs with rubber plugs on both sides. The upper end

shall, however, be connected to a pipe for filling with water and getting the required head poured at one time permit.

2. Sewer lines shall be tested for a straightness by :
  - (i) Inserting a smooth ball 12 mm less than the internal diameter of the pipe. In the absence of obstruction such as yarn or mortar projecting at the joints the ball should roll down the invert of the pipe and emerge at the lower end.
  - (ii) Means of a mirror at one end and a lamp at the other end. If the pipe line is straight the full circle of light will be seen otherwise obstructions or deviations will be apparent.
  - (iii) The contractor shall give a smoke test to the drain and sewer at his own expense and charges, if directed by the Consultant/ Client/ Architect.
  - (iv) A test register shall be maintained which shall be signed and dated by contractor. Architect and representative of consultants.

**q) MASONRY WORK**

Masonry work for manhole, chambers, septic tanks and such other works as required shall be constructed from local best quality bricks in cement mortar 1 : 5 mix (1 cement : 5 coarse sand) or as specified in the Bill of Quantities. All joints shall be properly raked to receive plaster.

**r) CEMENT CONCRETE FOR PIPE SUPPORT**

1. Wherever specified or shown on the drawings, all pipes shall be supported in bed all round or in haunches. The thickness and mix of concrete shall be as given in the Bill of Quantities. Widths of the bedding shall be as per Para 13.
2. Unless otherwise directed by the Consultant/ Client/ Architect, cement concrete of bed, all rounds or in haunches shall be laid as follows:

	Upto 1.5 m depth	Upto 3 m depth	Beyond 3 m depth
RCC, stoneware pipes in open ground (above sub soil water)	All round (1 : 5 : 10)	In haunches (1 : 5 : 10)	In haunches (1 : 5 : 10)
C.I.pipes in sub soil water	All round (1 : 3 : 6)	In haunches (1 : 3 : 6)	In haunches (1 : 3 : 6)
RCC or S.W. pipes in sub soil water	All round (1 : 3 : 6)	All round (1 : 3 : 6)	All round (1 : 3 : 6)
RCC or S.W. pipes under floors or building	All round (1 : 2 : 4)	All round (1 : 2 : 4)	All round 3. : 2 : 4)

3. RCC pipes or C.I. or stoneware pipes may be supported on brick masonry or precast RCC or in situ cradles. Cradles shall be as shown on the drawing.
4. Pipes in loose soil or above ground shall be supported on brick or stone masonry pillars as shown on the drawings.
5. Hand mixing on properly constructed platforms may be allowed for small quantities by the Consultant/ Client/ Architect. Rate for cement concrete shall be inclusive of all shuttering and centering at all depths and heights.
6. Concrete work shall be of such thickness and mix as given in the Bill of quantities.
7. All concrete work shall be cured for a period of at least 7 days. Such work shall be kept moist by means of gunny bags at all times. All pipes trenches and foundations shall be kept dry during curing period.

**7.6 SEWER MANHOLES WITH FRAME AND COVER:**

**7.6.1 SCOPE**

This specification covers the requirements for providing and constructing of Brick Masonry (for up to 3 mtr. depth) / RCC M 20 grade or 1:1x1/2 :3 mix (for more than 3 mtr. depth) manholes with steps, frame, cover and vent shafts.

#### **7.6.2 STANDARDS**

The following standards/codes, unless otherwise specified herein, shall be referred. In all cases, the latest revision of the standards /codes shall be referred to.

IS : 210	Specification for gray 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 mild steel and medium tensile steel bars and hard drawn steel wire for concrete reinforcement
IS : 516	Methods of tests for strength of concrete
IS : 651	Specification for salt-glazed stoneware pipes and fittings
IS : 1077	Specification for common burnt clay building bricks
IS : 1726	Specification for cast iron manhole covers and frames
IS : 1786	Specification for high strength deformed steel bars and wires for concrete reinforcement
IS : 2116	Specification for sand for masonry mortars
IS : 3495	Methods of tests of burnt clay building bricks
IS : 5455	Specification for cast iron steps for manholes

#### **7.6.3 CODES OF PRACTICE**

IS : 456	Code of practice for plain and reinforced concrete
IS : 2212	Code of practice for brickwork
IS : 2250	Code of practice for preparation and use of masonry mortars
IS : 4111	Code of practice for ancillary structures in sewerage system part 1 manholes
IS : 4127	Code of practice for laying of glazed stoneware pipes

#### **7.6.4 LOCATION**

Manholes shall be constructed in accordance with the drawings at the locations indicated thereon.

#### **7.6.5 CONSTRUCTION MANHOLES:**

At every change of alignment, gradient or diameter of a drain, there shall be a manhole or inspection chamber. Bends and junctions in the drains shall be grouped together in manhole as far as possible. The maximum distance between manholes shall be according to NBC.

Manholes of different types and sizes as specified shall be constructed in the sewer line at such places and to such levels and dimensions as shown in the drawings or as directed by the Engineer-in-charge. The size specified shall indicate the inside dimensions between brick faces of the manholes.

Where the diameter of the drain is increased, the crown of the pipe shall be fixed at the same level and necessary slope given in the invert of the manhole chamber. In exceptional cases and where unavoidable, the crown of the branch sewer may be fixed at lower level but in such cases the peak flow level of the two sewers shall be kept the same.

Sewers of unequal sectional area shall not be jointed at the same invert in a manhole. The invert of the smaller sewer at its junction with main shall be at least 2/3 the diameter of the main above the invert of the main. The branch sewers shall deliver sewage in the manhole in the direction of main flow and the junction must be made with care so that flow in main is not impeded.



No drain from house fittings, e.g. gully trap or soil pipe, etc. to manhole shall normally exceed a length of 6 m unless it is unavoidable.

Manholes 90 x 80 cm are generally constructed within compound for house drainage only and near the buildings for house drainage. Manholes 1.2 m x 90 cm are generally constructed for main drainage work for depths less than 1.5 m.

Manhole 1.4 m x 90 cm is of the arched type and is generally constructed for main drainage works where depth is 1.50 m or more. The width of manholes shall be increased more than 90 cm on bends or junctions or pipes with diameter greater than 450 mm and that the benching width on either side of the channel is minimum 20 cm.

Manholes 1.4 m internal diameter are generally constructed for main drainage works where depth is 2.45 m or more as an alternative to manholes of arch type. The diameter shall be increased suitably, for pipes with diameter greater than 450 mm in the same manner as in the case of rectangular manholes.

Before deciding size of manholes, it shall be as specified in BOQ or as per Local Municipal Bye Laws. When manholes are constructed on foot path, these shall be provided with cover of medium duty casting and when built within the width of the road under vehicular traffic, these shall be provided with cover of heavy duty casting.

#### **7.6.6. EXCAVATION**

The excavation for manhole shall be true to dimensions and levels shown on the plans or as directed by the Engineer-in-charge.

#### **7.6.7 BED CONCRETE**

The manhole shall be built on a bed of foundation PCC 1 : 2 : 4 unless required by local authorities. The thickness of the bed concrete shall be 15 cm for manholes up to 4.5 m depth and 30 cm for depths beyond 4.5 m unless otherwise specified or directed by the Engineer-in-charge. In bad ground, special foundations as suitable shall be provided.

#### **7.6.8. BRICK MASONRY / CEMENT CONCRETE WORK**

##### **BRICK MASONRY**

For depth up to 3 mtr, manhole shall be constructed with masonry wall, for more than 3 mtr. Depth, it shall be of M 20 grade as specified below:

The brick work shall be with class 75 bricks in cement mortar 1:4 (1 cement: 4 coarse sand). The brick work shall be with class 75 bricks in cement mortar 1:4 (1 cement: 4 coarse sand). The external joints of the brick masonry shall be finished smooth, and the joints of the pipes with the masonry shall be made perfectly leak proof. For arched type and circular manholes, brick masonry in arches and arching over the pipes shall be in cement mortar 1 : 3 (1 cement: 3 fine sand). In the case of manholes of circular type the excess shaft shall be corbelled inwardly on three sides at the top to reduce its size to the cover frame to be fitted.

The walls shall be built of one brick thickness for depths up to 4.25 m. below a depth of 4.25 mtr in ordinary subsoil the wall thickness shall be increased to one and half brick and at 9.75 m below ground two brick thick walls

##### **CEMENT CONCRETE WORK**

The walls shall be built of M20 grade (1 cement : 1.5 coarse sand : 3 coarse aggregate having 20 mm nominal size) with 15 cm thickness for depth up to 4.5 m. Below a depth of 4.5 m in ordinary subsoil the wall thickness shall be increased to 30 cm

The thickness of the wall shall be take the total load coming over it including earth pressure & water pressure. The chamber shall be tested for water tightness.

The wall shall further be water proofed with addition of approved water proofing compound in a quantity as per manufacturer's specifications. In case Local Authorities/Bye Laws specify richer specifications, the same shall be adopted.

For earth work excavation, bed concrete work, R.C.C. work and refilling of earth, respective specifications shall be followed.

### PLASTER AND POINTING

In case of brick walls, the walls of the manholes shall be plastered inside with 20 mm thick cement plaster 1:2 (1 cement: 2 coarse sand) finished smooth. The plaster shall further be water proofed with addition of approved water proofing compound in a quantity as per manufacturer's specifications. In case Local Authorities/Bye Laws specify richer specifications, the same shall be adopted.

For earth work excavation, bed concrete brick work, plaster and pointing, R.C.C. work and refilling of earth, respective specifications shall be followed.

### 7.6.9 BENCHING

The channels and benching shall be done in cement concrete 1:1.5:3 (1 cement : 1.5 coarse sand : 3 graded stone aggregate 20 mm nominal size) and rendered smooth with neat cement. The depth of channels and benching shall be as given in Table .

SIZE OF DRAIN ABOVE	TOP OF CHANNEL AT DEPTH OF BENCHING	
	THE CENTER ABOVE	SIDE WALLS
	BED CONC.	BED CONC.
10 cm	15 cm	20 cm
15 cm	20 cm	30 cm
20 cm	25 cm	35 cm
25 cm	30 cm	40 cm
30 cm	35 cm	45 cm

### 7.6.10 FOOT RESTS

All manholes deeper than 0.8 m shall be provided with foot rests.

7.6.10.1 Foot rest shall be CI type, each weighing 5.5 Kg, 1:2:4 coping.

7.6.10.2 Alternatively MS foot rest shall be provided. These shall be embedded 20 cm deep in 20 x 20 x 10 cm blocks of cement concrete 1:2:4 (1 cement : 4 coarse sand : 4 graded stone aggregate 20 mm nominal size). The concrete block with M.S. foot rest placed in its center shall be cast in situ along with the RCC wall & finished smooth.

SIZE OF DRAIN MM	TOP OF CHANNEL AT THE CENTER ABOVE BED CONCRETE CM	DEPTH OF BENCHING AT SIDE WALLS ABOVE BED CONCRETE CM
100	15	20
150	20	30
200	25	35
250	30	40
300	35	45
350	40	50
400	45	55
450	50	60

Foot rests which shall be of 20x20 Sq. M.S. bars.

Foot rests shall be fixed 40 cm apart vertically and staggered laterally and shall project 10 cm beyond the surface of the wall. The top foot rest shall be 45 cm below the manhole cover.

Foot rests shall be painted with coal tar, the portion embedded in the cement concrete block being painted with thick cement slurry before fixing.

### 7.6.11 MANHOLE COVERS AND FRAMES

The frame of manhole shall be firmly embedded to correct alignment and levels in R.C.C. slab or plain concrete as the case may be on the top of the masonry. After completion of the work, manhole covers shall be sealed by means of thick grease.

#### **7.6.12 MEASUREMENTS**

Manholes shall be enumerated under relevant items. The depth of the manhole shall be reckoned from the top level of RCC cover to the invert level of channel. The depth shall be measured correct to a cm. The extra depth shall be measured and paid as extra over the specified depth.

#### **7.6.13 RATE**

The rate shall include the cost of materials and labour involved in all the operations described above but exclude the cost of (i) excavation, (ii) refilling (iii) dewatering if required. These items shall be paid for separately under relevant items of work.

Payment for extra depths of manholes shall be made separately under relevant items of work.

### **7.7 DROP CONNECTION**

In cases where branch pipe sewer enters the manhole of main pipe sewer at a higher level than the main sewer, a drop connection shall be provided. The work shall be carried out as per specifications and RCC pipes and special conforming to IS: 458 shall be of the same size as that of the branch pipe sewer.

For 150 and 250 mm main line, if the difference in level between the water line (peak flow level) and the invert level of the branch line is less than 60 cm, a drop connection may be provided within the manhole by giving suitable ramp. If the difference in level is more than 60 cm, the drop shall be provided externally.

The sewer main lines shall be designed with 0.8 full flow.

#### **7.7.1 EXCAVATION**

The excavation shall be done for the drop connection at the place where the branch line meets the manhole the excavation shall be carried up to the bed concrete of the manhole and to the full width of the branch line.

#### **7.7.2 MEASUREMENTS**

Drop connection shall be enumerated. The depths beyond 60 cm shall be measured in running metres correct to a cm under relevant items.

#### **7.7.3 RATE**

The rate shall include the cost of labour and materials involved in all the operations described above but excluding the cost of excavations and refilling.

#### **7.7.4 TESTING**

The interior of manholes shall be cleared of all debris after construction and before testing the same for water tightness by Contractor.

Water for testing of manholes along with pipeline shall be arranged by Contractor at his own cost.

#### **7.7.5 R.C.C PRE CAST M.H.F.C.**

Manufacture, supply delivery at site of work and fixing on top of manhole precast RCC Frame & cover suitable to drainage M.H. and including cost of reinforcement M.S. Angles or Flat, curing, mold work etc.

#### **7.7.6 GENERAL SPECIFICATION**

R.C.C Precast manhole frame & cover shall be manufacture as per standard type design. Frame shall confirm to IS: 12592 part – II – 1991. Cover shall confirm to IS : 12592 part – I – 1988.

### **7.7.7 MATERIAL**

Sand, cement, water, aggregates and reinforcement steel shall conform to relevant I.S. specifications. Thickness of frame shall be 10 cm. Necessary reinforcement, M.S. angle or flat shall be placed as per design during the concreting work fabrication of R.C.C. M.H.F.C shall be carried out by mechanically vibrating process.

### **7.7.8 INSPECTION :**

Inspection of materials will be carried out at work site by the Engineer who shall carry out inspection as soon as material is brought on work site. Inspection will be carried out normally within one week time. The supplier has to take care of the following points.

The manufacturer has to go in for one line stenciling for identifying size and class for proper separation.

The unloaded material has to be stacked in manageable batches with adequate inspection space like spreading the pieces etc. to permit proper inspection.

### **7.7.9 TRANSIT RISK**

The contractor shall bring goods at his own risk or it should be covered against the transit risk at its own cost.

### **7.7.10 TEST CERTIFICATE**

The contractor shall always provide manufacturer's test certificate in accordance with every batch/lot of goods so manufactured and supplied.

The supplier shall also produce in addition to manufacturer's test certificate as mentioned in above, the inspection certificate issued by Engineer for the same purpose.

### **7.7.11 FIXING**

Precast R.C.C. frame shall be fixed on the top of manhole and properly embedded in cement concrete 1:1.5:3 in required quantity in such a way that the top of the cover when placed in position shall remain at the finished road level.

### **7.7.12 MEASUREMENT**

The measurement shall be made on number basis subsequent to fixing the frame on top of manhole and placing the cover in the frame.

### **7.7.13 MARKING**

Each manhole frame and cover shall have cast on them the following information.

- a) Manufacturer's name or trademark.
- b) Grade denoted by abbreviation such as HD, MD or LD.
- c) The word SWD or sewer to denote storm water drain or sewer respecting if desired.
- d) An identification name as required by purchaser.

## **8.0 EQUIPMENT SPECIFICATIONS:**

### **8.1 HYDROPNEUMATIC SYSTEM**

#### **8.1.1 SCOPE:**

The specification covers design, performance, manufacture, construction features, inspection, testing, delivery, installation, commissioning of Hydro pneumatic pressurized system consisting of balancing tank with mounting pads, pump-motor set with coupling and coupling guard, common base plate, bell mouth, piping, isolation valves, NRVs, fittings, control panel, pressure switches, etc. and other accessories required for complete installation of hydro pneumatic system at site.

#### **8.1.2 CONSTRUCTION FEATURES:**

The major components of the system shall be as follows :

#### 8.1.2.1 TANK:

The tank shall be of M.S. fabricated. The shell and dished ends shall be fabricated from 8 mm and 10 mm thick M.S. plate respectively.

The tank shall be supplied with air compressor with all accessories to supply compressed air to the tank. The compressor shall be oil free, Teflon coated. Due to this, air shall be compressed when the water enters and shall supply the water at constant pressure.

Alternatively FRP tank (Pressure vessel) for min. 8 Kg/cm<sup>2</sup> Pressure rating with inbuilt aircell to be provided if specified in BOQ.

The tank shall be provided with all accessories viz. mounting arrangement, isolation valve, pressure gauge, etc.

#### 8.1.2.2 PUMP:

Two types of pumps i.e. inline vertical centrifugal pump or centrifugal end suction / monoblock pumps shall be provided. Variable frequency drive shall be provided with one of the installed pump – if specified in Schedule of quantity.

The pump – motor set and shall be suitable for 3 Ph., 415 V, 50 Hz., AC power supply and having 2900 RPM speed. The pump shall be installed with isolation butterfly valve, non return valve, etc. The detailed specification for pump & motor is as below :

#### **Vertical inline / End suction / monoblock Centrifugal Pump**

#### 8.1.2.3 Codes & Standards :

The design and manufacture of the pump shall comply with all currently applicable statutes, regulations and safety codes in the locality where the equipment will be installed.

#### 8.1.2.4 Design Features:

The pump shall be capable of developing required total head at rated capacity. Impeller shall be closed type and shall be dynamically balanced. The pump shall have non overloading characteristics.

#### 8.1.2.5 Constructional Features :

The casing shall be of rigid construction and shall have side suction and side delivery in case of inline pump and side suction and central delivery in case of submersible centrifugal pump.

The pump shall have very small length suction and delivery pipe connections which will result in minimum friction loss.

Impeller shall be of one piece and shall be of SS CF8 M .

The shaft shall be of S.S. and its surface shall be properly finished.

Shaft sleeves shall be provided to protect shaft from any damage.

Bearing shall be ball or roller type.

Mechanical seal shall be provided to avoid any leakage.

#### 8.1.2.5 Inspection & Testing :

The pump shall be offered for visual inspection before dispatch.

Material test certificates for the various pump components shall be furnished for purchaser's approval.

Hydrostatic test shall be carried out at 1.5 times the maximum discharge pressure.

All the tests shall be witnessed by purchaser.

#### 8.1.2.6 Drawings:

Following drawings shall be furnished by the vendor:

- 1) Overall dimensional drawing.  
Cross-sectional drawings with Bill of Material and Material of Construction

#### 8.1.2.7 Accessories:

The pump shall be provided with all accessories such as base plate, foundation bolts, strainer, pressure gauge, etc. All accessories required for proper and safe operation shall be furnished with the pumps.

#### 8.1.2.8 PRESSURE SWITCH:

The system shall be installed with the pressure switch which shall be set at predetermined pressure to automatically control the pump operation.

### 8.2 VALVES

#### 8.2.1 Scope:

This specification covers the design requirements, features of construction, inspection, testing, painting, delivery, installation and commissioning of manually hand wheel operated butterfly valves, spring operated dual / single plate non return valve & non rising sluice valve with hardwares & gaskets, etc. at site.

#### 8.2.2 Codes & Standards:

The design and manufacture of the valves shall comply with all currently applicable statutes, regulations and safety codes in the locality where the equipment will be installed. Nothing in this specification shall relieve the vendor of this responsibility. Ball valve according to relevant BS/Butterfly Valves shall be conforming to BS 5155, PN 1.0, Non Return Valves shall conform to API 594 / 598 & Sluice valve shall conform to IS 14846 PD.

#### 8.2.3 Design Requirements for Ball Valves :

Ball valve shall be provided on suction and delivery side of each pump.

Valves shall be provided with SS ball & stem.

The valve shall be flanged type.

All internal wetted parts shall be of S.S.

Seating shall be of PTFE.

OR

#### 8.2.3 Design Requirements for Butterfly Valves :

Butterfly valve shall be provided on suction and delivery side of each pump.  
Valves shall be provided with integrally moulded liner to provide perfect seating arrangement.

The valve shall be flanged type.

All internal wetted parts shall be of S.S.

Disc seal shall be of EPDM.

#### 8.2.4 Design Requirements for Non Return Valves :

Non Return Valve shall be provided on delivery side of each pump.  
The non return valves shall be provided with soft seating.

The valve shall be mounted horizontally.  
The valves shall be designed for minimum head loss  
Hydraulic passage shall be designed to avoid cavitations.  
The valves shall have non slam characteristic. This is to be achieved by suitably designed spring.  
All internal wetted parts shall be of S.S.

#### 8.2.5 Design Requirements of Sluice Valve :

8.2.5.1 Valves shall be provided with back seating arrangement.

8.2.5.2 Integral / Renewable body and wedge rings shall be provided.

8.2.5.3 Collared drain plugs of gunmetal shall be provided for all valves.

8.2.5.4 Stuffing box gland shall be of bolted type.

8.2.5.5 Valves shall be with non-rising spindle type.

8.2.5.6 The seat rings shall be riveted over and above press fitted.

8.2.5.7 Valves shall be flanged and drilling shall conform to the standard as specified in data sheet.

8.2.5.8 Face to face dimension shall conform to IS 14846, PD.

#### 8.2.6 Cleaning:

Prior to factory inspection, all manufacturing waste such as metal chips debris and all other foreign material shall be removed from interior of valve. All mill scale, rust, oil, grease, chalk and all other deleterious material shall be removed from the interior and exterior surfaces.

#### 8.2.7 Painting:

Valves shall first be given two coats of zinc base primer after completely cleaning the surface and then it shall be coated with three coats of coal tar epoxy paint. The resulting coating shall be uniform and smooth and shall adhere perfectly to the surface.

Valves used in pipes carrying water, the inside coating shall not contain any constituent soluble in water or any ingredient which could impart any taste or odour to the water.

#### 8.2.8 Tests & Inspection:

Valves shall be tested as per the relevant Standards with latest revisions.

Valves shall be offered for visual inspection and dimensional checks.

The hydrostatic and water tightness testing shall be witnessed by the purchaser.

Valve shall be offered for inspection and following tests. ( before painting ) at Vendor's shop.

- Visual inspection with dimensional checks.
- Hydrostatic test

#### 8.2.9 Tender Drawings :

The following drawings shall be submitted by tenderer along with their offer.

Preliminary outline dimensional drawings.

Typical cross section drawings.

Flow v/s head loss curve for Non-return valves

#### 8.2.10 SUCTION AND DELIVERY PIPE, FITTINGS, FLANGES:

8.2.10.1 All suction, delivery and header pipe shall conform to IS 1239, heavy duty (Class C) and shall be hot dipped galvanized. Fittings shall be as per the pipe thickness. All pipe shall have flanges connection & pipe shall conform to BS 10, Table - D. All hardwares shall be zinc plated.

#### 8.2.10.2 SYSTEM OPERATION:

When the system will switch on, the pump shall start pumping water into hydro pneumatic or balancing tank when all the service taps will close in the system, pressure shall build in the tank. As soon as the pressure will reach to cut off pressure, the pump shall shut off. When the taps will open and the end user shall get pressurized water and as the pressure will reach to cut in pressure, the pump shall automatically start.

### 8.2.10.3 TESTING :

The system shall be tested minimum 1.5 times the working pressure.

### 8.3 TECHNICAL DATA SHEET FOR DOMESTIC / FLUSHING WATER SUPPLY:

SR.NO	PARTICULAR	SPECIFICATIONS
<b>1.0</b>	<b>DOMESTIC / FLUSHING WATER HYDRO PNEUMATIC TANK</b>	
1.1	Capacity	As per BOQ
1.2	No. of Unit	As per BOQ
1.3	Material of Construction	M.S. conforming to IS 2062 / FRP
1.4	Shell thickness	8 mm / Suitable for 8 Kg/cm <sup>2</sup> pressure rating.
1.5	Dished end thickness	10 mm/ Suitable for 10 Kg/cm <sup>2</sup> pressure rating.
1.6	Test Pressure	10 kg / cm <sup>2</sup> minimum
1.7	Painting	<i>Epoxy</i>
1.8	Type of Air Compressor	Oil free, Teflon coated / Inbuilt Air cell
1.9	Tank outlet size	As per Manufacture's configuration
<b>2.0</b>	<b>PUMPS</b>	
2.1	Type	In line vertical / centrifugal end suction or monoblock
2.2	Number of Units	As per BOQ
2.3	Design capacity of each pump Main Pump	As per BOQ
2.4	Total head at design capacity	As per BOQ
2.5	Suction Pressure at rated capacity (NPSHa)	Positive Suction
2.6	Total duration of operation	Continuous
2.7	Speed	1500 / 2900 RPM
2.8	Location	Indoor
<b>2.9</b>	<b>FEATURE OF CONSTRUCTION</b>	
2.9.1	Impeller	Closed
2.9.2	Shaft	Coupled



SR.NO	PARTICULAR	SPECIFICATIONS	
2.9.3	Drive Transmission	Direct	
2.9.4	Seal	Gland Packing	
2.9.5	Mounting	Common base plate	
2.9.6	No. of stage	Single	
2.9.8	Starter Pump	DOL / VFD	
2.9.9	Flange drilling	As per BS 10, Table D, flat face with off centre bolt holes	
<b>2.10</b>	<b>LIQUID DATA</b>		
2.10.1	Liquid handled	Water	
2.10.2	Specific gravity	1.0	
2.10.3	Temperature	Ambient temp.	
<b>2.11</b>	<b>MATERIAL OF CONSTRUCTION</b>	(AS INDICATED IN BOQ OR AS SPECIFIED BLEOW IF NOT GIVEN IN BOQ)	
2.11.1	Base plate	M.S. IS 226	
2.11.2	Pump Casing	C.I.	
2.11.3	Impeller	SS CF 8 M	
2.11.4	Shaft	S.S AISI 410	
2.11.5	Wearing Ring	SS 316	
2.11.6	Painting	Epoxy	
2.11.7	Hardware in contact with water	Hot dipped galvanized	
2.11.8	Companion flanges	M.S., BS 10, Table D	
<b>2.12</b>	<b>ACCESSORIES &amp; SERVICES REQUIRED</b>		
2.12.1	Base Plate	YES	
2.12.2	Foundation bolts	YES	
2.12.3	Companion flanges	YES	
2.12.4	Spare parts required	YES	
2.12.5	Maintenance tools required	YES	
<b>3.0</b>	<b>Cut in pressure</b>	<i>Working Pump</i> ( As per IS)	<i>Stand by Pump</i> ( As per IS)
<b>4.0</b>	Cut off pressure	<i>Working Pump</i> ( As per IS)	<i>Stand by Pump</i> ( As per IS)

SR.NO	PARTICULAR	SPECIFICATIONS
5.0	INDUCTION MOTOR	
5.1	Type	Squirrel cage Induction
5.2	Mfg. Standard	IS 325
5.3	Rated Voltage	415 Volts, 3 Phase, 50 Hz., AC
5.4	Voltage and frequency variation	± 10% voltage variation ± 5% frequency variation ± 10% combined voltage and frequency variation
5.5	Speed in RPM	1500/2900 RPM
5.6	Class of Insulation	Class B
5.7	Degree of Protection	IP 55
6.0	Suction & delivery piping	MS, hot dipped galvanized, Class 'C'
7.0	Suction, delivery valves & header valves	Required, flanged Cast Iron valves with SS internal parts Make : Kirloskar / KSB / ZOLOTO/AUDCO/FLOVEL Flanged Ball / Butterfly valve on suction and delivery of each pump & Flanged Non slam, spring operated dual plate type check valve on delivery side of each pump & on header
8.0	Control Panel	With Starter. One pump of similar rating shall have VFD Required with all protections & sequential timer for main pumps Also required Finolex / CCI / Gloster make cable from motor to panel
9.0	Level Indicator	Required for 0-5 mtr. Range and shall be panel mounted and interlocking with pump
10.0	Pressure switch	Provided for each pump
11.0	Pressure Gauge	Required at delivery of each pump & on header. Range 0-7 kg/cm <sup>2</sup>
12.0	Gaskets	'Champion ' make
13.0	Hardware	Zinc coated

#### 8.4 CENTRIFUGAL PUMPS

##### 8.4.1 SCOPE:

This specification covers the supply, installation, testing & commissioning of Centrifugal type (monoblock/moonset/End suction) pumps. The scope also includes delivery piping upto Discharge

Header with necessary pipe, fittings, etc. Each pump shall have isolation gun metal gate valve & NRV at delivery side. The pipe shall be GI class B.

**8.4.2 CODES AND STANDARDS:**

The design and manufacture of the pump shall comply with all currently applicable statutes, regulations and safety codes in the locality where the equipment will be installed.

**8.4.3 DESIGN FEATURES:**

8.4.3.1 The pump shall be capable of developing required total head at rated capacity.

8.4.3.2 Impeller shall be enclosed type and shall be dynamically balanced.

8.4.3.3 The pump shall have non overloading characteristics.

8.4.3.4 The pump shall have positive suction.

**8.4.4 CONSTRUCTIONAL FEATURES:**

8.4.4.1 The casing shall be of rigid construction and shall have central delivery pipe.

8.4.4.2 The casing shall be of Cast Iron.

8.4.4.3 The pump shall have very small length suction and delivery pipe connections which will result in minimum friction loss in case of moonset pumps.

8.4.4.4 Impeller shall be of one piece and shall be of SS CF 8 M.

8.4.4.5 The shaft shall be of S.S. and its surface shall be properly finished.

8.4.4.6 Shaft sleeves shall be provided to protect shaft from any damage.

8.4.4.7 Bearing shall be ball or roller type.

8.4.4.8 Mechanical seal shall be provided to avoid any leakage.

**8.4.5 INSPECTION AND TESTING:**

8.4.5.1 The pump shall be offered for visual inspection before dispatch.

8.4.5.2 Material test certificates for the various pump components shall be furnished for purchaser's approval.

8.4.5.3 Hydrostatic test shall be carried out at 1.5 times the maximum discharge pressure.

8.4.5.4 All the tests shall be witnessed by purchaser.

**8.4.6 DRAWINGS:**

Following drawings shall be furnished by the vendor:

- 1) Overall dimensional drawing.
- 2) Cross-sectional drawings with Bill of Material and Material of Construction

**TECHNICAL SPECIFICATIONS FOR CENTRIFUGAL PUMPS**

SR. NO.	PARTICULAR	SPECIFICATIONS
1.0	Type	Centrifugal Monoblock / Monoset / End suction
2.0	Number of Units	As per BOQ

SR. NO.	PARTICULAR	SPECIFICATIONS
3.0	Design capacity of each pump	As per BOQ
4.0	Total head at design capacity	As per BOQ
5.0	Total duration of operation	As per BOQ
6.0	Speed	2900 RPM
7.0	Location	As per BOQ & Layout
<b>8.0</b>	<b>FEATURE OF CONSTRUCTION</b>	
8.1	Impeller	Enclosed
8.2	Shaft	Coupled
8.3	Drive Transmission	Direct
8.4	Seal	Mechanical
8.5	Mounting	Base plate
8.6	No. of stage	Single
8.7	Nozzle orientation A. Suction B. Discharge	Side suction Top discharge
8.8	Starter	DOL for upto 5 KW & Star / Delta for more than 5 KW rating
8.9	Flange drilling	As per BS 10, Table F, raised face with off center bolt holes
<b>9.0</b>	<b>LIQUID DATA</b>	
9.1	Liquid handled	HVAC make up soft Water
9.2	Specific gravity	1.0
9.3	Temperature	Ambient temp.
<b>10.0</b>	<b>MATERIAL OF CONSTRUCTION</b>	
10.1	Base plate	M.S. IS 226
10.2	Pump Casing	Cast Iron
10.3	Impeller	SS CF8 M
10.4	Shaft	S.S AISI 410
10.5	Wearing Ring	S.S AISI 410
10.6	Painting	Epoxy
10.7	Hardware in contact with water	Hot dipped galvanized
10.8	Companion flanges	M.S., BS 10, Table F
10.9	Make	KSB / KIRLOSKER/GROUNDFOS
<b>11.0</b>	<b>ACCESSORIES &amp; SERVICES REQUIRED</b>	
11.1	Base Plate	YES
11.2	Foundation bolts	YES
11.3	Companion flanges	YES
11.4	Spare parts required	YES
11.5	Maintenance tools required	YES
<b>12.0</b>	<b>MOTOR :</b>	
12.1	Power Supply	230 / 415 Volts, 3 phase, 50 Hz. AC
12.2	Class of Insulation	Class B
12.3	Degree of Protection	IP 55

SR. NO.	PARTICULAR	SPECIFICATIONS
13.0	Delivery piping	GI, Class `B`
14.0	Delivery valves & header valves	Gun Metal flanged valves Make : AUDCO / ZOLOTO / KSB / IVC For monoset pump : Flanged Ball / Butterfly valve on delivery side of each pump & Flanged Non Return Valve on delivery side of each pump & on header For monoblock / end suction pump : Flanged Ball / Butterfly valve on suction & delivery side of each pump & Flanged Non Return Valve on delivery side of each pump & on header
15.0	Starter Panel	Required with pump interlocking with respect to tank levels. Also required Finolex / Polycab make cables up to starter panel.
16.0	Level Indicator	Required for 0-5mtr. Range and shall be panel mounted and interlocking with pump and over head tank.
17.0	Pressure Gauge	Required at delivery of each pump & on header. 0 –7 kg/sq.cm

## 8.5 GUN METAL GATE VALVE

### 8.5.1 SCOPE:

This specification covers supply, installation, testing & commissioning of Gun Metal gate valve with gaskets, hardware, etc. at site.

### 8.5.2 CODES AND STANDARDS:

8.5.2.1 The design and manufacture of the valves shall comply with all currently applicable statutes, regulations and safety codes in the locality where the equipment will be installed. Nothing in this specification shall relieve the vendor of this responsibility. Valves shall be conforming to IS 778 PN 1.0 (Class 1).

### 8.5.3 DESIGN REQUIREMENTS FOR GATE VALVES:

8.5.3.1 Valves shall be provided with back seating arrangement.

8.5.3.2 Body seat shall be Integral type.

8.5.3.3 Collared drain plugs of gunmetal shall be provided for all valves.

8.5.3.4 Stuffing box gland shall be of integral bolted type.

8.5.3.5 Valves shall be with non-rising spindle type.

8.5.3.6 Valves shall be flanged and drilling shall conform to the standard as specified in data sheet.

8.5.3.7 Face to face dimension shall be as per IS 778 PN 1.0.

8.5.3.8 All face and seat rings shall be force fitted and additionally shall be riveted to the recesses in the C.I. casting.

#### **8.5.4 CLEANING:**

Prior to factory inspection, all manufacturing waste such as metal chips, debris and all other foreign material shall be removed from the interior of the valve. All mill scale, rust, oil, grease, chalk and all other material shall be removed from the interior and exterior surfaces.

#### **8.5.5 PAINTING:**

8.5.5.1 Valves shall first be given two coats of zinc base primer after completely cleaning the surface and then it shall be coated with three coats of coal tar epoxy paint. The resulting coating shall be uniform and smooth and adhere perfectly to the surface.

8.5.5.2 Valve used in pipes carrying water, the inside coating shall not contain any constituent soluble in water or any ingredient which could impart any taste or odour to the water

#### **8.5.6 DIRECTION OF FLOW:**

Direction of flow shall coincide with the flow direction indicated by "arrow" cast on the valve body.

#### **8.5.7 TESTS AND INSPECTION:**

8.5.7.1 Valves shall be offered for visual inspection and dimensional check.

8.5.7.2 Valves shall be tested as per IS 778 PN 1.0 with latest amendments.

8.5.7.3 The hydrostatic testing shall be witnessed by the purchaser.

8.5.7.4 Valve shall be dispatched only after visual inspection and clearing instruction for dispatch.

#### **8.5.8 TENDER DRAWINGS:**

The following drawings shall be submitted by Bidder along with the quotation.

8.5.8.1 Preliminary outline dimensional drawings.

8.5.8.2 Typical cross section drawings.

**DOCUMENT: TECHNICAL DATA SHEET FOR GUN METAL GATE VALVE**

<b>SR. NO.</b>	<b>PARTICULARS</b>	<b>PUMP HOUSE</b>
1.0	Type of Valves	Flanged, Non rising spindle type
2.0	Size range and quantity	As per BOQ
3.0	Fluid	Water
4.0	Pressure Rating	Class 1
5.0	Stem	Non Rising
6.0	Ends	Flat faced Flanged as per IS 778 Class 1
7.0	Bonnet	Screwed on
8.0	Disc.	Solid wedge
9.0	Operation	Hand wheel Operation
10.0	Seat	Integral
11.0	Other requirements	Valves shall close in clockwise rotation of the hand wheel.
12.0	Body / bonnet	Leaded Tin Bronze conforming to IS 318, LTB2
13.0	Disc	Leaded Tin Bronze conforming to IS 318, LTB2
14.0	Stem	High Tensile Brass
15.0	Body seat	Bronze IS 318 Gr LTB2
16.0	Disc seat	Bronze IS 318 Gr LTB2
17.0	Stem nut	Bronze IS 318 GR LTB2
18.0	Back Seat Bush	Bronze IS 318 GR LTB2
19.0	Stuffing box	Bronze IS 318 Gr LTB2
20.0	Gland	Bronze IS 318 Gr LTB2
21.0	Packing	Graphited Asbestos
22.0	Bolts, studs & nuts	Carbon Steel IS :1367 Class 4.6 / 4
23.0	Testing :	
	Shell test	15 Kg / Cm <sup>2</sup>
	Seat test	10 Kg / Cm <sup>2</sup>

**8.6 GUN METAL NON RETURN VALVE**

#### **8.6.1 SCOPE:**

This specification covers the supply, installation, testing & commissioning of Gun Metal Non Return Valve with gasket hardware, etc. at site.

#### **8.6.2 CODES AND STANDARDS:**

8.6.2.1 The design and manufacture of the valves shall comply with all currently applicable statutes, regulations and safety codes in the locality where the equipment will be installed. Nothing in this specification shall relieve the vendor of this responsibility. The valve shall be conforming to IS 778 PN 1.0 (Class 1).

#### **8.6.3 DESIGN REQUIREMENTS FOR NON RETURN VALVES:**

8.6.3.1 The non return valves shall be provided with metal seating.

8.6.3.2 The valve shall be mounted horizontally.

8.6.3.3 The valves shall be designed for minimum head loss.

8.6.3.4 Hydraulic passage shall be designed to avoid cavitations.

8.6.3.5 The valves shall have non slam characteristic.

#### **8.6.4 CLEANING:**

8.6.4.1 Prior to factory inspection, all manufacturing waste such as metal chips debris and all other foreign material shall be removed from interior of valve. All mill scale, rust, oil, grease, chalk and all other deleterious material shall be removed from the interior and exterior surfaces.

#### **8.6.5 PAINTING:**

8.6.5.1 Valves shall first be given two coats of zinc base primer after completely cleaning the surface and then it shall be coated with three coats of coal tar epoxy paint. The resulting coating shall be uniform and smooth and shall adhere perfectly to the surface.

8.6.5.2 Valves used in pipes carrying water, the inside coating shall not contain any constituent soluble in water or any ingredient which could impart any taste or odour to the water.

#### **8.6.6 TESTS AND INSPECTION:**

8.6.6.1 Valves shall be tested as per the relevant Standards with latest revisions.

8.6.6.2 Valves shall be offered for visual inspection and dimensional checks.

8.6.6.3 The hydrostatic and water tightness testing shall be witnessed by the purchaser.

8.6.6.4 Valve shall be offered for inspection and following tests. (Before painting) at Vendor's shop.

- Visual inspection with dimensional checks.
- Hydrostatic test

#### **8.6.7 TENDER DRAWINGS:**

The following drawings shall be submitted by tenderer along with their offer.

8.6.7.1 Preliminary outlines dimensional drawings.

8.6.7.2 Typical cross section drawings.

8.6.7.3 Flow v/s head loss curve for Non-return valves



<b>SR. NO.</b>	<b>PARTICULARS</b>	<b>PUMP HOUSE</b>
1.0	Type of Valves	Flanged, Single door Swing type
2.0	Size range and quantity	As per BOQ
3.0	Fluid	Domestic Water
4.0	Pressure Rating	Class 1
5.0	Ends	Flat faced Flanged as per IS 778 Class 1
6.0	Bonnet	Screwed On
7.0	Disc.	Single door swing type
8.0	Seat	Integral
9.0	Body / bonnet	Leaded Tin Bronze conforming to IS 318, LTB2
10.0	Disc	Leaded Tin Bronze conforming to IS 318, LTB2
11.0	Hinge pin	High Tensile Brass
12.0	Body seat	Bronze IS 318 Gr LTB2
13.0	Disc seat	Bronze IS 318 Gr LTB2
14.0	Back Seat Bush	Bronze IS 318 GR LTB2
15.0	Stuffing box	Bronze IS 318 Gr LTB2
16.0	Gland	Bronze IS 318 Gr LTB2
17.0	Packing	Graphited Asbestos
18.0	Bolts, studs & nuts	Carbon Steel IS :1367 Class 4.6 / 4
19.0	Testing :	
19.1	Shell test	15 Kg / Cm <sup>2</sup>
19.2	Seat test	10 Kg / Cm <sup>2</sup>

**9.0 LIST OF APPROVED MAKES:**

<b>Sr. No.</b>	<b>Item</b>	<b>Approved Make</b>
1	SWR PVC PIPE & FITTINGS 6 KG CM <sup>2</sup> ; FITTINGS : 6 KG CM <sup>2</sup> ECO. DRAIN PIPE & FITTINGS	FINOLEX / SUPREME/PRINCE SUPREME/ ASTRAL
2	GULLY TRAP	GIRCO / TIRUMALA / SONIA/ SUPREME/ ASTRAL
3	STONE WARE PIPES	GIRCO / TIRUMALA / SONIA
4	RCC HUME PIPES	INDIAN HUME PIPE / PRANALI
5	C.I. PIPE & FITTINGS	NICO OR EQ.
6	PPR PIPES & PPR FITTINGS	SUREME/PRINCE/
7	M.S/G.I. PIPES FOR WATER SUPPLY	TATA / JINDAL/ SWASTIK
8	ASTM/CPVC PIPE & FITTINGS FOR WATER SUPPLY	ASTRAL / SUPREME/ASHIRWAD /
9	COMPOSITE PLUMBING PIPE & COMPOSITE FITTINGS	KITEC OR EQ.
10	G.I. PIPES FITTINGS WATER SUPPLY	DRP-M / R-BRAND / ZOLOTO
11	GI TO GI JOINTS	CHAMPION / EQUIVALENT
12	SOLVENT CEMENT	SUPREME / KISSAN / FINOLEX
13	BALL VALVES	LEADER / ZOLOTO / AUDCO
14	WHEEL VALVES	LEADER / ZOLOTO/AUDCO
15	DCV / NRV	ZOLOTO/SPIREX/AUDCO
16	TAR	SHALIBIND / TIKIBOND-BS
17	SELF PRIMING SEWAGE PUMPS	HBD / GRUNDFOS
18	VALVES	AUDCO/ZOLOTO / R.B. / KBL / KSB
21	PRESSURE GAUGE	BELLS / H GURU
22	BOTTLE TRAP & WASTE COUPLING	JAQUAR / KHOLAR
23	DEWATERING PUMPS	GROUNDFOSS/KIRLOSKER/ KSB
24	HYDROPNEUMATIC SYSTEM	GRUNDFOSS OR EQUIVALENT
25	SANITARY FIXTURES	HINDWARE / PARRYWARE / CERA /KHOLAR
26	METALLIC BELLOWS	BELLOW FLEX / PRICISION / DHRUV / B.D. ENGR.
27	SOLAR SYSTEM	SOAHEART/RECOLD/TATA-BP
28	ELECTRIC GEYSER	A-O SMITH/ RECOLD/SPHERHOT
29	SEWAGE TREATMENT PLANT	THERMAX / ION EXCAHNGE / EQUIVALNET

- NOTE : (1) Equivalent makes shall be approved by PMC before procurement  
(2) Make & Model No. of Sanitary & Bath Fixtures will be finalized by the Architect.

**MAKE OF MATERIAL**

SR.NO.	ITEM	STANDARD MAKE
1	HT VCB	ABB / SIEMENS / SCHNEIDER
2	H.T. CABLE ( XLPE )	FINOLEX / GLOSTER / RAVIN / AVOCAB
3	TRANSFORMERS	VOLTAMP / CROMPTON / AREVA
4	BUSDUCT / BUSBAR TRUNKING	LEGRAND/SQUARE D / SIEMENS
5	DG ENGINE	VOLVO PENTA / CATER PILLAR / PERKINS / MITSUBISHI
6	DG ALTERNATOR	STAMFORD / LEROY SOMMERS
7	LT PANELS	MARINE ELECTRICALS / NOEL ELECTRICALS / J J INDUSTRIES / JAGRUTI ELECTRICALS PVT. LTD.
8	DISTRIBUTION BOARDS	LEGRAND / SCHNEIDER / SIEMENS,ABB
9	MEDIUM VOLTAGE CABLE	FINOLEX / GLOSTER / RAVIN / AVOCAB
10	CABLE TRAY ( LADDER TYPE / PERFORATED)	OBO BETTERMANN
11	UPS	EMERSON / APC
12	SPD (SURGE ARRESTER)	PHEONIX CONTACT / OBO BETTERMANN
13	LT SWITCHGEAR (ALL RANGE)	SIEMENS / SCHNEIDER / L & T /ABB
14	LT CONTACTORS	SIEMENS / SCHNEIDER ELECTRIC / L & T
15	BUSBAR SUPPORT	POWERMAT OR EQUIVALENT
16	METERS (ANALOG)	CONSERVE / DIEF
17	METERS (DIGITAL)	NIPPEN / CONSERVE / DIEF
18	ENERGY METER	SCHNEIDER / L&T / DIEF
19	LOAD MANAGER	SCHNEIDER / CONSERVE/ DIEF
20	RELAYS	SIEMENS / AREVA / SCHNEIDER / ABB / DIEF
21	INDICATING LAMPS	SIEMENS / SCHNEIDER / L & T / MG / SALZER
22	LIGHTING AUTOMATION SYSTEM	SCHNEIDER/LEGRAND/HONEYWELL /ABB/SIEMENS
23	ELECTRIC TIMER	SIEMENS / LEGRAND / L&T
24	ROTARY SWITCH	SIEMENS / KEYCEE / SALZER

**MAKE OF MATERIAL**

SR.NO.	ITEM	STANDARD MAKE
25	PUSH BUTTON AND PUSH BUTTON SET	SIEMENS / SCHNEIDER ELECTRIC / L & T
26	SELECTOR SWITCH	KEYCEE / SALZER
27	APFC RELAY (3 CT CONTROLLER)	ENERCON / BELUK / EPCOS /
28	LT CAPACITORS	L & T / EPCOS / PMX / SHREEM
29	LUGS	DOWELL'S / 3D / JAINSON / COMET / HMI
30	BIMETALLIC LUGS	HMI / HEX / CONNECT
31	CABLE GLAND	JAINSON / 3D / COMET / HMI
32	PVC CONDUITS AND ACCESSORIES	PRECISION / DIAMOND
33	M.S. CONDUIT AND ACCESSORIES	AKG / BEC / STEELCRAFT
34	MODULAR SWITCHES, SOCKETS & OTHER ACCESSORIES	LEGRAND(ARTEOR / BITICHINO) / MK – EQUIVALENT TO LEGRAND BITICHINO RANGE
35	METAL CLAD SOCKET WITH MCB	LEGRAND
36	PVC TAPE	STEEL GRIP
37	PVC JUNCTION BOX	HENSEL / CLIPSAL
38	WIRES FOR INTERNAL WIRING	FINOLEX / RAJNIGANDHA / RR KABEL
39	FLEXIBLE WIRES	FINOLEX / RAJNIGANDHA / RR KABEL
40	TELEPHONE CABLE	DIGILINK / POLYCAB / FINOLEX
41	COAXIAL TV CABLE	DELTON / HAVELLS / POLYCAB / FINOLEX
42	DATA CABLE (CAT 6/6 A)	DIGILINK / LAPP INDIA / AVAYA
43	MULTICORE FLEXIBLE CABLE	FINOLEX / POLYCAB / HAVELLS
44	FIRE ALARM SYSTEM	BOSCH / NOTIFIER / HONEYWELL – ESSER / SIEMENS / MORLEY
45	FIRE ALARM & MUSIC WIRE	LAPP INDIA / FINOLEX

**MAKE OF MATERIAL**

SR.NO.	ITEM	STANDARD MAKE
46	CONNECTORS (COLOURS AS PER PHASE & NEUTRAL)	WAGO / PHOENIX CONTACT
47	FUNCTIONAL LIGHT FIXTURES	PHILIPS / THORN / ZUMTOBEL
48	DECORATIVE LIGHT LUMINAIRE	ARTLITE / THORN / ZUMTOBEL / PHILIPS
49	OUTDOOR DECORATIVE LIGHT LUMINAIRE	ARTLITE / THORN / ZUMTOBEL / PHILIPS
50	CONTROL TRANSFORMER [ PT / CT ]	ASHMOR / KAPPA / NEWTEK
51	PAINT	NEROLAC / ASIAN PAINTS
52	CEILING FAN / EXHAUST FAN	CROMPTON / BAJAJ / ORIENT / HAVELLS
53	FLOOR TRUNKING	MK / LEGRAND / OBO BETTERMANN
54	FLOOR JUNCTION BOX	LEGRAND / MK / OBO BETTERMANN
55	PA SYSTEM SPEAKERS	BOSCH / PHILIPS
56	MULTIPLEXER	PELCO / PHILIPS
57	CCTV MONITOR	SAMSUNG / SONY
58	CCTV CAMERA	SIEMENS/PELCO/ HONEYWELL / AVTRON
59	FIRE EXTINGUISHER	FIREEX, MINIMEX
60	INVERTER	XSI / APC/ MICROTECH
61	ACCESS CARD SYSTEM	SIEMENS / HONEYWELL / SCHNEIDER
62	DATA SWITCH	CISCO / D-LINK / IBM / SIEMENS / AWAYA
63	CAT-6	D-LINK / AWAYA
64	EPABX	AWAYA-NORTEL / SIEMENS
65	DG SET CONTROLLER / SYNCRONISING CONTROLLER	DEIF / WOODWARDS
66	EARTHING AND EARTHING ACCESSORIES	OBO BETTERMANN / FURSE

**MAKE OF MATERIAL**

SR.NO.	ITEM	STANDARD MAKE
67	LIGHTNING PROTECTION SYSTEM SPECIALIST VENDOR	OBO BETTERMANN / FURSE
68	CO-AXIAL CABLES	FINOLEX / BELDEN

# **TECHNICAL SPECIFICATIONS FOR SUPPLY OF DISTRIBUTION TRANSFORMER (OIL TYPE)**

**TECHNICAL SPECIFICATIONS FOR DISTRIBUTION TRANSFORMER (OIL TYPE)****1.0 SCOPE OF WORK**

- 1.1 This specification are intended to cover engineering, design, manufacture, assembly, testing at manufacturer's works, packing and forwarding, delivery and transportation F.O.R. site of Transformer complete in all respect with all equipment, fittings and accessories for efficient and trouble-free operation as per the technical specified below

**2.0 CODES & STANDARDS**

- 2.1 The design, material, construction, manufacture, inspection, testing and performance of power transformers shall comply with all currently applicable statutes, regulations and safety codes in the locality where the equipment will be installed. The equipment shall also conform to the latest applicable standards and codes of practice.
- 2.2 Transformers shall conform to the current applicable standards and codes of practice as specified as under. In case of conflict between the applicable reference standards and this specification, this specification shall govern.

Sr.	Item	Relevant IS	Relevant IEC
1	Power transformer	IS 2026	IEC 76
2	Fittings & Accessories	IS 3639	
3	Climate Proofing	IS 3202	IEC 354
4	Loading of Transformer	IS 6600	IEC 296
5	Oil	IS 335	IEC 137
6	Bushings	IS 20650	IEC 144
7	Degree of Protection	IS 2147	IEC 76
8	Testing, Tolerances on guaranteed Particulars	IS 2026	IEC 76
9	Buchholz Relay	IS 3637	
10	Electrical Insulation	IS 1271	IEC 85

**3.0 DESIGN BASIS & SITE CONDITIONS**

- 3.1 All the equipment and components provided in the transformer and accessories shall be suitably designed for installation and satisfactory operation as specified below.

Site conditions	
Location Tripura	Site altitude 560M-800M above mean sea level
Ambient temperature	Relative humidity



Maximum <b>41</b> ° C		Maximum <b>85</b> %	
Minimum <b>05</b> ° C		Minimum <b>35</b> %	
Design <b>45</b> ° C		Design <b>90</b> % at <b>45</b> ° C	
<b>Seismic factor Zone IV</b> as per IS:1893		<b>Rainfall 722 mm/year</b>	
<b>Environmental Tropical/wet &amp; Dry climate</b>		<b>Location of Equipment Outdoor</b>	
<b>Wind speed annual avg 4.35</b>			
<b>Electrical system data:</b>			
<b>Power supply for Equipment</b>			
Voltage <b>11 kV ± 15 %</b>		Frequency <b>50 Hz ± 3 %</b>	
<b>Permissible combined voltage &amp; frequency variation</b>	<b>± 6 %</b>	<b>System design faults level (Symmetrical)</b>	<b>32 kA for 1 sec. max.</b>
<b>System earthing LV side neutral solidly earthed</b>		<b>Wiring 3 phase, 3 wire on 11kV system 3 phase, 4 wire on 415V system</b>	
<b>Auxiliary power supply :</b>			
<b>Power supply</b>		<b>240V AC, 1-Ph, 50Hz</b>	
<b>Control Supply</b>		-----	
<b>Space heater power supply</b>		<b>240V AC, 1-Ph, 50Hz</b>	
<b>Illumination power supply</b>		<b>240V AC, 1-Ph, 50Hz</b>	
<b>Plug-socket power supply</b>		<b>240V AC, 1-Ph, 50Hz</b>	

#### 4.0 TECHNICAL REQUIREMENTS

##### 4.1 GENERAL CONSTRUCTIONAL FEATURES

- 4.1.1 The transformer shall be able to withstand a short circuit between phases and between phase to ground at one side for 5 sec. without damage maintaining rated voltage on the other non-affected side. It shall be capable of withstanding without permanent damage the thermal and dynamic stresses resulting from short-circuit symmetrical R.M.S. and asymmetrical peak currents. Thermal capability shall be sufficient to allow short-circuit current to flow for the specified time without any damage to the equipment.

The Bidder shall provide necessary proof to prove the dynamic stability of the transformer proposed to be supplied to withstand the short-circuit either by testing or by submitting the Test Certificates for testing conducted on similar transformer at Government recognized Testing Laboratory (CPRI, ERDA, etc.). The Certificate shall be applicable to the configuration of transformer proposed to be supplied and tested at not less than the circuit fault levels specified on the Data Sheets.

- 4.1.2 Similar parts, particularly removable ones, shall be interchangeable.
- 4.1.3 Pipes and pipe fittings, screws, studs, nuts and bolts used for external connections shall be as per the relevant standards. Bolts and nuts exposed to atmosphere shall be galvanized.
- 4.1.4 Nuts, bolts and pins used inside the transformers and tap changer compartments shall be provided with lock washers or locknuts.
- 4.1.5 Exposed parts shall not leave pockets where water can collect.
- 4.1.6 Internal design of transformer shall ensure that air is not trapped in any location.
- 4.1.7 Facility shall be provided for lubrication of bearings and mechanisms.
- 4.1.8 Materials in contact with oil shall be such as not to contribute to the formation of acid in oil. Surface in contact with oil shall not be galvanized or cadmium plated.
- 4.1.9 Labels shall be provided for all identifiable accessories like relays, switches, fans, current transformers etc. All label plates shall be of non-corrosive material.
- 4.1.10 All internal connections and fastenings shall be capable of operating under overloads and over-excitation allowed as per specified standards without injury.

#### 4.2 PAINTING

- 4.2.1 The interior of all transformer tanks and other oil filled chambers and internal structural steel work shall be cleaned of all scale and dust by shot blasting unless otherwise approved. These surfaces shall be painted with not less than two coats of heat resistant, oil insoluble and insulating varnish. Steel surfaces exposed to the weather shall be thoroughly cleaned and have a priming coat of zinc chromate applied. The second coat shall be of an oil and weather resistant nature, preferably of distinct colour from the prime and finish coats. The final coat shall be of a glossy oil and weather resisting non fading paint of specified shade.
- 4.2.2 Metal parts not accessible for painting shall be made of corrosion-resistant material.
- 4.2.3 Interior surfaces of mechanism chambers and marshalling kiosks shall receive three coats of paint after proper cleaning. The final coat shall be of a light colour anti-condensation paint.

#### 4.3 ELECTRICAL AND PERFORMANCE REQUIREMENTS

- 4.3.1 Transformers shall operate without injurious heating at the rated kV at any voltage within +7.5% to –7.5 % of the rated voltage of that particular tap.
- 4.3.2 Transformers shall be capable of delivering the rated current at a voltage equal to 105 percent of the rated voltage without exceeding the limiting temperature rise.
- 4.3.3 Unless otherwise specified, transformers shall be designed for operation at a frequency of 50 Hz.
- 4.3.4 The maximum flux density in any part of the core and yokes, at normal voltage and frequency shall be such that the flux density under over voltage conditions shall not exceed the maximum permissible values for the type of core and yoke material used. The type of material and values of flux density in the core/ yoke for the 100%, 125% and 140% and the hysteric characteristic curves shall be included in the Bid, and shall be subject to approval. In case of transformers with variable flux density the voltage variation which affects the flux density at every tap shall be kept in view while designing transformers.

- 4.3.5 Unless otherwise specified, transformers shall be designed for the following over fluxing withstand capability:
- 110% - Continuous for all transformers.
  - Transformers shall operate below the knee of the saturation curve at 110 percent voltage to reduce ferro resonance and non-linear oscillations.
- 4.3.6 Unless otherwise stated, transformers shall be capable of operation continuously, in accordance with the applicable standard loading guide at their rated kVA and at any of the specified voltage ratios.
- 4.3.7 Overloads shall be allowed within the conditions defined in the loading guide of the applicable standard. Under these conditions, no limitations by terminal bushings, on-load tap changers or other auxiliary equipment shall apply.
1. Transformer core shall be built up of low loss non-ageing, cold rolled grain oriented silicon steel insulated laminations. Adequate cooling ducts shall be provided. Transformer tanks shall be of robust construction fabricated out of M.S. plate. All welded joints and valves shall be tested after fabrication of the tank to withstand up pressure of 1.0 kg/sq.cm. in excess of the static head of oil. Bolted joints shall carry non-deteriorating -gaskets.
  2. Transformer cooling shall be as specified under equipment schedule with fixed or removable radiator tubes of seamless construction and adequately braced to the tank.
  3. All normal fittings required under section 14 of IS: 2026 - Part I shall be provided. Additional fittings shall also be provided as stipulated in the Datasheet.
  4. The transformer shall be supplied with oil conforming to IS: 335. The transformer shall be delivered after drying out and ready to put into commissioning without further drying out at site.
  5. The thermal ability to withstand short circuit shall be demonstrated by the calculations.
  6. The dynamic ability to withstand short circuit shall be demonstrated by reference to tests on similar transformers.
  7. Every care shall be taken to ensure that the design and manufacture of all transformers shall be such as to reduce noise and vibration to the level obtained in good modern practice.
  8. The transformers shall be designed with particular attention to the suppression of harmonic voltage, especially the third and fifth, so as to eliminate wave form distortion and from any possibility of high frequency disturbances reaching such a magnitude as to cause interference with communication circuits.
  9. All rated quantities subject to the guarantees shall be within the tolerances given in applicable standards.
  10. The finally assembled core with all the clamping structures shall be free from deformation and shall not vibrate during operation.
  11. All internal metal parts of the transformer, with the exception of individual laminations, core bolts and their individual laminations, core bolts and their individual clamping plates shall be earthen.
  12. Windings shall be subjected to a shrinking and seasoning process, so that no further shrinkage occurs during service. Adjustable devices shall be provided for taking up possible shrinkage in service.
  13. Materials used in the insulation and assembly of the windings shall be insoluble, non-catalytic and chemically inactive in the hot transformer oil, and shall not soften or be otherwise affected under the operating conditions.
  14. The completed core and coil assembly shall be dried in vacuum at not more than 0.5 mm of mercury absolute pressure and shall be immediately impregnated with

oil after the drying process to ensure the elimination of air and moisture within the insulation. Vacuum may be applied in either vacuum oven tank or in the transformer tank.

#### 4.4 VALVES

- 4.4.1 Valves shall be of forged carbon steel up to 50 mm size and of gun-metal or of cast iron bodies with gun-metal fittings for sizes above 50 mm. They shall be of full-way type with screwed ends and shall be opened by turning counter clockwise when facing the hand wheel. There shall be no oil leakage when the valves are in closed position.
- 4.4.2 Every valve shall be provided with an indicator to show the open and closed positions and shall be provided with facility for padlocking in either open or closed position. All screwed valves shall be furnished with pipe plugs for protection.
- 4.4.3 All valves shall be provided with flanges having machined faces drilled to suit the applicable requirements. Oil-tight blank flanges shall be provided for each connection for use when any radiator is detached and for all valves opening to atmosphere. If any special radiator valve tools are required, the same shall be provided.

#### 4.5 TRANSFORMER COOLING EQUIPMENT

- 4.5.1 Radiators and coolers shall be designed to withstand the vacuum and pressure conditions specified for the tank. They shall be so designed as to avoid pockets in which moisture may collect, to completely drain oil into the tank and to prevent formation of gas pockets when the tank is being filled.
- 4.5.2 The clearance between all pipe work and live parts shall be more than the clearance for live parts to earth.
- 4.5.3 Unless otherwise approved, for transformers rated 1000 kVA and above, tank mounted radiators/coolers shall be of the detachable type with bolted and gasketed flanged connections.

#### 4.6 TAPS AND TAP CHANGE GEAR:

- 4.6.1 Tapings shall be On Load/Off Load (where ever applicable as mentioned in data sheets) and brought out from HV winding and terminated in an external motor operated tap switch with position indicator. Transformer output shall remain unaffected for any tap position.

#### 4.7 ON LOAD TAP CHANGE GEAR (IF APPLICABLE) :-

- 4.7.1 The tap changers shall be of ON circuit type mechanically rugged and arranged to provide for convenient inspection and maintenance without necessity for un-tanking. The position indicators shall be positive and there shall not be any ambiguity resulting into incomplete tap change with respect to the mechanical tap position indication. The operating handle of tap exchanger shall be brought out of the tank at the side at an accessible height from ground level. Tap changer operating switch mounted on the top of the transformer tanks will not be acceptable. Provision of padlocking the tap changers without interfering with visual tap position indicator shall be provided.
- 4.7.2 The main current carrying fixed and moving contacts shall be made of copper. The contacts performing making and breaking of current shall be of copper-tungsten to prevent contact erosion due to arcing.
- The compartment housing the assembly of selector switch shall be filled with the transformer oil.
- 4.7.3 The driving mechanism of OLTC shall comply with all the following requirements.
- Stored energy spring device with positive snap action for rotating moving contacts,

and spring carrying gear wheel to be rotated by a motor through a reduction gear, i.e. stored energy type mechanism.

Ability of motor to drive the mechanism for tap changing in the event of failure of stored energy spring device.

Facility for manual hand driving of mechanism.

- 4.7.4 The drive mechanism shall ensure positive operation of the selector switch by its dependence only on quick release of the stored energy by the spring and shall be independent of the motorized drive.

In order to prevent over-running of OLTC, the limit switches for both directions and mechanical type stop shall be provided.

- 4.7.5 OLTC tap changing driving mechanism motor shall be of squirrel cage totally enclosed type and shall comply with the specified Indian Standard. The motor shall be suitable for 415V, 3-ph, 50 Hz power supply and starting direct on line. The motor shall be designed to continuously operate at any frequency between 48 to 50 Hz in both directions. The motor shall have bearings capable of withstanding thrust due to the weight of the moving parts.

#### 4.8 LOSSES

- 4.8.1 The iron losses and copper losses shall be as mentioned in data sheet.

- 4.8.2 Bids will be evaluated based on the CBIP formula.

- 4.8.3 For the purpose of evaluation of Bids, the quoted load losses and iron losses shall be increased to take into consideration tolerance as permitted by applicable standards and as quoted.

In case of non-achievability of the losses at the time of testing, the contractor shall be penalized at the rate of Rs. 251423 per KW for iron losses & Rs. 75427 per KW for Copper losses.

#### 4.9 REJECTION

- 4.9.1 The client may reject any transformer if during tests or service any of the following conditions arise:

1. No load loss exceeds the guaranteed value by 20% or more.
2. Load loss exceeds the guaranteed value by 20% or more.
3. Impedance value exceeds the guaranteed value by + or - 10% or more.
4. The difference in impedance values of any two phases during single phase short circuit impedance test exceeds 2 percent of the average value guaranteed by the BIDDER.
5. Oil or winding temperature rise exceeds the specified value by 5 Deg.Cent.
6. Transformer fails on impulse test.
7. Transformer fails on power frequency voltage withstand test.
8. Transformer is proved to have been manufactured not in accordance with agreed specification.

- 4.9.2 The client reserves the right to retain the rejected transformer and take it into service until the BIDDER replace, at no extra cost, the defective transformer by a new transformer. Alternatively, the BIDDER shall repair or the replace the transformer within a reasonable period to the client satisfaction at no extra cost.

### 5.0 DRAWINGS & INFORMATION

### 5.1 ALONGWITH OFFER

5.1.1 The bidder shall submit completely filled data sheet as per the given format along with GA drawing indicating list of accessories.

Submit list of spare parts required for safe operation of equipment for **Two years**.

### 5.2 HANDING OVER DOCUMENTS

5.2.1 The supplier shall submit following:

1. GA drawing
2. HV/LV Cable Box
3. Foundation layout
4. Rating and Diagram Plate
5. Data sheet indicating results of tests
6. Test reports
7. O & M manuals

## 6.0 INSPECTION AND TESTING

6.1 Following tests should be preformed as acceptance test at **manufacturing place**,

1. Measurement of winding resistance at all taps
2. Measurement of voltage ratio and check' of voltage vector relationship
3. Measurement of impedance volt age/short-circuit impedance (principal tapping) and load loss
4. Measurement of no-load loss and current
5. Measurement of insulation resistance
6. BDV of insulating oil
7. Tests on on-load tap-changers
8. Magnetic balance test
9. Functioning of equipments at marshalling box
10. Submission of test reports and certificates for all the bought out components from the sub-suppliers for the tests carried out at the respective manufacturer's works
11. Calibration reports of meters used during testing
12. Any other special test, if asked for in data sheet

## 7.0 METHOD OF MEASUREMENT

7.1 Supply of the transformer including transport to site, loading and unloading etc. as specified will be treated as one unit for measurement and payment.

## 8.0 TRANSPORT, DELIVERY AND STORAGE

8.1 The prices shall be **F.O.R. site basis** including packing & forwarding charges. The quoted price must include all the costs for necessary mode of transportation up to the final location of transformer or site store. The transformer should be supplied with required storage arrangements suitable for placing in open storage yard. All incidental expenses during transportation shall be part of quoted prices including **transit insurance**. The charges for loading and unloading of equipments at site should form part of offer.

- 8.2 The transportation for any auxiliary item or detachable part of equipment should be simultaneous and carry necessary instructions for assembling and storage requirements.
- 8.3 The transformers and all associated oil-filled equipment shall generally be supplied completely filled with the oil along **with 10% excess quantity of oil** in the sealed non-returnable drums. The oil shall be new conforming to IS: 335 and shall be free from moisture and other impurities harmful to the transformer and shall have uniform quality throughout.

## 9.0 GUARANTEE AND WARRANTY

- 9.1 The Bidder shall stand guarantee for the performance of entire equipment and components for twelve (12) months from the date of commissioning or eighteen (18) months from the date of dispatch, whichever is earlier, as agreed up on and as reproduced in the purchase order within the tolerance specified or as permitted by the relevant standards for the equipment in his scope of supply. The Purchaser also reserves the right to use the rejected equipment or part thereof until the new equipment meeting the guaranteed performance is supplied by the Bidder.

## 10.0 SPARES

- 10.1 The bidder shall quote for minimum spares required for **two years** safe operation of transformer along with the offer separately.

## 11.0 ATTACHMENTS

- 11.1 • **Data sheet**

### DATASHEET

SR.	PARTICULAR	DETAILS	DATA TO BE FILLED BY THE BIDDER
<b>1.0</b>	<b>GENERAL FEATURES</b>		
1.1	Make		
1.2	Installation	Outdoor	
1.3	Service	Continuous	
1.4	Climate	Tropical, dusty, Humid	
1.5	Type of cooling	ONAN	
1.7	Allowable temperature rise	Oil - 50 deg.c. Winding - 55 deg.c.	
1.8	Painting	Epoxy, shade no. 631 as per IS:	
1.9	Oil type	Mineral oil	
1.10	Position	Plinth mounted	
<b>2.0</b>	<b>ELECTRICAL DATA:</b>		
2.1	Earthing: L.V. side	Solid	
2.2	No. of windings	Two	
2.3	Phase	3	
2.4	Frequency	50 Hz.	
2.5	Voltage ratio	11/0.433 V	
2.6	Phase connection	Delta – Star	
2.7	Vector group	Dyn – 11	
2.8	% impedance	Max. 5% without IS tolerance	

SR.	PARTICULAR	DETAILS	DATA TO BE FILLED BY THE BIDDER
2.9	Rating in KVA	1 Nos. 630 kVA	
2.10	Winding insulation class	"A"	
2.11	Terminations:	Cable box Disconnecting Type cable box with rain protected system at Horizontal/Vertical joints. Size: 1 No., 3 c x 240 mm. <sup>2</sup> AL H XLPE (E) CABLE.	
a)	H.V. side		
b)	L.V. side	Cable box Disconnecting Type cable box with rain protected system at Horizontal/Vertical joints. Size: As per SLD	
2.12	HV & LV separation:	180 Degree	
<b>3.0</b>	<b>TAP CHANGER:</b>		
3.1	Tapings	H.V.	
3.2	Tap changer	OFF load	
3.3	Tapping range	-5 % to +5%(630KVA)	
3.4	No. of steps	in steps of 2.5%	
<b>4.0</b>	<b>Limit for transformer operation under over load condition as per IS</b>	Required	
<b>5.0</b>	<b>ACCESSORIES:</b>		
	Double float Buchholz relay with alarm & trip contacts Marshalling box Sampling valve Plain oil level gauge Conservator & conservator drain valve Bidirectional rollers Oil temp. indicator with alarm & trip contacts Bottom drain/Filtre valve Double diaphragm Explosion vent Silica-gel breather Air release plug	Required	
	Separate neutral bushing Top oil filter valve Jacking pads Lifting lug Earthing terminal 1 set of detachable radiator with shutoff valve Winding temp. indicator with alarm & trip contacts Rating and diagram plate HV & LV gland plate	Required	
<b>6.0</b>	<b>PERFORMANCE DATA:</b>		
6.1	Rated guaranteed loses without IS tolerance		
a)	No load at 100% voltage	Required	
b)	Full load Cu. Loss	Required	
6.2	Rated No load current	Required	
a)	No load at 100% voltage		
6.3	Rated efficiency at 0.8 P.F.	Required	



SR.	PARTICULAR	DETAILS	DATA TO BE FILLED BY THE BIDDER
a) b) c)	At full load At 75% load At 50% load		
6.4 a) b) c)	Rated regulation At 0.9 P.F. lag At 0.8 P.F. lag At unity P.F.	Required	
6.5 a)	Impedance voltage Primary – Secondary	Required	
6.6	Load at which max. efficiency occurs	Required	
6.7	Maximum efficiency	Required	
6.8	Maximum flux density	Required	
6.9	Current density	Required	
<b>7.0</b>	<b>MECHANICAL DATA:</b>	Required	
7.1 a)	Weight: Core & windings	Required	
7.2	Dimensions (mm.): (Dimensions should be considered including all accessories)	Required	

# **TECHNICAL SPECIFICATIONS FOR INSTALLATION OF EXTERNAL LIGHTING**

**TECHNICAL SPECIFICATIONS FOR INSTALLATION OF EXTERNAL LIGHTING****1.0 SCOPE**

1.1 This section relates to specifications for installation, connection, testing and commissioning of street lighting and flood lighting installation of the project.

The job comprises of the following:

1. Lighting pole
2. Cable laying
3. Wiring to the fixture
4. Earthing

**2.0 CODES & STANDARDS**

2.1 The following standards and rules shall be applicable:

- IS 1913: General and safety requirements for light fittings.  
IS 1944: Code of practice for lighting public thoroughfares.  
IS 3528: Water proof electric lighting fittings.  
IS 3553: Water tight electric lighting fittings.  
IS 1239: M.S. tubular and other wrought steel pipe fittings.  
IS 10322: Luminaire for street lighting. (Parts/Sec. 3)

Indian Electricity Act and rules.

All codes and standards mean the latest. Where not specified otherwise the installation shall generally follow the Indian Standard Code of Practice or the British Standard Code of Practice in the absence of Indian Standard.

**3.0 MATERIALS REQUIRED**

3.1

**4.0 INSTALLATION OF SYSTEM**

4.1 Street lighting installation shall be carried out as per details shown in the drawing.

4.2 The poles shall be erected in perfect plumb with concrete foundation at a location shown in the drawing. The foundation shall be designed to withstand the static load as well as wind velocity and bending moment of the pole and shall be approved by the client prior to execution.

4.3 The junction box shall then be clamped to the erected pole as per details shown in the drawing.

4.4 The luminaires shall also be installed on the pole and be electrically wired to the respective junction box.

4.5 The cable lay out shall follow the tentative route as shown in the drawing. In case of any constraint on the cable route the same shall be brought to notice of the client.

4.6 The cable lay out shall be carried out in an underground manner and the said installation complete with electric connections.

4.7 Earthing installation shall follow the details for the same shown in the drawing.

4.8 The earthing station (coil type) and the earthing grid installation shall be carried out as

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per the specification for the said works given in section under title “Earthing” of this tender document.

- 4.9 On completion of the installation, the street light poles shall be painted with two coats of metal primer (Red Oxide) followed by two coats of Synthetic enamel of the shade as approved by the Engineer-in-charge.
- 4.10 The brackets shall be made of 38 mm. NB MS class “B” pipe approx. 1.8 mtr. long bent at the centre at an angle 120° C. with necessary holding brackets, hold fasts etc. with special reducer at the end to accommodate type of street light fitting to be fixed. Bracket shall have 1 coat of anti-corrosion paint before despatch to site and 2 coats of approved make and shade of aluminium paint. This bracket shall also be provided with one M.S. water tight box complete with the connector, neutral link, rewirable fuse etc.. See enclosed drawings of street light poles.
- 4.11 Installation of poles shall be done as per enclosed drawings of street light poles. The depth of pole to be buried in ground shall be 1/5th of the total pole length or as specified in drawing, whichever is more. Special care shall be taken in erecting poles so that these are not strained or damaged during erection and are firmly stayed till the foundation are secured. The pole shall be grouted inside ground pit (cross-section 600 x 600 mm.) with cement concrete 1:2:4. Before the placement of concrete around pole in the pit, necessary conduit pipes (not less than 25 mm. dia.) shall be placed for facilitating drawing of cables. Separate conduit shall be provided for incoming and outgoing cables. The cement concrete shall be protected from prematured drying by curing for atleast 7 days after pouring. All concrete surface from 150 mm. below ground level to top shall be finished smooth with cement mortar 1:4.
- 4.12 This includes fixing of street light fittings complete with accessories and lamps at the end of the pole/bracket, connecting it with 3 x 2.5 mm.<sup>2</sup> aluminium conductor, PVC insulated cable from water tight M.S. box, testing, commissioning. Third core shall be connected with earthing point of light fitting at one end and earthing point of marshalling box at the other end.

## 5.0 INSPECTION & TESTING

- 5.1 NA

## 6.0 METHOD OF MEASUREMENT

- 6.1 NA

# **TECHNICAL SPECIFICATIONS FOR INSTALLATION OF EARTHING SYSTEM**

**TECHNICAL SPECIFICATIONS FOR INSTALLATION OF EARTHING SYSTEM**

**1.0 SCOPE OF WORK**

1.1 This specification intended to cover assembly, installation and testing of earthing system complete in all respect with all equipments, fittings and accessories for efficient and trouble-free operation. The material to be supplied by the Contractor and work to be carried out by the Contractor shall be in general, but not limited to, conforming to the specification laid down for each item.

**2.0 CODES & STANDARDS**

2.1 The design, material, assembling, inspection and testing shall comply with all currently applicable statutes, regulations and safety codes in the locality where the system will be installed. The equipment shall also conform to the latest applicable standards and codes of practice as mentioned below.

2.2

Sr.	Item	Relevant IS
1	Code of Practice for Earthing	IS 3043
2	Insulation Co-ordination Application Guide	IS 3716
3	Code of Practice for Protection of Buildings and Allied Structures against Lightning	IS 2309
4	Indian Electricity Rules, 1956	
5	Indian Electricity Act, 1910	
6	National Electrical Code	

**3.0 MATERIALS REQUIRED**

3.1 All required hardware such as bolts, nuts, washers (round and spring type), anchor fasteners, screws, etc. of sizes and type as required shall be conforming to relevant IS. All hardware shall be hot-dip galvanized or zinc passivated /cadmium plated as per requirement of work either mechanical fabrication or electrical jointing.

3.2 All other items required for installation shall be as approved by site in-charge.

**4.0 INSTALLATION OF SYSTEM**

4.1 The plate/pipe electrode, as far as practicable, shall be buried below permanent moisture level but in no case less than 3 M below finished ground level

4.2 The plate/pipe electrode shall be kept clear of the building foundation and in no case, it shall be nearer by less than 2 M from outer face of the respective building wall / column

4.3 The plate electrode shall be installed vertically and shall be surrounded with 150 mm. thick layers of Charcoal dust and Salt mixture

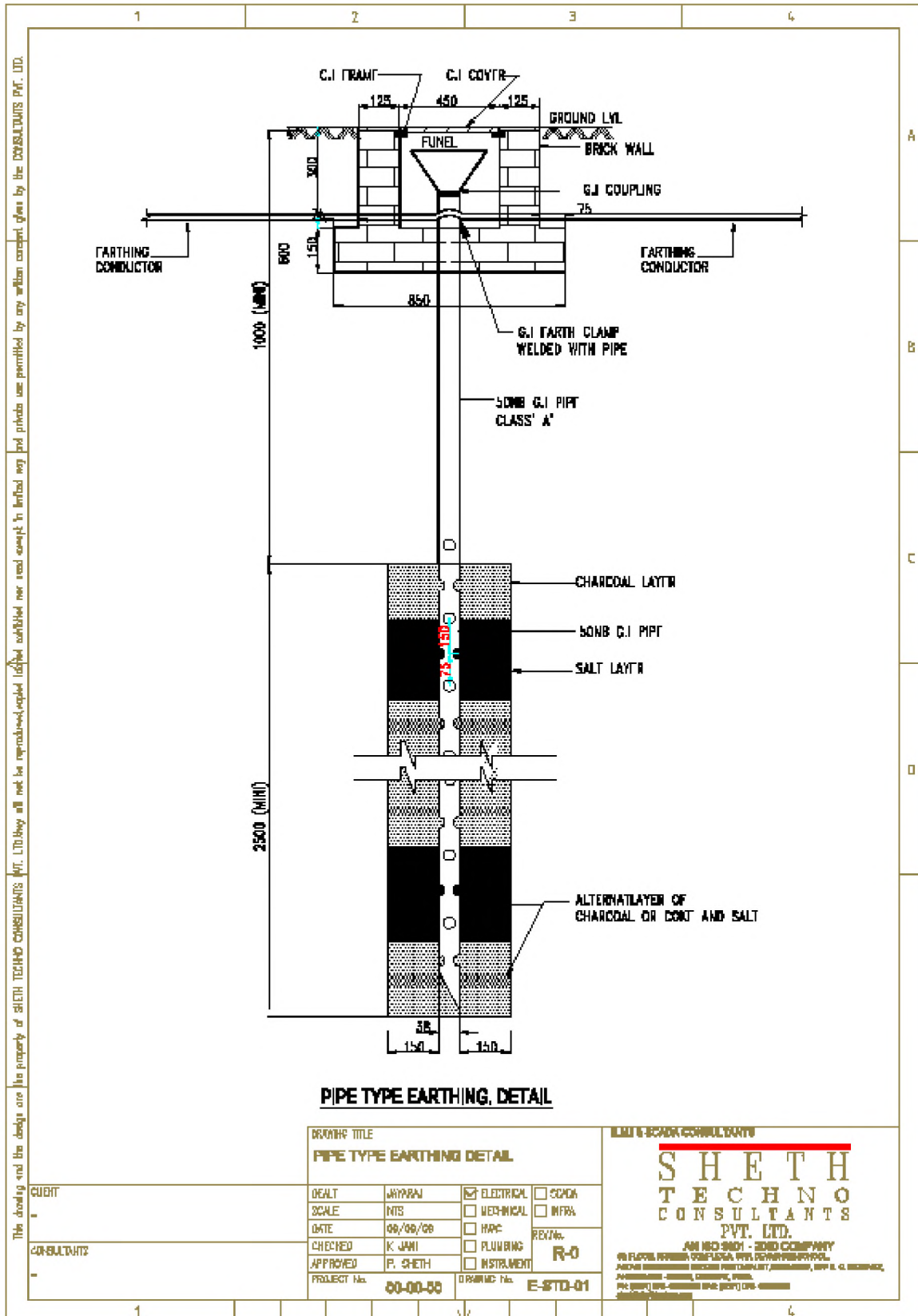
4.4 20 mm. dia. G.I. pipe for watering, shall run from top edge of the plate / pipe electrode to the mid level of block masonry chamber

4.5 Top of the pipe shall be provided with G.I. funnel and screen for watering the earth / ground through the pipe

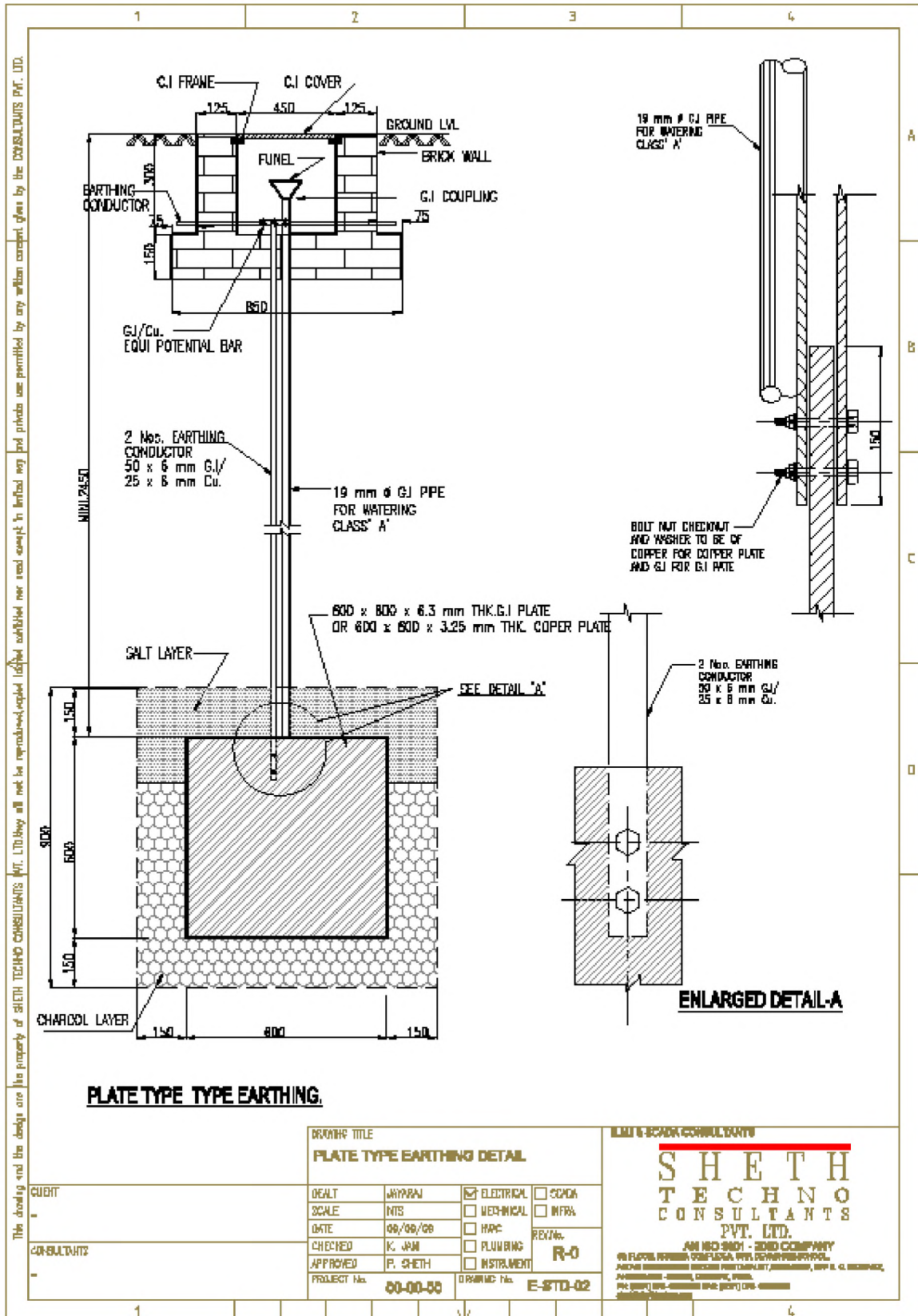
- 4.6 The funnel with screen over the G.I. pipe for watering to the earth shall be housed in a block masonry chamber as shown in the drawing
- 4.7 The masonry chamber shall be provided with a Cast Iron hinged cover resting over the Cast Iron frame which shall be embedded in the block masonry
- 4.8 Construction of the earthing station shall in general be as shown in the drawing and shall conform to the requirement on earth electrodes mentioned in the latest edition of Indian Standard IS: 3043, Code of Practice for Earthing Installation.
- 4.9 The earth conductors ( Strips / Wires, Hot dip G.I. / copper ) inside the building shall properly be clamped / supported on the wall with Galvanized Iron clamps and Hot Dip GI screws / bolts. The conductors outside the building shall be laid at least 600 mm. below the finished ground level/
- 4.10 The earth conductors shall either terminate on earthing socket provided on the equipment or shall be fastened to the foundation bolt and / or on frames of the equipment. The earthing connection to equipment body shall be done after removing paint and other oily substances from the body and then properly be finished
- 4.11 Over lapping of earth conductors during straight through in joints, where required, shall be of minimum 75mm. long and bitumen coated.
- 4.12 The earth conductors shall be in one length between the earthing grid and the equipment to be earthed
- 4.13 Minimum distance of 2 mtr shall be maintained between other electric conductor, earthing conductor and the conductor laid for the lightning protection system. Earthing and lightning protection system conductors shall be bonded to each other to prevent side flashover in case of non-availability of adequate clearance.
- 4.14 The earthing metal conductors, risers, earthing cables, etc. passing through walls shall be covered with galvanized iron sleeves for the passage through wall. Water stop sleeves shall also be provided wherever the earthing conductor enters the building from outside.

## 5.0 INSPECTION AND TESTING

- 5.1 The following earth resistance values shall be measured with an approved earth megger and recorded.
- Each earthing station
  - Earthing system as a whole
  - Earth continuity conductors
- 5.2 Earth conductor resistance for each earthed equipment shall be measured which shall not exceed 1 ohm in each case. In case of more earth resistance, the Contractor shall have to carry out necessary modification in the system without any cost implication to the Client.
- 5.3 Measurements of earth resistance shall be carried out before earth connections are made between the earth and the object to be earthed
- 5.4 All tests shall be carried out in presence of the consultant / client and report should be submitted in two sets.







# **TECHNICAL SPECIFICATIONS FOR HT INDOOR SWITCH GEAR**

**TECHNICAL SPECIFICATIONS  
FOR HT INDOOR SWITCH GEAR  
DESIGN, TESTING AND INSPECTION**

**1.0 SCOPE OF WORK**

- 1.1 Design, manufacture, testing and inspection at places of manufacturer; painting, supply, delivery to site of the switch gear with all related accessories and specifications as specified below with technical data sheet and bill of quantity.

**2.0 CODES & STANDARDS**

Sr.	Item	Relevant IS	Relevant IEC
1	Alternating current circuit breakers	IS 13118	
2	AC metal enclosed switchgear and control gear	IS 3427	IEC 62271

**3.0 DESIGN BASIS & SITE CONDITIONS**

- 3.1 All the equipment and components provided in the switch gear and accessories shall be suitably designed for installation and satisfactory operation as specified below.

Site conditions	
Location	Site altitude 50 M above mean sea level
Ambient air Temperature	50°C.
Ground Temperature	30°C.
Solar gain	1100 w/m <sup>2</sup>
Earth Resistivity	200 degC cm/w
Relative Humidity	95% Max
Atmospheric condition	Non corrosive, Humid and Dusty

Site conditions	
Location Tripura	Site altitude 560M-800M above mean sea level
Ambient temperature	Relative humidity
Maximum 41 °C	Maximum 85 %

Minimum	05 ° C	Minimum	35 %
Design	45 ° C	Design	90 % at 45 ° C
<b>Seismic factor</b>	Zone V as per IS:1893	<b>Rainfall</b>	722 mm/year
<b>Environmental climate</b>	Tropical/Wet/Dry	<b>Location of Equipment</b>	INDOOR
<b>Wind speed</b>	Annual avg. 4.35		
<b>Electrical system data:</b>			
<b>Power supply for Equipment</b>			
Voltage	11 kV ± 15 %	Frequency	50 Hz ± 3 %
<b>Permissible combined voltage &amp; frequency variation</b>	± 6 %	<b>System design faults level (Symmetrical)</b>	18.7 kA for 1 sec. max.
<b>System earthing</b>	LV side neutral solidly earthed	<b>Wiring</b>	3 phase, 3 wire on 11kV system 3 phase, 4 wire on 415V system
<b>Auxiliary power supply :</b>			
<b>Power supply</b>	240V AC, 1-Ph, 50Hz		
<b>Control Supply</b>	-----		
<b>Space heater power supply</b>	240V AC, 1-Ph, 50Hz		
<b>Illumination power supply</b>	240V AC, 1-Ph, 50Hz		
<b>Plug-socket power supply</b>	240V AC, 1-Ph, 50Hz		

### 3.2 GENERAL REQUIREMENTS

- 3.2.1 The scope generally describes to design, manufacture, assemble, connect, wire, supply, test and commission 11KV vacuum circuit breaker panel.
- 3.2.2 The unit shall consist off tee off spring assisted three position, three pole vacuum circuit breaker.
- 3.2.3 All equipment and materials shall be designed, manufactured and tested in accordance with the latest applicable Indian Standards (IS) except where modified and/or supplemented by this specification
- 3.2.4 The equipment shall meet the requirements of Indian Electricity Rules as amended up to date and relevant IS Codes of Practice. In addition, other rules and regulations as applicable to the work shall be followed. In case of any discrepancy, the more restrictive rule shall be binding

## 4.0 TECHNICAL REQUIREMENTS

#### 4.1 GENERAL CONSTRUCTIONAL FEATURES

- 4.1.1 The switchgear enclosure shall conform to the degree of protection IP-4X. The minimum thickness of sheet steel used shall be 2mm CRCA steel.
- 4.1.2 The switch gear assembly shall comprise a continuous, dead-front, line-up of free standing, vertical cubicles. Each cubicle shall have a front hinged door with latches and a removable back cover. All covers and doors shall be provided with recessed neoprene gaskets. All doors shall have pad locking arrangement. Switchgear shall be fire retardant type
- 4.1.3 Circuit breakers, instrument transformers, bus-bars, cable compartment etc., shall be housed in totally isolated air tight separate compartments within the cubicle. The design shall be such that failure of one equipment shall not affect the adjacent units. Suitable venting arrangement shall be provided to release the gas pressure developed due to the operation of the breaker or due to live arc of fault
- 4.1.4 Each cubicle shall be separated from adjacent one by grounded sheet steel barrier and bus sealing arrangement
- 4.1.5 The switchgear panel shall be of arc proof version. Test report as per DIN VDE 0670 part 601, IEC-694/IEC-298 shall be furnished
- 4.1.6 All relays, meters, switches and lamps shall be flush mounted on the respective cubicle door or on control cabinet built on the front of the cubicle
- 4.1.7 Each switchgear cubicle shall be provided with a thermostat controlled space heater and single phase plug point operated at 230 V AC. 50 Hz
- 4.1.8 Bus connection from bus compartment to breaker compartment & breaker compartment to cable compartment and bus compartment to adjacent panels shall be through sealed resin cast bushing assembly
- 4.1.9 Each breaker cubicle shall be provided with 'service' and 'test' position limit switches, each having at least 4 NO & 4 NC contacts. All fixing bolts, screws, etc. appearing on the panel shall be so arranged as to present a neat appearance. The swing of the door shall be more than 90 deg C.

#### 4.2 BUS AND BUS TAPS

- 4.2.1 The main buses and connections shall be of high conductivity copper, sized for specified continuous and fault current ratings with maximum temperature limited to 85 deg C (i.e. 35 deg C rise over 50 deg C ambient)
- 4.2.2 Adequate contact pressure shall be ensured by means of two bolts connection with plain and spring washers and locknuts
- 4.2.3 Bimetallic connectors shall be furnished for connections between dissimilar metals
- 4.2.4 All Busbars, Jumpers and connection shall be fully insulated for working voltage with adequate phase/ground clearances. Epoxy cast-resin shrouds for joints shall be provided. All jointing hardware shall have nylon caps. All busbars, links, jumpers etc. shall be sleeved with sleeves of Raychem/DSG make and non-in flammable heat shrinkable type. Busbars, links, live parts etc. shall have nonflammable shrouds.
- 4.2.5 No paper/cotton based insulation shall be used anywhere in the switch gear. Minimum amount of combustible and low smoke generation type insulating material shall be used.

- 4.2.6 Safety shutter, phase barrier, busbar seal-off bushing plate, support insulators etc. shall be non-inflammable high tracking fiber glass/epoxy insulation system of grade 94V-O as per UL
- 4.2.7 All buses and connections shall be supported and braced to withstand dynamic electro-magnetic stresses due to maximum short circuit current and also to take care of any thermal expansion
- 4.2.8 Busbars shall be colour coded for easy identification and so located that the sequence R-Y-B shall be from left to right, top to bottom or front to rear, when viewed from front of the switchgear assembly
- 4.2.9 The successful tenderer shall submit the calculation in support of selection of busbar conductor size, spacing and short time withstand capability
- 4.3 CIRCUIT BREAKER
- 4.3.1 Circuit breaker shall be triple pole, single throw, Vacuum type
- 4.3.2 Circuit breaker shall be draw out type, having SERVICE, TEST and DISCONNECTED positions with positive indication for each position
- 4.3.3 Circuit breakers of identical rating shall be physically and electrically interchangeable
- 4.3.4 Circuit breaker shall have motor wound spring charging facility with Mechanical & Electrical anti-pumping features and shunt trip. In addition facility for manual charging of spring shall be provided. The motor shall be suitable for operation with voltage variation from 85% to 110% of rated voltage. Spring charging motor shall be in a standard enclosure
- 4.3.5 For motor wound mechanism, spring charging shall take place automatically after each breaker closing operation. One open-close-open operation of the circuit breaker shall be possible after failure of power supply to the motor
- 4.3.6 Mechanical safety interlock shall be provided to prevent
1. The circuit breaker from being racked in or out of the service position when the breaker is closed
  2. Racking in the circuit breaker unless the control plug is fully engaged
  3. Closing & opening of the breaker in an intermediate position between 'service' & 'test' and between 'Test' and 'Disconnected' position
- 4.3.7 Automatic safety shutters shall be provided to fully cover the female primary contacts when the breaker is withdrawn from service position
- 4.3.8 Each breaker shall be provided with an emergency manual trip, mechanical ON-OFF indication, an operation counter and mechanism charge/discharge indicator. The manual trip device shall be located on the front door. Indicators with shrouds will be visible from front door even when breaker is closed.
- 4.3.9 Suitable padlocking arrangement shall be provided as stated below:  
Circuit Breaker operating handle in the OFF position  
Each feeder panel operating handle in CLOSED, OPEN, EARTH position
- 4.3.10 Each breaker shall be provided with following:  
Auxiliary switch, with 6 NO + 6 NC contacts, mounted on the draw out portion of the

switchgear

Position/cell switch with minimum 3 NO + 1 NC contacts, one each for TEST and SERVICE position

Auxiliary switch, with 4 NO + 4 NC contacts, mounted on the stationary portion of the switchgear and operated mechanically by a sliding lever from the breaker in SERVICE position

- 4.3.11 Limit/auxiliary switches shall be convertible type that is facility for changing N.O. contact to N.C. and vice-versa. Switch contact shall be rated 10A A.C. and 2A D.C. at operating voltage
- 4.3.12 Circuit breaker shall be draw out type, complete with transfer trunks, self-aligning primary and secondary disconnects, positive guides to ensure proper alignment
- 4.3.13 Each breaker shall be provided with suitable encased rollers
- 4.3.14 The trip coils shall be operated satisfactorily at voltage between 70 % and 110 % of rated control supply voltage
- 4.3.15 Each circuit breaker cubicle shall be provided with an earthing facility to earth the incoming or outgoing feeders by the arrangement specified below. Earthing facilities shall be fully interlocked to prevent faulty operation e.g. earthing of live parts
- 4.3.16 Separate earthing trunk, which can be inserted in place of circuit breakers, one trunk suitable for incoming and the other for outgoing circuits shall be provided
- 4.3.17 Positive earthing of circuit breaker frame shall be maintained when it is in the connected position and in all other positions in which the safety shutters are in open position
- 4.3.18 Insulation used for auxiliary switches shall be anti tracking type.

#### 4.4 INDICATION & MONITORING

- 4.4.1 Each breaker cubicle shall be equipped with following:
- One (1) number heavy duty spring return type TRIP-NORMAL-CLOSE control switch with pistol grip handle
- Three (3) indicating lights front of compartments:
- GREEN : Breaker Open  
 RED : Breaker Closed  
 AMBER : Trip  
 Blue : Spring charged/Low vacuum
- 4.4.2 Lamp shall be LED type with series resistor, Lamp and lens shall be replaceable from the front

#### 4.5 CURRENT TRANSFORMER

- 4.5.1 Current transformers shall be bar primary, cast resin type. All secondary connections shall be brought out to terminal blocks where Y or D connection will be made.
1. Class PS for differential & restricted earth fault relaying.
  2. Class 5P20 for other relaying.
  3. Class 1.0 and ISF < 5 for metering
- 4.5.2 The current transformer shall be capable of safely withstanding the short circuit, stresses corresponding to the fault level as indicated & shall be able to meet the short-time requirement specified

- 4.5.3 All CT secondary shall be earthed through separate switch link on terminal block. The secondary terminals of the CTS shall have the provision of shorting and disconnecting facilities by links
- 4.5.4 CT terminals & their polarities shall be clearly marked
- 4.6 VOLTAGE TRANSFORMER
- 4.6.1 Voltage Transformer shall be cast-resin, draw out type and shall have an accuracy class of 2.0, 3P. Voltage Transformer mounted on breaker carriage is not acceptable
- 4.6.2 High voltage windings of voltage transformer shall be protected by current limiting fuses. The voltage transformer and fuses shall be completely disconnected and visibly grounded in fully draw-out position
- 4.6.3 Low voltage fuses, sized to prevent overload, shall be installed in all ungrounded secondary leads. Fuses shall be suitably located to permit easy replacement while the switchgear is energied.
- 4.6.4 The connections from main circuit to PT shall be capable of withstanding short circuit stresses
- 4.7 RELAYS
- 4.7.1 Protective relay shall be micro processor based
- 4.7.2 Relays shall be of draw out design with built-in site testing facilities. Small auxiliary relays may be in non-draw out execution and mounted within the cubicle
- 4.7.3 Relays shall be rated for operation on 110 V secondary voltage and 5 A secondary current as shown on drawings. Number and rating of relay contacts shall suit the job requirements
- 4.8 METERS
- 4.8.1 All meters should be digital type of 96 x 96 mm accuracy class of  $\pm 1\%$ .
- 4.9 SECONDARY WIRING
- 4.9.1 The switchgear shall be fully wired at the factory to ensure proper functioning of control, protection, transfer and interlocking schemes
- 4.9.2 Fuse and links shall be provided to permit individual circuit isolation from bus wires without disturbing other circuits. All spare contacts of relays, switches and other devices shall be wired up to terminal blocks
- 4.9.3 Wiring shall be done with flexible, 650V grade, FRLS PVC insulated switchboard wires with stranded copper conductors of 2.5 mm<sup>2</sup> for control and current circuits and 2.5 mm<sup>2</sup> for voltage circuits. All power wiring like space heater supply etc. shall be carried out with min. 4 mm<sup>2</sup> Cu, conductor, Wiring of trip circuit shall be with fluoro-plastic wires
- 4.9.4 Each wire shall be identified, at both ends, with dependent & cross addressing permanent markers bearing wire numbers as per Contractor's Wiring Diagrams. Trip circuit shall have red color ferrule
- 4.9.5 Wire termination shall be made with crimping type ring connectors with insulating sleeves. Wires shall not be spliced between terminals
- 4.9.6 The wires shall run preferably through metallic through adequately supported along its run to prevent sagging due to flexibility or vibration. The control & power wires



shall be routed through separate troughs

- 4.9.7 Inter-panel wiring trough shall be furnished for wiring between switchgear cubicles. All wiring required for interlocking between the cubicles of any switchgear shall be furnished and installed. Wherever wires are passing through cutouts or openings they shall be protected by providing suitable grommet or gasket around the openings. Inter panel wiring at shipping sections shall be through terminal blocks placed suitably at intersection points
- 4.9.8 The colour of wire shall be taken as follows:
1. AC System Black
  2. DC System Grey
  3. Earthing System GREEN
- CT & PT Wiring System Red, Yellow, Blue colour code
- 4.10 TERMINAL BLOCKS
- 4.10.1 Terminal blocks shall be 660 V grade box-clamp type with marking strips ELMEX 10 mm<sup>2</sup> or equal. Terminal for C.T. Secondary leads shall be disconnecting link type and shall have provision for shorting. Terminal for P.T. Secondary lead shall also be disconnecting link type
- 4.10.2 Not more than two wires shall be connected to any terminal. Spare terminals equal in number to 20% active terminals shall be furnished. Multi connection terminal strip to be used if required
- 4.10.3 Terminal blocks shall be located to allow easy access. Wiring shall be so arranged that individual wires of an external cable can be connected to consecutive terminals
- 4.10.4 Terminal blocks for inter panel/external/Space Heater wiring shall be separate from inter panel wiring
- 4.10.5 All control wire shall be terminated with ring type insulated lug only
- 4.10.6 The terminal block shall be grouped according to circuit functions and individual terminals in each block shall be serially numbered in accordance with the drawings. Such numbering shall be legible, permanent and indelible
- 4.10.7 The terminal blocks of different voltage classes shall be segregated  
Similar type of terminal block shall be used for inter panel wiring at shipping sections
- 4.11 CABLE TERMINATION
- 4.11.1 Switchgear shall be designed for cable entry from the top. Sufficient space shall be provided for ease of termination and connection
- 4.11.2 Power cables shall be XLPE insulated, armored, overall PVC sheathed with stranded Aluminum/copper conductor
- 4.11.3 Control cables shall be PVC/XLPE insulated, armored, overall PVC sheathed with 2.5mm<sup>2</sup> stranded copper conductor
- 4.11.4 All provisions and accessories shall be furnished for termination and connection of cables, including removable aluminium gland plates, cables supports etc
- 4.11.5 The gland plates shall be minimum 4mm thick aluminium sheet. The gland plate and supporting arrangement for 1/C power cables shall be such as to minimise flow of eddy current
- 4.11.6 Sufficient space shall be provided between the power cable termination (end-boxes)

and gland plate. Core balance C.T.s, wherever specified, shall be accommodated within this space.

#### 4.12 GROUND BUS

- 4.12.1 A ground bus, rated to carry maximum fault current, shall extend full length of the switchgear
- 4.12.2 The ground bus shall be provided with two-bolt drilling with G.I. bolts and nuts at each end to receive 50 x 6 mm G.I. flat
- 4.12.3 Each stationary unit shall be connected directly to the ground bus. The frame of each circuit breaker and draw out P.T. unit shall be grounded through heavy multiple contacts at all times except when the primary disconnecting devices are separated by a safe distance
- 4.12.4 Wherever the schematic diagrams indicate a definite ground at the switchgear, a single wire for each circuit thus grounded shall be run independently to the ground bus and connected thereto
- 4.12.5 C.T. and P.T. secondary neutrals shall be earthed through removable links so that earth of one circuit may be removed without disturbing other
- 4.12.6 Suitable ground terminal, directly connected with the ground bus shall be provided in the cable chamber for grounding connection of cable screen/armour
- 4.12.7 All hinged doors shall be grounded using sliver plated and braided copper flexible of adequate size

#### 4.13 NAME PLATE

- 4.13.1 Nameplates of approved design shall be furnished at front & back side of each cubicle and at each instruments & device mounted on or inside the cubicle
- 4.13.2 The material shall be 3ply lamicol or approved equal, 3 mm thick with white letter on black background. The letters of the nameplates shall be engraved
- 4.13.3 The nameplate shall be held by self-tapping screws. Nameplate size shall be minimum 20 x 75mm for instrument/device and 40 x 150mm for panels.
- 4.13.4 Caution notice on suitable metal plate shall be affixed at the back of each vertical panel
- 4.13.5 Following plate size & letter size shall be considered for nameplate

SR.	NAMEPLATE NO.	PLATE SIZE (mm × mm)	LETTER SIZE (mm × mm)
1.0	Main nameplate	40 × 150	25 × 25
2.0	Equipment & device (Front)	20 × 75	5 × 5
3.0	Equipment & device (Internal)	6 × 20	3 × 3

#### 4.14 SPACE HEATER AND PLUG SOCKET

- 4.14.1 Each cubicle shall be provided with thermostat controlled space heaters and 10A, 3 pin plug socket

- 4.14.2 Cubicle heater, Plug/socket circuits shall have Individual MCBs
- 4.15 A.C. POWER SUPPLY
- 4.15.1 The following power supplies will be made available to the switchgear: A. C. supply: Double Feeder with manual change over switch
- 4.15.2 Isolating MCB will be provided at the switchgear for the incoming supplies
- 4.15.3 Bus-wires of adequate (minimum 4 sq.mm copper) capacity shall be provided to distribute the incoming supplies to different cubicles. Isolating MCB shall be provided at each cubicle for A.C. supplies
- 4.15.4 A.C. load shall be so distributed as to present a balance loading on three-phase supply system
- 4.16 TROPICAL PROTECTION
- 4.16.1 All equipment, accessories and wiring shall have fungus protection involving special treatment of insulation and metal against fungus, insects & corrosion
- 4.16.2 Screens of stainless steel shall be furnished on all ventilating louvers to prevent the entrance of insects
- 4.17 PAINTING
- 4.17.1 All surfaces shall be sanding blasted, pickled and grounded as required to produce a smooth, clean surface free of scale, grease rust and foreign adhering matter
- 4.17.2 After cleaning, the surfaces shall be given a phosphate coating followed by 2 coats of high quality primer and staved after each coat
- 4.17.3 The switchgear shall be finished in powder coat, shade RAL-7032 MATT finish
- 4.17.4 Sufficient quantity of touch-up paint (approx. 5 ltrs.) shall be furnished for application at site
- 4.18 ACCESSORIES
- 4.18.1 Earthing equipment suitable for earthing the bus or outgoing cable
- 4.18.2 Breaker carrier trolley if C.B. is of that design
- 4.18.3 Cubicle door opening key (1 for each panel)
- 4.18.4 Withdrawal handles for breaker
- 4.18.5 Commissioning spares (Provide list of spares along with offer)
- 4.19 DESIGN CRITERIA
- 4.19.1 The Switchgear shall be capable of continuous operation at specified rating under the following condition
- |  |   |           |
|--|---|-----------|
| Voltage variation                      | : | +/- 10 %  |
| Frequency variation                    | : | + 3%, -6% |
| Combined voltage & frequency variation | : | 10 %      |
- 4.19.2 The de rating of the equipments shall be done taking 50 deg C as an ambient temperature if it is designed at lower temperature. The maximum temp. in any part

of the equipment at specified rating shall not exceed 85 deg C considering reference ambient temperature as 50 deg C.

- 4.19.3 The breakers of the respective system shall have the breaking capacity corresponding to fault levels as specified
- 4.19.4 The breaker shall be **Vacuum type**. The circuit breaker shall be fitted with micro processor based self powered relay inside the front cover
- 4.19.5 The breaker ratings shall be as per drawing and bill of quantity
- 4.19.6 The cable termination shall be done by heat shrinkable termination method. The compartment should have sufficient height space for proper Termination/Bonding of cable leads

## 5.0 DRAWINGS & INFORMATION

- 5.1 Drawings, Data & Manuals shall submitted in triplicate with the bid and in quantities and procedures as specified in General Conditions of contract and/or elsewhere in the specification for approval & subsequent distribution after the issue of Letter of intent.

### 5.2 HANDING OVER DOCUMENTS

The supplier shall submit following:

- a. Breaker sizing calculation along with relevant Test Reports.
  - b. Outline dimensional drawing of the switchgear showing general arrangement, space requirements and cable entry points, location of breaker, CT, Pt busbar chamber, grounding arrangement etc.
  - c. Bill of Materials.
  - d. Typical foundation plan.
  - e. Typical breaker control schematic.
  - f. Test reports on circuit breaker/CT/PT.
  - g. Technical leaflets on & complete specifications & OEM address for bought out items. Bus bar & circuit
- 5.3 Instruction manuals of switchgear & individual equipment. The manual shall clearly indicate that the installation method, check-up and tests to be carried out before commissioning of the equipment as well as monitoring tests, their interval & maintenance/overhaling procedure & schedule

## 6.0 INSPECTION & TESTING

### 6.1 ROUTINE TESTS

- 6.1.1 The tests shall include but not necessarily limited to the following for switchgear
- 6.1.2 Operation under simulated service condition to ensure accuracy of wiring, correctness of control scheme & proper functioning of the equipment
- 6.1.3 All wiring and current carrying part shall be given appropriate High Voltage test
- 6.1.4 Test for meter/ relays for the respective function
- 6.2 Primary current and voltage shall be applied to all instrument transformers
- 6.3 Routine test shall be carried out on all equipment such as circuit breakers, instrument transformers, meters etc
- 6.4 One minute power frequency withstands insulation test as per relevant-IS

**6.5 TEST CERTIFICATE**

- 6.5.1 Certified reports of all the tests carried out at the works shall be furnished in three (3) copies for approval of the Owner
- 6.5.2 The equipment shall be dispatched from works only after receipt of Owner's written approval of the test reports
- 6.5.3 The test report shall furnish complete identification of the equipment such as serial no., rating, equipment designation as per schematic etc. & date of test.

**7.0 METHOD OF MEASUREMENT**

- 7.1 Supply of the HT switch gear including transport to site, loading and unloading etc. as specified will be treated as one unit for measurement and payment.

**8.0 TRANSPORT, DELIVERY AND STORAGE**

- 8.1 The prices shall be **F.O.R. site basis** including packing & forwarding charges. The quoted price must include all the costs for necessary mode of transportation up to the final location of HT switch gear on site store. The switch gear should be supplied with required storage arrangements suitable for placing in open storage yard. All incidental expenses during transportation shall be part of quoted prices including transit insurance. The charges for loading and unloading of equipments at site should form part of offer.
- 8.2 The transportation for any auxiliary item or detachable part of equipment should be simultaneous and carry necessary instructions for assembling and storage requirements.

**8.3 COMPLETENESS OF SUPPLY**

- 8.3.1 It is not the intent to specify completely herein all details of the equipment. Nevertheless, the equipment shall be complete and operative in all aspects and shall conform to highest standard of engineering, design and workmanship
- 8.3.2 Any material or accessories which may not have been specifically mentioned but which is necessary or usual for satisfactory and trouble free operation and maintenance of the equipment shall be furnished without any extra charge

**9.0 GUARANTEE AND WARRENTY**

- 9.1 The Bidder shall stand guarantee for the performance of entire equipment and components for twelve (12) months from the date of commissioning or eighteen (18) months from the date of dispatch, whichever is earlier, as agreed up on and as reproduced in the purchase order within the tolerance specified or as permitted by the relevant standards for the equipment in his scope of supply. The Purchaser also reserves the right to use the rejected equipment or part thereof until the new equipment meeting the guaranteed performance is supplied by the Bidder.

**10.0 SPARES**

- 10.1 The bidder shall quote for minimum spares required for two years safe operation of transformer along with the offer separately.

**11.0 ATTACHMENTS**

- 11.1 Datasheet



**TECHNICAL DATASHEET FOR HT SWITCH GEAR**

SR. NO.	PARTICULAR	DETAILS	DATA TO BE FILLED BY THE BIDDER
1.0	GENERAL :		
1.1	Make	As per Tender	
1.2	Model & Type no.	Pl. furnish	
1.3	Ambient temperature	50 deg. C	
1.4	Atmosphere	Non Corrosive, Humid, Dusty	
1.5	Location	Indoor	
2.0	ELECTRICAL DATA :		
2.1	Type of breaker	Vacuum Circuit Breaker	
2.2	Service	Continuous	
2.3	Voltage	11 KV <u>±</u> 10%	
2.4	System earthing	Solidly earthed	
2.5	Frequency	50 Hz. + 3% to - 3 %	
2.6	No. of phase	3	
2.7	System fault level	350 MVA	
2.8	Fault current	18.37 KA	
2.9	Max. system voltage	12 KV	
2.10	Power Pack unit	110V D.C derived from power pack connected on incoming P.T. supply. The rating suitable for min. three breaker operations	
2.11	Rated short time current	18.37 KA (1 sec.) rms	
2.12	Making capacity	46 KA (peak)	
2.13	Busbar current rating	630 A min.	
2.14	Cable entry	Bottom	
2.15	Cable size	3c x 240 sq.mm. XLPE armored cable (incoming) (E) 3c x 240 sq.mm. XLPE armored cable (outgoing) (E)	
2.16	Breaker particulars :		
	(a) Operating duty	0 – 3 min- CO – 3 min – CO	
	(b) Operating mechanism	Motor charged spring / manual trip & close	
	(c) Spring charging motor	230 V AC, 200 W[or as per manufacturer design]	
	(d) Trip / Closing coil	110 V DC, 180 W[or as per manufacturer design]	
	(e) Anti pumping feature	To be provided	
	(f) Latching requirement	Trip free	

SR. NO.	PARTICULAR	DETAILS	DATA TO BE FILLED BY THE BIDDER
	(g) Emergency trip push button	Required	
	(h) Space heater and cubicle lamp	Required	
	(i) Earthing truck	Required	
2.17	Constructional requirements		
	(a) Thickness of sheet steel for frame, enclosure, doors, covers and partitions	CRCA sheet & thickness as per tender specification, hinge type door with neoprene rubber gasket	
	(b) Degree of protection	IP 4X	
	(c) Colour	Epoxy powder coating – Siemens grey	
	(d) Earth bus size	50 □ 6 mm GI	
	(e) Foundation frame	ISMC-75, Suitable for three breakers with necessary bed plate and foundations bolt.	
	(f) Over all dimension	PI furnish	
	(g) Minimum area required on front side as well as rear side	PI furnish	
2.18	Annunciation Provision	To be Provided as per drawing	
2.19	RELAYS	To be Provided as per drawing	
	(a) Relay no. & type	O/C (51)      E/F (51N)	
	(b) Type of relay	Numerical      Numerical	
	(c) Plug Setting Range	5-200%      20-80%	
2.20	CURRENT TRANSFORMER		
	(a) Type of CT	Cast Resin, dual core, dual ratio as per SLD	
	(b) Accuracy class	As per SLD	
	(c) VA burden	As per SLD	
	(d) CT ratio	As per SLD	
2.21	POTENTIAL TRANSFORMER		
	(a) Type of PT	Cast Resin	
	(b) Accuracy class	As per SLD	
	(c) VA burden	As per SLD	
	(d) PT ratio	As per SLD	
2.22	PANEL ACCESSORIES		
	Toggle switch for space heater and socket	230 V A.C , 10 A	
	(b) Socket	5 pin 5/15 A with switch	
	(c) MCB for spring charging motor circuit	6 A , DP MCB	



SR. NO.	PARTICULAR	DETAILS	DATA TO BE FILLED BY THE BIDDER
	(d) MCB for ON / OFF	Double pole, 16 A, 110 V D.C for D.C ckt. Double pole, 16 A, 230 V A.C for A.C ckt.	
	Local / Remote selector switch	4 ways, 2 positions, lockable in any position, angular movement, stayput, lever type handle.	
	Auto- Off – Manual switch	18 way, 3 position, lockable in all position, stayput, wing type handle.	
	Breaker control switch ( Trip – Neutral – Trip )	6 ways, 3 position, spring return to neutral, angular movement, pistol grip type handle.	
	LED indicating lamp (230V A.C)	Breaker On - Red colour Breaker Off - Green colour Auto trip - Amber colour Trip ckt healthy - Amber colour Spring charged - Blue colour 100 ohm, 3 / 4 W resistor	
	LED indicating lamp (230V A.C)	2 / 3 W bulb for R , Y , B , Healthy indication	
	Space Heater	230 VA.C , 100 W	
	Panel Illumination	11 W CFL with switch for each panel	
	Limit switch for test and service position.	Required	

**Note : Other specifications not mentioned in datasheet shall be considered as per tender specifications**

# **TECHNICAL SPECIFICATIONS FOR H.V. XLPE CABLE**

**TECHNICAL SPECIFICATIONS FOR H.V. XLPE CABLE****1.0 SCOPE OF WORK**

1.1

The scope shall cover supplying, laying, testing and commissioning of 3 or 1 core cables of circular stranded aluminum conductors, XLPE extruded dielectric, screened, copper shielded and PVC outer sheathed. The cables will be armoured with galvanized steel armour.

Cables shall be capable of operating at a sustained conductor temperature of 90° c. and suitable for a maximum conductor short-circuits temperature of 250° c.

This specification gives the general requirement of cables. However, it is the responsibility of the vendor to obtain client's approval before the placement of orders to the main supplier/manufacturer.

**2.0 CODES & STANDARDS**

Sr.	Item	Relevant IS	Relevant IEC
1	Conductors of Insulated Cables	IS: 8130 - 1984	IEC: 228
2	Impulse tests on cables and their accessories		IEC: 230
3	Extruded solid dielectric-insulated power cables for rated voltage from 1 KV upto 30 KV.		IEC: 502
4	Test methods for insulations and sheaths of electric cables and chords.		IEC: 540
5	Test on cable over a sheath which has special protective functions and are applied by extrusion.		IEC: 229
6	Calculations of continuous current rating of cables (100% load factor).		IEC: 287
7	Cross-linked polyethylene insulated PVC sheathed cable for voltage from 3.3 KV upto 33 KV.	IS: 7098 (Part II)	
8	PVC insulation & sheath of electrical cables.	IS: 5831 - 1984	
9	Mild steel wires, formed wires and tapes for armouring of cables.	IS: 3975	
10	Electrical test methods for electric cables partial discharge test.		IEC: 885(2) - 1987 (Part II)
11	Methods of test for cables.	IS: 10810	

12	Common test methods for insulating and sheathing materials of electric cables.		IEC: 811
13	Impulse test on cables & other accessories		IEC: 230
14	Cable termination for gas insulated switchgear.		IEC: 859

**3.0****DESIGN BASIS & SITE CONDITIONS**

3.1 All the equipment and components provided in the transformer and accessories shall be suitably designed for installation and satisfactory operation as specified below.

3.2

<b>Site conditions</b>			
<b>Location</b> Tripura		<b>Site altitude</b> 560M-800M above mean sea level	
<b>Ambient temperature</b>		<b>Relative humidity</b>	
Maximum 41 °C		Maximum 85 %	
Minimum 05 °C		Minimum 35 %	
Design 45 °C		Design 90 % at 45 °C	
<b>Seismic factor</b> Zone IV as per IS:1893		<b>Rainfall</b> 722 mm/year	
<b>Environmental</b> Tropical/Wet/Dry climate		<b>Location of Equipment</b> Outdoor	
<b>Wind speed:</b> Annual avg. 4.35			
<b>Electrical system data:</b>			
<b>Power supply for Equipment</b>			
Voltage 11 kV ± 15 %		Frequency 50 Hz ± 3 %	
<b>Permissible combined voltage &amp; frequency variation</b>	± 6 %	<b>System design faults level (Symmetrical)</b>	18.37 kA for 1 sec. max.
<b>System earthing</b> LV side neutral solidly earthed		<b>Wiring</b> 3 phase, 3 wire on 11kV system 3 phase, 4 wire on 415V system	

**4.0****TECHNICAL REQUIREMENTS**

4.1 GENERAL CONSTRUCTIONAL FEATURES

4.1.1 **Conductors:**

The conductor shall be of circular stranded Aluminium conforming to IS: 8130 & IEC: 228. It shall be clean, reasonably uniform in size & shape smooth & free from harmful

defects. Any other form of conductor may also be accepted if in line with modern trends.

4.1.2 **Semi Conductor Barrier Tape/Tapes:**

The semi-conducting barrier tape/tapes shall be provided over the conductors.

4.1.3 **Conductor Screen:**

The conductor screen shall consist of an extruded layer of thermosetting semi-conducting compound which shall be extruded simultaneously with the core insulation.

4.1.4 **Insulation:**

The insulation shall be super clean XLPE compound applied by extrusion and vulcanized to form a compact homogenous body.

4.1.5 **Insulation Screen:**

1. Each insulation have an insulation screen in two parts consisting of:
2. A water barrier tape/Non-metallic semi-conducting swellable tape part and a metallic screen part.
3. The non-metallic part shall be directly applied upon the insulation of each core and may consist of an impregnated but nylon/PVC tape or a similar approved material or, an extruded semi-conducting material extruded simultaneously with the conductor screen and insulation (triple extrusion).
4. The semi-conductor shall be readily strippable and must not be bonded in such a manner that it has to be shaved or scraped to remove.
5. The metallic part shall consist of a copper tape helical applied with a 30% overlap over the water barrier tape/blocking tape. A binder tape of copper shall be applied over the copper wire metallic screen.

4.1.6 **Laying Up:**

1. The cores shall be identified on the non-metallic part of the insulation screen by legible printing on the length of each conductor or, by the inclusion of a marker tape.
2. The cores shall be laid up with a right hand direction of lay.
3. Binder tape/Moisture barrier:
4. During lay up, a suitable open spiral binder may be applied, at the manufacturer's discretion, before the application of an extruded inner covering.

4.1.7 **Fillers:**

Fillers shall be polypropylene.

4.1.8 **Inner Covering/Sheath:**

The inner covering shall be extruded over the laid up cores to form compact and circular bedding for the metallic layer.

4.1.9 **Metallic Layer:**

The metallic layer shall be galvanised steel wire.

4.1.10 **Outer Sheath:**

The tough outer sheath, black coloured best resisting PVC polyethylene compound type ST-2 as per IS: 5831 for the operating temperature of the cable shall be provided over the armour as specified in relevant standards by extrusion process.

4.1.11 **Cable Marking:**

1. Embossing on outer sheath:

The PVC outer sheath shall be legibly embossed with the legend: "ELECTRIC CABLE 11000 VOLT" etc.

The letter and figures shall be raised and shall consist of upright block characters. The maximum size of the characters shall be 13 mm. And the minimum size 15% of the cable circumference or 3 mm. whichever be the greater. The gap between the end of one set of embossed characters as above and the beginning of the next

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shall not exceed 150 mm.

2. Identification of Manufacturer and year of manufacture:

An identification of the manufacturer, year of manufacture, Cable size shall be embossed at regular intervals on the PVC outer sheath. This shall not affect the spacing between repetitions of the legend as given above.

4.2 SEALING AND DRUMMING:

- 4.2.1
1. After tests at the manufacturers' works, both ends of the cable shall be sealed to prevent the ingress of moisture during transportation and storage.
  2. Cable shall be supplied in lengths of 500 meters non-returnable drums of sufficiently sturdy construction.
  3. The spindle hole shall be 110 mm. minimum diameter.
  4. Each drum shall bear on the outside flange, legibly and indelibly in the English language, a distinguishing number, the manufacturer's name and particulars of the cable, viz. voltage, length, conductor size, cable type, insulation type and gross weight shall also be clearly visible. The direction for rolling shall be indicated by an arrow.

5.0 DRAWINGS & INFORMATION

- 5.1 Contractor shall submit the as built drawing of cable laying. Complete technical data sheet and QAP should be submitted after award of contract.

6.0 INSPECTION & TESTING

- 6.1 Routine tests shall be carried out in accordance with the relevant IEC standards/IS. The copies of routine test results shall be submitted along with each drum length or part thereof.

7.0 MEATHOD OF MEASUREMENT

- 7.1 All the items will be measured as mentioned in Bill of quantity.

8.0 TRANSPORT, DELIVERY AND STORAGE

- 8.1 The prices shall be **F.O.R. site basis** including packing & forwarding charges. The quoted price must include all the costs for necessary mode of transportation up to the final location or site store. The transformer should be supplied with required storage arrangements suitable for placing in open storage yard. All incidental expenses during transportation shall be part of quoted prices including **transit insurance**. The charges for loading and unloading of equipments at site should form part of offer.

9.0 GUARANTEE AND WARRENTY

- 9.1 The Bidder shall stand guarantee for the performance of entire equipment and components for twelve (12) months from the date of commissioning or eighteen (18) months from the date of dispatch, whichever is earlier, as agreed up on and as reproduced in the purchase order within the tolerance specified or as permitted by the relevant standards for the equipment in his scope of supply. The Purchaser also reserves the right to use the rejected equipment or part thereof until the new equipment meeting the guaranteed performance is supplied by the Bidder.

## DATASHEET

Sr. No.	Particulars	Description
<b>1.0</b>	<b>ENVIRONMENT DETAILS</b>	
1.1	Ambient Temp In Degree Celsius	50 Degree Celsius
1.2	Ground Temp In Degree Celsius	35 Degree Celsius
1.3	Relative Humidity	85 % At 35 Degree Celsius
1.4	Altitude	< 1000 Meter Above MSL
1.5	Atmosphere	Wet,Tropical
<b>2.0</b>	<b>SYSTEM DETAILS</b>	
2.1	System Voltage	11KV AND 6.6 KV, + / - 10%
2.2	System Frequency	50 Hz., +3% / -6%
2.3	Grounding	Solidly Earthed
2.4	Fault Level	For 11 KV System 18.37 KA for 1 Sec
		For 6.6 KV System 25 KA for 1 Sec.
<b>3.0</b>	<b>CABLE</b>	
3.1	No. of Cores	3 (Three)
3.2	<b>CABLE CONDUCTOR</b>	
3.2.1	Size Of Conductor	As per BOM
3.2.2	Material	High Purity Aluminium
3.2.3	Construction	Stranded
3.2.4	Shape	Compacted Circular
3.2.5	Confirming To	Is-8130
3.3	Conductor Screen	Extruded Semi-conducting Material
3.4	<b>CONDUCTOR INSULATION</b>	
3.4.1	Material	High Purity Void And Moisture Free Cross Linked Polyethylene (XLPE) Using Gas Curing Process
3.4.2	Thickness	> = 5.5mm
3.5	<b>INSULATION SCREEN</b>	EXTRUDED SEMI-CONDUCTING MATERIAL HAVING COPPER TAPE OVER IT
3.6	<b>CORE IDENTIFICATION TAPE</b>	Yes Required

Sr. No.	Particulars	Description
3.7	CORE LAYING	Right Hand Direction
3.8	INNER SHEATH / COVER	Extruded
3.9	ARMOURING	
3.9.1	Material	Flat Steel GI Strip
3.9.2	No Of Strip	4
3.9.3	Size Of Strip	0.8 mm
3.10	OUTER SHEATH	
3.10.1	Material	PVC
3.10.2	Type	St-2 As Per Is-5831-1984
3.10.3	Thickness	> = 1.4 Mm
3.10.4	Colour	Black
3.11	MARKING ON OUTER SHEATH	YES
3.11.1	Voltage Grade	Yes
3.11.2	No. of Cores/Size of Conductor / Material of Conductor	Yes
3.11.3	Type Of Insulation	Yes
3.11.4	Details About Armour	Yes
3.11.5	Details Of Standards	Yes
3.11.6	Year Of Manufacturer	Yes
3.11.7	Any Other Details	Yes
<b>4.0</b>	<b>TESTING</b>	
4.1	Type Test As Per Is	Certificate To Be Provided for each drum
4.2	Routine Test As Per Is	Yes To Be Witnessed By Client
4.3	Acceptance Test	Yes To Be Witnessed By Client
<b>5.0</b>	<b>CABLE DRUM</b>	<b>Non Returnable</b>
5.1	Material	Wooden / Steel
5.2	Marking On Cable Drum	As Per Manufacturer's Standard



# **TECHNICAL SPECIFICATIONS FOR INSTALLATION OF INTERNAL WIRING**

**TECHNICAL SPECIFICATIONS FOR INSTALLATION OF INTERNAL WIRING**

**1.0 SCOPE OF WORK**

1.1 This section covers, definition of point wiring, system of wiring and, installation, connection, testing and commissioning of point wiring for light points, ceiling fan points, exhaust fan points, convenience socket outlet points, power socket outlet points, bell outlet points etc. including fixing of light fixtures, ceiling fan, exhaust fan, wall fan, bell etc.

**2.0 CODES & STANDARDS**

2.1 The following standards and rules shall be applicable :

	IS : 732	Code of practice for electrical wiring installation (System voltage not exceeding 650 V)
	IS : 1646	Code of practice for fire safety of buildings (General) Electrical installation.
	IS : 9537 ( Part - 2 )	Rigid steel conduits for electrical wiring.
	IS : 2667	Fittings for rigid steel conduits for electrical wiring.
	IS : 3480	Flexible steel conduits for Electrical wiring.
	IS : 3837	Accessories for rigid steel conduit for electrical wiring.
	IS : 694	PVC insulated cables.
	IS : 9537 ( Part - 3 )	Rigid non-metallic conduits for electrical wiring.
	IS : 6946	Flexible (Pliable) non-metallic conduits for electrical installation.
	IS : 1293	3 pin plugs and sockets.
	IS : 8130	Specifications of conduits for electrical installation.
	IS : 3854	Switches for domestic purpose.
	IS : 3419	Fittings for rigid non-metallic conduits.
	IS : 4648	Guide for electrical layout in residential buildings Indian electricity act and rules

All standard and codes mean the latest.

**3.0 MATERIALS REQUIRED**

3.1 -----

**4.0 INSTALLATION OF THE SYSTEM****4.1 CONCEALED INSTALLATION WITH RIGID PVC CONDUIT**

- 4.1.1 All the rigid PVC conduit used for concealed installation shall be as per IS ; 9537 and its accessories shall be as per IS: 3419 (Small Wire Ropes).
- 4.1.2 Whenever necessary bends or diversion may be achieved by bending the conduits with the help of bending spring. No other method of bending is allowed
- 4.1.3 Conduit pipes shall be joined with the help of plain coupler fixed at the end with the help of vinyl solvent cement. No other method of joining is permissible
- 4.1.4 All other methods, no wires through conduit, bunching, etc. Shall be as specified in the concealed installation
- 4.1.5 Prior to fixing the conduits, the complete route shall be marked on site for the approval of consultant

**4.2 CONCEALED WIRING SYSTEM WITH RIGID PVC CONDUIT**

- 4.2.1 The rigid PVC conduits shall be used for concealed wiring system. The conduits shall be concealed in the concrete slab, floor, walls, beams, columns etc

**4.2.2 FIXING OF CONDUIT**

1. Conduits embedded in concrete shall be installed in the frame work before pouring concrete. The conduits shall be installed above the bottom reinforcing bars, and shall provide positive wire fastening of the conduit to the reinforcing rods at an interval of not more than one meter, but on either side of couplers or bends or putlet/pull/junction boxes or similar fittings, proper hold fast shall be fixed at a distance of 30 cm from the center of such fittings. Conduits embedded in the wall shall be fixed inside the chase . The chase in the wall shall be neatly made and be fixed in the manner desired. In the case of building under construction, chase shall be provided in the wall at the time of their construction and shall be filled up neatly with cement mortar 1:4 after erection of conduit and brought to the original finish of the wall. Cutting of horizontal chases in walls is prohibited. The conduits shall be fixed inside the chase by means of staples or by means of saddles not more than 60 cm apart.
2. Conduits shall be so arranged as to facilitate easy drawing of wires through them. Entire conduit layout shall be done in such a way as to avoid additional junction boxes other than light points. The wiring shall be done in a looping manner. All the looping shall be done in either switch boxes or outlet boxes. Looping in junction or pull boxes are strictly not allowed. Where conduits cross building expansion joints, adequate expansion fittings or other approved devices shall be used to take care of any relative movement
3. All conduits shall be installed so as to avoid steam and hot water pipes
4. Conduits shall be installed in such a way that the junction, derivation and pull boxes shall always be accessible for repairs and maintenance work. The location of junction/pull boxes shall be marked on the shop drawings and approved by the client
5. A separation of 200 mm shall be maintained between electrical conduits and hot water lines in the building

6. No run of conduit shall exceed ten mtr. between adjacent draw in points nor shall it contain more than two right angle bends, or other derivation from the straight line
7. Caution shall be exercised in using the PVC conduits in location where ambient temperature is 50 degree cel. or above. Use of PVC conduits in places where ambient temperature is mote than 60 deg. cel. Is prohibited. The entire conduit system including boxes shall be thoroughly cleaned after completion of installations and before drawing of wires. Conduit system shall be erect and straight as far as possible. Traps where water may accumulate from condensation are to be avoided and if unavoidable, suitable provision for draining the water shall be made
8. All jointing method shall be subject to the approval of the client
9. Separate conduits shall be provided for the following system.
  - 15 A power outlets.
  - 5 A outlets and lighting system.
  - Low voltage system.
  - Telephone/intercom system.
  - C.C.T.V. system
  - Sound system
  - Computer data cabling system
  - Equipment wiring

#### 4.3 CONDUIT JOINT

- 4.3.1
  1. Conduits shall be joined by means of plain couplers vinyl and/or solvent cement. Where there are long runs of straight conduit, inspection type couplers shall be provided at intervals , as approved by the client
  2. The conduits shall be thoroughly cleaned before making the joints
  3. In case of plain coupler joints, proper jointing material like a vinyl solvent cement (gray in color) or any material as recommended by the manufacturer shall be used.

#### 4.4 BENDS IN CONDUIT

- 4.4.1 Wherever necessary, bends or diversions may be achieved by bending the conduits or by employing normal bends. No bends shall have radius less than 2.5 times outside dia. of the conduit
- 4.4.2 Heat may be used to soften the PVC conduit for bending, but while applying heat to conduit, the conduit shall be filled with sand to avoid any damage to the conduit

#### 4.3 OUTLETS

- 4.3.1 All the outlets for fittings, switches etc. shall be boxes of substantial construction

- 4.3.2 In order to minimize condensation or sweating inside the conduits, all outlets of conduit system shall be properly drained and ventilated, but in such a manner as to prevent the entry of insects , etc.
- 4.3.3 Fixing between conduit and boxes, outlet boxes, switch boxes and the like must be provided with entry spouts and smooth PVC bushes.
- 4.3.4 Joints between conduit and any type of boxes shall be affected by means of conduit couplers in to each of which shall be coupled smooth PVC bush from inside the box. In any case all the joints shall be fully water tight.

**4.4 BUNCHING OF CABLES**

- 4.4.1 Cables of AC supply of different phase shall be bunched in separate conduits
- 4.4.2 The number of insulated wires/ cables that may be drawn into the conduits shall be as per the following table. In this table, the space factor does not exceed 40%. However, in any case conduits having lesser than 19 mm dia. shall not be used.

**MAXIMUM PERMISSIBLE NUMBER OF 650 VOLT GRADE SINGLE CORE CABLES THAT MAY BE DRAWN IN TO RIGID PVC CONDUITS.**

CABLE SIZE IN MM SQ.	SIZE OF CONDUITS (MM)			
	MAXIMUM NO. OF CABLES			
	25	32	38/40	51/50
1.5	8	15	---	---
2.5	6	10	---	---
4.0	4	8	12	---

**4.5 WIRING WITH RIGID STEEL CONDUIT**

- 4.5.1 All conduits and it's accessories shall be of threaded type and under no circumstances pin grip type or clamp type accessories be used

**4.6 FIXING OF CONDUIT**

- 4.6.1 Conduit pipes shall be fixed by heavy gauge spacer bar saddles. The saddles shall be of 3 mm x 19 mm galvanized mild steel flat, properly treated and securely fixed to support by means of nuts and bolts raw bolts, brass machine screws, as mentioned, at an internal of not more than one meter but on either side of couplers, or bends, or junction/pull/outlet boxes or similar fittings, saddles shall be fixed at a distance of 30 cm from the centre of such fittings.
- 4.6.2 Draw boxes shall be located at convenient location for easy drawing of wires
- 4.6.3 Every mains and sub mains shall run in independent conduits with an independent

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earth wire of specified capacity along the entire length of conduit

- 4.6.4 The conduits to be installed shall be of ample cross section area to facilitate the drawing of wires. The diameter of the conduit shall be selected as per table specified in these specifications. But in no case it shall be less than 25 mm diameter
- 4.6.5 Entire conduit layout shall be done such as to avoid additional junctions boxes other than for outlet points. Conduits shall be free from sharp edge and burrs. Conduits shall be laid in a neat and organized manner as directed and approved by the client. Conduit runs shall be planned so as not to conflict with any other services pipe, lines/duct
- 4.6.6 The entire conduit system shall be electrically and mechanically continuous and shall be bonded, together by means of approved type earthing clamp and earthed through a bare copper conductor of 14 SWG to the earthing terminals on the nearest distribution board
- 4.6.7 If required, connection between PVC and steel conduits shall be through a junction box. Direct connection between PVC and steel conduits are not allowed
- 4.6.8 Where exposed conduits are suspended from the structure, they shall be clamped firmly and rigidly to hangers of design to be approved by client. Where hangers are to be anchored to reinforced concrete, appropriate inserts and necessary devices for their fixing shall be left in position at the time of concreting, making holes and opening in the concrete will generally not be allowed. In case, it is unavoidable, prior permission of the client shall be obtained
- 4.7 CONDUIT JOINTS
- 4.7.1 Conduit pipes shall be joined by means of screwed couplers and screwed accessories, as per IS: 2667
- 4.7.2 The threads shall be free from grease or oil
- 4.7.3 In long distanced straight runs of conduit, inspection type couplers two way junction boxes at reasonable intervals shall be provided or running threads with couplers and lock nuts shall be provided. The bare threaded portion shall be treated with anti-corrosive paints. Threads on conduit pipes in all cases shall be between 11mm to 27mm long, sufficient to accommodate pipes to full threaded portion of couplers or accessories. Cut ends of conduit pipes shall have no sharp edges nor any burrs left, to avoid damage to the insulation of conductors while pulling them through such pipes
- 4.7.4 Brass female bushes shall be used in each conduit termination in a switch box, outlet box, electrical panel or any other box
- 4.7.5 Conduit shall be secured in each outlet box switch box, electrical panel or any other ox by means of one brass hexagonal lock nut and bush, outside and inside the box
- 4.7.6 At each building, expansion joints approved oil tight double wire wound flexible steel conduit or any other approved method shall be used. This shall be united on both sides with the rigid conduits by suitable union
- 4.7.7 Conduits installed in the plant room for mechanical equipment shall be properly clamped with the mechanical supports, but in no case, it shall be fixed with the body of the equipment

4.7.8 The connection of conduit to the mechanical equipment shall be through oil tight double wire wound flexible steel conduit. In any case the length of the flexible conduit shall not exceed one meter. The flexible conduit shall be properly clamped with the body of the equipment. They shall not in any case be clamped with any cover or any removable parts of the equipment

4.8 BENDS IN CONDUIT

4.8.1 All necessary bends in the system including diversion shall be done by bending pipes or by inserting suitable solid or circular inspection type normal box or similar fittings. Conduit fittings shall be avoided as far as possible on conduit system exposed to weather, where necessary, solid type fittings shall be used. Radius of such bends in conduit pipes shall be not less than 75 mm. No length of conduit shall have more than the equivalent of four quarter bends from outlet, the bends at the outlets not being counted

4.9 PROTECTION AGAINST DAMPNES

4.9.1 In order to minimize condensation or sweating inside the conduit, all outlets of conduit system shall be properly drained and ventilated, but in such a manner as to prevent the entry of insects, as far as possible

4.10 PROTECTION OF CONDUIT AGAINST RUST

4.10.1 The outer surface of the conduits including bends, junction boxes, etc., forming part of the conduit system shall be adequately protected against rust, particularly when such system is exposed to weather. In all cases, no bare/threaded portion of conduit pipe shall be allowed unless such bare threaded portion is treated with anti-corrosive coating or covered with approved plastic compound

4.11 BUNCHING OF CABLES

4.11.1 Unless otherwise specified, insulated conductors of different phases shall be bunched in separate conduit.

Wires carrying current shall be so bunched in the conduit that the out going and return wires are drawn into the same conduit. Wires originating from two different phases shall not be run in the same conduit

4.11.2 The number of insulated wires/cables that be drawn into the conduits shall be as per the following table.

MAXIMUM PERMISSIBLE NUMBER OF 650/1100 VOLTS GRADE SINGLE CORE CABLE THAT CAN BE DRAWN INTO RIGID STEEL CONDUITS.

CABLE SIZE IN MM SQ.	SIZE OF CONDUITS (MM)			
	MAXIMUM NO. OF CABLES			
	25	32	38	51
1.5	10	14	---	---

2.5	8	12	---	---
4.0	6	10	---	---

4.12 SWITCH AND SOCKET

- 4.12.1 Switches shall be installed at 900 mm above finished floor level unless otherwise indicated on the drawings
- 4.12.2 The switch controlling the light point or fan shall be connected on to the phase wire of the circuit and neutral shall be continuous, having no fuse or switch installed in the line except at the D.B. All fan regulators shall be fixed inside the switch boxes on adjustable flat M.S. strips/plates with tapped holes and brass machine screws, leaving ample space at the back and side for accommodating wires
- 4.12.3 The cover plates to the switch box shall be fixed by means of sunk head brass cadmium screws
- 4.12.4 Where two or more switches and fan regulators are installed together, they shall be provided with one gang cover plate with knockouts to accommodate required number of switches, sockets and regulators
- 4.12.5 The switch controlling the socket outlet shall be on the phase wire of the circuit. The third pin of the socket shall be connected to the earth continuity conductor of the circuit
- 4.12.6 The switch boxes, installed back-to-back in the same wall shall be offset from each other, 150 mm horizontally, to preclude noise transmission

4.13 DRAWING OF CONDUCTORS

- 4.13.1 The drawing and joining of copper conductor or wires shall be executed with due regard to the following precautions. While drawing insulated wires into the conduits, care shall be taken to avoid scratches and kinks which may cause breakage of conductors. There shall be no sharp bends
- 4.13.2 Insulation shall be shaved off for a length of 15 mm at the end of wire like sharpening of a pencil and it shall not be removed by cutting it square or ringing
- 4.13.3 FRLS insulated copper conductor wire ends before connection shall be properly soldered (at least 15 mm length) with soldering flux/copper solder, for copper conductor. Strands of wires shall not be cut for connecting to the terminals. All strands of wires shall be soldered at the terminals. All strands of wires shall be soldered at the end before connection. The connecting brass-screws shall have flat ends. All looped joints shall be soldered and connected through terminals block/connectors. The pressure applied to tighten terminal screws shall be just adequate, neither too much nor too less. Conductors having nominal cross section exceeding 4 sq. mm shall always be provided with crimping type cable sockets. At all bolted terminals, brass flat washer of large area and approved steel spring washers shall be used. Brass nuts and bolts shall be used for all connections
- 4.13.4 Only certified wire men and cable jointers shall be employed to do joining work



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- 4.13.5 For all internal wiring FRLS insulated wires of 650/1100 volts grade shall be used. The sub-circuit wiring for point shall be carried out in looping system and no joint shall be allowed in the length of the conductors. No wire shall be drawn in to any conduit, until all work of any nature that may cause injury to wire is completed. Care shall be taken in pulling the wires so that no damage occurs to the insulation of the wire. Before the wires are drawn into the conduits the conduits shall be thoroughly cleaned of moisture, dust, and dirt or any other obstruction by forcing compressed air through the conduits
- 4.14 JOINTS
- 4.14.1 The wiring shall be by looping back system, and hence all joints shall be made at main switches, distribution boards, socket outlets, lighting outlets and switch boxes only. No joints shall be made inside conduits and junction boxes.
- 4.14.2 Contractors shall be continuous from outlet to outlet. For joints where unavoidable, due to any specified reasons, prior permission in writing shall be obtained from the client before making such connections. Joints by twisting conductors are prohibited.
- 4.15 LOAD BALANCING
- 4.15.1 Balancing of circuit in three phase installation shall be planned before the commencement of wiring and shall be strictly adhered to
- 4.16 EARTHING
- 4.16.1 All earthing systems shall be in accordance with IS: 3043 - 1985 code of practice for earthing

# **TECHNICAL SPECIFICATIONS FOR INSTALLATION OF LIGHTING DBs**

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**TECHNICAL SPECIFICATIONS FOR INSTALLATION OF LIGHTING DBs****1.0 SCOPE**

- 1.1 This section relates to specifications for installation, connection, testing and commissioning of lighting distribution board (LDB) using TPN/FP/DP/SP MCB isolator & ELMCB, Earthing terminal, connector strip for phase neutral and earth for each circuit, CRCA sheet steel housing and complete the item installation. Common banking of neutral and earth conductor is not allowed.

**2.0 CODES & STANDARDS**

- 2.1

**3.0 MATERIALS REQUIRED**

- 3.1

**4.0 INSTALLATION OF SYSTEM**

- 4.1 The DB's shall be assembled and aligned together and be installed at site as per installation manual/instruction of the DB manufacturer.
- 4.2 The DB shall be installed in surface manner at the various location.
- 4.3 All minor electrical and mechanical work required to be attended to on the DB shall be completed in an approved manner after installation but before energizing the DB's.
- 4.4 The M.S. angle/channel iron frame used for installation of D.B. shall be hot dip galvanized (816 g/m<sup>2</sup>).
- 4.5 The DB shall be mounted on angle/channel frame with Anchor fastening only. Civil grouting is not acceptable.

**5.0 EARTHING INSTALLATION**

- 5.1

**6.0 INSPECTION & TESTING**

- 6.1 Prior to commissioning of the DB's following tests shall be carried out.
- 6.1.1 Mechanical endurance test shall be carried out by closing and opening of all the MCB's, switches etc.
- 6.1.2 Insulation resistance test shall be carried out between phases and between phase to earth bus, keeping the isolating switch in open position. Similar test shall be carried out keeping the isolating switch in closed position.
- All the interlocks, controls and tripping mechanism of the switch gears shall be tested for their proper functioning.

# **TECHNICAL SPECIFICATIONS FOR INSTALLATION OF DISTRIBUTION TRANSFORMER (OIL TYPE)**

**TECHNICAL SPECIFICATIONS FOR INSTALLATION OF DISTRIBUTION TRANSFORMER (OIL TYPE)****1.0 SCOPE**

- 1.1 This specifications intended to cover assembly, installation and testing of Transformer complete in all respect with all equipment, fittings and accessories for efficient and trouble-free operation. The material to be supplied by the Contractor and work to be carried out by the Contractor shall be in general, but not limited to, conforming to the specification laid down for each item.

**2.0 CODES & STANDARDS**

- 2.1 Following Indian Standards and Code of Practice shall be applicable to the work of erection and commissioning of the transformer.
- i. IS: 2027 Specification for Power and Distribution Transformers
  - ii. IS: 1886 Code of Practice for Installation and Maintenance of Transformers
  - iii. IS:335 Specification for New Insulating Oil
  - iv. IS: 10028 Drying out of the Transformer

**3.0 MATERIALS REQUIRED**

- 3.1 All required hardware such as bolts, nuts, washers (round and spring type), anchor fasteners, screws, etc. of sizes and type as required shall be conforming to relevant IS. All hardware shall be hot-dip galvanized or zinc passivated/cadmium plated as per requirement of work either mechanical fabrication or electrical jointing.
- 3.2 Equipment Grouting material such as cement, metal, sand, bricks, etc., if required, shall be supplied by the Contractor. The material shall be of approved make (Wherever applicable) for which the Contractor shall consult Engineer-in-charge before procuring the material.

**4.0 INSTALLATION OF SYSTEM**

- 4.1 The transformer shall be correctly positioned on channel over constructed concrete foundation. Leveling shall be checked and the transformer shall be aligned and checked for free movement over channels or rails. Stoppers shall be clamped to the transformer thereafter to prevent any movement.
- 4.2 In case, accessories like Buchholz relay, valves, explosion vent, silica-gel breather, etc. loose, all such items shall be checked for any transit damage. These accessories shall be thoroughly cleaned and correctly installed on the transformer.
- 4.3 The transformer tank shall be filled up with oil, however, some oil top up, if required, shall be done, adopting correct oil filling and topping practice. It shall be ensured that all radiators, valves, gauges, etc. are installed before oil is filled up. Oil shall be tested for dielectric strength before filling.
- 4.4 Wiring of devices such as Buchholz relay, Dial thermometers, etc. shall be carried out up to the marshalling box in case these items shall be supplied loose.
- 4.5 The devices such as Buchholz relay, OSR, WTI, OTI, ETPB etc. shall be checked for their operation of alarm/trip contacts by simulation.

- 4.6 After erection of transformer, touch up paint shall be applied, wherever required.
- 4.7 Connection of neutral with correct earthing station and transformer body, cable termination chamber, bus termination chamber, marshalling box, etc. shall be carried out as mentioned elsewhere in the inquiry document. Earth contact between tank and top plate, radiators, etc. shall be established by providing GI flats or such connection, if not done by the manufacturer.
- 4.8 The transformer should be charged after carrying out required tests as per IS and as specified in clause "Inspection and Testing". The test reports should be submitted to Client / Consultants prior to charging.

## 5.0 EARTHING INSTALLATION

- 5.1 The earth system shall generally cover the following.
- a. Equipment earthing for personnel and equipment safety.
  - b. System neutral earthing.
- 5.2 Following equipment and systems shall be provided for earthing connection.
- a. System neutrals at two distinct earthing stations.
  - b. Metallic non-current carrying parts of all electrical equipment such as transformer, operating handle, 11 kV Switchboard, LV Switchboard, etc.
  - c. Cable trays, racks.
  - d. Fence and Gate of transformer yard.
  - e. Lightning arrestors installed on 2-pole structure.
  - f. Cable shields and armour.
- 5.3 Civil construction material such as cement, sand, metal, bricks, etc. for construction of brick chamber for earthing station shall be supplied by the Contractor.
- 5.4 Minimum 3000 mm spacing between adjacent earthing stations shall be maintained unless stipulated otherwise. Minimum distance of pit from the boundary of building shall be 1000 mm.
- 5.5 The installation of earthing stations shall be strictly as per the drawing provided in the layout approved by the Electrical Inspector. Location of pits for earthing stations shall be decided such that fouling with surrounding equipment, foundations, structures, pipelines, etc. is avoided.
- 5.6 Earthing station designation shall be painted on top of CI cover of the pit. Further on bottom of the cover, the earthing station identification with earth resistance value and date of testing shall be painted.
- 5.7 Individual earthing station and earth electrode shall be provided with facility for disconnection to check its earth resistance periodically.
- 5.8 Excess earth after backfilling shall be disposed off at location shown by the Client, which shall be within the company premises.
- 5.9 Interconnection between earthing stations shall be strictly 600 mm below finished ground level.

**6.0 INSPECTION & TESTING**

6.1 List of tests to be carried out **at site** in presence of Client/Consultant's representative :

1. Measurement of BDV for transformer oil
2. Insulation Resistance test
3. Vector group test
4. Magnetic balance test
5. Winding Resistance test
6. WTI/OTI alarm & Trip confirmation
7. Transformer oil filtration (if required)
8. OSR, PRV trip confirmation

Test reports should be submitted to Client/Consultants in duplicate.

**7.0 METHOD OF MEASUREMENT**

7.1 Installation of the transformer including site testing and charging of transformer as specified will be treated as one unit for measurement and payment.

# **TECHNICAL SPECIFICATIONS FOR MEDIUM VOLTAGE PANEL BOARD**



**TECHNICAL SPECIFICATIONS FOR MEDIUM VOLTAGE PANEL**

**1.0 SCOPE OF WORK**

1.1 This scope shall cover design, manufacture, check test, and supply of medium and low voltage motor/power control Panel boards, MCB distribution boards etc. as described in this specification, as per drawings and schedule of quantities.

**2.0 CODES & STANDARDS**

2.1 The Panels shall comply with the latest edition of relevant Indian Standards and Indian Electricity Rules and Regulations. The following Indian standards shall be complied with:

Sr.	Item	Relevant IS	Relevant IEC
1	General requirements for switchgear and control gear for voltages not exceeding 1000 V AC or 1200 V DC	IS: 4237	
2	Switchgear bus bars, main connection and auxiliary wiring, marking and arrangement.	IS: 375	
3	Degree of protection provided by enclosures for Low voltage switch gear and control gear.	IS: 2147	
4	Terminal marking for electrical measuring instrument and their accessories.	IS: 8197	
5	Danger notice plates	IS: 2551	
6	Code of Practice for selection, installation and maintenance of switchgear and control gear.	IS: 10118	
7	Specification for factory built assemblies of switchgear and control gear for voltage up to and including 1000 V AC and 1200 V D.C.	IS: 8623	
8	Miniature circuit breakers.	IS: 8828	
9	Current transformers	IS: 2705	
10	Voltage transformer	IS: 3155	
11	Electrical relay for protection	IS: 3231	

12	Indicating instruments	IS: 1248	
13	Integrating instruments	IS: 722	
14	Control switches and push buttons	IS: 6875	
15	AC motor starters of voltage not exceeding 1000 V	IS: 1822	

The Panels also require approval of the client/consultant at various stage of their manufacture such as design, selection, construction, testing, shipping etc.

**3.0 DESIGN BASIS & SITE CONDITIONS**

- 3.1 Ambient Temperature : Max. / Min. = 50° C. / 6° C.
- Design temperature : 50 Degree C.
- Relative humidity : 95% max.
- Altitude : 20 M above MSL
- Location : Ahmedabad
- Voltage : 415+/- 10%, TPN
- Frequency : 50 Hz. + 3% to -6%
- Neutral : Solidly / earthed neutral.
- Fault level : 24 MVA, Symmetrical at 415V solidly earthed.

All the equipment and components provided in the transformer and accessories shall be suitably designed for installation and satisfactory operation as specified below.

<b>Site conditions</b>	
<b>Location</b> Tripura	<b>Site altitude</b> 560M-800M above mean sea level
<b>Ambient temperature</b>	<b>Relative humidity</b>
Maximum 41 <sup>0</sup> C	Maximum 85 %
Minimum 05 <sup>0</sup> C	Minimum 35 %
Design 45 <sup>0</sup> C	Design 90 % at 45 <sup>0</sup> C
<b>Seismic factor</b> Zone IV as per IS:1893	<b>Rainfall</b> 722 mm/year
<b>Environmental</b> Tropical/wet & Dry Climate	<b>Location of Equipment</b> Indoor
<b>Wind speed</b> Annual average 4.35	
<b>Electrical system data:</b>	

<b>Power supply for Equipment</b>				
Voltage <b>415 kV ± 5 %</b>			Frequency <b>50 Hz ± 3 %</b>	
<b>Permissible voltage &amp; frequency variation</b>	<b>combined frequency</b>	<b>± 6 %</b>	<b>System faults (Symmetrical)</b>	<b>30 kA for 1 sec. max.</b>
			<b>design level</b>	
<b>System earthing LV side neutral solidly earthed</b>			<b>Wiring 3 phase, 4 wire on 415V system</b>	
<b>Auxiliary power supply :</b>				
<b>Power supply</b>			<b>240V AC, 1-Ph, 50Hz</b>	
<b>Control Supply</b>			-----	
<b>Space heater power supply</b>			<b>240V AC, 1-Ph, 50Hz</b>	
<b>Illumination power supply</b>			<b>240V AC, 1-Ph, 50Hz</b>	
<b>Plug-socket power supply</b>			<b>240V AC, 1-Ph, 50Hz</b>	

**4.0**

**TECHNICAL REQUIREMENTS**

All the Panels shall be metal clad, totally enclosed, rigid, floor mounting, air insulated, cubicle type suitable for operation on three phase/single phase, 415 V/240 V, 50 Hz., neutral effectively grounded at transformer and short circuit level as mentioned in the drawings.

All the outdoor panel shall be double door type with IP54 protection class construction.

All the indoor panel shall have IP51 protection class construction.

The painting of all the metal part shall be as per the painting specification defined in the datasheet.

The Panels shall be designed to withstand heaviest condition at site, with maximum expected ambient temperature of 45°C, 90% humidity and salty, dusty weather.

**CUBICAL TYPE PANELS:**

**4.1 STRUCTURE**

- 4.1.1 The Panels shall be metal clad enclosed and be fabricated out of high quality CRCA sheet, suitable for indoor installation having dead front operated and floor mounting type.
- 4.1.2 All CRCA sheet steel used in the construction of Panels shall be 2 mm. thick and shall be folded and braced as necessary to provide a rigid support for all components. Joints of any kind in sheet steel shall be seam welded, all welding slag grounded off and welding pits wiped smooth with plumber metal.
- 4.1.3 The Panels shall be totally enclosed, completely dust and vermin proof and degree of protection being not less than IP: 51. Gaskets between all adjacent units and beneath all covers shall be provided to render the joints dust proof. All doors and covers shall be fully gasketed with foam rubber and/or rubber strips and shall be

lockable.

- 4.1.4 All panels and covers shall be properly fitted and secured with the frame and holds in the panel correctly positioned. Fixing screws shall enter into holes, taped into an adequate thickness of metal or provided with bolts and nuts. Self-threading screws shall not be used in the construction of Panels.
- 4.1.5 A base channel of 100 mm. x 50 mm. shall be provided at the bottom. A clearance of 300 mm. between the floor of the Panels and the bottom of the lower most units shall be provided.
- 4.1.6 Panels shall be preferably arranged in multi-tier formation. The Panels shall be of adequate size with a provision of 20% spare space to accommodate possible future additional switchgear. The size of the Panels shall be designed in such a way that the internal space is sufficient for hot air movement and the electrical component does not attain temperature more than 45<sup>0</sup>c. The entire electrical component shall be derated for 50<sup>0</sup>c. The ratings indicated in the drawing are de-rated for 50<sup>0</sup>c.
- 4.1.7 Knock out holes of appropriate size and number shall be provided in the Panels in conformity with the number, and the size of incoming and outgoing conduits/cables.
- 4.1.8 Alternately, the Panels shall be provided with removable sheet steel plates at top and bottom to drill holes for cable/conduit entry at site.
- 4.1.9 The Panels shall be designed to facilitate easy inspection, maintenance and repair.
- 4.1.10 The Panels shall be sufficiently rigid to support the equipment without distortion under normal and under short circuit condition. They shall be suitably braced for short circuit duty.
- 4.2 PROTECTION CLASS:
- 4.2.1 All the indoor Panels shall have protection class of IP 51 for indoor installation and IP 54 for outdoor installation.
- 4.3. PAINTING:
- 4.3.1 The painting shall be with 2 coats of epoxy primer along with two coats of PU paint [Anti-corrosive paint]. Paint shade shall be confirmed with the client.
- 4.4 CIRCUIT COMPARTMENTS:
- 4.4.1 Each circuit breaker and switch fuse unit shall be housed in separate compartments and shall be enclosed on all sides. Sheet steel hinged lockable door shall be duly interlocked with the breaker/switch fuse unit in 'ON' and 'OFF' position. Safety interlocks shall be provided for air circuit breaker to prevent the breaker from being drawn out when the breaker is in 'ON' position.
- 4.4.2 The door shall not form an integral part of draw out position of the circuit breaker. All instruments and indicating lamp shall be mounted on the compartment door. Sheet steel barriers shall be provided between the tiers in a vertical section.
- 4.5 INSTRUMENT COMPARTMENTS:
- 4.5.1 Separate adequate compartment shall be provided for accommodating instruments, indicating lamps, control contactors/relays and control fuses etc. These components shall be accessible for testing and maintenance without any danger of accidental contact with live parts of the circuit breaker/switch fuse unit, busbar and connections.
- 4.6 BUS-BARS:
- 4.6.1 The busbar shall be air insulated and made of high quality, high conductivity, high

strength Aluminum.

- 4.6.2 The busbar shall be of 3 phases and neutral system with separate neutral and earth bar. The bus bar and interconnection between bus bars and various components shall be of high conductivity Aluminum. The busbar shall be of rectangular cross-section designed to withstand full load current for phase bus bars and half rated current for neutral bus bars and shall be extensible on either side. The busbar size shall be as per drawing. The busbar shall have uniform cross-section throughout the length.
- 4.6.3 The bus bars and interconnections shall be insulated with heat shrinkable PVC sleeve and be colour coded in red, yellow, blue and black to identify the 3 phases and neutral of the system if specified in datasheet. The busbar shall be supported on unbreakable, non-hydroscopic SMC/DMC insulated supports at sufficiently close intervals to prevent bus bars sag and shall effectively withstand electromagnetic stresses in the event of short circuit capacity of 15 KA RMS symmetrical for 1 sec. and a peak short circuit withstand of 31.5 KA minimum.
- 4.6.4 The bus bar shall be housed in a separate compartment. The bus bar shall be isolated with 3 mm. thick Bakelite sheet to avoid any accidental contact. The bus bar shall be arranged such that minimum clearance between the bus bars to be maintained as below:
- |                            |   |                |
|----------------------------|---|----------------|
| Between phases             | : | 25 mm. minimum |
| Between phases and neutral | : | 25 mm.         |
| Between phases and earth   | : | 25 mm.         |
| Between neutral and earth  | : | 20 mm. minimum |
- 4.6.5 All bus bar connections shall be done by drilling holes in bus bars and connecting by chromium plated or tinned plated brass bolts and nuts. Additional cross-section of bus bar shall be provided in all Panels to cover up the holes drilled in the bus bar. Spring and flat washers shall be used for tightening the bolts.
- 4.6.6 All connections between bus bars and circuit breakers/switches and cable terminals shall be through aluminum strips of proper size to carry full rated current. These strips shall be insulated with insulating tapes.
- 4.7 ELECTRICAL POWER AND CONTROL WIRING CONNECTION:
- 4.7.1 Terminal for both incoming and outgoing cable connections shall be suitable for 1100 V grade, aluminum/copper conductor PVC insulated and sheathed, armoured cable and shall be suitable for connections of solder-less sockets for the cable size as indicated on the appended drawings for the Panels.
- 4.7.2 Power connections for incoming feeders of the main Panels shall be suitable for 1100 V grade aluminum conductor (LT XLPE) cables.
- 4.7.3 Both control and power wiring shall be brought out in cable alley for ease of external connections, operation and maintenance.
- 4.7.4 Both control and power terminals shall be properly shrouded.
- 4.7.5 10% spare terminals shall be provided on each terminal block. Sufficient terminals shall be provided on each terminal block, so that not more than one outgoing wire is connected per terminal.
- 4.7.6 Terminal strips for power and control shall preferably be separated from each other by suitable barriers of enclosures.
- 4.7.7 Wiring inside the modules for power, control, protection and instruments etc. shall be done with use of 660/1100 V grade, PVC insulated copper conductor cables conforming to IS: 694 and IS: 8130. Power wiring inside the starter module shall be

rated for full current rating of respective contactor, but not less than 4.0 sq.mm. cross-section area. For current transformer circuits, 2.5 sq.mm. copper conductor wire shall be used. Other control wiring shall be done with 1.5 sq.mm. copper conductor wires. Wires for connections to the door shall be flexible. All conductors shall be crimped with solderless sockets at the ends before connections are made to the terminals.

- 4.7.8 Control power for the Motor starter module shall be taken from the respective module switchgear outgoing. Control power wiring shall have control fuses, (HRC fuse type) for circuit protection. All indicating lamps shall be protected by HRC fuses.
- 4.7.9 Particular care shall be taken to ensure that the layout of wiring is neat and orderly. Identification ferrules shall be fitted to all the wire termination for ease of identification and to facilitate checking and testing.
- 4.7.10 Spring type washers shall be used for all copper and aluminium connections.
- 4.7.11 Final wiring diagram of the Panels power and control circuit with ferrules numbers shall be submitted along with the Panels as one of the documents against the contract.
- 4.8 **TERMINALS:**
  - 4.8.1 The outgoing terminals and neutral link shall be brought out to a cable alley suitably located and accessible from the panel front. The current transformers for instruments metering shall be mounted on the disconnecting type terminal blocks. No direct connection of incoming or outgoing cables to internal components of the distribution board is permitted; only one conductor may be connected in one terminal.
- 4.9 **WIRE-WAYS:**
  - 4.9.1 A horizontal PVC wire way with screwed covers shall be provided at the top to take interconnecting control wiring between different vertical sections.
- 4.10 **CABLE COMPARTMENTS:**
  - 4.10.1 Cable compartments of adequate size shall be provided in the Panels for easy termination of all incoming and outgoing cables entering from bottom or top. Adequate supports shall be provided in the cable compartments to support cables. All outgoing and incoming feeder terminals shall be brought out to terminal blocks in the cable compartment.
- 4.11 **EARTHING:**
  - 4.11.1 Copper earth bus of 40 X 6 mm shall be provided in the Panels for the entire length of the panel. The frame work of the Panels shall be connected to this earth bar. Provisions shall be made for connection from this earth bar on both sides of the panels to the main earthing bar coming from the earth pit. Door earthing shall be provided for all the compartments.
  - 4.11.2 The earth continuity conductor of each incoming and outgoing feeder shall be connected to this earth bar. The armour shall be properly connected with earthing clamp, and the clamp shall be made for connection from this earth pit on both sides of the Panels.
  - 4.11.3 The earth continuity conductor of each incoming and outgoing feeder shall be connected to this earth bar. The armour shall be properly connected with earthing clamp, and the clamp shall be ultimately bonded with the earth bar.
- 4.12 **LABELS:**
  - 4.12.1 Engraved metal labels shall be provided on all incoming and outgoing feeders. Single line circuit diagram showing the arrangements of circuit inside the distribution board

shall be pasted on inside of the panel door and covered with transparent laminated plastic sheet.

4.13 NAME PLATE:

4.13.1 A name plate with the Panel's designation in bold letters shall be fixed at top of the central panel. A separate name plate giving feeder details shall be provided for each feeder module door.

4.13.2 Inside the feeder compartments, the electrical components, equipments, accessories like switchgear, control gear, lamps, relays etc. shall suitably be identified by providing stickers.

4.13.3 Engraved name plates shall preferably be of 3 ply, (Red-White-Red or Black-White-Black) lamicold sheet. However, black engraved Perspex sheet name plates shall also be acceptable. Engraving shall be done with square groove cutters.

4.13.4 Name plate shall be fastened by counter sunk screws and not by adhesives.

4.14 DANGER NOTICE PLATES:

4.14.1 The danger notice plate shall be affixed in a permanent manner on operating side of the Panels.

4.14.2 The danger notice plate shall indicate danger notice both in Hindi and English and with a sign of skull and bones.

4.14.3 The danger notice plates, in general, meet the requirements of local inspecting authorities.

4.14.4 Overall dimensions of the danger notice plate shall be 200 mm. wide x 150 mm. high.

4.14.5 The danger notice plate shall be made from minimum 1.6 mm. thick mild steel sheet and after due pre-treatment to the plate, the same shall be painted white with vitreous enamel paint on both front and rear surface of the plate.

4.14.6 The letters, the figures, the conventional skull and bones etc. shall be positioned on plate as per recommendation of IS: 2551-1982.

4.14.7 The said letters, the figures and the sign of skull and bones shall be painted in signal red colour as per IS: 5-1978.

4.14.8 The danger plate shall have rounded corners. Location of fixing holes for the plate shall be decided to suit design of the Panels.

4.14.9 The danger notice plate, if possible, be of ISI certification mark. Suitable Voltage rated rubber mates to be provided.

4.15 INTERNAL COMPONENTS:

4.15.1 The Panels shall be equipped complete with all types of required number of auto transformer starters, switch fuse units, contactors, relays, fuses, meters, instruments, indicating lamps, push buttons, equipment, fittings, bus bars, cable boxes, cable glands etc. and all the necessary internal connections/wiring as required and as indicated on relevant drawings. Components necessary for the proper and complete functioning of the Panels but not indicated on the drawings shall be supplied and installed on the Panels.

4.15.2 All parts of the Panels carrying current including the components, connections, joints and instruments shall be capable of carrying their specified rated current continuously, without temperature rise exceeding the acceptable values of the relevant specifications at the part of the Panels.

4.15.3 All units of the same rating and specifications shall be fully interchangeable.

**COMPONENTS**

4.16 GENERAL:

4.16.1 The type, size and rating of the components shall be as indicated on the relevant drawings.

While selection of the capacity of the components resulting from the prevailing conditions like ambient temperature shall be allowed for. The thermal and magnetic trip rating shall be compensated for the ambient temperature.

The ratings indicated on the drawing are ratings anticipated at prevailing site conditions.

4.17 MINIATURE CIRCUIT BREAKERS:

4.17.1 Miniature Circuit breakers shall be current limiting type conformed with British standard BS: 3871 (Part I) 1965 and IS: 8825. The housing of MCBs shall be heat resistant and having high impact strength. The fault current of MCBs shall not be less than 9000 A at 230 V. The MCBs shall be flush mounted and shall be provided with trip free manual operating mechanism with mechanical 'ON' and 'OFF' indications.

4.17.2 The circuit breaker dollies shall be of the trip free pattern to prevent closing the breaker on a faulty circuit.

4.17.3 The MCB contacts shall be silver nickel and silver graphite alloy and tip coated with silver. Proper arc chutes shall be provided to quench the arc immediately. MCBs shall be provided with magnetic fluid plunger release for over current and short circuit protection. The overload or short circuit device shall have a common trip bar in the case of DP and TPN miniature circuit breakers. All the MCBs shall be tested and certified as per Indian Standards, prior to installation.

4.18 FUSE:

4.18.1 Fuses shall be of high rupturing capacity (HRC) fuse links and shall be in accordance with IS: 2000-1962 and having high rupturing capacity of not less than 35 MVA at 415 V. The back-up fuse rating for each motor/equipment shall be so chosen that the fuse does not operate on starting of motors/equipment. HRC fuses shall be of the make as specified in Make of Material.

4.19 AIR CIRCUIT BREAKER:

4.19.1 **Construction:**

The ACBs shall have following features:

1. Motorised with 230 V A.C. motor.
2. 230 V A.C closing and shunt trip coil
3. Draw out type with "service", "test", "isolated" and "maintenance" position.
4. Safety shutter of Fibre glass/polycarbonate sheet of 2mm thickness shall be provided
5. Mechanically trip free plus anti-pumping feature is to be provided.
6. Electrical trip free plus anti pumping shall be provided with relay ONLY and not by contactors.
7. Electrical/Mechanical operation counter shall be provided.
8. Door interlock with defeat features to be provided.
9. ACB shall be lockable in isolation position.



4.19.2 **Release:**

1. Thermal Magnetic release shall be direct acting type, tripping ACB mechanically.
2. Short circuit, overload and earth fault protection shall be provided.
3. Vendor to suggest release type for feeders of supply range characteristic and accuracy.

4.19.3 **ACB Performance:**

1. ACB performance inside panels at ambient 50 Degree.
2. Ith Symmetrical breaking, 35KA
3. Making capacity peak 87.5 KA
4. Short time rating, 1sec. 35KA

4.20 **CONTACTORS:**

- 4.20.1 The contractors shall meet with the requirements of IS: 2959 and BS: 775.
- The contractors shall have minimum making and breaking capacity in accordance with utilisation category AC3 and shall be suitable for minimum Class II intermittent duty.
- If the contractor forms part of a distribution board then a separate enclosure is not required, but the installation of the contractor shall be such that it is not possible to make an accidental contact with live parts.

4.21 **CURRENT TRANSFORMER:**

- 4.21.1 Where ammeters are called for C.T.s shall be provided for current measuring. Each phase shall be provided with separate current transformer of accuracy Class I and suitable VA burden for operation of associated metering and controls. Current transformer shall be in accordance with IS: 2705 - 1964 as amended upto date.

4.22 **PUSH BUTTONS:**

- 4.22.1 The push button unit shall comprise of the contact element, a fixing holder, and a push button actuator. The push button shall be momentary contact type. The contacts shall be of silver alloy and rated at 10 Amps. continuous current rating. The actuator shall of standard type and colour as per its usage for ON, OFF and TRIP.

4.23 **INDICATING LAMPS:**

- 4.23.1 Indicating lamps shall be transformer operated low voltage rated and shall be supplied complete with translucent covers to diffuse the lamp light.
- Colour shade for the indicating lamps shall be as below – the LED shall be 22.5 mm and self coloured:

ON indicating lamp	:	Red
OFF indicating lamp	:	Green
TRIP indicating lamp	:	Amber
PHASE indicating lamp	:	Red, Yellow, and Blue

4.24 **DIGITAL MULTI FUNCTION METER**

- 4.24.1 The load manager shall be digital type with RS485 port. It should measure KW, KVA, KVAR, V, I, PF etc.

**5.0 DRAWING & INFORMATION**

- 5.1 Prior to fabrication of the Panels the supplier/contractor shall submit for consultant's approval the shop/vendor drawing consisting of G.A. drawing, sectional elevation, single line diagram, bill of material etc. and design calculations indicating type, size, short circuiting rating of all the electrical components used, busbar size, internal wiring size, Panels dimension, colour, mounting details etc.. The contractor shall submit manufacturer's catalogues of the electrical components installed in the Panels.

## 6.0 INSPECTION & TESTING

- 6.1 At all reasonable times during production and prior to transport of the Panels to site, the supplier/contractor shall arrange and provide all the facilities at their plant for inspection.
- 6.2 Testing of Panels shall be carried out at factory and at site as specified in Indian standards in the presence of consultant. The test results shall be recorded on a prescribed form. The test certificate for the test carried out at factory and at site shall be submitted in duplicate to the consultant for approvals.

## 7.0 METHOD OF MEASUREMENT

- 7.1 All the items will be measured as mentioned in Bill of quantity.

## 8.0 TRANSPORT, DELIVERY & STORAGE

- 8.1 The prices shall be **F.O.R. site basis** including packing & forwarding charges. The quoted price must include all the costs for necessary mode of transportation up to the final location of site or site store. All incidental expenses during transportation shall be part of quoted prices including **transit insurance**. The charges for loading and unloading of equipments at site should form part of offer.

## 9.0 GUARANTEE & WARRENTY

- 9.1 The Bidder shall stand guarantee for the performance of entire equipment and components for twelve (12) months from the date of commissioning or eighteen (18) months from the date of dispatch, whichever is earlier.

## 10.0 SPARES

- 10.1 The bidder shall quote for minimum spares required for **two years** safe operation of transformer along with the offer separately.

## 11.0 ATTACHMENTS

- 11.1
- **Data Sheet**

**TECHNICAL DATA SHEET FOR MEDIUM VOLTAGE DISTRIBUTION BOARD**

SR. NO.	PARTICULARS	DESCRIPTION
1.0	Site Condition	
1.1	Type	Indoor
1.2	Mounting	Floor, Indoor
1.3	Ambient Temperature	50° C.
1.4	Atmosphere	Wet & Tropical
2.0	OPERATIVE CONDITION	
2.1	Voltage	415 V ± 10 %
2.2	No. Of Phase	3
2.3	System	3 Ø , 4 WIRE
2.4	Frequency	50 HZ, + 3 % / - 6 %.
2.5	Fault Level	18 MVA
2.6	Fault Current	As per SLD
3.0	CONTROL SYSTEM	
3.1	Voltage	
	For Indication	230 V A.C.
	For Metering	230 V A.C.
	For Protection	230 V A.C.
3.2	Control Supply Through Control Transformer	230 V A.C. only
3.3	Control Wiring	2.5 MM <sup>2</sup> FRLS Cu. Wire 4.0 MM <sup>2</sup> FRLS cu. Wire for CT ckt.
4.0	BUSBAR	
4.1	Phase Bus bar	
A.	Material	Aluminium
B.	Support	SMC/DMC
C.	Insulation	Epoxy Moulded ( Resin )
D.	Insulating Barriers	Fibre Glass / Poly Carbonate Of Minimum 1.5 Mm Thick And To Be Of Fr4 Class
E.	Current Density	1.0 Amp. / mm <sup>2</sup>
4.2	Neutral Bus bar	
	Material	Aluminium
4.3	Earth Bus bar	
	Material	GI
5.0	Source changeover System	Not Required
6.0	PAINTING	
6.1	Sheet Should Be 7 Tank Processed, Oven Baked At 310°C. With Powder coating.	

SR. NO.	PARTICULARS	DESCRIPTION
6.2	Type Of Primer	EPOXY PRIMER
6.3	Type Of Paint	PU
6.4	Shade	
	Exterior	Shall be confirmed with client
	Interior	Shall be confirmed with client
6.5	Degree Of Protection	IP 51
6.6	Max. Temperature Rise Inside The Panel (°C.)	35 ° C. above ambient
7.0	CONTROL WIRING	
7.1	Wire Size	3 C × 4.0 mm <sup>2</sup> as specified 3 C × 2.5 mm <sup>2</sup> / 3 C × 1.5 mm <sup>2</sup> /4 C x 1.5 mm <sup>2</sup>
8.0	HARDWARE ( ZINC PLATED )	YES
9.0	SPACE HEATER	230 V A.C. With thermostat control
10.0	POCKET FOR DRAWINGS AT DOOR	YES
11.0	Illumination and switched power plug	YES

# **TECHNICAL SPECIFICATIONS FOR LIGHTING & POWER DISTRIBUTION BOARDS**

**TECHNICAL SPECIFICATIONS FOR LIGHTING DISTRIBUTION BOARDS**

**1.0 SCOPE OF WORK**

1.1 This section relates to specifications for supply of lighting distribution board (LDB) & Power distribution board (PDB) TPN/FP/DP/SP MCB isolator & ELMCB, Earthing terminal, connector strip for phase neutral and earth for each circuit, CRCA sheet steel housing and complete the item supply. Common banking of neutral and earth conductor is not allowed.

**2.0 CODES & STANDARDS**

2.1 The Distribution Board shall comply with the latest edition of relevant Indian Standards and Indian Electricity Rules and Regulations. The following Indian standards shall be complied with:

Sr.	Item	Relevant IS	Relevant IEC
	General requirements for switchgear and control gear for voltages not exceeding 1000 V AC or 1200 V DC	IS: 4237	
	Switchgear bus bars, main connection and auxiliary wiring, marking and arrangement.	IS: 375	
	Terminal marking for electrical measuring instrument and their accessories.	IS: 8197	
	Miniature circuit breakers.	IS: 8828	

**3.0 DESIGN BASIS & SITE CONDITIONS**

3.1 All the equipment and components provided in the DB and accessories shall be suitably designed for installation and satisfactory operation as specified below.

<b>Site conditions</b>			
<b>Location</b> Tripura		<b>Site altitude</b> 560-800M above mean sea level	
<b>Ambient temperature</b>		<b>Relative humidity</b>	
Maximum 41 ° C		Maximum 85 %	
Minimum 05 ° C		Minimum 5 %	
Design 45 ° C		Design 90 % at 45 ° C	
<b>Seismic factor</b> Zone IV as per IS:1893		<b>Rainfall</b> 722 mm/year	
<b>Environmental</b> Tropical/Wet/dry climate		<b>Location of Equipment</b> Indoor	
<b>Wind speed</b> Annual avg. 4.35			
<b>Electrical system data:</b>			
<b>Power supply for Equipment</b>			
<b>Voltage</b> 415 V ± 5 %		<b>Frequency</b> 50 Hz ± 3 %	
<b>Permissible combined voltage &amp; frequency variation</b>	± 6 %	<b>System design faults level (Symmetrical)</b>	10 kA for 1 sec. max.
<b>System earthing</b> LV side neutral solidly earthed		<b>Wiring</b> 3 phase, 4 wire on 415V system	
<b>Auxiliary power supply :</b>			
<b>Power supply</b>		-----	
<b>Control Supply</b>		-----	
<b>Space heater power supply</b>		-----	
<b>Illumination power supply</b>		-----	
<b>Plug-socket power supply</b>		-----	

**4.0 TECHNICAL REQUIREMENTS**

4.1 SYSTEM

4.1.1 The lighting distribution boards shall be suitable for operation on 415/240 volt, 50 cycle per second, A.C supply system. The lighting & power distribution boards MCB shall be capable of withstanding short circuit current of 10 KA.

**4.2 CONSTRUCTION :**

- 4.2.1 The DB's shall be factory made and of those and as per the G.A. layout enclosed. General arrangement lay out of the DB's shall be approved by the consultants in charge before starting the manufacture.
- 4.2.2 The DB shall metal clad duly fabricated from 2mm. thick high quality CRCA sheet metal.
- 4.2.3 The DB shall be wall mounted and dead front operated.
- 4.2.4 The DB shall totally be enclosed and made dust, vermin and weather proof such that it meets to IP42 protection classification for installation.
- 4.2.5 A detachable cover plate of 2 mm thick CRCA sheet to be provided on front of the board such that all live parts of the electrical accessories mounted on the board can be accessible only on removal of the said cover plate.
1. The cover plate shall be fixed to the board with adequate size zinc passivated machine screws.
  2. Above the detachable cover plate, one additional hinged door of 2 mm thick CRCA sheet shall be provided with a suitable locking arrangement.
- The hinged door shall be provided with a suitable gasket capable of withstanding corrosive & humid atmosphere and to maintain degree of enclosure protection to IP 42 as per IS: 13947 for installation.
- 4.2.6 The DB shall have top/Bottom entry arrangement for incoming and out going cables/conduits.
- 4.2.7 All hardware to be used in manufacture of the DB shall be S.S 304 to prevent corrosion due to humid atmosphere prevailing at the project site.
- 4.2.8 All internal electrical connections shall be carried out using 660/1100 volt grade, FRLS insulated, Copper conductor of ISI approved make, having rated current carrying capacity to carry continuous full current of respective switch Fuse rating at operating conditions prevailing at the project site.
- 4.2.9 The DB internals shall be earthed with use of Copper wires/strips running through out the length. Size of the earthing strip/wire shall be as shown in the respective drawing.
- 4.2.10 All non current carrying metal surface of the DB's shall adequately be treated and painted.
- 4.2.11 The surface imperfection shall then be rectified with applications of putty.
- 4.2.12 The DB's shall be provided with electric components and accessories as per the details shown in the drawing for the respective electric distribution board. The circuit connection from all the circuit MCB shall be brought to connector provided on top or bottom of the DB with suitable lugs. The connector shall be suitable to receive phase, neutral and earth wire/cable coming from each individual circuit. The connector's shall have circuit identification tag.
- 4.2.13 Use of paper/fabric base laminates is not acceptable.

**4.3 PAINTING**

- 4.3.1 The painting shall be as per "PAINTING" specification only.

**5.0 DRAWING & INFORMATION**

The following drawings shall be submitted along with the bid:

General arrangement drawing showing overall dimensions, weight, internal arrangement and mounting details.

Terminal chamber, showing bus-bar arrangement with all dimensions.

Power wiring diagram



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- 6.0 METHOD OF MEASUREMENT**
- 6.1 Supply of the Lighting DB including transport to site, loading and unloading etc. as specified will be treated as one unit for measurement and payment.
- 7.0 TRANSPORT, DELIVERY & STORAGE**
- 7.1 The prices shall be F.O.R. site basis including packing & forwarding charges. The quoted price must include all the costs for necessary mode of transportation up to the final location of Lighting DB on site store. The Lighting DB should be supplied with required storage arrangements suitable for placing in open storage yard. All incidental expenses during transportation shall be part of quoted prices including transit insurance. The charges for loading and unloading of equipments at site should form part of offer.
- 8.0 GUARANTEE & WARRENTY**
- 8.1 The quotes values of parameters shall be within given tolerance for given period of service life.
- 9.0 SPARES**
- 9.1 The bidder shall quote for minimum spares required for two years safe operation of Distribution Board along with the offer separately
- 10.0 ATTACHMENTS**
- 10.1 Supply BOQ for LDB & PDB
- 11.0 Make of Materials**
- 11.1 **DB Enclosure** - Hagger, Legrand
- 11.2 **MCB** - C & S, Indio Asian ,Siemens ,L&T ,ABB

# **ERECTION, TESTING & COMMISSIONING OF ELECTRICAL INSTALLATIONS**

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**ERECTION, TESTING & COMMISSIONING OF ELECTRICAL INSTALLATIONS****1.0 SCOPE OF WORK**

- 1.1 The intent of this specification is to define the requirements for the installation, testing and commissioning of the electrical system like H.T VCB panel, transformer, L.T. panels, Cables, earthing network, Internal and External lighting, Light fixtures etc.. Requirement of this project shall be as specified in bill of quantities / approved drawings / general specifications or as per the battery limits fixed by the owner / consultant.

**2.0 STANDARDS**

- 2.1
1. The work shall be carried out in the best workman like manner in conformity with this specification, the relevant specification / codes of practice of the Indian Standards Institution, approved drawings and the instructions issued by the authorised representative, from time to time. Some of the relevant Indian Standards are listed elsewhere in this tender document.
  2. In addition to the standards mentioned in 2.1, all works shall also conform to the requirement of the following :
  3. Indian Electricity Act and Rules framed thereunder.
  4. Fire Insurance Regulations.
  5. Regulations laid down by the Chief Electrical Inspector of the State / State Electricity Board / Union Territory.
  6. Regulations laid down by the Factory Inspector of the State / Union Territory.
  7. Any other regulations laid down by the local authorities.
  8. Installation & operation manuals of original manufacturers of equipment.

**3.0 ERECTION**

- 3.1 The contractor shall make his own arrangement for safe transportation of all the items to the erection site and also carry out complete loading / unloading during transportation. Equipment shall not be removed from packing cases unless the floor has been made ready for installing them. The cases shall be opened in presence of the client / consultant or his authorised representative. The empty packing cases shall be returned to the stores and any document if found with the equipment shall be handed over to the client's representative. Any damage or shortage noticed shall be reported to the client / consultant in writing immediately after opening of packing cases.

**3.2 ONAN TYPE TRANSFORMER****1. Erection**

Transformer complete with radiators, bushings, conservator and miscellaneous accessories shall be thoroughly inspected and any damage noticed shall be reported to the client / consultant. Before erection of transformer, the level of rails on foundation shall be checked and minor corrections if necessary shall be carried out. After the completion of erection, necessary stoppers shall be provided at the wheels. All loosely supplied fittings / accessories shall be cleaned and mounted on the transformer and connections made. After completely assembling & installation, the transformer shall be cleaned and touched up with a paint supplied by the manufacturer applied wherever necessary. All cover bolts shall be checked for proper tightness. (The foundation of transformer and rail fixing will be made by some other agency).

**2. Testing**

Winding insulation resistance shall be measured from primary and secondary to ground and between primary and secondary.

Test the operation of thermister type sensor relay in accordance with the manufacturer's instructions.

Check the polarity of terminals and the phase sequence.

Proforma for transformer tests :

**3. Proforma for transformer tests :**

- Transformer name plate.
- Insulation resistance test with 1000 V meagre.
  - a) between primary to earth
  - b) between secondary to earth
  - c) between primary and secondary
- Operation of the tap changer.
  - Operation of the tap at tap No. 1
  - Operation of the tap at tap No. 2
  - Operation of the tap at tap No. 3
  - Operation of the tap at tap No. 4
  - Operation of the tap at tap No. 5
- Polarity marking and phase sequence.
- Earth resistance:           Body & Neutral tank.

[This proforma shall be jointly signed by the CLIENT/ CONSULTANT and the contractor in duplicate].

**3.3 POWER CONTROL CENTER / MOTOR CONTROL CENTER, DISTRIBUTION BOARDS****1. Erection**

Electrical panels and bus duct shall be delivered in convenient shipping section by the manufacturer. The contractor shall make his own arrangement for safe transportation of all the items to the erection site and also carry out complete loading / unloading during transportation. The contractor shall be responsible for final assembly and interconnection of busbars / wiring. Foundation channel shall be grouted in the flooring by the contractor. Switchgear shall be aligned and levelled on their base channels and bolted to them as per the instructions of the client / consultant. The earth bus shall be made continuous throughout the length. Loosely supplied relays and instruments shall be mounted and connected on the switchgear. The contacts of the drawout circuit breaker shall be checked for proper alignment and interchangeability.

After erection, the switchboard shall be inspected for dust and vermin proof. Any hole which might allow dust or vermin etc. to enter the panel shall be plugged suitably at no extra cost. If the instrument transformers are supplied separately, they shall be erected as per the direction of the client / consultant. The contractor shall fix the cable glands after drilling the bottom / top plates of all switchboards with suitable holes at no extra cost.

Range of overload relays / timers etc. shall be checked with requirement of motor actually to be connected at site and if the same is undersized / oversized, it shall be brought to the notice of the client / consultant, who shall arrange procurement of corrected components. However, the contractor shall not charge anything extra for labour for such replacements.

The busduct shall be suitably supported between switchgear and transformer. The

opening in the wall where the duct enters, the switchgear room shall be sealed to avoid rain water entry. The foundation of the switchgear shall be raised suitably for minor adjustment to ensure proper alignment and connection of the busduct at no extra cost. Expansion joints, flexible connection, etc. supplied by the manufacturer / contractor of the busduct shall be properly connected.

**2. Testing**

Before electrical panel is energised, the insulation resistance of each bus shall be measured from phase to ground. Measurement shall be repeated with circuit breakers in operating positions and contacts open.

Before switchgear is energised, the insulation resistance of all control circuits shall be measured from line to ground.

The following tests shall be performed on all circuit breakers during erection.

- Contact alignment and wipe shall be checked and adjustment where necessary in accordance with the breaker manufacturer’s instructions.
- Each circuit breaker shall be drawn out of its cubicles, closed manually and its insulation resistance measured from phase to phase and phase to ground.
- All adjustable direct acting trip devices shall be set using values given by the consultant/ manufacturer.
- The dielectric strength of insulating oil wherever applicable shall be checked.
- Before switchgear is energised, the following tests shall be performed one each circuit breaker in its test position.
- Close and trip the circuit breaker from its local control switch push button or operating handle. Switchgear control bus may be energised to permit test operation of circuit breaker with A.C. closing with prior permission of the client / consultant.
- Test tripping of the electrically operated circuit breaker by operating mechanical trip device.
- Test proper operation of circuit breakers latch, check carriage limit switch if provided. Test proper operation of lockout device in the closing circuit. Wherever provided by simulating conditions which would cause a lockout to occur.
- Trip breaker either manually or by applying current or voltage to each of its associated protective release.
- Before switchgear is energised, the tests covered above shall be repeated with each breaker in its normal operating position.
- Capacitor banks shall be tested as per manufacturer’s instructions. In addition, test for output and/or capacitance, insulation resistance test and test for efficiency of discharge device shall be carried out.
- All electrical equipment alarms shall be tested for proper operation by causing alarms to sound under simulated abnormal conditions.

**3. Performa For PCC, MCC, DB, Control Panel Test**

- Circuit breaker or contactor module designation / bus no.
- Insulation resistance test (contacts open, breaker racked in position)
  - a) between each phase of bus : Mega ohm
  - b) between each phase and earth : Mega ohm
  - c) DC and AC control and auxiliary circuits : Mega ohm
  - d) between each phase of CT / PT and between  
CT & PT circuit if any : Mega

ohm

- CT checks
  - a) CT ratio
  - b) CT secondary resistance
  - c) CT polarity check
- Check for contact alignment and wipe.
- Check / test all releases / relays.
- Check mechanical interlocks.
- Check electrical interlocks.
- Check switchgear / control panel wiring.
- Check breaker / contactor circuit for :
  - a) Closing - local & remote (wherever applicable)
  - b) Tripping - local & remote (wherever applicable)
- Opening time of breaker / contactor.
- Closing time of breaker / contactor.

[This proforma shall be jointly signed by the CLIENT / CONSULTANT and the contractor in duplicate].

### 3.4 INSTALLATION OF CABLE NETWORK

Cable network shall include power, control and lighting cables which shall be laid in underground trenches, hume pipe open trenches, cable trays, G.I. pipes, or on building structures as detailed in the relevant drawings, cable schedules or as per the client / consultant's instructions. Supply & installation of cable trays, G.I. pipes / conduits, cable glands and sockets of both end isolators, junction boxes, remote push button stations, etc. shall be under the scope of the contractor.

#### 1. General requirements for handling cables :

- Before laying cables, this shall be tested for physical damage, continuity, absence of cross phasing, insulation resistance to earth and between conductors. Insulation resistance tests shall be carried out with 500 / 1000 V megger.
- The cables shall be supplied at site, wound on wooden drums as far as possible. For smaller length and sizes, cables in properly coiled form can be accepted. The cables shall be laid by mounting the drum of the cable on drum carriage. Where the carriage is not available, the drum shall be mounted on a properly supported axle, and the cable laid out from the top of the drum. In no case the cable will be rolled on as it produces kinks which may damage the conductor.
- Sharp bending of cable shall be avoided. The bending radius for PVC insulated and sheathed, armoured cable shall not be less than 10 D, where "D" is overall diameter of the cable.
- While drawing cables through G.I. pipes, conduits, RCC pipes, ensure that size of pipe is such that, after drawing cables, 40% area is free. After drawing cables, the end of pipe shall be sealed with cotton / bituminous compound.
- High voltage (11 KV and above), medium voltage (240 V and above) and other control cables shall be separated from each other by adequate spacing or running through independent pipes / trays.
- Armoured cables shall never be concealed in walls / floors / roads without

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G.I. pipes, conduits or RCC pipes.

- Joints in the cable throughout its length of laying shall be avoided as far as possible and if unavoidable, prior approval of site engineer shall be taken. If allowed, proper straight through epoxy resin tight joint shall be made, without any additional cost.
- A minimum loop of 3 mtr. shall be provided on both ends of the cable, and on both ends of straight through cable joint. This additional length shall be used for fresh termination in future. Cable for this loop shall be paid for supply and laying.
- Cable shall be neatly arranged in the trenches / trays in such manner so that criss-crossing is avoided and final take off to the motor / switchgear is facilitated. Arrangement of cable within the trenches / trays shall be the responsibility of the contractor.
- All cable routes shall be carefully measured and cable cut to the required lengths and undue wastage of cables to be avoided. The routes indicated in the drawings are indicative only and the same may be rechecked with the client / consultant before cutting of cables. While selecting cable routes interference with structures, foundations, pipelines, future expansion of buildings etc. should be avoided.
- All temporary ends of cables must be protected against dirt and moisture to prevent damage to the insulation. For this purpose, ends of all PVC insulated cables shall be taped with an approved PVC or rubber insulating tapes. Use of friction type or other fabric type tape is not permitted. Lead sheathed cables shall be plumbed with lead alloy.
- Wherever cable rises from underground / concrete / masonry trenches to motors / switchgears / push buttons, these shall be taken in G.I. pipes of suitable size, for mechanical protection upto 300 mm. distance of concerned cable gland or as instructed by the client / consultant.
- The cable pass through foundation / walls of other underground structures, the necessary ducts for opening will be provided in advance for the same. However, should it become necessary to cut holes in existing foundation of structures the electrical contractor shall determine the location and obtain approval of the client / consultant before cutting is done.

## **2. LAYING OF CABLES (UNDERGROUND SYSTEM)**

Cables shall be so laid in trench that this will not interfere with other underground structure. All water pipes, sewage lines or other structures which become exposed by excavation shall be properly supported and protected from injury until the filling has been rammed solidly in places under and around them. Any telephone or other cables coming in the way are to be properly shielded / diverted as directed by the owner / consultant.

- Cable shall be laid at minimum depth of 750 mm. in case of L.T. and 1200 mm. in case of H.T. from ground level. Excavation will be generally in ordinary alluvial soil. The width of trench shall be sufficient for laying of required no. of cables.
- Sand bedding 75 mm. thick shall be made below and above the cables. Layer of bricks (full size) shall be laid above sand bedding on the sides and above the of cables to cover cable completely. More than one cable can be laid in the same trench by providing a brick on edge between two cables. However, the relative location of cables in trench shall be maintained till termination. The surface of the ground after back filling the earth shall be made good so as to conform in all respects to the surrounded ground and to the entire satisfaction of the client / consultant.
- For all underground cables, route markers should be used :
  - a) Separate route markers should be used for LT, HT and telephone

cables.

- b) Route markers should be grounded in ground with 1:2:4 cement concrete pedestal size 230 x 230 x 300 mm..
- c) Cable markers should be installed at an interval not exceeding 30 mtr. along the straight routes of cables at a distance of 0.5 mtr. away from centre of cable with the arrow marked on the cable markers plate indicating the location of cable. Cable markers should also be used to identify change in direction of cable route and for location of every joint in underground cable.
- RCC hume pipe for crossing road in cable laying shall be provided by employer. No deduction shall be made for cable laying in hume pipe for not providing bricks, sand and excavation. RCC hump pipe at the ends shall be sealed by bituminous compound after laying and testing of cables by electrical contractor without any extra charge.

### 3. LAYING OF CABLE IN MASONRY TRENCHES

- Masonry / concrete trenches for laying of cables shall be provided by employer. However, steel members such as M.S. angles / flats etc. shall be provided and grouted by electrical contractor to support the cables without any extra charge. Cables shall be clamped to these supports with minimum saddles / clamps. More than one tier of cables can be provided in the same trench if the no. of cables are more.
- Entry of cables in trenches shall be sealed with bituminous MASTIC compound to stop entry of water in trenches.

### 4. LAYING OF CABLES IN CABLE TRAYS

- Cable trays and steel members such as M.S. angle / channel / flats etc. shall be provided and fixed by the erector.
- Cable shall be fixed in cable trays in single tier formation and cables shall be clamped with aluminium flat clamps and galvanised bolts / nuts.
- Earthing flat / wire can also be laid in cable tray alongwith cables.
- After laying of cables, minimum 20% area shall be spare.

### 5. TERMINATION AND JOINTING OF CABLES

- a) For HT cables suitable size of Reychem termination kit shall be used.
- b) Use of glands :

All PVC cables upto 1.1 KV grade, armoured or unarmoured shall be terminated at the equipment / junction box / isolators / push buttons / control accessories, etc. by means of suitable size double compression type cable glands. Armour of cable shall be connected to earth point. The contractor shall drill holes for fixing glands wherever necessary. Wherever threaded cable gland is to be screwed into threaded opening of different size, suitable galvanised threaded reducing bushing shall be used of approved type.

In case of termination of cables at the bottom of the panel over a cable trench having no access from the bottom, a close fit holes should be drilled in the bottom plate for all the cables in one line, then bottom plate should be split in two parts along the centre line of holes. After installation of bottom plate and cables with glands, it shall be sealed with cold sealing compound.

- **USE OF LUGS / SOCKETS**

All cable leads shall be terminated at the equipment terminals, by means of crimped type solderless connectors unless the terminals at the equipment ends are suitable for direct jointing without lugs / sockets.

The following is the recommended procedure for crimped joints and the same shall be followed :



- a) Strip off the insulation of the cable and with every precaution, not in severe or damage any strand. All insulation's to be removed from the stripped portion of the conductor and ends of the insulation should be clean and square.
- b) The cable should be kept clean as far as possible before assembling it with the terminal / socket. For preventing the ingress of moisture and possibility of re-oxidation after crimping of the aluminium conductors, the socket should be filled with corrosion inhibiting compound. This compound should also be applied over the stripped portion of the conductor and the palm surface of socket.
- c) Correct size and type of socket / ferrule / lug should be selected depending on size of conductor, and type of connection to be made.
- d) Make the crimped joint by suitable crimping tool.
- e) If after crimping the conductor in socket / lug, some portion of the conductor remains without insulation the same should be covered sufficiently with PVC tape.
- f) For HT cable upto 11 KV the manufacturer's recommendation should be followed.

- **DRESSING OF CABLE INSIDE THE EQUIPMENT**

After fixing of cable glands, the individual cores of cable shall be dressed and taken along the cable ways (if provided) or shall be fixed to the panels with polyethylene straps. Cable shall be dressed in such a manner that small loop of each core is available inside the panel.

For motors of 20 HP and above, terminal box if found not suitable for proper dressing of aluminium cables, the erector shall modify the same without any additional cost.

Cables inside the equipment shall be measured and paid for.

- **IDENTIFICATION OF CABLES / WIRES / CORES**

Power cables shall be identified with red, yellow and blue PVC tapes. For trip circuits identification, additional red ferrules shall be used only in the particular cores of control cable at the termination points in the switchgear / control panels and control switches.

In case of control cables all cores shall be identified at both ends by their wire numbers by mean of PVC ferrules or self sticking cable markers, wire numbers shall be as per schematic / connection drawing. For power circuit also, wire numbers shall be provided if required as per the drawings of switchgear manufacturer / supplier.

## 6. TESTING OF CABLES

- Before energising, the insulation resistance of every circuit shall be measured from phase to ground. This requires 3 measurements if one side is grounded and 6 measurements for 3 phase circuits.
- Where splices or terminations are required in circuits rated above 650 volts, measure insulation resistance of each length of cable before splicing and/or terminating. Repeat measurements after splices and/or terminations are complete.
- DC high voltage test shall be made after installation on the following :
  - a) All 1100 volts grade cables in which straight through joints have been made.
  - b) All cables above 1100 V grade.

For record purpose test data shall include the measured values of current versus time. leakage

The DC high voltage test shall be performed as detailed below :

Cables shall be installed in final position with all the straight through joints complete. Terminations shall be kept unfinished so that motors, switchgear, transformer etc. are not subjected to test voltage.

The test voltage and duration shall be as per relevant codes and practices of Indian Standards Institution.

- PROFORMA FOR TESTING CABLES

DATE OF TEST

- a) Drum No. from which cable taken.
- b) Cable from \_\_\_\_\_ to \_\_\_\_\_
- c) Length of run of this cable \_\_\_\_\_ meter
- d) Insulation resistance test
  - i) between core-1 to earth \_\_\_\_\_ mega-ohm
  - ii) between core-2 to earth \_\_\_\_\_ mega-ohm
  - iii) between core-3 to earth \_\_\_\_\_ mega-ohm
  - iv) between core-1 to core-2 \_\_\_\_\_ mega-ohm
  - v) between core-2 to core-3 \_\_\_\_\_ mega-ohm
  - vi) between core-3 to core-1 \_\_\_\_\_ mega-ohm
- vii) duration used : 1 KV
- e) High voltage test \_\_\_\_\_ Voltage Duration
  - i) between core an earth.
  - ii) between individual cores

[This proforma shall be jointly signed by the CLIENT / CONSULTANT and the contractor in duplicate].

**4.0 EARTHING NETWORK**

**4.1 INSTALLATION AND CONNECTION**

1. The plate/pipe electrode, as far as practicable, shall be buried below permanent moisture level but in no case not less than 3 M below finished ground level.
2. The plate/pipe electrode shall be kept clear of the building foundation and in no case, it shall be nearer by less than 2 M from outer face of the respective building wall / column.
3. The plate electrode shall be installed vertically and shall be surrounded with 150 mm. thick layers of Charcoal dust and Salt mixture.
4. 19 mm. dia. G.I. pipe for watering, shall run from top edge of the plate / pipe electrode to the mid level of block masonry chamber.
5. Top of the pipe shall be provided with G.I. funnel and screen for watering the earth / ground through the pipe.
6. The funnel with screen over the G.I. pipe for watering to the earth shall be housed in a block masonry chamber.
7. The masonry chamber shall be provided with a Cast Iron hinged cover resting over the Cast Iron frame which shall be embedded in the block masonry.
8. Construction of the earthing station shall in general be as shown in the drawing and shall conform to the requirement on earth electrodes mentioned in the latest

edition of Indian Standard IS : 3043, Code of Practice for Earthing Installation.

9. The earth conductors (Strips / Wires copper / Hot dip G.I.) inside the building shall properly be clamped / supported on the wall with Galvanised Iron clamps and Mild Steel Zinc Passivated screws / bolts. The conductors outside the building shall be laid atleast 600 mm. below the finished ground level.
10. The earth conductors shall either terminate on earthing socket provided on the equipment or shall be fastened to the foundation bolt and / or on frames of the equipment. The earthing connection to equipment body shall be done after removing paint and other oily substances from the body and then properly be finished.
11. Over lapping of earth conductors during straight through in joints, where required, shall be of minimum 75mm. long.
12. The earth conductors shall be in one length between the earthing grid and the equipment to be earthed

#### 4.2 EARTH LEADS AND CONNECTIONS

1. Earth lead shall be bare copper or Galvanised steel as specified with sizes shown on drawings. Copper lead shall have a phosphor content of not over 0.15 %. G.I. strip buried in the ground shall be protected with bitumen and hessian wrap or polythene faced hessian and bitumen coating. At road crossing necessary hume pipes shall be laid. Earth lead run on surface of wall or ceiling shall be fixed on saddles so that strip is atleast 8 mm away from the wall surface.
2. The complete earthing system shall be mechanically and electrically bonded to provide an independent return path to the earth source.

#### 4.3 TEST

1. The entire earthing installation shall be tested as per requirements of Indian Standard Specification IS : 3043.
2. The following earth resistance values shall be measured with an approved earth megger and recorded.
  - 1) Each earthing station
  - 2) earthing system as a whole
  - 3) Earth continuity conductors
3. Earth conductor resistance for each earthed equipment shall be measured which shall not exceed 5 ohm in each case.
4. Measurements of earth resistance shall be carried out before earth connections are made between the earth and the object to be earthed.
5. All tests shall be carried out in presence of the Pmc

### 5.0 CONCEALED / SURFACE CONDUIT WORKS

#### 5.1 LAYING OF CONDUITS

1. Conduits shall be laid before casting in the upper portion of a slab / in PCC if below flooring or otherwise, as may be instructed in accordance with approved drawings, so as to conceal the entire run of conduits and ceiling outlet boxes. Conduits shall be so laid that they are interconnected. This is required to facilitate pulling of wires from different openings in case of any of the outlet is blocked during slab casting. Vertical drops shall be cut by the contractor to sufficient depth to allow full thickness of plaster over conduits. The width of the chases will be made to accommodate the required number of conduits. The chases will be filled with cement, coarse
2. When the conduit is to be embedded in a concrete member it shall be adequately tied to the reinforcement to prevent displacement during casting. Tie wire to be

supplied by the contractor.

3. Cutting of chases in any RCC member / finished floor / already finished surface is not allowed unless prior approval of Site Engineer is taken in site instruction book. If a chase is cut in an already finished surface, the contractor shall fill the chase and finish it to match the existing finish including painting at his cost to Site Engineer's satisfaction.
4. Contractor shall not cut any iron bars to fix the conduits. Puncher of wooden / steel shuttering for RCC slab / beams / column etc. for conduit work is also not allowed, unless Site Engineer permits in site instruction book under special conditions.
5. Run of conduit pipe through expansion joints in RCC members should be avoided as far as possible and if unavoidable, flexible conduit pipe should be used with ceiling outlet box on both sides of expansion joints.
6. Conduit on surface of RCC walls / RCC members shall be avoided as far as possible and if unavoidable prior approval of Site Engineer on sample saddles, clamps screws and a minimum 5 mtr. conduit laid on surface shall be taken, to achieve best possible workmanship. Distance between 2 consecutive clamps for fixing conduit on surface shall not exceed 900 mm. wooden patties for fixing saddles / clamps shall be used. Use of roll plug / steel fastener with hard setting / sealing compound is recommended.
7. In case of stone masonry, necessary conduits with M.S. boxes should be placed as the masonry is in progress, since after completing masonry, it is very difficult to cut chases in walls. Special location of cement concrete shaft is also recommended to conceal conduit in stone masonry and the same shall be provided by client / consultant.
8. In ground floor conduiting below the flooring should be avoided. Wherever it is unavoidable G.I. pipe should be used with prior approval of Site Engineer.

## 5.2 CEILING / WALL OUTLET BOXES FOR LIGHTS / FANS

1. Outlet boxes shall be of steel with aluminium cover and so installed as to maintain continuity throughout. These shall be protected at the time of laying by filling with jute / earth / cotton etc. so that no cement mortar finds its way inside during concreting or plastering etc. Typical sketches for such outlet boxes shall be supplied along with other working drawings. In beams conduit socket shall be provided in place of outlet boxes. The same shall be used for installation of luminaire.
2. For fixing light fixtures / brackets, outlet boxes complete with check nut for holding conduits shall be used. For lighting fixture suitable for 20 watts fluorescent tubes / incandescent lamps / mercury vapour lamps, only one outlet box is required. For fixing lighting suitable for 40 watts fluorescent lamps, two numbers outlet boxes should be provided at a distance of 300 mm. away from the centre in the longitudinal direction of the fixture, so that the use of patties / roll plug etc. may be avoided, as well as wiring from outlet box to the light fitting is to be installed in RCC beam and due to heavy reinforcement at the bottom of beam it is not possible to provide outlet boxes simple conduit should be provided. However alternative fixing arrangement shall be made in consultation with client / consultant.
3. For fixing ceiling fans, circular outlet boxes, 100 mm. diameter, complete with 12 mm. dia. Mild Steel rod 300 mm. long, for holding 12 mm. dia. Mild Steel cover 125 mm. dia. at bottom shall be used.

## 5.3 DRAW OUT JUNCTION BOXES

Steel drawout boxes at angle dimensions shall be provided at a convenient points on walls / ceilings to facilitate pulling of long runs of cables / wires. These shall be completely concealed with Anodised Aluminium, flush with plaster works. These draw boxes should be five sided. The location of these boxes is to be decided prior to fixing, as per site requirement and following should be treated as general guidance for deciding the location of these :

1. These should be provided at a place where these are not in direct view.

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- Recommended place is 400 / 450 mm. below ceiling, if conduits are running vertically.
2. Junction box in the offset of bottom of RCC beam and vertical wall should not be provided.
  3. If junction boxes are coming side by side for two or more conduits, one common M.S. box of proper size can be used to act as junction box.
  4. If junction box is to be provided in ceiling, its position should be so located that it is in line with other light / fan points.
  5. Junction boxes should never be used for splitting one conduit into two or more. Junction box for such functions is avoidable and for this, number of conduits to be connected to one switch board should be calculated correctly as per drawing before laying conduits in ceiling.
  6. Locating junction boxes on outer surface of exterior walls of building should be avoided as these are in direct view and are also exposed to weather.
  7. Junction boxes should never be closed permanently by plaster. Removable covering of aluminium should be provided for conduit junction boxes for M.S. junction boxes removable hylem plate should be provided. This cover may be painted with wall colour.
  8. Junction boxes in important areas should be avoided and can be located in toilets / corridors / service shafts and stores etc.

#### 5.4 SWITCH BOXES

Steel boxes of required sizes, shall be provided to house speed regulators of fans, switches for lights, fans, plug sockets etc. as per requirement of drawings. These should be so designed that accessories on Anodised aluminium sheet could be mounted with tapped holes and brass machine screws, leaving ample space at the back and on the sides for accommodating wires and check nuts at conduit entries. These shall be attached to conduits by means of check nuts on all walls of the boxes through which the conduits are entering. These shall be completely connected leaving edges flush with finished wall surfaces. Anodised aluminium cover should be fixed to these switch boxes by means of brass chrome plated machine screws and cup washers. Utmost care shall be taken by contractor to ensure that all switch boxes are in line and level.

Inside each switch box, one bolt shall be welded to receive earthing wire.

#### 5.5 SWITCH AND SOCKET

Switches shall be installed at 900 mm above finished floor level unless otherwise indicated on the drawings.

The switch controlling the light point or fan shall be connect on to the phase wire of the circuit and neutral shall be continuous, having no fuse or switch installed in the line except at the D.B. All fan regulators shall be fixed inside the switch boxes on adjustable flat M.S. strips / plates with tapped holes and brass machine screws, leaving ample space at the back and side for accommodating wires.

The cover plates to the switch box shall be fixed by means of sunk head brass cadmium screws.

Where two or more switches and fan regulators are installed together, they shall be provided with one gang cover plate with knockouts to accommodate required number of switches, sockets and regulators.

The switch controlling the socket outlet shall be on the phase wire of the circuit. The third pin of the socket shall be connected to the earth continuity conductor of the circuit

The switch boxes, installed back-to-back in the same wall shall be offset from each other, 150 mm horizontally, to preclude noise transmission.

**5.6 CLEANING AND PROTECTION OF CONDUIT SYSTEM**

The entire conduit system including outlet boxes, junction boxes and switch boxes shall be thoroughly cleaned after completion of erection and tested for not blockage by air / sound or steel wire prior to finishing of building by air / sound or steel wire prior to finishing of building and before drawing in of cables / wires to safeguard conduit system against filling up with the plaster / cement slurry / water etc. all the outlet and switch boxes will have to be provided with temporary jute / cotton filling, covers and plugs etc.. Within tendered cost which shall be replaced later on by hylem / sheet cover after wiring as required.

**5.7 TESTING OF INSTALLATION**

Before a completed installation is put into service, the following tests shall be complied with:

**1. INSULATION RESISTANCE**

The insulation resistance shall be measured by applying 500 volt megger with all fuses in places, circuit breaker and all switches closed.

The insulation resistance in gegohms of an installation, measured shall not be less than 50 megohms divided by the number of points on the circuit.

The insulation resistance shall be measured between

EARTH TO PHASE

EARTH TO NEUTRAL

PHASE TO NEURAL

PHASE TO PHASE

**2. EARTH CONTINUITY PATH**

The earth continuity conductors shall be tested for electrical continuity and the electrical resistance of the same along with the earthing lead but excluding any added resistance or earth leakage circuit-breaker, measured from the connection, with the earth electrode to any point in the earth continuity conductor in the completed installation and shall not exceed one ohm.

**3. POLARITY OF SINGLE POLE SWITCHES**

A test shall be made to verify that every no-linked, single pole switch is connected to one of the phase of the supply system.

**4. COMPLETION CERTIFICATES**

All the above tests shall be carried out in presence of client and the results shall be recorded in prescribed forms. Any default during the testing shall be immediately rectified and that section of the installation shall be re tested. The completed test result from shall be submitted to the client for approval.

On completion of an electric installation a certificate shall be furnished by the contractor, countersigned by the certified supervisor under whose direct supervision the installation was carried out. This certificate shall be in a prescribed form as required by the local electric supply authority.

**6.0 INSTALLATION OF LIGHTING FIXTURES / FANS****6.1 INSTALLATION OF LIGHTING FIXTURES**

Scope of work under this item shall start from light point, with a 5 A bakelite connector, 2 core 1.5 mm.<sup>2</sup> PVC insulated wires from this connector to the connector inside the lighting fixture, connections, fixing of lighting fixture complete with all accessories, lamps on wall / roof / steel truss etc. testing the lighting fixture and commissioning. If wire length of light point is enough to reach connector of light fitting, connector in light point can be deleted.

**6.2 INSTALLATION OF EXHAUST FANS**

Scope of work under this system shall start from exhaust fan point, with a ceiling rose, 2 core 2.5 mm.<sup>2</sup> PVC insulated wire from ceiling rose to connector of exhaust fan, connections, making fan opening in walls including repair / finishing fixing of exhaust fan complete with accessories and louvers on walls with hold-fasts, testing the exhaust fans and commissioning.

**7.0 INSTALLATION OF EXTERNAL LIGHT FIXTURES**

**7.1 BRACKET FOR STREET LIGHT FITTINGS**

The brackets shall be made of 38 mm. NB MS class “B” pipe approx. 1.8 mtr. long bent at the centre at an angle 120° C. with necessary holding brackets, hold fasts etc. with special reducer at the end to accommodate type of street light fitting to be fixed. Bracket shall have 1 coat of anti-corrosion paint before despatch to site and 2 coats of approved make and shade of aluminium paint. This bracket shall also be provided with one M.S. water tight box complete with the connector, neutral link, rewirable fuse etc.. See enclosed drawings of street light poles.

**7.2 INSTALLATION OF POLES**

Installation of poles shall be done as per enclosed drawings of street light poles. The depth of pole to be buried in ground shall be 1/5th of the total pole length or as specified in drawing, whichever is more. Special care shall be taken in erecting poles so that these are not strained or damaged during erection and are firmly stayed till the foundation are secured. The pole shall be grouted inside ground pit (cross-section 600 x 600 mm.) with cement concrete 1:2:4. Before the placement of concrete around pole in the pit, necessary conduit pipes (not less than 25 mm. dia.) shall be placed for facilitating drawing of cables. Separate conduit shall be provided for incoming and outgoing cables. The cement concrete shall be protected from premature drying by curing for atleast 7 days after pouring. All concrete surface from 150 mm. below ground level to top shall be finished smooth with cement mortar 1:4.

**7.3 INSTALLATION OF STREET LIGHT FIXTURES**

This includes fixing of street light fittings complete with accessories and lamps at the end of the pole / bracket, connecting it with 3 x 2.5 mm.<sup>2</sup> aluminium conductor, PVC insulated cable from water tight M.S. box, testing, commissioning. Third core shall be connected with earthing point of light fitting at one end and earthing point of marshalling box at the other end.

**7.4 GENERAL NOTES FOR STREET LIGHTING**

1. For supplying and laying of cables, technical specification (wiring) shall be applicable reference shall be made under heading Cable Work elsewhere in the tender.
2. For street light poles along roads, nearest finished road level shall be taken as ground level and for poles along compound wall / away from roads, existing ground / finished ground shall be taken as ground level.
3. Distance of 1 mtr. shall be maintained between centre of pole and centre of curb of road. For compound wall poles, distance between compound wall and poles shall be 3 mtrs.
4. A loop of 1.5 mtr. of cable shall be provided near each street light pole for all incoming and outgoing cable.

**8.0 COMPLETION TESTS**

- 8.1 After supply and installation of complete project or a particular building / area, following tests shall be carried out by the contractor before switching on the power

to installation and the results shall be recorded and submitted to the Site-Engineer. If results are not satisfactory / as per standards set herewith, the contractor shall identify the defects / short coming and shall rectify the same. Nothing extra shall be paid for carrying out these tests and contractor has to arrange all necessary instruments.

#### 8.2 INSULATION RESISTANCE TO EARTH

This is to be measured with all fuse links in place, all switches ON, all lamps and appliances in position by applying a voltage not less than twice the working voltage (subject to a limit of 500 V). Insulation resistance of the whole or any part of the installation to earth must not be less than 50 mega-ohms divided by the number of outlets (points and switch positions) except that it need not exceed one mega-ohm for the whole installation.

#### 8.3 INSULATION RESISTANCE BETWEEN CONDUCTORS

Tests to be made between all the conductors connected to one pole or phase conductor of the supply and all the conductors connected to the middle wire or neutral or the other pole or phase conductors of the supply. For this test, all lamps shall be removed and all switches put ON. The result of the test must be 50 mega-ohms divided by the number of outlets (points and switch positions) but need not exceed 1 mega-ohm for the whole installation.

#### 8.4 POLARITY OF SINGLE POLE SWITCHES

Tests shall be made to verify that all non-linked single pole switches are on phase conductor (live) and not on neutral or earth conductor. This can be done by connecting test lamps between two terminals of switch and earth. If the lamp lights up when switch is ON and either terminal is touched, the switch is correctly installed.

#### 8.5 RESISTANCE OF METAL CONDUITS / SHEETS (EARTH CONTINUITY TEST)

In case of cables encased in metal whether conduit of metallic sheathing, the total resistance of the conduit or sheathing from the earthing point any other position in the completed installation shall not exceed 2 ohms. This can be carried out by following circuit :

One end of the lead is connected to the ECC and its connection with the electrode and the other to the farthest point of the ECC. First, current through the circuit is measured with the resistance of 2 ohms short circuited by the link. Next, current is measured through the two ohms resistance by disconnecting the two leads from the ECC and joining them together. If current is more in the first case, the resistance of ECC is less than 2 ohms.

### 9.0 HANDING OVER / TAKING OVER

- 9.1 After completion of works and tests specified above, the various building of the project can be taken over by the employer as and when these are ready in all respects. However, the defect liability period of 12 months would start from the date, when all the buildings of the project have been completed and handed over, unless employer agrees for defect liability period in phased due to non-completion of civil work of few buildings for which electrical contractor is not responsible.

### 1.10 HANDING OVER / TAKING OVER

The Tenderer shall indicate the makes of tools, test equipment and other item listed below:

#### 1. TOOLS

- A. Set of spanners of sizes 6 mm to 32 mm width across flat
- Adjustable wrench of 36 mm jaw width



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- Adjustable wrench of 23 mm jaw width
- B. Heavy duty screw driver with full size insulated handle and blade length of
- 100 mm
  - 50 mm
  - 200 mm
2. TEST EQUIPMENT
- A. 2500 V megger motor operated
- B. 500 V megger hand operated
- C. Multimeter (Battery operated) satisfying the following
- With 0-1 mA, 0-100 mA, 0-1A and 0-5A, AC & DC current ranges
  - With 0-100 mV, 0-3V, 0-30 V, 0-300 V and 0-1000V AC & DC voltage ranges
  - The resistance ranges shall be atleast five (0-100) m ohm, (0-1) Ohm, (0-10) Ohm, (0-100) Ohm, (0-100) mega ohm
  - The Input impedance shall not be less than one mega Ohms for voltage ranges
3. LADDERS
- Ladder shall be made out of light aluminium alloy of good strength. They shall be of step ladder, foldable, self supporting type with spreader of metallic angles or high strength nylon straps. The ladder shall be provided with shoes on bottom of legs. Rugs shall be flat type having thickness of 30 mm in case of 3 meters long ladders and 60 mm for 6 metres long ladder.
- 3 metres long
  - 6 metres long
4. Tong tester - ammeter range 0 to 30, 150 & 300 Amps AC and voltmeter (0-600) V, class 1.0 with leads and leather case.

# **TECHNICAL SPECIFICATIONS FOR LT XLPE CABLE**

**TECHNICAL SPECIFICATIONS FOR LT XLPE CABLE**

**1.0 SCOPE OF WORK**

- 1.1 This section shall cover supply, laying, testing and commissioning of medium voltage XLPE cables.
- 1.2 This specification gives the general requirement of cables. However, **it is the responsibility of the vendor to take the joint measurement and obtain client's approval before the placement of orders** to the main supplier / manufacturer.

**2.0 CODES & STANDARDS**

2.1 The following standards and rules shall be applicable :

Sr. No	Item	Relevant IS	Relevant IEC
	XLPE insulated electric cables (heavy duty).	IS : 7098 Part I	
	Recommended current ratings for cables.	IS : 3961	
	Aluminium conductors for insulated cables	IS : 8130	Indian Electricity Act and Rules.

**3.0 DESIGN BASIS & SITE CONDITIONS**

3.1 All equipment and materials will be selected and rated for use at the following site conditions.

Site conditions	
<b>Location</b> Tripura	<b>Site altitude</b> 560M-800M above mean sea level
<b>Ambient temperature</b>	<b>Relative humidity</b>
Maximum 41 °C	Maximum 85 %
Minimum 5 °C	Minimum 35 %
Design 45 °C	Design 90 % at 45 °C
<b>Seismic factor</b> Zone IV as per IS:1893	<b>Rainfall</b> 722 mm/year
<b>Environmental climate</b> Tropical/wet & Dry	<b>Location of Equipment</b> Ground/Air
<b>Wind speed</b> Annual avg. 4.35	
<b>Electrical system data :</b>	
<b>Power supply for Equipment</b>	
<b>Voltage</b> 415 V ± 5 %	<b>Frequency</b> 50 Hz ± 3 %

<b>Permissible combined voltage &amp; frequency variation</b>	$\pm 6 \%$	<b>System design faults level (Symmetrical)</b>	<b>30 kA for 1 sec. max.</b>
<b>System earthing</b>	<b>LV side neutral solidly earthed</b>	<b>Wiring</b>	<b>3 phase, 4 wire on 415V system</b>

**4.0**

**TECHNICAL REQUIREMENTS**

4.1 GENERAL CONSTRUCTIONAL FEATURES

4.1.1 The medium voltage cables shall be supplied, laid, connected, tested and commissioned in accordance with the drawings, specifications, relevant Indian Standards specifications, manufacturer's instructions. The cables shall be delivered at site in original drums with manufacturer's name, size, and type, clearly written on the drums.

4.2 **MATERIAL :**

Medium voltage cable shall be XLPE insulated. PVC sheathed, aluminium or copper conductor, armoured conforming to IS: 7098 Part I.

4.2.1 **Type:**

The cables shall be circular, multi core, annealed copper or aluminium conductor, XLPE insulated and PVC sheathed, armoured or unarmoured.

4.2.2 **Conductor:**

Uncoated, annealed copper / aluminium, of high conductivity upto 4 mm.<sup>2</sup> size, the conductor shall be solid and above 4 mm.<sup>2</sup>, conductors shall be concentrically stranded as per IEC : 228.

4.2.3 **Insulation:**

XLPE rated 70° c. extruded insulation

4.2.4 **Core Identification:**

Two core	:	Red and Black
Three cor	:	Red, Yellow and Blue
Four core	:	Red, Yellow, Blue and Black
Single core	:	Green, Yellow for earthing

Black shall always be used for neutral.

4.2.5 **Assembly:**

Two, three or four insulated conductors shall be laid up, filled with non-hygroscopic material and covered with an additional layer of thermoplastic material.

4.2.6 **Armour:**

Galvanised steel flat strip / round wires applied helicaly in single layers complete with covering the assembly of cores.

For cable size upto 25 Sq. mm. : Armour of 1.4 mm dia G.I. round wire

For cable size above 25 Sq. mm. : Armour of 4 mm wide 0.8 mm thick G.I strip

4.2.7 **Sheath:**

XLPE 70 deg.c. rated extruded.  
Inner sheath shall be extruded type and shall be compatible with the insulation provided for the cables.

Outer sheath shall be of an extruded type layer of suitable PVC material compatible with the specified ambient temp. 50 deg. C and operating temperature of cables. The sheath shall be resistant to water, ultraviolet radiation, fungus, termite and rodent attacks. The colour of outer sheath shall be black.

Sequential length marking required at every 1.0 mtr. interval on outer sheath

Vendor has to furnish resistance / reactance / capacitances of the cable

4.2.8 **Rating:** Up to and including 1100 Volts.

## 5.0 DRAWINGS & INFORMATION

5.1 Contractor shall submit the as built drawing of the cable laying drawing.

### 5.2 HANDINGOVER DOCUMENTS

The supplier shall submit following:

1. Data sheet indicating results of tests
2. Test reports

## 6.0 INSPECTION AND TESTING

6.1 All cables shall be adequately protected against any risk of mechanical damage to which they may be liable in normal conditions of handling during transportation, loading, unloading etc.

The cable shall be supplied in single length i.e. without any intermediate joint or cut unless specifically approved by the client.

The cable ends shall be suitably sealed against entry of moisture, dust, water etc. with cable compound as per standard practice.

### 6.2 **Finished Cable Tests at Manufacturer's Works:**

The finished cables shall be tested at manufacturer's works. Following routine tests for each and every length of cable and copy of test results shall be furnished for each length of cable along with supply. If specified, the cables shall be tested in presence of client's representative.

#### 6.2.1 **Voltage Test:**

Each core of cable shall be tested at room temperature at 3 KV A.C. R.M.S. for duration of 5 minutes.

#### 6.2.2 **Conductor Resistance Test:**

The D.C. Resistance of each conductor shall be measured at room temperature and the results shall be corrected to 20° c. to check the compliance with the values specified in IS 8130 - 1976.

### 6.3 Cable Test Before and After Laying of Cables at Site

6.3.1 Insulation Resistance test between phases and phase to Neutral and phase to earth.

6.3.2 Continuity test of all the phases, neutral and earth continuity conductor.

6.3.3 Sheathing continuity test.

6.3.4 Earth resistance test of all the phases and neutral.

## 7.0 METHOD OF MEASUREMENT

7.1 The cables will be measured in meters. The unit rate shall include cutting the cable into required lengths, packing, loading, unloading, insurance, transportation, delivery to stores/site as per work order, stocking in stores, testing of cables at stores etc. of medium voltage cable. Total quantity in meters shall be measured lug to lug basis.

## 8.0 TRANSPORT, DELIVERY AND STORAGE

8.1 The cable shall be supplied in the actual length as per detailed purchase order

8.2 The cable shall be dispatched at client's stores or at site as per detailed instructions given by client at later stage.

- 8.3 The cable shall be loaded from the main vendor's store and properly stacked as per instruction of client's local representative. All such labour and transportation charges shall be clearly mentioned in the offer.

**9.0 GUARANTEE OF PERFORMANCE**

- 9.1 The quotes values of parameters shall be within given tolerance for given period of service life.

# **TECHNICAL SPECIFICATIONS FOR INTERNAL WIRING**

**TECHNICAL SPECIFICATIONS FOR INTERNAL WIRING**

**1.0 SCOPE OF WORK**

- 1.1 This section covers, definition of point wiring, system of wiring and supply, installation, connection, testing and commissioning of point wiring for light points, ceiling fan points, exhaust fan points, convenience socket outlet points, power socket outlet points, bell outlet points etc. including fixing of light fixtures, ceiling fan, exhaust fan, wall fan, bell etc

**2.0 CODES & STANDARDS**

- 2.1 The following standards and rules shall be applicable:

Sr. No.	Item	Relevant IS	Relevant IEC
1	Code of practice for electrical wiring installation (System voltage not exceeding 650 V)	IS: 732	
2	Code of practice for fire safety of buildings (General) Electrical installation.	IS: 1646	
3	Rigid steel conduits for electrical wiring.	IS: 9537 (Part - 2)	
4	Fittings for rigid steel conduits for electrical wiring.	IS: 2667	
5	Flexible steel conduits for Electrical wiring.	IS: 3480	
6	Accessories for rigid steel conduit for electrical wiring.	IS: 3837	
7	PVC insulated cables.	IS: 694	
8	Rigid non-metallic conduits for electrical wiring.	IS: 9537 (Part - 3)	
9	Flexible (Pliable) non-metallic conduits for electrical installation.	IS: 6946	
10	3 pin plugs and sockets.	IS: 1293	
11	Specifications of conduits for electrical installation.	IS: 8130	
12	Switches for domestic purpose.	IS: 3854	
13	Fittings for rigid non-metallic conduits.	IS: 3419	
14	Guide for electrical layout in residential buildings Indian electricity act and rules.	IS: 4648	

**3.0 DESIGN BASIS & SITE CONDITIONS**

- 3.1 All the equipment and components provided in the transformer and accessories shall be suitably designed for installation and satisfactory operation as specified below.



<b>Site conditions</b>			
<b>Location</b> Tripura		<b>Site altitude</b> 560M-800M above mean sea level	
<b>Ambient temperature</b>		<b>Relative humidity</b>	
Maximum 41 °C		Maximum 85 %	
Minimum 05 °C		Minimum 35 %	
Design 45 °C		Design 90 % at 50 °C	
<b>Seismic factor</b> Zone IV as per IS:1893		<b>Rainfall</b> 722 mm/year	
<b>Environmental climate</b> Tropical/Wet/Dry		<b>Location of Equipment</b> Indoor	
<b>Wind speed</b> Annual avg. 4.35			
<b>Electrical system data:</b>			
<b>Power supply for Equipment</b>			
<b>Voltage</b> 415 V ± 5 %		<b>Frequency</b> 50 Hz ± 3 %	
<b>Permissible combined voltage &amp; frequency variation</b>	± 6 %	<b>System design faults level (Symmetrical)</b>	10 kA for 1 sec. max.
<b>System earthing</b> LV side neutral solidly earthed		<b>Wiring</b> 3 phase, 4 wire on 415V system	

**4.0 TECHNICAL REQUIREMENTS**

**4.1 POINT WIRING**

- 4.1.1 A point shall consist of the branch wiring from the distribution board together with a switch as required, including the ceiling rose or pendant holder or swan holder, or ceiling fan box or socket or suitable termination. A point shall include, in addition, the earth continuity conductor/wire from the distribution board to the earth pin/stud of the outlet/switch box and to the outlet points
- 4.1.2 Supply, installation, fixing of conduits with necessary accessories, junction/pull/inspection/switch boxes and outlet boxes
- 4.1.3 Supplying and drawing of wires of required size including earth continuity wire
- 4.1.4 Supply, installation and connection of flush type switches, sockets, cover plates, switch plates, and fixing fan regulator etc
- 4.1.5 The point shall be complete with the branch wiring from the distribution board to the outlet point, through switch board, conduit with accessories, junction, pull, inspection boxes, control switch, socket, outlet boxes, ceiling roses, button/swan holder, connector etc

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**4.2 POINT RATE**

- 4.2.1 The rate per point shall include supply, installation, connection, testing and commissioning of point as described under “point wiring”. The measurements of the points will be enumerated

**4.3 SYSTEM OF WIRING**

- 4.3.1 Unless otherwise mentioned on the drawings, the system of point wiring shall be as follows:

The system of wiring shall consist of single core, FRLS insulated, 650/1100 volt grade, copper conductor wires/cables laid through exposed (surface mounted) PVC conduits as directed & wherever required, conduits shall be concealed in walls and slabs

**4.4 GENERAL**

- 4.4.1 Prior to laying of conduits, the contractor shall submit for approval, the shop drawing for conduit layout indicating the route of the conduits, number and size of the conduits, location of junction/inspection/pull/outlet boxes, size and location of switch boxes, number and size of wires pulled through each conduit and all other necessary relevant details. Only after the drawings are approved, the contractor shall proceed with the work of laying of conduits.

**4.5 MATERIAL****4.5.1 PVC Conduit**

All non-metallic PVC conduits shall conform to IS: 9537 ( Part - 3 ). The conduit shall be planed and of type as specified in IS: 9537 and shall be used with the corresponding accessories (Refer IS: 3419 specification for fittings for rigid non metallic conduits). PVC conduits shall be rigid unplasticised, heavy gauge having 2.0 mm. wall thickness upto 20 mm. diameter conduit and 2.5 mm. wall thickness for all sizes above 20 mm. diameter

**4.5.2 M.S. Conduit**

Conduits shall conform to IS: 9537 ( Part - 2 ), finished with galvanized surface. No steel conduit less than 25 mm. in diameter shall be used. Conduits shall be solid drawn or lap welded type, with minimum wall thickness for conduits having 25 mm. and above diameter

The conduits shall be delivered to the site of construction in original bundles and each length of conduit shall bear the label of manufacturers

The conduit accessories such bends, coupling etc. shall be conforming to the relevant Indian Standard specification

**4.5.3 Boxes**

1. All the boxes for switches, sockets and other receptacles, junction boxes, pull boxes and outlet boxes shall be fabricated from 2.0 mm. thick mild sheet painted with two coats of red-oxide and then two coats of enamel paints as called for. Colour of the paints shall be as approved by the client. The boxes shall have smooth external and internal finished surface
2. Boxes in contact with earth or exposed to the weather shall be of 2 mm. mild steel and hot dip galvanized after fabrication
3. Separate screwed earth terminal shall be provided in the box for earthing purpose
4. All boxes shall have adequate no. of knock out holes of required diameter for conduit entry
5. Switch boxes to receive switches, socket outlets, power outlets, telephone

outlets, fan regulators, etc. shall be fabricated to the approved shape and size to accommodate all the devices without overcrowding.

6. Outlet boxes to receive ceiling fan shall be fitted with adequately sized rod
7. Hook to fix ceiling fan. The boxes shall be of minimum depth of 65 mm.
8. Boxes installed for concealed wiring shall be provided with suitable extension rings or plaster covers as required. Boxes for use in masonry block or tiled walls shall be square cornered tile type, or standard boxes having square cornered tile type covers. These boxes shall be installed in the centre of the masonry block or tiles
9. Cast metal boxes installed in wet locations and boxes installed flush with the outside of exterior surface shall be gasketed

4.5.4 Cover Plate

The cover of the boxes to receive outlet points shall be of best anodized sheet cut to shape and size or plate of approved manufacturers of switches

4.5.5 Cables

1. The cables shall conform to IS: 697. For all internal wiring FRLS insulated cables of 650/1100 volts grade, single core shall be used
2. The conductors shall be plain annealed copper conductors complying with IS: 1554
3. The conductors shall be circular copper conductor
4. The insulation shall be FRLS compound complying with the requirements of IS: 697. It shall be applied by an extrusion process and shall form a compact homogenous body.
5. The thickness of FRLS insulation shall be as set out in the relevant standards
6. The cores of all cables shall be identified by colours in accordance with the following sequence.

Single phase	Red
Three phase	Red, Yellow, Blue
Neutral	Black
Earth	Green or Green/Yellow

7. Means of identifying the manufacturer shall be provided throughout the length of cable
8. Unless otherwise specified in the drawings the size of the cables used for internal wiring shall be as follows:
  - In case of circuit wiring for lights, exhaust fans, ceiling fans, bell, convenience socket outlet points (P+N+E):

2.5sq.mm.	From D.B. to switch boards.
1.5sq.mm.	From switch boards to outlet points

- In case of power socket outlet circuit having not more than two 15 A power outlet (P+N+E):

7.0sq.mm.	From D.B. to first power outlet
2.5sq.mm.	From first power outlet to second power outlet

- In case of power socket outlet circuit having single 15 A power outlet (like water heater) (P+N+E):

7.0sq.mm.	From D.B. to power outlet.
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- In case of 15 A. power outlet for window Air conditioner or other likewise

appliances (P+N+E):

7.0sq.mm.	From D.B. to power outlet.
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- The earth continuity conductor shall be similar to circuit cables and shall be drawn through conduit along with other circuit cables. The size of the earth continuity conductor shall be as follows:

**MINIMUM SIZE OF EARTH CONTINUITY CONDUCTOR NOT FORMING PART OF THE SAME CABLE AS THE ASSOCIATE CIRCUIT CONDUCTOR**

Nominal cross-section area of largest associated copper circuit conductor in sq.mm.	Nominal cross-sectional area of earth continuity conductor in sq.mm.
1.5	1.5
2.5	2.5
7.0	7.0

Separate circuit shall run for each water heater, kitchen equipment, window air conditioner, and similar outlets at location as shown on drawing

**4.5.6 Switches**

- Switches shall conform to IS: 3854, IS: 1293 and IS: 4615. The switches shall be single pole, single or two way as shown on the drawings or as specified. They shall be of moulded type rated for 250 volt, and of full 5/15 A capacity. They shall be provided with insulated dollies and covers
- The switches shall be rocker operated with a quiet operating mechanism with bounce free snap action mechanism enclosed in an arc resistant chamber.
- The switches shall have pure silver and silver cadmium contacts.
- The switches shall be flush modular type.
- The make of the switches shall be as indicated in the drawings or BOQ or make of material or as suggested and approved by the client.
- The switches installed in outdoor area shall be industrial, metal clad type, and shall be provided in weather proof enclosures, complete with weather proof gasketed covers.

**4.5.7 Socket**

- The sockets shall conform to IS: 1293. Each socket shall be provided with control switch of appropriate rating. The sockets shall be moulded type, rated for 250 volts, and either of full 5 A or 15 A capacity, as mentioned on the drawings.
- Sockets shall be of three pin type, the third in being connected to earth continuity conductor.
- The socket shall be flush modular type.
- The sockets installed in machine room, plant room or wet/damp area shall be metal clad weather proof type.
- The finishing and make of all the sockets shall be same as light switch.
- The socket shall have fully sprung contacts and solid brass shrouded
- Terminals to ensure positive electrical connections.
- The sockets shall be provided with automatic shutters, which open only when earth pin of the plug inserts in the socket.
- The socket shall be provided with three pin plug top suitable to the socket and of the same make as socket.

**5.0 DRAWINGS & INFORMATION**

N.A.

**6.0 INSPECTION AND TESTING****6.1 INSULATION RESISTANCE TEST**

6.1.1 The insulation resistance shall be measured by applying 500 volt megger with all fuses in places, circuit breaker and all switches closed

6.1.2 The insulation resistance in megohms of an installation, measured shall not be less than 50 megohms divided by the number of points on the circuit

6.1.3 The insulation resistance shall be measured between

1. EARTH TO PHASE
2. EARTH TO NEUTRAL
3. PHASE TO NEURAL
4. PHASE TO PHASE

**6.2 EARTH CONTINUITY PATH**

6.2.1 The earth continuity conductors shall be tested for electrical continuity and the electrical resistance of the same along with the earthing lead but excluding any added resistance or earth leakage circuit-breaker, measured from the connection, with the earth electrode to any point in the earth continuity conductor in the completed installation and shall not exceed one ohm

**6.3 POLARITY OF SINGLE POLE SWITCHES**

6.3.1 A test shall be made to verify that every no-linked, single pole switch is connected to one of the phase of the supply system

**6.4 COMPLETION CERTIFICATES**

6.7.1 All the above tests shall be carried out in presence of client and the results shall be recorded in prescribed forms. Any default during the testing shall be immediately rectified and that section of the installation shall be re tested. The completed test result form shall be submitted to the client for approval

6.7.2 On completion of an electric installation a certificate shall be furnished by the contractor, countersigned by the certified supervisor under whose direct supervision the installation was carried out. This certificate shall be in a prescribed form as required by the local electric supply authority.

**7.0 INSTALLATION OF THE SYSTEM****7.1 CONCEALED INSTALLATION WITH RIGID PVC CONDUIT**

7.1.1 All the rigid PVC conduit used for concealed installation shall be as per IS ; 9537 and its accessories shall be as per IS: 3419 (Small Wire Ropes).

7.1.2 Whenever necessary bends or diversion may be achieved by bending the conduits with the help of bending spring. No other method of bending is allowed

7.1.3 Conduit pipes shall be joined with the help of plain coupler fixed at the end with the help of vinyl solvent cement. No other method of joining is permissible

7.1.4 All other methods, no wires through conduit, bunching, etc. Shall be as specified in the concealed installation

7.1.5 Prior to fixing the conduits, the complete route shall be marked on site for the approval of consultant

## 7.2 CONCEALED WIRING SYSTEM WITH RIGID PVC CONDUIT

7.2.1 The rigid PVC conduits shall be used for concealed wiring system. The conduits shall be concealed in the concrete slab, floor, walls, beams, columns etc

### 7.2.2 FIXING OF CONDUIT

1. Conduits embedded in concrete shall be installed in the frame work before pouring concrete. The conduits shall be installed above the bottom reinforcing bars, and shall provide positive wire fastening of the conduit to the reinforcing rods at an interval of not more than one meter, but on either side of couplers or bends or putlet/pull/junction boxes or similar fittings, proper hold fast shall be fixed at a distance of 30 cm from the center of such fittings. Conduits embedded in the wall shall be fixed inside the chase . The chase in the wall shall be neatly made and be fixed in the manner desired. In the case of building under construction, chase shall be provided in the wall at the time of their construction and shall be filled up neatly with cement mortar 1:4 after erection of conduit and brought to the original finish of the wall. Cutting of horizontal chases in walls is prohibited. The conduits shall be fixed inside the chase by means of staples or by means of saddles not more than 60 cm apart.
2. Conduits shall be so arranged as to facilitate easy drawing of wires through them. Entire conduit layout shall be done in such a way as to avoid additional junction boxes other than light points. The wiring shall be done in a looping manner. All the looping shall be done in either switch boxes or outlet boxes. Looping in junction or pull boxes are strictly not allowed. Where conduits cross building expansion joints, adequate expansion fittings or other approved devices shall be used to take care of any relative movement
3. All conduits shall be installed so as to avoid steam and hot water pipes
4. Conduits shall be installed in such a way that the junction, derivation and pull boxes shall always be accessible for repairs and maintenance work. The location of junction/pull boxes shall be marked on the shop drawings and approved by the client
5. A separation of 200 mm shall be maintained between electrical conduits and hot water lines in the building
6. No run of conduit shall exceed ten mtr. between adjacent draw in points nor shall it contain more than two right angle bends, or other derivation from the straight line
7. Caution shall be exercised in using the PVC conduits in location where ambient temperature is 50 degree cel. or above. Use of PVC conduits in places where ambient temperature is mote than 60 deg. cel. Is prohibited. The entire conduit system including boxes shall be thoroughly cleaned after completion of installations and before drawing of wires. Conduit system shall be erect and straight as far as possible. Traps where water may accumulate from condensation are to be avoided and if unavoidable, suitable provision for draining the water shall be made
8. All jointing method shall be subject to the approval of the client
9. Separate conduits shall be provided for the following system.
  - 15 A power outlets.

- 5 A outlets and lighting system.
- Low voltage system.
- Telephone/intercom system.
- C.C.T.V. system
- Sound system
- Computer data cabling system
- Equipment wiring

7.3 CONDUIT JOINT

- 7.3.1
1. Conduits shall be joined by means of plain couplers vinyl and/or solvent cement. Where there are long runs of straight conduit, inspection type couplers shall be provided at intervals , as approved by the client
  2. The conduits shall be thoroughly cleaned before making the joints
  3. In case of plain coupler joints, proper jointing material like a vinyl solvent cement (gray in color) or any material as recommended by the manufacturer shall be used.

7.4 BENDS IN CONDUIT

- 7.4.1
- Wherever necessary, bends or diversions may be achieved by bending the conduits or by employing normal bends. No bends shall have radius less than 2.5 times outside dia. of the conduit
- 7.4.2
- Heat may be used to soften the PVC conduit for bending, but while applying heat to conduit, the conduit shall be filled with sand to avoid any damage to the conduit

7.5 OUTLETS

- 7.5.1
- All the outlets for fittings, switches etc. shall be boxes of substantial construction
- 7.5.2
- In order to minimize condensation or sweating inside the conduits, all outlets of conduit system shall be properly drained and ventilated, but in such a manner as to prevent the entry of insects , etc.
- 7.5.3
- Fixing between conduit and boxes, outlet boxes, switch boxes and the like must be provided with entry spouts and smooth PVC bushes.
- 7.5.4
- Joints between conduit and any type of boxes shall be affected by means of conduit couplers in to each of which shall be coupled smooth PVC bush from inside the box. In any case all the joints shall be fully water tight.

7.6 BUNCHING OF CABLES

- 7.6.1
- Cables of AC supply of different phase shall be bunched in separate conduits
- 7.6.2
- The number of insulated wires/ cables that may be drawn into the conduits shall be as per the following table. In this table, the space factor does not exceed 40%. However, in any case conduits having lesser than 19 mm dia. shall not be used.
- MAXIMUM PERMISSIBLE NUMBER OF 650 VOLT GRADE SINGLE  
CORE CABLES THAT MAY BE DRAWN IN TO RIGID PVC  
CONDUITS.

CABLE SIZE IN MM SQ.	SIZE OF CONDUITS (MM)			
	MAXIMUM NO. OF CABLES			
	25	32	38/40	51/50
1.5	8	15	---	---
2.5	6	10	---	---
7.0	4	8	12	---

**7.7 WIRING WITH RIGID STEEL CONDUIT**

7.7.1 All conduits and it’s accessories shall be of threaded type and under no circumstances pin grip type or clamp type accessories be used

**7.8 FIXING OF CONDUIT**

7.8.1 Conduit pipes shall be fixed by heavy gauge spacer bar saddles. The saddles shall be of 3 mm x 19 mm galvanized mild steel flat, properly treated and securely fixed to support by means of nuts and bolts raw bolts, brass machine screws, as mentioned, at an internal of not more than one meter but on either side of couplers, or bends, or junction/pull/outlet boxes or similar fittings, saddles shall be fixed at a distance of 30 cm from the centre of such fittings.

7.8.2 Draw boxes shall be located at convenient location for easy drawing of wires

7.8.3 Every mains and sub mains shall run in independent conduits with an independent earth wire of specified capacity along the entire length of conduit

7.8.4 The conduits to be installed shall be of ample cross section area to facilitate the drawing of wires. The diameter of the conduit shall be selected as per table specified in these specifications. But in no case it shall be less than 25 mm diameter

7.8.5 Entire conduit layout shall be done such as to avoid additional junctions boxes other than for outlet points. Conduits shall be free from sharp edge and burrs. Conduits shall be laid in a neat and organized manner as directed and approved by the client. Conduit runs shall be planned so as not to conflict with any other services pipe, lines/duct

7.8.6 The entire conduit system shall be electrically and mechanically continuous and shall be bonded, together by means of approved type earthing clamp and earthed through a bare copper conductor of 14 SWG to the earthing terminals on the nearest distribution board

7.8.7 If required, connection between PVC and steel conduits shall be through a junction box. Direct connection between PVC and steel conduits are not allowed

7.8.8 Where exposed conduits are suspended from the structure, they shall be clamped firmly and rigidly to hangers of design to be approved by client. Where hangers are to be anchored to reinforced concrete, appropriate inserts and necessary devices for their fixing shall be left in position at the time of concreting, making holes and opening in the concrete will generally not be allowed. In case, it is unavoidable, prior permission of the client shall be obtained



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**7.9 CONDUIT JOINTS**

- 7.9.1 Conduit pipes shall be joined by means of screwed couplers and screwed accessories, as per IS: 2667
- 7.9.2 The threads shall be free from grease or oil
- 7.9.3 In long distanced straight runs of conduit, inspection type couplers two way junction boxes at reasonable intervals shall be provided or running threads with couplers and lock nuts shall be provided. The bare threaded portion shall be treated with anti-corrosive paints. Threads on conduit pipes in all cases shall be between 11mm to 27mm long, sufficient to accommodate pipes to full threaded portion of couplers or accessories. Cut ends of conduit pipes shall have no sharp edges nor any burrs left, to avoid damage to the insulation of conductors while pulling them through such pipes
- 7.9.4 Brass female bushes shall be used in each conduit termination in a switch box, outlet box, electrical panel or any other box
- 7.9.5 Conduit shall be secured in each outlet box switch box, electrical panel or any other ox by means of one brass hexagonal lock nut and bush, outside and inside the box
- 7.9.6 At each building, expansion joints approved oil tight double wire wound flexible steel conduit or any other approved method shall be used. This shall be united on both sides with the rigid conduits by suitable union
- 7.9.7 Conduits installed in the plant room for mechanical equipment shall be properly clamped with the mechanical supports, but in no case, it shall be fixed with the body of the equipment
- 7.9.8 The connection of conduit to the mechanical equipment shall be through oil tight double wire wound flexible steel conduit. In any case the length of the flexible conduit shall not exceed one meter. The flexible conduit shall be properly clamped with the body of the equipment. They shall not in any case be clamped with any cover or any removable parts of the equipment

**7.10 BENDS IN CONDUIT**

- 7.10.1 All necessary bends in the system including diversion shall be done by bending pipes or by inserting suitable solid or circular inspection type normal box or similar fittings. Conduit fittings shall be avoided as far as possible on conduit system exposed to weather, where necessary, solid type fittings shall be used. Radius of such bends in conduit pipes shall be not less than 75 mm. No length of conduit shall have more than the equivalent of four quarter bends from outlet, the bends at the outlets not being counted

**7.11 PROTECTION AGAINST DAMPNESS**

- 7.11.1 In order to minimize condensation or sweating inside the conduit, all outlets of conduit system shall be properly drained and ventilated, but in such a manner as to prevent the entry of insects, as far as possible

**7.12 PROTECTION OF CONDUIT AGAINST RUST**

- 7.12.1 The outer surface of the conduits including bends, junction boxes, etc., forming part of the conduit system shall be adequately protected against rust, particularly when such system is exposed to weather. In all cases, no bare/threaded portion of conduit pipe shall be allowed unless such bare threaded portion is treated with anti-corrosive coating or covered with approved plastic compound.

7.13 BUNCHING OF CABLES

7.13.1 Unless otherwise specified, insulated conductors of different phases shall be bunched in separate conduit.

Wires carrying current shall be so bunched in the conduit that the out going and return wires are drawn into the same conduit. Wires originating from two different phases shall not be run in the same conduit

7.13.2 The number of insulated wires/cables that be drawn into the conduits shall be as per the following table.

MAXIMUM PERMISSIBLE NUMBER OF 650/1100 VOLTS GRADE SINGLE CORE CABLE THAT CAN BE DRAWN INTO RIGID STEEL CONDUITS.

CABLE SIZE IN MM SQ.	SIZE OF CONDUITS (MM)			
	MAXIMUM NO. OF CABLES			
	25	32	38	51
1.5	10	14	---	---
2.5	8	12	---	---
7.0	6	10	---	---

7.14 SWITCH AND SOCKET

7.14.1 Switches shall be installed at 900 mm above finished floor level unless otherwise indicated on the drawings

7.14.2 The switch controlling the light point or fan shall be connected on to the phase wire of the circuit and neutral shall be continuous, having no fuse or switch installed in the line except at the D.B. All fan regulators shall be fixed inside the switch boxes on adjustable flat M.S. strips/plates with tapped holes and brass machine screws, leaving ample space at the back and side for accommodating wires

7.14.3 The cover plates to the switch box shall be fixed by means of sunk head brass cadmium screws

7.14.4 Where two or more switches and fan regulators are installed together, they shall be provided with one gang cover plate with knockouts to accommodate required number of switches, sockets and regulators

7.14.5 The switch controlling the socket outlet shall be on the phase wire of the circuit. The third pin of the socket shall be connected to the earth continuity conductor of the circuit

7.14.6 The switch boxes, installed back-to-back in the same wall shall be offset from each other, 150 mm horizontally, to preclude noise transmission

7.15 DRAWING OF CONDUCTORS

7.15.1 The drawing and joining of copper conductor or wires shall be executed with due regard to the following precautions. While drawing insulated wires into the conduits, care shall be taken to avoid scratches and kinks which may cause breakage of conductors. There shall be no sharp bends

- 7.15.2 Insulation shall be shaved off for a length of 15 mm at the end of wire like sharpening of a pencil and it shall not be removed by cutting it square or ringing
- 7.15.3 FRLS insulated copper conductor wire ends before connection shall be properly soldered (at least 15 mm length) with soldering flux/copper solder, for copper conductor. Strands of wires shall not be cut for connecting to the terminals. All strands of wires shall be soldered at the terminals. All strands of wires shall be soldered at the end before connection. The connecting brass-screws shall have flat ends. All looped joints shall be soldered and connected through terminals block/connectors. The pressure applied to tighten terminal screws shall be just adequate, neither too much nor too less. Conductors having nominal cross section exceeding 4 sq. mm shall always be provided with crimping type cable sockets. At all bolted terminals, brass flat washer of large area and approved steel spring washers shall be used. Brass nuts and bolts shall be used for all connections
- 7.15.4 Only certified wire men and cable jointers shall be employed to do joining work
- 7.15.5 For all internal wiring FRLS insulated wires of 650/1100 volts grade shall be used. The sub-circuit wiring for point shall be carried out in looping system and no joint shall be allowed in the length of the conductors. No wire shall be drawn in to any conduit, until all work of any nature that may cause injury to wire is completed. Care shall be taken in pulling the wires so that no damage occurs to the insulation of the wire. Before the wires are drawn into the conduits the conduits shall be thoroughly cleaned of moisture, dust, and dirt or any other obstruction by forcing compressed air through the conduits

7.16 JOINTS

- 7.16.1 The wiring shall be by looping back system, and hence all joints shall be made at main switches, distribution boards, socket outlets, lighting outlets and switch boxes only. No joints shall be made inside conduits and junction boxes.
- 7.16.2 Contractors shall be continuous from outlet to outlet. For joints where unavoidable, due to any specified reasons, prior permission in writing shall be obtained from the client before making such connections. Joints by twisting conductors are prohibited.

7.17 LOAD BALANCING

- 7.17.1 Balancing of circuit in three phase installation shall be planned before the commencement of wiring and shall be strictly adhered to.

7.18 EARTHING

- 7.18.1 All earthing systems shall be in accordance with IS: 3043 - 1985 code of practice for earthing

**8.0 METHOD OF MEASUREMENT**

- 8.1 All the items will be measured as mentioned in Bill of quantity.

**9.0 TRANSPORT, DELIVERY AND STORAGE**

The wire shall be supplied in the actual length as per detailed purchase order

The wire shall be dispatched at client's stores or at site as per detailed instructions given by client at later stage.

The wire shall be loaded from the main vendor's store and properly stacked as per instruction of client's local representative. All such labour and transportation charges shall be clearly mentioned in the offer.

**10.0**                    **GUARANTEE AND WARRENTY**

10.1                    The quotes values of parameters shall be within given tolerance for given period of service life.

**11.0**                    **SPARES**

11.1                    NA

**12.0**                    **ATTACHMENTS**

12.1                    NA

# **TECHNICAL SPECIFICATIONS FOR LIGHT FIXTURE**

**TECHNICAL SPECIFICATIONS FOR SUPPLY OF LIGHT FIXTURE**

**1.0 SCOPE OF WORK**

1.1 The scope of work shall cover the supply, installation and testing of various types of light fixtures.

**2.0 CODES & STANDARDS**

2.1 The following standards and rules shall be applicable :

IS 3646 (1960)	Code of practice for interior illuminator.
IS 1913(1969)	General and Safety requirements for electric lighting fittings.
Indian Electricity Act and Rules issued here under.	

**3.0 DESIGN BASIS & SITE CONDITIONS**

3.1

<b>Site conditions</b>			
<b>Location</b> Tripura			
<b>Ambient temperature</b>		<b>Relative humidity</b>	
Maximum 41 °C		Maximum 85 %	
Minimum 05 °C		Minimum 35 %	
Design 45 °C		Design 90 % at 45 °C	
<b>Environmental</b> Tropical/dry/wet climate		<b>Location of Equipment</b> Indoor/Outdoor	
<b>Wind speed</b> Annual avg 4.35			
<b>Electrical system data:</b>			
<b>Power supply for Equipment</b>			
Voltage 415 V ± 5 %		Frequency 50 Hz ± 3 %	
<b>Permissible combined voltage &amp; frequency variation</b>	± 6 %	<b>System design faults level (Symmetrical)</b>	10 kA for 1 sec. max.
<b>System earthing</b> LV side neutral solidly earthed		<b>Wiring</b> 3 phase, 4 wire on 415V system	

**4.0 TECHNICAL REQUIREMENTS**

4.1 GENERAL REQUIREMENTS

- 
- 4.1.1 All fixtures shall be complete with accessories and fixings necessary for installation whether so detailed under fixture description or not
- 4.1.2 Fixture housing, frame or canopy shall provide a suitable cover for the fixture outlet box of fixture opening
- 4.1.3 Fixture shall be installed at mounting heights as detailed on the drawings or instructed on site by the client's representative
- 4.1.4 Fixtures and/or fixture outlet boxes shall be provided with hangers to adequately support the complete weight of the fixture. Design of hangers and method of fastening other than shown on the drawings or herein specified shall be submitted to the client's representative for approval
- 4.1.5 Fixture shall be completely wired and constructed to comply with the regulations and standards for Electric Lighting Fixtures, unless otherwise specified. Fixtures shall bear manufacturer's name and the factory inspection label unless otherwise approved
- 4.1.6 Wiring within the fixture and for connection to the branch circuit wiring shall be not less than 1.5 sq.mm. copper for 250 Volt application. Wire insulation shall suit the temperature conditions inside the fixture and wires bypassing the choke shall be heat protected with a heat resistant sleeve
- 4.1.7 Metal used in lighting fixtures shall be not less than 22 SWG or heavier if so required to comply with specifications or standards. Sheet steel reflectors shall have a thickness of not less than 20 SWG. The metal parts of the fixtures shall be completely free from burrs and tool marks. Solder shall not be used as mechanical fastening device on any parts of the fixture
- 4.1.8 Ferrous metal shall be bonderized and given a corrosion resistant phosphate treatment or other approved rust inhibiting prim coat to provide a rust-proof base before application of finish
- 4.1.9 Non-reflecting surfaces such as fixture frames and trim shall be Alluminium die cast
- 4.1.10 All the fixtures are as per the IP - 54 insulation class
- 4.1.11 Vendor shall be responsible for measuring the level of illumination after installation
- 4.1.12 Lighting fixtures shall be designed for minimum glare and for continuous operation under specified atmospheric condition
- 4.1.13 All fixtures shall be complete with accessories like power factor improvement capacitors, ballast, ignitor etc
- 4.1.14 Flourescent fixture shall be of sheet steel casing with corrosion resistance finish. It shall be provided with separate wiring channel with cover plate and an earth terminal. All screw shall be chromium brass only. Lamp and starter holders shall be of tough moulded plastic with spring loaded rotor type connector. Condensers shall be low loss paper impregnated hermetically sealed. Internal wiring shall be neatly clipped and where by passing the ballast, a suitable heat resistance barrier or sleeve shall be provided.
- 4.2 REFLECTOR
- 4.2.1 Light reflecting surface shall be mirror finished having the reflection factor of not less than 80%. All parts of reflector shall be completely covered by finish and free from irregularities. It shall be capable of withstanding a 6 mm. radius bend without showing sign of cracking, peeling or loosening from the base metal. Finish shall be capable of withstanding 72 hours exposure to ultra violet sun lamp placed 10 cm. from the surface without discoloration, hardening or warping and retain the same
-

reflection factor after exposure. Test result shall be furnished for each lot of fixtures

4.2.2 Lighting fixture reflectors shall generally be manufactured from sheet steel of aluminium of not less than 20 SWG. They shall be readily removable from the housing for cleaning and maintenance without disturbing the lamps and without the use of tools. They shall be security mounted to the housing by means of positive fastening devices of a captive type.

4.2.3 Polystyrene egg-box type louvers shall be provided whenever specified. Appropriate captive type fixing devices shall be incorporated for securing these

#### 4.3 BALLAST

4.3.1 Lighting fixtures ballasts shall be designed manufactured and supplied in accordance with the relevant standard IS 6616 and shall function satisfactorily under site conditions specified. The ballasts shall have a long service life and low power loss

4.3.2 Ballasts shall be mounted using self-licking, anti-vibration fixings and shall be easy to remove without removing the fittings

4.3.3 Ballast shall contain a thermosetting type compound not subject to softening or liquefying under any operating conditions or upon ballast failure. The ballasts shall be of the inductive and heavy duty type Filled with polyester of equivalent. They shall be free from hum and protected from the atmospheres. Ballasts which produce a humming sound shall be replaced free of cost by the supplier. HPMV lamp ballasts shall be provided with suitable tapings

#### 4.4 STARTERS

4.4.1 Lighting fixtures starters shall be of the safety type (i.e. if the lamps fails to ignite at the first start, no further starting must be possible without attending to the tube light. Starters shall have bimetal electrodes and high mechanical strength

4.4.2 Starters shall be replaceable without disturbing the reflector or lamps and without the use of any tool. Starters shall have brass contacts and radio interference capacitor

#### 4.5 CAPACITORS

4.5.1 Lighting fixture capacitors shall have a constant value of capacitors and shall be connected across the supply of individual lamp circuits

4.5.2 Each capacitor shall be suitable for operation at 240 volts  $\pm$  5% single phase 50 Hz with a suitable value of capacitance so as to correct the power factor of lists corresponding lamp circuit to the extent of 0.98 lag

4.5.3 The capacitors shall be hermetically sealed preferably in metal container to prevent seepage of impregnating material and ingress of moisture

#### 4.6 LAMP HOLDER

4.6.1 Lamp holders for fluorescent tubes shall be of the spring loaded, low contact resistance, bi-pin rotor type, resistant to wear and suitable for operation at the specified temperature, without deterioration in insulation valve, contact resistance of lamp holding quality. They shall hold the lamp in position under normal condition of shock and vibration

4.6.2 Lamp-holders for incandescent and HPSV lamps shall be of G.L.S. type manufactured in accordance with relevant standards and designed to give long and satisfactory service



**4.7 LUMINAIRES**

- 4.7.1 HPSV fixture shall be of single die cast aluminium made out of LM6 canopy , anodized high purity aluminium reflector, toughened glass at the front and die cast aluminium control gear box complete with all accessories mention in 3.22 with pre-wired up to connector block and loop in and loop out facilities
- 4.7.2 Street light fixture shall be of single die cast aluminium housing with provision for the easy removal of gear box during maintenance. Acrylic bowl shall be linked to one end and toggle shall be provided. Neoprene rubber and felt gasket shall be provided between acrylic bowl and fixture to prevent entry of insects and moisture
- 4.7.3 Industrial low bay fitting shall be of die cast aluminium housing, high purity Al. Reflector, acrylic cover and wire guard

**4.8 LAMPS**

- 4.8.1 Lamps shall be supplied and installed in all lighting fixtures furnished under this contract
- 4.8.2 Lamps used for temporary lighting service shall not be used in the final lamping of fixture units
- 4.8.3 Lamps shall be of wattage and type as shown on the drawings and schedules. Where not shown, the details shall be ascertained from the client before procurement
- 4.8.4 Lamps for permanent installation shall not be placed in the fixtures until so directed by the Client's representative, and this shall be accomplished directly before the respective portions are ready for occupation

**5.0 DRAWINGS & INFORMATION**

- 5.1 As per of the proposal the bidder furnish relevant descriptive and illustrative literature on lighting fixtures and accessories and following drawings/ data for the respective lighting fixtures:-
1. Dimensional Drawings.
  2. Mounting details cable entry facilities and weights.
  3. Light distribution diagrams (Zonal & Isokandora)
  4. Light absorption and utilization factors.
  5. Lamp output V/S temp. curves.

**6.0 INSPECTION AND TESTING**

- 6.1 Each fixture shall be tested at 1500 volts rms. 50 Hz for one minute and no flashover or breakdown shall occur between current carrying parts and ground
- 6.2 Insulation resistance of each fixture shall be tested at 500 V.D.C. and the insulation resistances so measured shall not be less than 2 mega ohms between all current carrying parts and ground
- 6.3 Each fixture complete with its proper lamp/lamps shall be shown to operate satisfactorily at its normal voltage and frequency
- 6.4 Each fixture shall be examined visually to ensure that it is complete in all respects and satisfactorily finished
- 6.5 Type and routine test certificates shall be submitted for tests conducted as per relevant IS/BS for the fixture and accessories

**7.0 METHOD OF MEASUREMENT**

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Supply of the fixture including transport to site, loading and unloading etc. as specified will be treated as one unit for measurement and payment.

## 8.0 TRANSPORT, DELIVERY AND STORAGE

The prices shall be **F.O.R. site basis** including packing & forwarding charges. The quoted price must include all the costs for necessary mode of transportation up to the final location of fixture or site store. The fixture should be supplied with required storage arrangements suitable for placing in open storage yard. All incidental expenses during transportation shall be part of quoted prices including **transit insurance**. The charges for loading and unloading of equipments at site should form part of offer.

## 9.0 GUARANTEE AND WARRENTY

- 9.1 The Bidder shall stand guarantee for the performance of entire fixtures and components for twelve (12) months from the date of commissioning or eighteen (18) months from the date of dispatch, whichever is earlier, as agreed up on and as reproduced in the purchase order within the tolerance specified or as permitted by the relevant standards for the equipment in his scope of supply. The Purchaser also reserves the right to use the rejected equipment or part thereof until the new equipment meeting the guaranteed performance is supplied by the Bidder.

## 10.0 SPARES

- 10.1 The bidder shall quote for minimum spares required for **two years** safe operation of light fixtures along with the offer separately.

**TECHNICAL SPECIFICATION  
FOR  
SUPPLY OF  
CLOSED CIRCUIT TELEVISION**

**TECHNICAL SPECIFICATION FOR SUPPLY OF CLOSED CIRCUIT TELEVISION SYSTEM**

**1.0 SCOPE OF WORK**

1.1 The work under this system shall consist of design, supply, installation, testing, training & handing over of all materials, equipment's and appliances and labor necessary to commission the said system. The CCTV System shall comprise of fixed dome Cameras, Fixed C-mount Cameras and Hi speed dome Cameras with Video encoder and power supply units, monitoring stations. All recording shall be done in Network video recorder through network switch available in control room. It shall also include laying of cabling, necessary for installation of the system as indicated in the specification and Bill of Quantities. Any openings/chasing in the wall/ceiling required for the installation shall be made good in appropriate manner. The software for Access control and CCTV system shall run on a single platform.

**2.0 DESIGN BASIS & SITE CONDITIONS**

2.1 All the equipment and components provided in the transformer and accessories shall be suitably designed for installation and satisfactory operation as specified below.

<b>Site conditions</b>	
<b>Location</b> Tripura	<b>Site altitude</b> 50 M above mean sea level
<b>Ambient temperature</b>	<b>Relative humidity</b>
Maximum 44 °C	Maximum 85 %
Minimum 08 °C	Minimum 27 %
Design 50 °C	Design 90 % at 50 °C
<b>Seismic factor</b> Zone III as per IS:1893	<b>Rainfall</b> 1500 mm/year
<b>Environmental</b> Tropical/humid/corrosive conditions	<b>Location of Equipment</b> indoor
<b>Electrical system data:</b>	
<b>Power supply for Equipment</b>	
Voltage 240 V ± 5 %	<b>Frequency</b> 50 Hz ± 3 %

**3.0 TECHNICAL REQUIREMENTS**

3.1 SYSTEM DESIGN AND ARCHITECTURE

CCTV system should be designed such as to cover the strategic locations and sensitive areas of High end cameras with Day/Night features to be installed for outdoor and perimeter security application, these cameras shall be IR Compatible so that IR Lamps can be introduced at a later stage to enhance night vision. All Speed domes shall be rugged and shall be weather proof as per specifications. The fixed dome cameras shall necessarily be of Varifocal / fixed lens as per detailed specifications. Day/Night Cameras with built in zoom lenses shall be provided for select indoor/outdoor locations as per the detailed BOQ. Also the systems should utilize only industry standard protocol.

System should be programmed such that operator's intervention if required shall be minimal and the system should provide features like guard tours, preset positions and the preset positions will be linked to perimeter protection system/intrusion system in

future. The DVR's/NVR's should allow for recording of events both continuous and motion triggered as per requirement and recordings should be able to create evidences and support post event analysis.

3.2 INDOOR VARIFOVAL CAMERA (If Applicable)

3.2.1 The Fixed Dome camera unit shall be 1/3" interline Sony Super HAD CCD type Color with a sensor array of 752 x 582.It supports a frame rate of 25 fps. It shall be possible to use lenses of 3.5 - 9 mm. The complete unit shall be housed in a dome and base unit, both preferably made from injection molded plastic. It shall be possible to adjust the camera head inside the dome in both the planes so that it can be wall or ceiling mounted. The camera shall operate on Power over Ethernet and as well as support 12 volts D.C.

TECHNICAL SPECIFICATION FOR VARIFOVAL CAMERA

Image Sensor	1/3" Sony Super HAD CCD
Effective Pixels	PAL: 752 (H) x 582 (W)
Scanning System	2:1 Interface, V 50Hz,
Video Output	1 Vp-p, 75 ohms unbalanced
Resolution	470 TV Lines
Minimum Illumination	0.1 Lux F1.2
Image resolution	704x576,640x480,528x384,704x288,352x288,176x144
Back Light Compensation	Auto (center area)
Gain Control	Auto AGC
Shutter Control	AES: 1/50 (60) - 1/100,000 sec.
S/N Ratio	More than 48dB
Day & Night	Auto switch
Lens	Built-in Varifocal Lens 3.5 – 9 mm.
Protocols	-
Video Compression	H.264
Video Input	1 channel
Video Output	1 channel
Alarm Input	1 channel
Alarm Output	1 channel
Operating Temperature	+10* C to +60* C
Power Supply	POE / DC 12V +/-10% tolerance
Power Consumption	4.0 W

3.3 FIXED C MOUNT CAMERA (If Applicable)

3.3.1 The High-Resolution Day Night Camera shall be of 1/3"SONY Progressive Scan CCD type, compact of rugged design and shall employ solid state circuitry. The camera shall deliver clear, high resolution color picture without geometric distortion.

The High-Resolution Day Night Camera shall have a minimum of 480 TV lines of resolution utilizing an effective pixel count of no less than 752 (H) x 582 (V) PAL.

The Camera shall comply with the enclosed datasheet.

TECHNICAL SPECIFICATION FOR CMount CAMERA:

CCD Image	1/3" Sony Super HAD CCD
Effective Pixels	752 (H) x 582 (V) PAL
Scanning Frequency	PAL: 2:1 Interlace
Horizontal Resolution	480 TV Lines or more
Video Output	1 Vp-p, 75 ohms
Synchronization	Internal or Linelock (on / off)
Minimum Illumination	0.1 Lux, F1.2 color mode
Signal to Noise Ratio	More Than 48dB
Backlight Compensation	On / Off switch
Shutter control	Auto Luminance Control 1/60 (50) - 1/100,000 sec
Auto Iris Control	Video Drive or DC Drive selectable switch
Day & Night	Electronic
Gain Control	Automatic or Manual
Image Resolution	PAL: 704 × 576, 528 × 384, 704 × 288, 352 × 288, 176 × 144
Protocols	-
Video Compression	H.264 / MPEG4
Video Input	1 channel
Video Output	1 channel
Alarm Input	1 channel
Alarm Output	1 channel
Operating Temperature	-10° C - + 50° C
Power Source	POE / AC24V/DC12V(Low Voltage) / AC100-AC240V (AC Mains)
Power consumption	5W Maximum

3.4 LENS

3.4.1 The Lenses Shall be Fixed/ Varifocal Lens type. The lens should not be made from plastic. The lenses shall be auto iris type with internal spot filter.

Focal Length (mm)	5 ~ 50 (10x)
Iris Range	F1.6 ~ T360 (Equivalent to F360)

Angle of View(HXV)1/3”:	
Wide	51°17’ X 39°36’
Tele	5°30’ X 4°07’
Focusing Range (From Front Of Lens) (m)	∞ ~ 0.3
Back Focal Distance (In Air) (mm)	7.52 (W) - 7.46 (T)
Mount	CS/C mount

3.5 HOUSING

The Environmental Camera Housing shall include, as a minimum, the following features/ functions/ specifications:

- 3.5.1 The Environmental Camera Housing shall incorporate a side-hinged lid to provide easy access to the camera and lens for trouble-free installation and servicing.
- 3.5.2 The Environmental Camera Housing shall be purpose aluminium camera housing complete with anti-reflective ABS polymer sunshield, plexi-glass face-plate with polycarbonate front and rear.
- 3.5.3 The Environmental Camera Housing shall be totally protected from dust and strong jets of water, and must have an International Standards IP Protection Classification of sixty- six (IP66).
- 3.5.4 The Environmental Camera Housing shall utilize three (3) weatherproof cable entry glands on the rear of the housing to allow for easy installation of power, video and control cables.
- 3.5.5 The Environmental Camera Housing manufacturer shall offer the housing with factory installed sunshield, heater, and blower and prepackaged with a wall mount.
- 3.5.6 The Environmental Camera Housing shall have a removable camera sled that can be secured along any position in the housing.

3.5.7 TECHNICAL SPECIFICATION FOR OUTDOOR HOUSING:

Power:	
a. Housing	Camera power
b. Heater rating	110 D 230 V AC, 40 W
Finish	Centre section: extruded and die cast aluminum, front and rear sections: robust plastic
Protection rating	IP66 BS EN 60 529
Material	Toughened glass window Housing body/sunshield: Aluminum extrusions Front and rear end caps: Die-cast aluminum
Finish	Housing body: Polyester powder coat, RAL9006 White Aluminium
Heater	PTC resistor heating element, thermostatically

	controlled
Operating Temperature: Housing	- 4° to 140°F (-20° to 60°C)

3.6 OUTDOOR HI-SPEED DOME CAMERA (If Applicable)

3.6.1 The Dome camera system would be consisting of a 1/4" image format, DSP color CCD camera with a 36X Optical zoom and 12X digital zoom auto-iris lens delivering the power of 432X zoom to ensure that the finest details are captured. The Unit shall have a camera with 480 TV lines and auto focus lens, a high-speed pan/tilt in a dome enclosure. The enclosure for outdoor pan tilt dome camera shall be weatherproof and constructed from die cast aluminum. The High speed dome shall have an integral RS-485 communication channel for direct control via the Digital Video Recorder.

3.6.2 The auto dome shall contain an integral 360-degree pan/tilt device. This variable speed pan/tilt shall be capable of operating in the manual mode to speeds up to 300 degree per second (variable speed). The camera shall operate on 24 volts A.C. The auto dome system shall be compatible with the Network Video Recording software.

THE CAMERA SHALL COMPLY WITH THE ENCLOSED DATASHEET.

Image Sensor	1/4" Sony Ex View HAD CCD
TV System	2:1 Interface, PAL
Horizontal Resolution	480 TV Lines
Synchronization	Internal / External V-Lock
Optical Lens	36X Zoom, f=3.4 – 122mm
Digital Zoom	12X (Upto 432X with Optical Zoom)
AGC	Auto
Minimum Illumination	1.4 Lux /F1.4 (Color), 0.01 Lux F1.4 (B/W)
S/N Ratio	> 50dB
BLC	On/Off
Shutter Speed	Auto: 1/50 - 1/10000 sec, Manual: 22 steps
White Balance	Auto, Indoor, Outdoor
Camera Title	More than 16 characters
Day / Night Function	Yes, with infrared IR-Cut (Auto / Manual)
Preset	More than 190
PTZ Position Display	ON / OFF
Communication Interace	RS-485/RS232
Pan Range	360° Endless
Pan Speed	Manual: Approx. 0.3°/s-300°/s Preset: Up to Approx. 400°/s
Tilt Range	0°~90° (Automatic Flip)
Tilt Speed	Manual: Approx. 0.5°~60°/s Preset: Up to Approx. 160°/s
Sequence	1 / 2 / 3 / 4 / 5 / 6 / 7 / 8



Pattern	1 / 2 / 3 / 4
Automatic Flip	Yes
Protocol	-
Alarm Function	7 Inputs / 2 Output
Dual Stream	Yes
Security measures	User & Host
User & Host Level	3 levels
RS485 protocols	Yes
Water and Dust Resistance	IP66 Standard Compatible(except Indoor Dome) TVS 3000V Thunder Proof(Just for Outdoor Dome)
Power Supply	AC 24V , 50Hz /60 Hz
Working Temperature/Humidity	-30° ~ 60°(Outdoor) / -10° ~ 50°(Indoor)
Power Consumption	50W

3.7 DIGITAL VIDEO RECORDER WITH IN-BUILT REQUIRED HARD DISK

- 3.7.1 Digital Video Recorder should be fully integrated, stand-alone video recording management solution having stable embedded operating system..
- 3.7.2 It should Record from Thirty two analog channels using high resolution H.264 video compression & support viewing & recording video in CIF, 2CIF, or 4CIF/D1 resolutions.
- 3.7.3 It should support VGA 16:9, 16:10, and 4:3 aspect ratios in various resolutions
- 3.7.4 It should have built-in web viewer for remote viewing, playback, control and configuration
- 3.7.5 It should be control using USB mouse, front panel and remote control.
- 3.7.6 It should support remote configuration and management of devices on surveillance system.
- 3.7.7 It should support powerful search functions that allow searches based on time/date stamps, motion or input triggers, and smart searches that allow searches on changes in recorded video.
- 3.7.8 It should support 10/100 Base-T Ethernet port for local or wide area network connection
- 3.7.9 **Recording**
  - 1. The Video Recorder shall split recording archives into two partitions. Alarm recordings (input and motion) are stored on one partition, while continuous recordings are stored on a separate one
  - 2. The Video Recorder shall record automatically in the background, support schedule based continuous recording
  - 3. The Video Recorder shall record at up to 25 (PAL) images per second, per channel at CIF resolution.

4. The Video Recorder shall be capable of recording at 2CIF and 4CIF resolution.

#### 3.7.10 **Viewing & Controlling**

1. The Video Recorder shall support connection to the Digital Joystick keyboard that allows loop through connections to control multiple recorders from a single keyboard.
2. The Video Recorder shall contain alarm handling functions. The alarm functions shall include Motion detection in user-definable areas on any camera input.
3. The Video Recorder shall be operated and programmed via the onscreen display menu system using the front panel control keys, the mouse or the remote control.
4. The Video Recorder shall provide two monitor outputs to provide full-screen, quad (main monitor only), and sequenced viewing.
5. The Video Recorder shall provide the Control Center PC software or a built-in web application via a network for live viewing, playback, and configuration. The Control Center shall allow minimum four users to control the DVR simultaneously.
6. The Video Recorder shall include an authenticity check for both local and remote playback.
7. The Video Recorder shall allow local archiving via a USB device.
8. The Video Recorder shall support Real Time Streaming Protocol (RTSP) to deliver live video over the Internet to an appropriate mobile device.

#### 3.7.11 **Video Recorder Specifications:**

1. Video Inputs
  - a. Inputs: 32 looping BNC, auto termination Composite video 1 Vpp, 75 ohm, automatic termination; PAL/NTSC auto-detect
  - b. AGC: Automatic gain adjustments for each video input
2. Video Outputs
  - a. Outputs:
    - 1) Monitor A: VGA RGB
    - 2) Monitor B: VGA RGB
  - b. Live Resolution (SVGA): 800 x 600 (4:3), 1024 x 768 (4:3), 1280 x 1024 (5:4), 1366 x 768 (16:9), 1440 x 900 (16:10)
  - c. Digital Zoom: 2 times
  - d. Streaming Video: H.264 compression
3. Audio
  - a. Inputs: Mono RCA, 1.0 Vpp
  - b. Output: Mono RCA, 1.0 Vpp
  - c. Compression: ADPCM
  - d. Sample Rate: 16 kHz per channel
  - e. Bit Rate: 8-bit
4. Alarm Handling
  - a. Inputs: 8 or 16 or 32 inputs configurable NO/NC, max. input

- voltage 15 VDC
- b. Outputs: 4 Relay outputs, configurable NO/NC, max. rated 30 VAC, 40 VDC 0.5 A continuous or 10 VA
- 5. Control
  - a. RS485: Output signals according to RS485, max. signal voltage -8 to +12 V
  - b. Ethernet: RJ45, 10/100 BaseT according to IEEE802.3
  - c. USB 2.0: One front and one rear USB connector for mouse or USB memory device
- 6. Storage : As per requirement (Specified in BOQ)
- 7.Environmental
  - a. Operating Temperature: +0°C to +40°C

Operating Humidity: <93% non-condensing

3.8 TRANINIG

- 3.8.1
  - 1. All training shall be by the contractor and shall utilize specified manuals and As-Built Documentation
  - 2. Operator training shall include total seven sessions each of six-hour encompassing:
    - Modifying text and graphics
    - Sequence of operation review
    - Selection of all displays and reports
    - Use of all specified OS functions
    - Use of portable operators terminals
    - Trouble shooting
    - Password assignment and modification
  - 3. The training shall be under taken in two phases. One training session shall be conducted at system completion, and the other shall be conducted within forty-five days of system completion.

**4.0 DRAWING & INFORMATION**

- 4.1 Schematic Diagram of complete systems indicating, Ratings, details , sizes of all the Products or components.

**5.0 INSPECTION & TESTING**

- 5.1 Performance of each equipment in coordination with other systems to prove the functional requirements.

**6.0 METHOD OF MEASUREMENT**

- 6.1 Supply of the products including transport to site, loading and unloading etc. as specified will be treated as one unit for measurement and payment after successful commissioning.

**7.0 TRANSPORT, DELIVERY & STORAGE**

- 7.1 The prices shall be **F.O.R. site basis** including packing & forwarding charges. The quoted price must include all the costs for necessary mode of transportation up to the final location or site store. All incidental expenses during transportation shall be part of quoted prices including **transit insurance**. The charges for loading and unloading of equipments at site should form part of offer.

## **8.0 GUARANTEE & WARRENTY**

- 8.1
1. All component, system software, parts and assemblies supplied by the contractor shall be guaranteed against defects in materials and workmanship for one year from the acceptance date.
  2. Labour to troubleshoot, repair, reprogram, or replace system components shall be furnished by the contractor at no charge to the owner during the warranty period.
  3. All corrective software modifications made during warranty service periods shall be updated on all user documentation and on user and manufacturer archived software disks.

# **TECHNICAL SPECIFICATIONS FOR ELV WIRING**

**TECHNICAL SPECIFICATIONS FOR ELV WIRING**

**1.0 SCOPE OF WORK**

- 1.1 This section relates to specification for the supply, installation, connection, testing and commissioning of the wiring for Telephone / Computer / Fire detection / Music & Signage & wiring installation including supply of telephone cables, Multiple flexible wires, Shielded Wire, CAT-5 UTP computer signal wire, Junction boxes, Outlet boxes, and other related accessories required to complete the wiring and installation.
- 1.2 The main hardware of the systems shall be supplied by the client

**2.0 CODES & STANDARDS**

- 2.1 The cables shall be conforming to the following standards of latest revision :

Sr.	Item	Relevant IS	Relevant IEC
1	PVC insulated (heavy duty) electric cable.	IS : 1554 ( Part I )	
2	Copper conductors in insulated cables and cords.	IS : 8130	
3	Mild steel wires, strips and tapes.	IS : 3975	

- 2.2 **For Armoured Cables,**

Sr.	Item	Relevant IS	Relevant IEC
1	PVC insulated and sheath of electric cables	IS : 5831	
2	Recommended current rating for cables.	IS : 3961 ( Part I )	

- 2.3 Cables shall also meet the requirement of Indian Electricity rules, Fire Insurance Association and Electrical Inspector.

The wire for the systems shall confirm to IS: 694, 1554, 624 and local fire department.

The CCTV & Security Access System cable shall confirm to BS : 2316 and American Military standard MIL -C - 17 / JSS - 51100 and of Radio frequency co-axial type ( RG - 11 )

**3.0 DESIGN BASIS & SITE CONDITIONS**

- 3.1 The extra low voltage system wiring installation shall be carried out in the manner as approved by the local Authority. If found necessary, the drawing for installation shall be got approved by the local sanctioning authorities before commencement of

the work.

Separate conduits of 25 mm. diameter (minimum) shall be laid for extra low voltage system cables / wires.

- 3.2 The installation of conduits shall be carried out as per detailed specification given under section "INTERNAL WIRING".
- 3.3 All cables, lay on cable racks / trays shall be neatly stitched together.
- 3.4 Extra low voltage system wires / cable terminations both at the junction boxes and at the socket outlets shall be done as per method approved by consultants and in conformity with their rules and regulations.
- 3.5 The final branch connections with single / twin pair cables in conduits and the minimum number of cables in each conduit shall be as follows:

Conduit dia. in mm.	Max. No. of cables
20	2 Nos. single pair
25	6 Nos. single pair
32	12 Nos. single pair
40	18 Nos. single pair

All the cables/wires provided shall be suitably designed for installation and satisfactory operation as specified below.

<b>Site conditions</b>	
<b>Location</b> Tripura	
<b>Ambient temperature</b>	<b>Relative humidity</b>
Maximum 41 °C	Maximum 85 %
Minimum 05 °C	Minimum 35 %
Design 45 °C	Design 90 % at 45 °C
<b>Electrical system data:</b>	
<b>Power supply for Equipment</b>	
Voltage 12V to 90V ± 15 %	<b>Frequency</b> 10Hz to 300Hz ± 3 %
<b>Permissible combined voltage &amp; frequency variation</b> ± 6 %	

**4.0 TECHNICAL REQUIREMENTS**

4.1 SYSTEM:

4.1.1	<u>Voltage</u>	<u>Frequency</u>
Fire alarm, Security	12 V DC	10 Hz. -100 KHz
Music & P.A. system	30 V AC	20 Hz. - 20 KHz.
Telephone system	90 V AC	300 Hz. - 5 KHz.

4.1.2 The extra low voltage system cables will be terminated on the tag block / junction

box located at each floor.

- 4.1.3 From this tag block / junction boxes, separate M.S. conduits shall run for individual outlet connections to each area through tag boxes / junction boxes.
- 4.1.4 The conduits shall run in the surface manner in the vertical shaft and shall run in surface / concealed manner at every floor between shaft and the outlet box through tag box / junction boxes located on each floor.
- 4.1.5 Extra low voltage system cables / multi pair telephone cables shall be pulled through the above conduits and then be connected at both ends.

#### 4.2 MATERIAL OF CONSTRUCTION

##### 4.2.1 Conduit:

M.S. conduit, conduit accessories, steel junction boxes, etc. to be used for telephone wiring system shall have material specifications as described in section under title "INTERNAL WIRING " of this tender document.

##### 4.2.2 Cables & Wires:

The type of cables and the services shall be as follows :

#### 4.3 TELEPHONE CABLE

- 4.3.1 Telephone multipart cable shall confirm to P & T specifications.
- 4.3.2 Annealed tinned bare copper conduction 0.6 mm. dia.
- 4.3.3 Cores twisted into pairs, pairs laid - up, fully filled and taped with suitable absorbent tape.
- 4.3.4 Armouring of galvanized steel wire.
- 4.3.5 PVC insulated, PVC inner sheathed and outer sheathed.
- 4.3.6 Aluminium Mylar tape with drain wire

#### 4.4 FIRE DETECTION & ALARM SYSTEM :

- 4.4.1 The wire for the systems shall confirm to IS: 694, 1554, 624 and local fire department.
- 4.4.2 Annealed tinned copper conductor 1.5 mm<sup>2</sup>
- 4.4.3 2 core twisted into pair
- 4.4.4 Shielded Al. Mylar tape.
- 4.4.5 PVC insulated, PVC inner sheathed and outer FRLS sheathed

#### 4.5 C.C.T.V. & SECURITY ACCESS SYSTEM :

- 4.5.1 The system cable shall confirm to BS : 2316 and American Military standard MIL -C - 17 / JSS - 51100 and of Radio frequency co-axial type ( RG - 11 )
- 4.5.2 Annealed tinned copper conductor.
- 4.5.3 Polyethylene insulated.
- 4.5.4 Annealed bare copper braiding.



- 4.5.5 PVC sheathing
- 4.5.6 Characteristic impedance - 75 ohm  $\pm$  3
- 4.6 INSTRUMENT CABLES :
- 4.6.1 Multipair cables shall be used for transferring digital / analog signals from electrical meters to PLC.
- 4.6.2 Cable shall be capable of withstanding normal and short circuit condition of various systems to which it is connected, without damage, transportation to site, installation at site and operation.
- 4.6.3 Cable shall be capable of performing satisfactorily when laid in trenches, trays and directly buried in the ground.
- 4.6.4 All overhead wiring shall be supported in cable trays. The shield shall be grounded at one location only. All the wiring, cables, and termination points shall be suitably identified as per applicable codes and practices.
- 4.6.5 The vendor shall provide detailed cable scheduling mentioning the make, standard followed and other necessary details so as to satisfy the specified requirements.
- 4.7 SIGNAL CABLES :
- 4.7.1 Multi core twisted cables shall be rated for 660 / 1100 volts.
- 4.7.2 The cable shall be 1.0 mm.<sup>2</sup> multi stranded, PVC coated, high conductivity annealed tinned copper conductor with PVC insulation and sheathing, 100% aluminium Mylar shielding with copper drain conductor, galvanized steel armouring and overall PVC sheathing. Rip cord shall also be provided.
- 4.7.3 Multi core cables shall have the following additional features :
- 4.7.4 Pair identification by color coding / numbering.
- 4.7.5 Individual pair shielding and testing, apart from overall shielding and twisting. All the cables shall be of flame-retardant type .All the cables shall be terminated using Siemens type gland.
- 4.8 JUNCTION BOXES FOR EXTRA LOW VOLTAGE SYSTEM :
- 4.8.1 The junction boxes / the telephone tag blocks shall be suitable for the multi pair wires / cables and shall have two terminal blocks, cross connect type. All incoming and outgoing cables shall be terminated on separate terminal blocks. The cross connecting jumpers shall be insulated wires of same diameter and connected in same manner.
- 4.8.2 The junction boxes shall be mounted inside fabricated sheet steel boxes with removable hinged covers and lockable type and shall be painted as specified in section "Painting ".
- 5.0 DRAWINGS & INFORMATION
- Not applicable
- 6.0 INSPECTION AND TESTING
- Performance of each equipment in coordination with other systems to prove the functional requirement.

**7.0 METHOD OF MEASUREMENT**

- 7.1 The extra low voltage system cable shall include supply, laying, connection, testing and commissioning of multi pair cable / wire on ceiling / wall on cable trays / racks including all supports and shall be measured and paid on running length basis. Cable trays / racks shall be paid for separately.
- 7.2 The multi pair junction boxes for extra low voltage system shall consist of strip, jumpered interconnections enclosure etc. and shall be measured and paid as one unit.
- 7.3 The conduit wiring for extra low voltage system outlet point shall include wire / cable in M.S. conduits and shall include junction boxes, pull boxes, 2A two pair connector / socket in M.S. box, outlet plate etc. from the floor tag blocks to the outlet point.

**8.0 TRANSPORT, DELIVERY AND STORAGE**

The prices shall be **F.O.R. site basis** including packing & forwarding charges. The quoted price must include all the costs for necessary mode of transportation up to the final location or site store. The ELV Wiring cables/wires should be supplied with required storage arrangements suitable for placing in open storage space. All incidental expenses during transportation shall be part of quoted prices including **transit insurance**. The charges for loading and unloading of equipments at site should form part of offer.

**9.0 GUARANTEE OF PERFORMANCE**

The Bidder shall stand guarantee for the performance of entire wiring for twelve (12) months from the date of commissioning or eighteen (18) months from the date of dispatch, whichever is earlier, as agreed up on and as reproduced in the purchase order within the tolerance specified or as permitted by the relevant standards for the wiring in his scope of supply.

**10.0 ATTACHEMENTS**

- Datasheet

**DATASHEET**

Sr. No.	Particular	Description
1.1	Category 6 UTP Cable	
1.1.1	Class	E attenuation
1.1.2	Stander	ISO/IEC 11801, CENELEC EN50173 and TIA/EIA 568B.
1.1.3	Certify	UL
1.1.4	Performance guaranteed	6 connections in any length channel configuration up to 100 mtr
1.1.5	Support	Category 6/Class E NEXT, PSNEXT, FEXT, ELFEXT, PSELFEXT and return loss extrapolated to 250 MHz
1.1.6	Capability	Excess of 1 Gbps to the workstation in accordance with application standard
1.1.7	Supportive standard	IEEE 802.3 1000BASE-T, TIA-854-A 1000BASE-TX, ATM Forum CB1G plus other legacy LANs and applications as well as Video also.
1.1.8	Physical Specifications :	
	Weight	not more than 11.88 kg/305 m
	Nominal Jacket Thickness	not more than 0.022 in (0.559 mm)
	Nominal Outside Diameter	not more than 0.232 in (5.89 mm)
	Operating Temperature	-4°F to 140°F (-20°C to 60°C)
	Gauge:	23 AWG
1.2	Category 6 information outlet	
1.2.1	General	Category 6 outlets shall meet or exceed Category 6 transmission requirements for connecting hardware, as specified in TIA/EIA 568-B Commercial Building Telecommunications Cabling Standard and ISO/IEC 11801:21002 Second Edition, CENELEC EN 50173, and TIA/EIA568B
1.2.2	Standard	TIA/EIA 568-B Commercial Building Telecommunications Cabling Standard and ISO/IEC 11801:2002 Second Edition, CENELEC EN 50173, and TIA/EIA568B

Sr. No.	Particular	Description
1.2.3	Compatible with	Category 5E, 5 and 3 cords and cables
1.2.4	Design	Supporting to T568 A & B wiring
1.2.5	Capabilities	Being in a modular patching situation or as a modular telecommunication outlet (TO) supporting current 10BASE-T, Token Ring, 100 Mbps TP-PMD, 155 Mbps ATM, 622 Mbps ATM using parallel transmission schemes and evolving high-speed, high-bandwidth applications, including Ethernet, 1000BASE-T and 1 Gbps ATM
1.2.6	Supports	Category 6/Class E NEXT, PSNEXT, FEXT, ELFEXT, PSELFEXT and return loss extrapolated to 250 MHz
1.2.7	Certified	UL & cUL
1.2.8	Physical Specifications	
A	Dimensions	HxWxD: 2.0 cm x 2.0 cm x 3.1 cm - Universal
B	A/B labeling	
C	Plastic Material	High-impact, flame retardant, thermoplastic
D	Flammability Rating	UL-rated 94 V-0
E	Operating Temperature	14°F to 140°F (-10°C to 60°C)
F	Storage Temperature	40°F to 158°F (-40°C to 70°C)
G	Humidity	95% (non-condensing)
H	TIE/EIA Category	6
I	TIE/EIA Category	6
1.3	Category 6 Patch Panel (24/48 port)	
1.3.1	Electrical performance guaranteed	To meet or exceed TIA/EIA 568-B.2-1 Category 6 & ISO/IEC Category 6/Class E specifications.
1.3.2	Standard	ISO/IEC 11801, CENLEC EN 50173 and TIA/EIA
1.3.3	Certified	UL
1.3.4	Capabilities	network line speeds in excess of 1 gigabit per second
1.3.5	Back ward compatible	Category 5 e, 5 & 3 cords and cables
1.3.6	Panel configuration	24/48 port with A/B labeling & 110IDC connector terminations on rear of panel.

Sr. No.	Particular	Description
1.3.7	Physical Specifications	
A	Plastic Material	High-impact, flame retardant, thermoplastic
B	Flammability Rating	UL-rated 94 V-0
C	Operating Temperature	14°F to 140°F (-10°C to 60°C)
D	Storage Temperature	-40°F to 158°F (-40°C to 70°C)
E	Humidity	95% (non-condensing)
F	TIA/EIA Category	6
1.4	Category 6 Patch Cord	
1.4.1	Standard	TIA/EIA & ISO/IEC Category 6/Class E specifications
1.4.2	Performance guaranteed	Meet or exceed the channel specifications of the TIA "Category 6" up to 250 MHz
1.4.3	Supports	Complies Category 6/Class E NEXT, PSNEXT, FEXT, ELFEXT, PSELEFEXT and return loss extrapolated to 250 MHz
1.4.4	Protection	Antisnag features which provide protection from snagging during moves and re arrangements
1.4.5	Backward compatible	Category 5 and category 5E
1.4.6	Physical Specifications	
A	Contact Material	Phosphor Bronze
B	Contact Plating	Gold 50 micro-inch (1.27 microns), nickel 100 micro inch (2.54 microns)
C	Insertion Life	750 minimum
D	Plug Material	Polycarbonate UL-rated 94 V-O
E	Operating Temperature	14°F to 140°F (-10°C to 60°C)
F	TIA/EIA Category	6
G	UL and cUL	CM (cordage)
1.5	Face Plate for Information Outlet	
1.5.1	Contains	Slots that cover the screws to house labels and covers  Two labels and covers included

Sr. No.	Particular	Description
1.5.2	Numbering	Both side for installation & maintenance identification
1.5.3	Provision	Blank to fill the unused outlet openings
1.5.4	Material	High impact, flame retardant, UL rated 94V-0 thermoplastic
1.6	Network Rack -15U (each per floor)	
1.6.1	Height	15U
1.6.2	Size	600 mm wide x 450mm deep
1.6.3	Cover	Top
1.6.4	Horizontal Cable Manager	2
1.6.5	Front section	Glass door & lock
1.6.6	MS door & glass door	Powder coated
1.6.7	Bottom/Upper cover	Suitable for sufficient cable opening (30-40 Cat 6 cable)
1.6.8	Fan	Single fan position with loaded fan
1.6.9	Distribution boxes	One 4 port (5 Amp x 4 socket)
1.6.10	Front & rear angles	19 "
1.7	Network Rack-42U (for server room)	
1.7.1	Height	42U
1.7.2	Size	600 mm wide x 1000 mm deep
1.7.3	Front door	Toughened glass
1.7.4	Cover	Top
1.7.5	Rear MS doors	With venting options
1.7.6	Horizontal Cable Manager	4
1.7.7	Front section	Glass door & lock
1.7.8	MS door & glass door	Powder coated
1.7.9	Bottom/Upper cover	Suitable for sufficient cable opening (00-400 Cat 6 cable)
1.7.10	Fan	4 fan position with 4 cooling fans
1.7.11	Distribution boxes	One vertical box on back side( 5/15Amp x 10 socket)

Sr. No.	Particular	Description
1.7.12	Front & rear angles	19"
1.8	24 port Layer 2 data switch (each floor)	
1.8.1	Port	24 port 10/100 Mbps RJ45 Ethernet port
1.8.2	10/100/1000 Mbps	2 dual purpose
1.8.3	Power supply redundancy	1 serial port for control and RPS adaptor
1.8.4	Switch	Stackable
1.8.5	Capacity	Minimum 12Gbps Switching capacity 100 Gbps Stacking capacity 9 Mpps Packet Forwarding capacity 75 Mpps total stack packet forward capacity
1.8.6	Features	Protocol and Port based VLAN, 802.1X authentication, MAC based port authentication, Multilayer packet processing, 802.3ad, IGMP snooping, 4 priority queues per port, Jumbo Frame Support, One to One & One to Many port mirroring, SSH2 and SSL support
1.8.7	Foot print	1 RU
1.9	24 port Layer 2+ data switch (each floor)	
1.9.1	Port	24 port 10/100 Mbps RJ45 Ethernet port 4 combo 1000 Base SFP shared with RJ45 Ethernet port
1.9.2	Switch	Stackable switch with dedicated stacking port at back plane
1.9.3	Power supply redundancy	1 serial port for control and RPS adaptor
1.9.4	Capacity	Minimum 94 Gbps aggregate switching throughput capacity Minimum 35 Mpps Packet Forwarding capacity, 230 Mpps total stack packet forward capacity
1.9.5	Features	Protocol and Port based VLAN, 802.1X authentication, MAC based port authentication, Web based authentication, Multilayer packet processing, 802.3ad, IGMP snooping, 8 priority queues per port, Dynamic VLAN assignment, Jumbo Frame Support, One to One & One to Many port mirroring, SSH2 and SSL support

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Sr. No.	Particular	Description
1.9.6	Upgradeable options	Suitable for layer 3 features such as static routes, RIP V2, inter VLAN routing, VRRP
1.9.7	Upgradeable options	Suitable for layer 3 features such as static routes, RIP V2, inter VLAN routing, VRRP



# **TECHNICAL SPECIFICATIONS FOR SUPPLY OF FIRE ALARM SYSTEM**

**TECHNICAL SPECIFICATIONS FOR SUPPLY OF FIRE ALARM SYSTEM**

**1.0 SCOPE OF WORK**

- 1.1 Supply, installation, testing & commissioning of **Conventional Fire Alarm System** in accordance with the specifications, drawings & schedule of quantities. Conventional (analog), fire detection and alarm system complete with Conventional (analog) heat and smoke sensors, Conventional Manual call point and hooters. The distributed Intelligent Fire Alarm Control Panel (FACP) shall function as fully stand-alone panel. FACP shall have its own microprocessor, software and memory complying with BS5839 Part 4 (1995) and should bear CE mark.

**2.0 CODES & STANDARDS**

The specifications and standards listed below form a part of this specification. The system shall fully comply with the latest issue of these standards, if applicable.

- A. National Fire Protection Association (NFPA) - USA:
  - No. 12 CO2 Extinguishing Systems (low and high)
  - No. 12B Halon 1211 Extinguishing Systems
  - No. 13 Sprinkler Systems
  - No. 13A Halon 1301 Extinguishing Systems
  - No. 15 Water Spray Systems
  - No. 16 Foam/Water Deluge and Spray Systems
  - No. 17 Dry Chemical Extinguishing Systems
  - No. 17A Wet Chemical Extinguishing Systems
  - Clean Agent Extinguishing Systems
  - No. 72 National Fire Alarm Code
  - No. 101 Life Safety Code
- B. Underwriters Laboratories Inc. (UL) - USA:
  - No. 268 Smoke Detectors for Fire Protective Signaling Systems
  - No. 864 Control Units for Fire Protective Signaling Systems
  - No. 268A Smoke Detectors for Duct Applications
  - No. 521 Heat Detectors for Fire Protective Signaling Systems
  - No. 464 Audible Signaling Appliances
  - No. 38 Manually Actuated Signaling Boxes
  - No. 346 Water flow Indicators for Fire Protective Signaling Systems
  - No. 1076 Control Units for Burglar Alarm Proprietary Protective Signaling Systems
  - No. 1971 Visual Notification Appliances
- C. Local and State Building Codes.
- D. All requirements of the Authority Having Jurisdiction (AHJ)

**3.0 DESIGN BASIS & SITE CONDITIONS**

All the equipment and components provided in the Fire Alarm System and accessories shall be suitably designed for installation and satisfactory operation as specified below.

<b>Site conditions</b>	
<b>Location: -----</b>	<b>Site altitude 560M-800M above mean sea level</b>
<b>Ambient temperature</b>	<b>Relative humidity</b>
Maximum 41 ° C	Maximum 85 %
Minimum 25 ° C	Minimum 35 %
Design 45 ° C	Design 90 % at 45 ° C
<b>Seismic factor Zone IV as per IS:1893</b>	<b>Rainfall 722 mm/year</b>
<b>Environmental Tropical/Wet/Dry climate</b>	<b>Location of Equipment Outdoor</b>
<b>Electrical system data:</b>	
<b>Power supply for Equipment 240V AC, 3-Ph, 50Hz</b>	
<b>Voltage 240 V ±15 %</b>	<b>Frequency 50 Hz ± 3 %</b>

**4.0 TECHNICAL REQUIREMENTS**

**4.1 PANEL**

- 4.1.1 An Intelligent Analog Conventional Fire Alarm System (IFAS) shall be provided to effect total control over the life safety services required in the building. The IFAS shall be of the analog Conventional, distributed processing, real time, multitasking & multi-user type. The system shall be provided with Conventional and Analog fire alarm initiating, annunciating and controlling devices. The Conventional and intelligent system shall be such that smoke sensors, thermal sensors, manual call points, etc. can be identified with point address.
- 4.1.2 IFAS shall operate on 230 V AC supply & Smoke detectors shall be powered using the IFAS based smoke detection circuits. Devices shall receive power and communication from the same pair of conductors. IFAS shall provide for resetting smoke detectors, fault isolation and sensor loop operation. It shall be possible to mix different fire devices within the same loop to optimize field wiring.
- 4.1.3 Provide alarm indication of INDIVIDUAL sensors. Systems that provide alarm indication on a zone basis alone shall not be acceptable. Panels should provide for detector pre-maintenance alarm indication for dust accumulation. The panel should check each detector once every 24 hrs. For contamination for this purpose. Based on the site condition the user should have the discretion to either clean the detector immediately or manually change the alarm threshold level on the panel (by programming) after ascertaining that it is a pre-maintenance alarm and not a developing alarm condition at the site.
- 4.1.4 Setting smoke sensor sensitivity remotely (from the Intelligent Fire Alarm System) to either high sensitivity manually or on a pre-programmed sequence e.g. (Day / Night) period. The panel shall regularly supervise all the sensors and devices on the loop and initiates fire or trouble alarm whenever required.

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- 4.1.5 The IFAS shall process the true continuous analog signal from the sensors. System using step setting to represent analog signal will not be accepted. Whenever the detector reaches the alarm threshold, the detector should send a dynamic analog value corresponding to the temperature / smoke density level for display in the panel. An alarm condition shall be sensed at the central panel when an analog sensor reports a value greater than the threshold value. Each thermal detector shall be individually accessed from the panel and asked to display the actual temperature sensed by it.
- 4.1.6 The pre-alarm level for thermal detector and smoke detector shall be user defined. When the pre-alarm level is reached the panel signals warning at which moment the actual temperature / analog value corresponding to the pre-alarm smoke density level shall be displayed.
- 4.1.7 When an alarm condition is sensed at the control panel from a smoke or heat detector, a delay time is started. If the sensor is still in alarm after the delay time expires, an alarm condition is reported. The delay time shall be adjustable from 0 to 990 secs.
- 4.1.8 Each detector shall use the minimum of power for economic circuits, so that it shall have capacity to connect 126 devices per loop. These devices can either be Smoke / Heat sensors or Monitor / control Modules. However only 100 devices are to be connected to one loop and the rest will be for future expansion.
- 4.1.9 Software zones shall be circuited and protected by Fault Isolation Modules such that in the event of a zone / loop short-circuit not more than twenty (20) devices shall be left non-functional.
- 4.1.10 Monitor Modules shall be provided to monitor and address Manual Pull Stations and other contact type input devices.
- 4.1.11 The panel should have an 80 character backlit LCD display which shall display date, time & description for Analog Sensors to indicate alarms and trouble situations. This display is to be utilised by the panel to display various information as per design.
- 4.1.12 LCD display at the IFAS shall be provided to indicate point in alarm or trouble. It shall be possible to command test, reset and alarm silence from the FACP. IFAS switches shall allow authorized personnel to accomplish the following independent of the central console.
- 4.1.13 The LCD display shall indicate the loss of AC power condition and the printer shall record the same. Following restoration to normal AC power, the fault indicator shall be reset, and the printer shall record the same. The LCD display shall indicate the loop in trouble and the printer shall record same.
- 4.1.14 Fault isolation of fire zones shall be provided to enable part of a fault-tolerant loop to continue operating when a short occurs on the loop. Fault-isolation module shall have a LED that latches to indicate a short on the loop.
- 4.1.15 Perform a walk test function such that an operation can be periodically checked out for all initiating devices. As each device is placed into an alarm condition the IFAS shall print the condition and automatically reset the device. No audible signals shall be initiated from the zone to prevent disruption of building occupants. If a zone is inadvertently left in the walk test mode, it shall automatically reset to normal after the idle time is exceeded.
- 4.1.16 The memory data for panel configuration and operation shall reside in non-volatile memory (EEPROM). Removal of the board shall not cause loss of memory. IFAS shall provide general purpose inputs for monitoring such functions low battery or AC power failure. IFAS shall provide password protection and programmable outputs, which can operate relays or logic level devices. Each IFAS shall have a battery

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back up.

- 4.1.17 Programming functions shall include alarm / trouble type assignment, point descriptor assignment, alarm message assignment, etc. Data file for the LCD display and a printer shall be stored in EEPROM. Programming may be carried out from the panel key board or utilizing PC setup software via laptop / desktop computer.

#### 4.2 DETECTORS

- 4.2.1 Each detector shall incorporate indicator “LED” at the detector which shall blink during normal condition and light up on actuation of the detector to locate the detector which is operated. The detector shall not be affected by a failure of the response indicator lamp.
- 4.2.2 All detectors shall be fitted with plug-in system type connections only, from the maintenance and compatibility point of view.
1. The detector shall be vibration and shock proof. When disassembling for cleaning purposes, its components must not be damaged by static over voltage.
  2. The detector shall so designed as to be resistant to environmental criteria such as air currents, humidity, temperature fluctuations, and pressure and shall not cause false alarm due to the above conditions in normal working atmosphere.
- 4.2.3 An alarm release shall not effect a detector’s good functioning. After resetting the alarm, the detector shall resume operations without readjustment of any kind.
- 4.2.4 The mutisensor or multitech smoke detector which will have both photoelectric as well as thermal detection elements shall have inbuilt microprocessor, not microcontroller, and shall be capable of taking an independent alarm decision. The detector Shall be capable of being addressed electronically and there should be no need of programming the detector manually by dip, rotary or decade switches. Each intelligent Conventional smoke detector's sensitivity shall be capable of being programmed electronically as: most sensitive, more sensitive, normal, less sensitive or least sensitive. In addition to the five sensitivity levels the detector shall provide a prealarm sensitivity setting, which shall be settable in 5% increments of the detector's alarm sensitivity value. The detector should continue to give TRUE alarms even if the loop controller on the main panel fails.. Alarm condition shall be based upon the combined input from the photoelectric and thermal detection elements. Each detector shall be capable of transmitting prealarm and alarm signals in addition to the normal, trouble and need cleaning information. It shall be possible to program control panel activity to each level. Each smoke detector may be individually programmed to operate at any one of five (5) sensitivity settings. Each detector microprocessor shall contain an environmental compensation algorithm that identifies and sets ambient "environmental thresholds approximately six times an hour.. The microprocessor shall monitor the environmental compensation value and alert the system operator when the detector approaches 75% and 100% of the allowable environmental compensation value.
- 4.2.5 Under fire condition, presence of smoke shall trigger the circuit of the detector and shall send a signal to the control panel.
- 4.2.6 All fire sensors shall mount on a common base to facilitate the changing of sensor type if building conditions change. The base shall be incompatible with conventional detectors to preclude the mounting of a non-intelligent device.
- 4.2.7 Each sensor shall contain an LED which shall blink each time the sensor is scanned by the IFAS. If the IFAS determines that the sensor is in alarm, the IFAS shall command the sensor LED to remain on to indicate them.
- 4.2.8 Each sensor shall be capable of being tested for alarm via command from the IFAS. Each sensor shall respond to IFAS scan for information for its type identification.

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	Photoelectric smoke sensors shall contain an optical sensing chamber. Ionization smoke sensors shall contain a unipolar dual chamber.
4.2.9	Temperature sensor will provide temperature measurement when it reaches pre-alarm in normal course. However the operator has the option of calling up the temperature measured by the specific detector as and when required.
4.2.10	Secondary response indicator shall be provided outside the closed room for indication through any of the detectors in the room.
4.2.11	The fault isolator device shall detect and isolate a short-circuited segment of a fault tolerant loop. The devices shall automatically determine a return to normal condition of the loop and restore the isolated segment. Devices shall be placed every 20 detectors / modules / field devices to limit the number lost on the event of short-circuit.
4.3	<b>MANUAL CALL POINT</b>
4.3.1	Under normal conditions push button shall be in the depressed condition. In the case of fire when the glass cover is broken the push button shall be released by the spring action and shall actuate an alarm at the control panel through its switching contacts. In additions to this, there shall be a LED indicator on the monitor module for visual indication to locate the call point easily.  The manual stations shall be the non-coded resettable key insert type general alarm devices, painted red and suitable for surface for surface or flush mounting. Manual stations shall be interfacial to a monitor module that is Conventional. The manual station shall have normally open fire alarm and annunciator contacts and these contacts shall close on activation. Contacts shall remain closed until station is manually reset.
4.4	<b>SPEAKER-STROBES</b>
	Low Profile Speaker-Strobe
4.4.1	The low profile speaker/strobe shall not extend more than (2.5cm) past the finished wall surface, and provide a switch selectable audible output of 2W (90dBA), 1W (87dBA), 1/2W (84dBA), or 1/4W (81dBA) at 10 ft  Strobes shall provide synchronized flash output that shall be switch selectable for output values of 15cd, 30cd, 75cd & 110cd. Wattage and candela settings shall be visible with the cover installed. When the cover is installed, no mounting hardware shall be visible. In and out screw terminals shall be provided for all wiring.
<b>5.0</b>	<b>DRAWINGS &amp; INFORMATION</b>
5.1	ALONGWITH OFFER
5.1.1	Submit list of spare parts required for safe operation of equipment for <b>Two years.</b>
5.2	HANDING OVER DOCUMENTS
5.2.1	The supplier shall submit following: <ul style="list-style-type: none"> <li>a. GA drawing</li> <li>b. Data sheet indicating results of tests</li> <li>c. Test reports</li> <li>d. O &amp; M manuals</li> </ul>
<b>6.0</b>	<b>INSPECTION AND TESTING</b>
6.1	Performance of each equipment in coordination with other systems to prove the

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functional requirement.

## 7.0 METHOD OF MEASUREMENT

- 7.1 Supply of the Fire Alarm System including transport to site, loading and unloading etc. as specified will be treated as one unit for measurement and payment.

## 8.0 TRANSPORT, DELIVERY AND STORAGE

- 8.1 The prices shall be **F.O.R. site basis** including packing & forwarding charges. The quoted price must include all the costs for necessary mode of transportation up to the final location of fire alarm system or site store. The fire alarm system should be supplied with required storage arrangements suitable for placing in open storage yard. All incidental expenses during transportation shall be part of quoted prices including **transit insurance**. The charges for loading and unloading of equipments at site should form part of offer.
- 8.2 The transportation for any auxiliary item or detachable part of equipment should be simultaneous and carry necessary instructions for assembling and storage requirements.

## 9.0 GUARANTEE OF PERFORMANCE

- 9.1 The Bidder shall stand guarantee for the performance of entire equipment and components for twelve (12) months from the date of commissioning or eighteen (18) months from the date of dispatch, whichever is earlier, as agreed up on and as reproduced in the purchase order within the tolerance specified or as permitted by the relevant standards for the equipment in his scope of supply. The Purchaser also reserves the right to use the rejected equipment or part thereof until the new equipment meeting the guaranteed performance is supplied by the Bidder.

## 10.0 SPARES

- 10.1 The bidder shall quote for minimum spares required for **two years** safe operation of fire alarm system along with the offer separately.

# TECHNICAL SPECIFICATIONS FOR EXTERNAL LIGHTING



**TECHNICAL SPECIFICATIONS FOR SUPPLY OF EXTERNAL LIGHTING**

**1.0 SCOPE OF WORK**

1.1 This section relates to specifications for supply (wherever called for), installation, connection, testing and commissioning of street lighting and flood lighting installation of the project.

The job comprises of the following:

1. Lighting pole
2. Cable laying
3. Wiring to the fixture
4. Earthing

**2.0 CODES & STANDARDS**

2.1

Sr.	Item	Relevant IS	Relevant IEC
1	General and safety requirements for light fittings	IS 1913	
2	Code of practice for lighting public thoroughfares	IS 1944	
3	Water proof electric lighting fittings	IS 3528	
4	Water tight electric lighting fittings	IS 3553	
5	M.S. tubular and other wrought steel pipe fittings	IS 1239	
6	Luminaries for street lighting. (Parts/Sec. 3)	IS 10322	

**3.0 DESIGN BASIS & SITE CONDITIONS**

3.1 All the equipment and components provided and accessories shall be suitably designed for installation and satisfactory operation as specified below.

Site conditions	
Location Tripura	Site altitude 560-800 M above mean sea level
Ambient temperature	Relative humidity
Maximum 41 °C	Maximum 85 %
Minimum 05 °C	Minimum 35 %
Design 45 °C	Design 90 % at 45 °C

<b>Seismic factor</b> Zone IV as per IS:1893		<b>Rainfall</b> 722 mm/year	
<b>Environmental climate</b> Tropical/wet/Dry		<b>Location of Equipment</b>	
<b>Wind speed</b> Annual avg. 4.35			
<b>Electrical system data:</b>			
<b>Power supply for Equipment</b>			
<b>Voltage</b> 415 V ± 5 %		<b>Frequency</b> 50 Hz ± 3 %	
<b>Permissible voltage &amp; variation</b>	<b>combined frequency</b> ± 6 %	<b>System faults level (Symmetrical)</b>	<b>As per SLD</b>

4.0

**TECHNICAL REQUIREMENTS**

4.1 SYSTEM

- 4.1.1 The street lighting installation for the project shall be carried out by use of outdoor type, weather proof luminaries, to be mounted on tubular steel pole.
- 4.1.2 Electric power supply at 415 volt, three phase, four wire, 50 Hz. to be tapped from the street lighting panel.
- 4.1.3 The electric power shall be distributed to the street lighting poles through electric cables and shall be distributed equally on three phase of the electric power supply system.
- 4.1.4 Individual control fuse with junction box shall be provided on each poles. The junction box shall be weather proof, having gasketed hinged cover.
- 4.1.5 The street light poles shall be earthed individually with coil type earth station using 8 SWG G.I wire.
- 4.1.6 Electric cable required for the street lighting installation shall be 1100 volt grade, PVC insulated and sheathed, armoured cable having stranded Al. conductor of rating as mentioned in the drawing/BOQ.

4.2 LIGHTING POLES

- 4.2.1 The street light poles shall be fabricated from heavy duty cold-rolled steel tubes conforming to IS: 1239 and hot dip galvanized or painted as specified.
- 4.2.2 The street light pole shall be fabricated as per the details and dimensions shown in the drawing.
- 4.2.3 The street light poles shall have base plate, a large excess panel, and necessary fixture mounting bracket at top.
- 4.2.4 The access panel shall provide easy access to a multiway connector and MCB, to be mounted inside the pole. The access shall be specially fabricated with adequate reinforcement and weather protection gasket to prevent ingress of moisture and vandal proofed.

- 4.2.5 Poles shall have large diameter entries for incoming and outgoing cables and two earth studs.
- 4.2.6 The poles fabricated shall conform to the drawings and where such drawing is not available, the contractor shall make such drawing and have it approved before fabricated.
- 4.2.7 The pole shall house a multiway ELMEX type terminal block and MCB as shown on the drawings. Poles shall have concrete coping.
- 4.3 CABLE LAYING
- 4.3.1 Electric cable for the street lighting installation shall follow specification under the heading “L.T XLPE cable”.
- 4.3.2 Cable shall be terminated in a 4-way terminal block inside the pole or to the attached junction box as shown on drawings.
- 4.3.3 Cable route shall be as shown on the drawings or the contractor shall mark out the route and lay the cables only upon approval of the route.
- 4.3.4 Cable laying shall be done with excavation, backfilling of trench with sand & bricks at bottom & top.
- 4.4 EARTHING
- 4.4.1 All street light fixtures and poles shall be earthed as specified under section “EARTHING”.
- 4.4.2 Earth electrode shall be of 8 SWG coil type and shall otherwise meet to the specification given under heading “Earthing”.

## 5.0 INSTALLATION OF SYSTEM

Street lighting installation shall be carried out as per details shown in the drawing.

The poles shall be erected in perfect plumb with concrete foundation at a location shown in the drawing. The foundation shall be designed to withstand the static load as well as wind velocity and bending moment of the pole and shall be approved by the client prior to execution.

The junction box shall then be clamped to the erected pole as per details shown in the drawing.

The luminaries shall also be installed on the pole and be electrically wired to the respective junction box.

The cable lay out shall follow the tentative route as shown in the drawing. In case of any constraint on the cable route the same shall be brought to notice of the client.

The cable lay out shall be carried out in an underground manner and the said installation complete with electric connections.

Earthing installation shall follow the details for the same shown in the drawing.

The earthing station (coil type) and the earthing grid installation shall be carried out as per the specification for the said works given in section under title “Earthing” of this tender document.

On completion of the installation, the street light poles shall be painted with two coats of metal primer (Red Oxide) followed by two coats of Synthetic enamel of the

shade as approved by the Engineer-in-charge.

The brackets shall be made of 38 mm. NB MS class “B” pipe approx. 1.8 mtr. long bent at the centre at an angle 120° C. with necessary holding brackets, hold fasts etc. with special reducer at the end to accommodate type of street light fitting to be fixed. Bracket shall have 1 coat of anti-corrosion paint before despatch to site and 2 coats of approved make and shade of aluminium paint. This bracket shall also be provided with one M.S. water tight box complete with the connector, neutral link, rewirable fuse etc.. See enclosed drawings of street light poles.

Installation of poles shall be done as per enclosed drawings of street light poles. The depth of pole to be buried in ground shall be 1/5th of the total pole length or as specified in drawing, whichever is more. Special care shall be taken in erecting poles so that these are not strained or damaged during erection and are firmly stayed till the foundation are secured. The pole shall be grouted inside ground pit (cross-section 600 x 600 mm.) with cement concrete 1:2:4. Before the placement of concrete around pole in the pit, necessary conduit pipes (not less than 25 mm. dia.) shall be placed for facilitating drawing of cables. Separate conduit shall be provided for incoming and outgoing cables. The cement concrete shall be protected from premature drying by curing for atleast 7 days after pouring. All concrete surface from 150 mm. below ground level to top shall be finished smooth with cement mortar 1:4.

This includes fixing of street light fittings complete with accessories and lamps at the end of the pole/bracket, connecting it with 3 x 2.5 mm.<sup>2</sup> aluminium conductor, PVC insulated cable from water tight M.S. box, testing, commissioning. Third core shall be connected with earthing point of light fitting at one end and earthing point of marshalling box at the other end.

Distance of 1 mtr. shall be maintained between centre of pole and centre of kerb of road. For compound wall poles, distance between compound wall and poles shall be 3 mtrs.

A loop of 1.5 mtr. of cable shall be provided near each street light pole for all incoming and outgoing cable.

## **6.0 DRAWING & INFORMATION**

- 6.1 On award of the contract, the contractor shall submit the fully dimensioned general arrangement drawings complete with plan, elevation and sectional views. As built drawing should be submitted indicating cable rout, exact position of light fixtures.

## **7.0 INSPECTION & TESTING**

- 7.1 Test certificate should be produced for IR test carried out on all LT cables and panels. All the lamps should be controlled as per required control logic. Operation of timer, contactor circuits should be tested.

Report of actual Lux level should be submitted.

## **8.0 METHOD OF MEASUREMENT**

- 8.1 Supply, Installation, connection, testing and commissioning of each light fitting with lamp, control gear, earthing etc. shall be considered as one unit for measurement and payment.

Supply, installation, connection, testing and commissioning of each lighting pole, concrete coping/foundation, base plate, junction box/access panel, internal connection from fuse to the light fixture with 2.5 mm.<sup>2</sup> copper conductor wire, earthing etc. shall be considered as one unit for measurement and payment.

All cabling work shall be measured on the basis of unit length and the cost shall

include, cost of cable, excavation, laying, back filling, cable terminations and connection in junction box or pole terminal box etc.

**9.0 TRANSPORT, DELIVERY & STORAGE**

- 9.1 The prices shall be **F.O.R. site basis** including packing & forwarding charges. The quoted price must include all the costs for necessary mode of transportation up to the final location or site store. All incidental expenses during transportation shall be part of quoted prices including **transit insurance**. The charges for loading and unloading of equipments at site should form part of offer.

**10.0 GUARANTEE & WARRENTY**

- 10.1 The Bidder shall stand guarantee for the performance of entire equipment and components for twelve (12) months from the date of commissioning or eighteen (18) months from the date of dispatch.

# AUXILIARY ITEMS FOR ELECTRICAL INSTALLATIONS

**AUXILIARY ITEMS FOR ELECTRICAL INSTALLATIONS****1.0 LOCAL PUSH BUTTON STATIONS****1.1 CONSTRUCTION FEATURES**

The constructional features of the local push button stations shall be as follows:

- 1.1.1 Metal enclosed, weather proof, suitable for mounting on wall or steel structures. The enclosure shall be die cast aluminum or sheet metal of 2 mm thickness.
- 1.1.2 Outdoor type push buttons shall be completely, weather, dust and vermin proof and shall be provided with canopy. Degree of protection shall be IP:55.
- 1.1.3 Metal parts shall be given tropicalising treatment as per standards and painted with one coat of epoxy primer and two coats of light gray epoxy paint.
- 1.1.4 Provided with inscription plates of rear engraved Perspex with white letters on black background. The letter size shall be 6 mm.
- 1.1.5 Provided with two earthing terminals suitable for 14 SWG G.I wire.
- 1.1.6 Provided with removable undrilled gland plate and cable glands for appropriate sizes of cable. The cable entry shall be from the bottom.
- 1.1.7 Push button contact shall be designed for extra robust both mechanical and electrical operation. High quality material shall be used in their construction to ensure mechanical life exceeding 10 million switching operations. The contact shall be of silver alloy of 10 A continuous current rating.

**1.2 PUSH BUTTONS**

- 1.2.1 All push buttons shall be:
  - Fitted with one (1) normally open and one (1) normally closed contacts rated to carry and breaks 6 Amps at 415 Volts (10 A at 240 V AC)
  - Provide integral escutcheon plates marked with its function.
- 1.2.2 The open/close/start push buttons shall be of the momentary contact push to actuate type and shall be green in color.

**1.3 TYPE OF PUSH BUTTON STATIONS**

- 1.3.1 The following types of push button stations shall be supplied:

Push button station, suitable for indoor/outdoor installation and shall comprise two push buttons viz 'START' and 'STOP' for control of non-reversible motors with on indicating lamp. Both the P.B. shall be of lockable type with key.

**1.4 INSPECTION & TESTING**

- 1.4.1 The local push button stations shall be offered for inspection after assembly. Routine and acceptance tests shall be carried out during inspection.

**1.5 TEST EQUIPMENTS**

1.5.1 Vender shall ensure to use calibrated test equipment having valid calibration test certificates from standard laboratories traceable to National Standards.

1.6 DRAWINGS

1.6.1 On award of the contract, the contractor shall submit the fully dimensioned general arrangement drawings complete with plan, elevation and sectional views.

**2.0 CABLE TRAY**

The scope covers design and manufacture, inspection, testing and delivery of cable trays, necessary hardware, fittings & accessories.

2.1 GENERAL REQUIREMENTS

2.1.1 The cable trays shall be prefabricated hot dip galvanized ladder type. The ladder type trays shall consist of side runners and horizontal rungs.

2.1.2 The ladder type trays and its accessories shall have rigid welded construction and shall be fabricated out of 2mm thick Hot rolled sheet steel. The rungs shall be welded to the side runners.

2.1.3 Side runners shall be 75 x 15mm channel with the flange facing inside. Rungs shall be 35 x 15mm slotted channel type construction and shall be spaced 250mm apart. All perforated channel type tray shall be 30mm high one piece channel made out of 2 mm thick sheet steel and hot dip galvanized.

2.1.4 Cable trays shall be suitable for a cable weight of 100kg/mtr. running length of tray and it shall be supported @ 2m intervals.

2.1.5 The side runner channel and all accessories will have two holes on each end for fixing splice plates. Two splice plated (one on inside face and one on outside face) will be provided for each side runner. The side runner will also have suitable holes at every meter for clearing earthing strip. Suitable tapped holes shall be provided on the runner top and bottom for supporting and fixing tray covers at every meter.

2.1.6 Hot dip galvanizing shall be done after fabrication as per relevant Indian Standards Specification. The amount of galvanizing shall be 816 gm/m<sup>2</sup>.

2.1.7 The type of construction shall be such as to facilitate easy handling, assembly and installation at site. The straight length of cable tray shall be min. 2.5 meters (without splice plate).

2.1.8 The workmanship shall be such as to ensure easy laying of cables without causing damage to cables. All surfaces shall be free from defects such as burrs, sharp edges etc.

2.1.9 The hardware shall conform to relevant Indian Standard specifications and shall be able to withstand the maximum loading conditions as required. All hardware fittings shall be hard chrome cadmium plated/zinc passivity. All hardware's shall include bolts, nuts and washers etc.

2.1.10 The bends, tees, reducers and droppers shall have bending radius of 750mm for L.T. & 1250mm for HT cables respectively.

**3.0 DATA SIGNAL CABLES**

3.1 Part No. 3105A, Tin Coppered ( Data lane ) Insulated, Twisted pair overall 100% Coverage Belofoil, Al., Polyester Shield, 22 AWG ( 7 x 30 ), Standard Tinned Copper Train Wire, Overall 90% coverage, Tin Copper braid, Shield, Black, UV resistance, PVC jacket, colour chart, Part - 1, colour White / Blue.



**4.0 LIGHTING CONTROLLER**

4.1 SCOPE

4.1.1 The scope covers design, manufacture, supply, installation, connection, testing of relay based lighting controller as mentioned below.

4.2 GENERAL

- 4.2.1 Incomer supply : 230 V, 50 Hz.
- Outputs : 10 Amp. Switched output
- Channels : 12 / 6
- Protection : 10 Amp. SP MCB
- Switching Device : 16 Amp. Contactor
- Memory : 96 scene EEPROM
- Network control : Required
- Communication port : RS - 485
- Analog control : Required
- Electronic Ballast control : Required
- Key pad interface : Required
- Panic / fire alarm input : Required
- Fade times : 0 - 10 seconds
- Presets : Internal selectable
- Construction : Steel with powder coating
- Mounting : Wall mounting

**5.0 JUNCTION BOX**

- 5.1 The junction box shall be made out of 2 mm mild steel sheet.
- 5.2 The total depth of junction box shall be 65 mm while the width and length shall be 300 mm.
- 5.3 The lower compartment shall accommodate the cables running through the junction box.
- 5.4 The upper compartment shall be used for diverting cable out of floor trunking for further drawing through the conduit.
- 5.5 The upper compartment shall be provided with knock out for conduit entry on two opposite sides perpendicular to main run of the floor trunking.
- 5.6 The partition plate between upper and lower compartment shall have opening in staggered way for bringing out cable from trunking.
- 5.7 The top cover of the junction box shall be hinged type and shall be made from brass / SS. So as to give decorative look to the exposed cover top.

**6.0 ELBOW / TEE JOINT**

- 6.1 It shall be made out of 2 mm mild steel sheet.

- 6.2 The total depth shall be 65 mm while the width and length shall be 300 mm.
- 6.3 The lower compartment shall accommodate the cables running through the junction box.
- 6.4 The upper compartment shall be used for diverting cable out of floor trunking for further drawing through the conduit.
- 6.5 The upper compartment shall be provided with knock out for conduit entry on free side opposite to the direction of turn of ELBOW and free side of TEE JOINT.
- 6.6 The partition plate between upper and lower compartment shall have opening in staggered way for bringing out cable from trunking.
- 6.7 The top cover of the junction box shall be hinged type and shall be made from brass / SS. So as to give decorative look to the exposed cover top.

## **7.0 PAINTING**

- 7.1 The painting process shall be of seven tank process.
- 7.2 The primer shall be bromite based red oxide. Two coat of red oxide shall be applied.
- 7.3 The outer surface shall be coated using two coat of black coal tar compound.

**TRIPURA INDUSTRIAL DEVELOPMENT CORPORATION**

**Tender for Setting up of Land Custom Station Muhurighat, Belonia,  
Tripura**

**TIDC/LCS/CIVIL/MUHURIGHAT/01/2018-19**

**BOOK – 3**

**Bill of Quantities & Drawings**

Project Management Consultants: -

November 2018

**IL&FS Cluster Development Initiative Limited**

## LCS MUHURIGHAT AT BELONIA

### COST SUMMARY

<b>SL NO</b>	<b>DESCRIPTION</b>	<b>AMOUNT</b>	<b>REMARKS</b>
1	Civil, Interior, Plumbing and Sanitary Works	Rs. 47,829,947	
2	Internal Roads & Cross Drainage works	Rs. 20,310,297	
3	Compound Wall Estimate	Rs. 5,168,002	
4	Watersupply works	Rs. 6,132,974	
5	Site Development	Rs. 2,725,050	
6	Ware house with Toilet Block	Rs. 21,795,570	
7	Plant and Machinery	Rs. 3,000,000	
8	Electrical	Rs. 6,717,583	
	<b>GRAND TOTAL =</b>	<b>Rs. 113,679,423</b>	

## LCS MUHURIGHAT AT BELONIA

### CIVIL, INTERIOR, PLUMBING AND SANITARY WORKS

SL NO	DESCRIPTION	UNIT	QTY.	RATE	AMOUNT	SOR 2017 ITEM NO
<b>I</b>	<b>EARTHWORK</b>					
1.0	Clearing jungle including uprooting of rank vegetation, grass, brush wood, trees and saplings of girth upto 30 cm measured at a height of 1 m above ground level and removal of rubbish upto a distance of 50 m outside the periphery of the area cleared.	Sqm	5,776.00	6.20	35,811.20	2.1
2.0	Surface dressing of the ground including removing vegetation and in-equalities not exceeding 15 cm deep and disposal of rubbish, lead upto 50 m and lift upto 1.5 m.					
	All Kind of soil	Sqm	5,776.00	12.10	69,889.60	2.4
3.0	Earth work in excavation by mechanical means (Hydraulic excavator) / manual means over areas (exceeding 30cm in depth, 1.5m in width as well as 10 sqm on plan) including disposal of excavated earth, lead upto 50m and lift upto 1.5m, disposed earth to be levelled and neatly dressed.					
	All Kind of soil	Cum	450.00	128.00	57,600.00	12.12
4.0	Earth work in excavation by mechanical means (Hydraulic excavator) / manual means in foundation trenches or drains (not exceeding 1.5 m in width or 10 sqm on plan) including dressing of sides and ramming of bottoms, lift upto 1.5 m, including getting out the excavated soil and disposal of surplus excavated soil as directed, within a lead of					
	All Kind of soil	Cum	1,450.00	150.10	217,645.00	12.13
5.0	Filling available excavated earth (excluding rock) in trenches, plinth, sides of foundations etc. in layers not exceeding 23cm in depth, consolidating each deposited layer by ramming and watering, lead up to 50 m and lift upto 1.5 m.					
	-All kinds of soil	Cum	699.95	116.40	81,474.18	2.16
6.0	Extra for additional lift of 1.5m or part thereof					
	-All kinds of soil	Cum	75.00	27.20	2,040.00	2.17
7.0	Supplying and filling in plinth, under floor, foundations etc. with sand (fine) from local quarry with all lifts including spreading in horizontal layers, watering, grading to required slope, ramming, consolidating and compacting each layer by using plate compactor or by any suitable method complete.	Cum	450.00	615.70	277,065.00	2.18

SL NO	DESCRIPTION	UNIT	QTY.	RATE	AMOUNT	SOR 2017 ITEM NO
8.0	Supplying chemical emulsion in sealed containers including delivery as specified.					2.19
	Chlorpyriphos/Lindane emulsifiable concentrate of 20%	Ltrs	150.00	287.60	43,140.00	2.19.1
	Treatment of soil under plinth filling using chemical emulsion @ 1 litre per hole 300 mm apart including drilling 12mm dia holes and plugging with sand filling.					2.20.3
	With Chlorpyriphos/Lindane E.C. 20% with 1% concentration.	Sqm	365.00	48.80	17,812.00	2.20.3.1
9.0	Providing and laying dry brick on edge flooring in required pattern complete.	Sqm	850.00	628.10	533,885.00	10.4
<b>II</b>	<b>PLAIN CEMENT CONCRETE WORK.</b>					
1	Providing and laying in position cement concrete of specified grade excluding the cost of centring and shuttering -					4.1
	-All work upto plinth level:					
a)	1:3:6 ( 1 Cement: 3 fine sand : 6 graded stone aggregate 20 mm nominal size)	Cum	225.65	7,567.60	1,707,628.94	4.1.5
2	Providing and laying damp-proof course with cement concrete 1:2:4 (1 cement: 2 coarse sand : 4 graded stone aggregate 12.5mm/20mm nominal size).					4.5.1
a)	D.P.C 50mm thick	Sqm	178.00	460.40	81,951.20	4.5.1.2
3	Centering shuttering including struttings, propping etc. and removal of form work for:					4.3
a)	Foundations, footings, bases for columns etc. for mass concrete with steel formwork.	Sqm	285.00	234.30	66,775.50	4.3.1

SL NO	DESCRIPTION	UNIT	QTY.	RATE	AMOUNT	SOR 2017 ITEM NO
<b>III</b>	<b>REINFORCED CEMENT CONCRETE WORK.</b>					
1	Providing and laying in position specified grade of reinforced cement concrete excluding the cost of centring, shuttering, finishing and reinforcement.					5.1
	-All work upto plinth level:					
a)	1:1½:3 ( 1 Cement: 1½ fine sand : 3 graded stone aggregate 20 mm nominal size).	Cum	358.00	8,439.60	3,021,376.80	5.1.2
2	Reinforced cement concrete work in walls (any thickness), including attached pilasters, buttresses, plinth and skirting courses, fillets, columns, pillars, piers, abutments, posts and struts etc. upto floor five level excluding cost of centring, shuttering, finishing and reinforcement.					5.2
	In walls (any thickness), including attached pilasters, buttresses, piers, abutments etc.					5.2.1
	1:1½:3 ( 1 Cement: 1½ fine sand : 3 graded stone aggregate 20 mm nominal size)	Cum	158.00	8,708.70	1,375,974.60	5.2.1.2
3	In plinth and skirting courses, fillets, columns, pillars, posts and struts.					5.2.2
	1:1½:3 ( 1 Cement: 1½ fine sand : 3 graded stone aggregate 20 mm nominal size)	Cum	252.00	8,967.30	2,259,759.60	5.2.2.2
4	Reinforced cement concrete work in beams, suspended floors, roofs having slope upto 15° landings, balconies, shelves, chajjas, lintels, bands, plain window sills, staircases and spiral stair cases upto floor five level excluding the cost of centring, shuttering, finishing and reinforcement-					5.3
	RCC work in suspended floors, roofs having slope upto 15° landings, balconies, shelves and chajjas.					5.3.1
	1:1½:3 ( 1 Cement: 1½ fine sand : 3 graded stone aggregate 20 mm nominal size)	Cum	319.00	8,841.00	2,820,279.00	5.3.1.2
5	Providing and laying in position machine batched, machine mixed and machine vibrated design mix cement concrete of specified grade for reinforced cement concrete work including pumping of concrete to site of laying but excluding the cost of centring, shuttering, finishing and reinforcement, including admixtures in recommended proportions as per IS 9103 to accelerate, retard setting of concrete, improve workability without impairing strength and durability as per the direction of Engineer-in-Charge.					5.31
5.1	All works upto plinth level					5.31.1
	Reinforced cement concrete grade M-25 using 410 kg of cement per cum	Cum	12.00	9,896.50	118,758.00	5.31.1.1
5.2	All works upto Floor five level					5.31.2
	Reinforced cement concrete grade M-25 using 410 kg of cement per cum	Cum	17.00	10,044.60	170,758.20	5.31.2.1

SL NO	DESCRIPTION	UNIT	QTY.	RATE	AMOUNT	SOR 2017 ITEM NO
6	Centering shuttering including struttings, propping etc. and removal of form work for:					5.9
a)	Foundations, footings, bases for columns etc. for mass concrete with Timber Plank	Sqm	465.00	226.10	105,136.50	5.9.1.1
b)	Walls (any thickness), including attached pilasters, buttresses, plinth and string courses etc. using shuttering ply	Sqm	375.00	327.80	122,925.00	5.9.3
c)	Suspended floors, roofs, landings, balconies and access platform with 12 mm thick shuttering ply.	Sqm	1,648.00	452.10	745,060.80	5.9.4.2
d)	Lintels, beams, plinth beams, girders, bressumers and cantilevers with shuttering ply.	Sqm	2,350.00	327.70	770,095.00	5.9.5.1
e)	Columns, Pillars, Piers, Abutments, Posts and Struts with shuttering ply.	Sqm	1,473.00	429.30	632,358.90	5.9.6.1
5	Reinforcement for R.C.C. work including straightening, cutting, bending, placing in position and binding all complete upto floor five level.					5.20
a)	Thermo-Mechanically Treated bars/ Cold twisted deformed steel bars.	Kg	76,844.00	59.70	4,587,586.80	5.20.4



SL NO	DESCRIPTION	UNIT	QTY.	RATE	AMOUNT	SOR 2017 ITEM NO
<b>IV</b>	<b>STEEL WORKS</b>					
1.0	Providing structural steel work riveted, bolted or welded in built up sections, trusses and framed work, including cutting, hoisting, fixing in position and applying a priming coat of approved steel primer all complete as required	Kg.	3,750.00	75.80	284,250.00	9.2
2.0	Supplying and fixing rolling shutters of approved make, made of required size M.S. laths interlocked together through their entire length and jointed together at the end by end locks mounted on specially designed pipe shaft with brackets, side guides and arrangements for inside and outside locking with push and pull operation complete including the cost of providing and fixing necessary 275mm long wire springs grade No.2 and M.S. top cover of required thickness for rolling shutters & with handles, hold fast including embedding in cement concrete of required grade required for fixing in position, all necessary fittings, including applying of approved steel primer etc. complete as required:-					9.6
	Supplying and fixing rolling shutters of approved make, made of required size M.S. laths interlocked together through their entire length and jointed together at the end by end locks mounted on specially designed pipe shaft with brackets, side guides and arrangements for inside and outside locking with push and pull operation complete including the cost of providing and fixing necessary 275mm long wire springs grade No.2 and M.S. top cover of required thickness for rolling shutters & with handles, hold fast including embedding in cement concrete of required grade required for fixing in position, all necessary fittings, including applying of approved steel primer etc. complete as required:-					9.6
2.1	80x1.25mm M.S. laths with 1.25 mm thick top cover.	Sqm.	14.00	2,420.30	33,884.20	9.6.1
2.2	Providing and fixing ball bearing for rolling shutters (exceeding 10 sqm area) of approved make complete as required.	Each	12.00	407.00	4,884.00	9.7
3.0	Providing and fixing hand rail using structural steel etc.of approved size by welding etc. to steel ladder railing, balcony railing and staircase railing etc. including cutting, hoisting, fixing in position and applying a priming coat of approved steel primer complete as required:-					9.16
3.1	M.S. tube	Kg.	126.00	106.00	13,356.00	9.16.1

SL NO	DESCRIPTION	UNIT	QTY.	RATE	AMOUNT	SOR 2017 ITEM NO
3.2	E.R.W. tubes.	Kg.	93.00	120.90	11,243.70	9.16.2
3.4	G.I.pipes.	Kg.	70.00	115.70	8,099.00	9.16.3
4.0	Providing and fixing M.S. round holding down bolts with nuts and wahser plates complete as per standard design.	Kg.	75.00	76.30	5,722.50	9.17
<b>V</b>	<b>STRUCTURAL STEEL WORK</b>					
1.0	Providing and painting all steelwork with (i) one primer coat of inorganic zinc silicate (min. Vs 62%) 50 micron (ii) one coat of epoxy HB MIO brown (min Vs 55%) 75 micron (iii) one coat of polyurethane paint (min. Vs. 40%) 40 microns including all material,one coat of epoxy HB paint (min. Vs 60%) 100 microns (iv) labour, scaffolding etc. The surface shall be shot blast to SA 2.5 standard using grit. The paint shall be applied as manufacturer's specifications and the item shall include necessary testing, test certificate etc.					
a)	One coat of inorganic zinc silicate, 50 microns & One coat of polyurethane paint, 40 microns.	MT	18.34	25,000.00	458,575.00	
2.0	Providing hot dip galvanizing to steel work, insert plates, insert angles, hold fasts, etc as specified as per IS 4759 for a thickness of 100 microns.	Mt	0.49	25,000.00	12,175.00	
3.0	Providing, fabricating & fixing in position stainless steel work of grade SS 316 for any structural members, insert plates, bolts, nuts, washers, signages, railings including specified finishes etc.	Kg	250.00	700.00	175,000.00	
4.0	Providing and Shear Studs 19mm X 95 mm 3/4 S3L 53/16 (Nelson Brand)	Nos	50.00	82.00	4,100.00	
	(Panchsheel Fasteners Pvt. Ltd, 5008, Bazara Sirkiwalan,Haus Qazi, New Delhi - 110006 T - 011 23218332)					
5.0	Providing and fixing TR60 X 0.9mm S350 Grade metal deck for composite floor.	Sqm	48.00	901.00	43,248.00	
6.0	Providing and fixing short length G.I. grating all complete. (for Cafeteria Kitchen)	Sqm	14.00	400.00	5,600.00	

SL NO	DESCRIPTION	UNIT	QTY.	RATE	AMOUNT	SOR 2017 ITEM NO
<b>VI</b>	<b>WATERPROOFING</b>					
	<b>RCC Retaining wall</b>					
1.0	Retaining wall waterproofing to be carried out as per the procedure/ specifications of M/s. Nina Concrete Systems Pvt. Ltd.	Sqm	450.00	1,500.00	675,000.00	
	Providing & mixing fiber mesh stealth e3 multi dimensional 100% virgin polypropylene fibers in the concrete of the retaining wall @ 0.45 kg/cum of concrete, stealth e3 fibers shall be added to the concrete during the mixing process either by batching plant or mixer alternatively stealth e3 fibers can be added directly into the transit mixer at site, immediately prior to placing the concrete.					
	Providing & applying AH hydrocap crystallization based waterproofing system of M/s Anti hydro International Inc. USA over the PCC as a slurry application in 2 coats at the dosage rate of 1 kg/sqm on the external surface of the retaining wall, curing for 3 days etc complete. incl grouting construction joints using waterproof slurry cement with cebex 100 @ 225 gms /bag of cement .					
	Providing & applying 25mm thick water proof protective screed to retaining wall admixed with proof sol integral water proofing compound @ 2% by weight of cement & e3 stealth fibers @ 80 gms/bag of cement .The top surface when still green shall be covered with a slurry of cement , proof sol & water trowelled to smooth finish.					
<b>VII</b>	<b>BRICK WORK</b>					
	<b>Note:</b>					
	Manual mixing of cement mortars have been considered here. However, for using of mechanical mixer, the cost will differ with manual mixing as referred to SH:3/Mortar.					
	Sand can be either coarse or fine as required/available. Here, provision of fine sand is considered only due to non-availability of coarse sand in Tripura. However, if design dictates for use of coarse sand, then separate analysis may be made as per site condition.					
	Bricks shall be soaked in water before use for a period for the water to just penetrate the whole depth of the bricks. Alternatively bricks may be adequately soaked in stacks by profusely spraying with clean water at regular intervals for a period not less than six hours. When the bricks are soaked they shall be removed from the tank sufficiently early so that at the time of laying they are skin-dry. Such soaked bricks shall be stacked on a clean place where they are not again spoiled by dirt earth etc.					



SL NO	DESCRIPTION	UNIT	QTY.	RATE	AMOUNT	SOR 2017 ITEM NO
3.0	First class brick work in superstructure above plinth level & upto floor-five level including cost of all materials as required complete:-					6.3
3.1	In cement mortar 1:5 ( 1 cement : 5 fine sand ).	Cum.	350.00	5,800.20	2,030,070.00	6.3.4
4.0	Second class brick work in superstructure above plinth level & upto floor-five level including cost of all materials as required complete:-					6.4
4.1	In cement mortar 1:5 ( 1 cement : 5 fine sand ).	Cum.	5.00	5,197.70	26,001.49	6.4.4
5.0	Rough cast plaster upto 10 m height above ground level with a mixture of sand and gravel or crushed stone graded from 6 mm to 10 mm nominal size dashed over and including the fresh plaster in two layers a) Under layer 12 mm cement plaster 1 : 4 ( 1 cement : 4 fine sand ) b) Top layer 10 mm cement plaster 1 : 3 ( 1 cement : 3 fine sand ) mixed with 10% fine grounded hydrated lime by volume of cement and curing complete.					12.7
5.1	Ordinary Cement finish using ordinary cement.	Sqm.	50.00	794.70	39,735.00	12.7.1
6.0	Half brick masonry work with second class bricks in foundation and plinth including cost of all materials as required complete:-					6.11
6.1	In cement mortar 1:4 ( 1 cement : 4 fine sand ).	Sqm.	35.00	634.50	22,207.50	6.11.3
7.0	Half brick masonry work with first class bricks in superstructure upto floor five level including cost of all materials as required complete:-					6.12
7.1	In cement mortar 1:4 ( 1 cement : 4 fine sand ).	Sqm.	250.00	787.30	196,825.00	6.12.3
8.0	Half brick masonry work with second class bricks in superstructure upto floor five level including cost of all materials as required complete:-					6.13
8.1	In cement mortar 1:4 ( 1 cement : 4 fine sand ).	Sqm.	65.00	704.40	45,786.00	6.13.4
9.0	Providing 18 mm plastering upto 10 m height from ground level with terazzo finished, rubbed and polished complete, underlayer 12 mm cement plaster 1 : 3 ( 1 cement : 3 fine sand ) and top layer 6 mm thick marble chips of 3 mm and downsize laid in cement marble powder mix 3:1 ( 3 cement : 1 marble powder ) by weight in proportion of 4:7 ( 4 cement marble powder mix : 7 marble chips ) by volume complete.	Sqm.	90.00	419.10	37,719.00	

SL NO	DESCRIPTION	UNIT	QTY.	RATE	AMOUNT	SOR 2017 ITEM NO
	<b>MORTAR BANDS</b>					
10.0	Extra for providing & placing in position 2 nos 6mm dia MS bars at every 6th course of full brick masonry work including anchorage in joints of 75mm in each side in superstructure for all level including cost of all materials as required complete:-					6.18
10.1	In cement mortar 1:5 ( 1 cement : 5 fine sand ).	Cum.	437.50	372.30	162,882.18	6.18.4
11.0	Extra for providing & placing in position 2 nos 6mm dia MS bars at every 4th course of half brick masonry work including anchorage in joints of 75mm in each side in superstructure for all level including cost of all materials as required complete:-					6.19
11.1	In cement mortar 1:4 ( 1 cement : 4 fine sand ).	Sqm.	650.00	157.60	102,440.00	6.19.3
	<b>VIII WOOD, PVC, DOORS AND WINDOWS WORK</b>					
1.0	Providing wood work in frames of doors, windows, clerestory windows and other frames, wrought framed and fixed in position :					8.1
1.1	Sal Wood	Cum	8.00	67,196.70	537,573.60	8.1.1
1.2	Local Teak Wood	Cum	15.00	54,568.30	818,524.50	8.1.3
2.0	Providing and fixing ISI marked oxidised M.S. handles conforming to IS:4992 with necessary screws etc. complete :					8.64
2.1	125 mm	No	25.00	29.30	732.50	8.64.1
2.2	100 mm	No	40.00	23.40	936.00	8.64.2
3.0	Providing and fixing oxidised M.S. Safety chain with necessary fixtures for doors. (Weighing not less than 450 gms.)	No	65.00	82.70	5,375.50	8.67
4.0	Providing and fixing IS : 12817 marked stainless steel butt hinges with stainless steel screws etc. complete :					8.68
4.1	125 x 64 x 1.90 mm	No	60.00	79.00	4,740.00	8.68.1
4.2	100 X 58 X 1.90 mm	No	36.00	60.10	2,163.60	8.68.2
5.0	Providing and fixing aluminium tower bolts ISI marked anodised (anodic coating not less than grade AC 10 as per IS : 1868 ) transparent or dyed to required colour or shade with necessary screws etc. complete :					8.95
5.1	300x10 mm	No	30.00	109.70	3,291.00	8.95.1

SL NO	DESCRIPTION	UNIT	QTY.	RATE	AMOUNT	SOR 2017 ITEM NO
6.0	Providing and fixing in position 38 mm thick solid core marine blockboard flush door shutters with marine ply and T.W. lipping 38mmx12mm with T.W. beading (Architrave) 6mmx38mm to teakwood frames including brass oxidized fittings , SS finish door handle of savax make, door closer of Minos make and deadlock, hinges 3 nos of Kich make, door stopper including vision panel wherever required finishes with Approved laminated sheet of 1 mm thick on all sides as directed.	Sqm	160.00	8,500.00	1,360,000.00	
8.0	Providing, fabricating and fixing glazed aluminium windows (fixed,louvered, openable and sliding etc. as per details and specifications mentioned in the drawing) using 83X 38mm heavy sections for subframes, frames, shutter frames mullions, couplers, tubular sections, beadings etc. from approved manufacturers including 8mm thick toughened glass, commercially available fixtures, holdfasts, fixing by drilling in concrete (if required) handles, stainless steel IMEX hinges for openable windows, approved locking arrangement for sliding windows,locks, approved imported heavy ball bearing rollers and guides alongwith anti-rattling pieces/guides at top and bottom. Neoprene gaskets for fixing glass and anodizing all aluminium sections to a thickness of anodic film not less than 20 microns (or powder coated) and sealing all the joints with approved make silicon sealant etc. complete as directed.	Sqm	180.00	6,500.00	1,170,000.00	
9.0	Providing and fixing MS Railing 1000mm high made out of 20mm X 40mm or equivalent MS flat type blusters fixed on floor with anchor fastener bolt to be covered with MS cover plate. Top hand rail of 50mm dia MS pipe fixed to circular vertical pipe with 18mm MS pipe, all complete as per drawings and as directed complete.	Rmt	138.00	5,000.00	690,000.00	
12.0	Providing, fabricating and fixing in position at all heights & locations openable/fixed M.S. grill made out of 10 mm thick including fixing the frame to jamb with required nos & size of anchor dashfastners.cleaning and priming with two coats of zinc rich primer and painted with two under coats and one finished coat of synthetic enamel paint; grill fixed with steel screws etc. complete to satisfaction of EIC. (To Windows)	Sqm	273.50	1,750.00	478,625.00	

SL NO	DESCRIPTION	UNIT	QTY.	RATE	AMOUNT	SOR 2017 ITEM NO
13.0	Providing and fixing Railing 1000mm high made out of 20mm X 40mm or equivalent Brush SS flat type blusters fixed on floor with anchor fastener bolt to be covered with brush SS cover plate. Top hand rail of 50mm dia SS pipe fixed to circular vertical pipe with 18mm brush SS pipe, 12mm thickness clear toughened glass with Machine Edge Polish (MEP) on all sides to be fixed with SS stud at all four corners. All complete as per drawings and as directed complete.	Rmt	94.00	12,000.00	1,128,000.00	
<b>IX FLOORING, SKIRTING AND CLADDING WORK</b>						
1.00	Providing and laying cement concrete 1:2:4 (1 cement: 2 fine sand : 4 graded stone aggregate 20 mm nominal size) flooring finished with a floating coat of neat cement including cement slurry, rounding of edges and strips and cost of glass strips etc. complete.					10.5
i)	40 mm thick	Sqm	74.00	481.50	35,631.00	10.5.1
2.0	Providing and fixing Marble stone in floors over 20 mm thick bed of cement mortar 1 : 4 ( 1 cement : 4 fine sand ) jointed with ordinary cement slurry including pointing with white cement mixed with of matching shade, including rubbing and polishing complete.					10.28
a)	18 mm thick Marble stone					10.28.1
i)	Makrana white marble 2nd quality	Sqm	148.00	3,600.40	532,859.20	10.28.1.1
3.0	Providing and fixing Kota stone in floors over 20 mm thick bed of cement mortar 1 : 4 ( 1 cement : 4 fine sand ) jointed with ordinary cement slurry including pointing with ordinary cement mixed with pigment of matching shade, including rubbing and polishing complete.					10.31
i)	Kota stone slab 25mm thick	Sqm	130.00	1,133.30	147,329.00	10.31.1
4.0	Kota stone slabs 25 mm thick in risers of steps, skirting, dado and pillars laid on 12 mm (average) thick cement mortar 1 : 3 ( 1 cement : 3 fine sand ) and jointed with ordinary cement slurry mixed with pigment to match the shade of slabs, including rubbing and polishing complete.	Sqm	90.00	1,358.30	122,247.00	10.32
5.0	Providing and laying polished vitrified floor tiles in different sizes (thickness to be specified by the manufacturer) with water absorption less than 0.08 % and conforming to IS : 15622 of approved make in all colours, shades over 20 mm thick bed of cement mortar 1 : 4 ( 1 cement : 4 fine sand ) jointed with ordinary cement slurry including pointing with white cement mixed with pigment of matching shade complete.					10.42



SL NO	DESCRIPTION	UNIT	QTY.	RATE	AMOUNT	SOR 2017 ITEM NO
5.1	Size of tile 60x60 cm	Sqm	3,240.00	1,108.20	3,590,568.00	10.42.2
5.2	Size of tile 100x100 cm	Sqm	340.00	2,118.90	720,426.00	10.42.4
6.0	Providing and laying Vitrified tiles in different sizes (thickness to be specified by manufacturer), with water absorption less than 0.08 % and conforming to I.S. 15622, of approved make, in all colours & shade, in skirting, riser of steps, over 12 mm thick bed of cement mortar 1:3 (1 cement: 3 coarse sand), jointing with grey cement slurry @ 3.3kg/sqm including grouting the joint with white cement & matching pigments etc. complete.					10.45
6.1	Size of tile 60x60 cm	Sqm	375.00	1,134.30	425,362.50	10.45.2
6.2	Size of tile 100x100 cm	Sqm	85.00	2,145.10	182,333.50	10.45.4
7.0	Providing and laying rectified glazed ceramic floor tiles 300 x 300 mm or more ( thickness to be specified by the manufacturer ) of 1st quality conforming to IS : 15622 of approved make in all colours, shades except white, ivory, grey, fume red, brown over 20 mm thick bed of cement mortar 1 : 4 ( 1 cement : 4 fine sand ) jointed with ordinary cement slurry including pointing with white cement mixed with pigment of matching shade complete.	Sqm	268.00	927.90	248,677.20	10.41
8.0	Providing and fixing 1st quality ceramic glazed wall tiles conforming to IS : 15622 ( thickness to be specified by the manufacturer ) of approved make in all colours, shades of any size as approved by Engineer-in-charge in skirting, risers of steps and dados over 12 mm thick bed of cement mortar 1 : 3 ( 1 cement : 3 fine sand ) jointed with ordinary cement slurry including pointing with white cement mixed with pigment of matching shade complete.	Sqm	693.00	677.50	469,507.50	10.38
9.0	Providing and laying Polished Granite stone flooring in required design and patterns, in linear as well as curvilinear portions of the building all complete as per the architectural drawings with 18 mm thick stone slab over 20 mm (average) thick base of cement mortar 1:4 (1 cement : 4 fine sand) laid and jointed with cement slurry and pointing with white cement slurry admixed with pigment of matching shade including rubbing , curing and polishing etc. all complete as specified and as directed by the Engineerin-Charge.					7.13
i)	Polished Granite stone slab jet Black, Cherry Red, Elite Brown, Cat Eye or equivalent.	Sqm	423.50	3,303.90	1,399,201.65	7.13.1

SL NO	DESCRIPTION	UNIT	QTY.	RATE	AMOUNT	SOR 2017 ITEM NO
11.0	Kota stone slabs 25 mm thick in risers of steps, skirting, dado and pillars laid on 12 mm (average) thick cement mortar 1 : 3 ( 1 cement : 3 fine sand ) and joined with ordinary cement slurry mixed with pigment to match the shade of slabs, including rubbing and polishing complete.	Sqm	336.00	1,358.30	456,388.80	10.32
12.0	Providing and fixing Glass mosaic tiles on finished plain wall surface of size 20 mm x 20 mm x 4 mm in all colour, design , fixing in customize design as per direction of Engineer-in- Charge. The glass mosaic tiles to be fixed on the wall surface with the help of approved adhesive applied at the rate of 2.5 kg per sqm and grouting of the same. The rate is inclusive of all operation, material and required pattern approved by Engineer-in-Charge.	Sqm	145.00	1,839.00	266,655.00	10.53

SL NO	DESCRIPTION	UNIT	QTY.	RATE	AMOUNT	SOR 2017 ITEM NO
	<b>Wash Basin Counter</b>					
13.0	Constructing <b>Counters for wash basin</b> of upto 600mm wide & variable length as per Architectural drawing; consisting a) 18 mm thick upto 600 mm wide mirror pre-polished approved 16mm thick <b>composite marble stone</b> in single piece of 3000mm long. (Top of the counter)sandwiched with, in back coat of 20 mm thick cement sand mortar (1:3) laid over 40 mm thick upto 600 mm wide one side polished Cudappa. b)18mm thick upto 80mm wide of facia for exposed surface in single piece fixed in position S.S.cleats and fixed with epoxy resin .Both edges of granite to be moulded as per design and polished. c) c)18mm thick 200mm high pre polished steel grey granite fixed on wall with top edge polished to received cill of the granite as per drawing. d) <b>25 mm thick</b> upto 550 mm x 740 mm Cuddappa sandwiched vertical partition both exposed faces and edge polished in 2 layers cuddppa stone slab packed back to back between 20mm thick Cement sand Mortor (1:3) e) sandwiched vertical end partition of 18 mm thick 600 mm wide x 1000mm high mirror pre polished composite marble stone in one piece and 600mm x 740 mm	Rmt	85.00	8,500.00	722,500.00	
	<b>Note:</b> All exposed nosing edges shall be moulded as specified.Necessary cutouts for sink etc.to be done.					
	Top exposed finished surface in plan shall be measured in length and width and shall be paid in sqm.					
	Rate shall inclusive all items mentioned above.					

SL NO	DESCRIPTION	UNIT	QTY.	RATE	AMOUNT	SOR 2017 ITEM NO
	<b>PANTRY COUNTER .</b>					
14.0	Constructing <b>Counters for pantry</b> of upto 600mm wide & variable length as per Architectural drawing; consisting a) 18 mm thick upto 600 mm wide mirror pre-polished approved Steel Grey Granite stone in single piece of 3000mm long. (Top of the counter) sandwiched with, in back coat of 20 mm thick cement sand mortar (1:3) laid over 40 mm thick upto 750 mm wide one side polished Cudappa. b) 18mm thick upto 80mm wide of facia for exposed surface in single piece fixed in position S.S.cleats and fixed with epoxy resin .Both edges of granite to be moulded as per design and polished to create double thickness.Both granite exposed edges to be moulded as per design and polished. c) 18mm thick 200mm high pre polished steel grey granite fixed on wall with top edge polished to received cill of the granite as per drawing. d) 25 mm thick upto 600 mm x 740 mm Cuddappa sandwiched vertical partition both exposed faces and edge polished in 2 layers cuddppa stone slab packed back to back between 20mm thick Cement sand Mortor (1:3) e) sandwiched vertical end partition of 18 mm thick 600 mm wide x 1000mm high mirror pre-polished Steel Grey Granite stone in one piece and 600mm x 740 mm cuddapah stone with both exposed faces and edge polished in 2 pieces cuddppa stone slab packed back to back with 20mm thick Cement sand Mortar (1:3).	Rmt	40.00	12,500.00	500,000.00	
	f) 40mm thick upto 600 mm wide both side polished Cudappa stone for shelf at middle level with SS cleats and fixed with epoxy. g) 40mm thick upto 600 mm wide one side polished cuddapah stone on floor level laid over cement sand mortar (1:3) & 20mm thick. etc.complete as per drawing and as directed by EIC.					
	Note : All exposed nosing edges shall be moulded.Necessary cutouts for sink etc.to be done.					
	Rate shall inclusive all items mentioned above.					

SL NO	DESCRIPTION	UNIT	QTY.	RATE	AMOUNT	SOR 2017 ITEM NO
<b>X</b>	<b>CEILING WORK</b>					
1.0	Providing and fixing plain Multipurpose Cement board (High Pressure steam cured) as per IS : 14862 : 2000 with suitable screws for fibre cement board in ceiling etc. complete (frame work to be paid separately) :					11.19
1.1	6 mm thick cement board	Sqm	480.00	558.40	268,032.00	11.19.1
2.0	Providing and fixing false ceiling at all height including providing and fixing of frame work made of special sections, power pressed from M.S. sheets and galvanized with zinc coating of 120 gms/sqm (both side inclusive) as per IS : 277 and consisting of angle cleats of size 25 mm wide x 1.6 mm thick with flanges of 27 mm and 37mm, at 1200 mm centre to centre, one flange fixed to the ceiling with dash fastener 12.5 mm dia x 50mm long with 6mm dia bolts, other flange of cleat fixed to the angle hangers of 25x10x0.50 mm of required length with nuts & bolts of required size and other end of angle hanger fixed with intermediate G.I. channels 45x15x0.9 mm running at the spacing of 1200 mm centre to centre, to which the ceiling section 0.5 mm thick bottom wedge of 80 mm with tapered flanges of 26 mm each having lips of 10.5 mm, at 450 mm centre to centre, shall be fixed in a direction perpendicular to G.I. intermediate channel with connecting clips made out of 2.64 mm dia x 230 mm long G.I. wire at every junction, including fixing perimeter channels 0.5 mm thick 27 mm high having flanges of 20 mm and 30 mm long,					11.25
	the perimeter of ceiling fixed to wall/partition with the help of rawl plugs at 450 mm centre, with 25mm long dry wall screws @ 230 mm interval, including fixing of gypsum board to ceiling section and perimeter channel with the help of dry wall screws of size 3.5 x 25 mm at 230 mm c/c, including jointing and finishing to a flush finish of tapered and square edges of the board with recommended jointing compound, jointing tapes , finishing with jointing compound in 3 layers covering upto 150 mm on both sides of joint and two coats of primer suitable for board, all as per manufacturer's specification and also including the cost of making openings for light fittings, grills, diffusers, cutouts made with frame of perimeter channels suitably fixed, all complete as per drawings, specification and direction of the Engineer in Charge but excluding the cost of painting with :					
2.1	12.5 mm thick tapered edge gypsum board conforming to IS: 2095-Part I	Sqm	110.00	800.10	88,011.00	11.25.1

SL NO	DESCRIPTION	UNIT	QTY.	RATE	AMOUNT	SOR 2017 ITEM NO
<b>XI</b>	<b>FINISHING WORK</b>					
1.0	12 mm cement plaster of mix					12.1
i)	In cement mortar 1 : 4 ( 1 cement : 4 fine sand )	Sqm	2,937.00	150.50	442,018.50	12.1.2
2.0	15 mm cement plaster on the rough side of single or half brick wall of mix:					12.2
i)	In cement mortar 1 : 4 ( 1 cement : 4 fine sand )	Sqm	2,937.00	174.80	513,387.60	12.2.2
3.0	20 mm cement plaster of mix :					20.3
i)	In cement mortar 1 : 4 ( 1 cement : 4 fine sand )	Sqm	1,743.00	209.60	365,332.80	20.3.2
4.0	6 mm cement plaster of mix :					20.4
i)	In cement mortar 1 : 4 ( 1 cement : 4 fine sand )	Sqm	1,426.00	135.30	192,937.80	20.4.2
5.0	6 mm cement plaster in single layer finished with a floating coat of neat cement, curing and a thick coat of lime wash on top when dry on wall bearings for RCC slabs and beams complete.					20.6
i)	In cement mortar 1 : 3 ( 1 cement : 3 fine sand )	Sqm	127.00	207.20	26,314.40	20.6.1
6.0	Providing and applying plaster of paris putty of 2 mm thickness over plastered surface to prepare the surface even and smooth complete.	Sqm	6,325.00	119.60	756,470.00	12.13
7.0	White washing with lime to give an even shade on new work ( three or more coats ) complete.	Sqm	60.00	20.10	1,206.00	12.21
8.0	Distempering with oil bound washable distemper of approved brand and manufacture and of required shade on new work ( two or more coats ), over and including water thinnable priming coat to give an even shade. [Payment shall be made after submission of Test Certificate issued by the Manufacturer]	Sqm	450.00	92.60	41,670.00	12.24
9.0	Applying one coat of water thinnable cement primer of approved brand and manufacturer on wall surface complete.	Sqm	75.00	34.10	2,557.50	12.27
10.0	Finishing walls with water proofing cement paint of required shade of approved brand and manufacture on new work ( two or more coats applied @ 3.84 kg/10 sqm) complete. [Payment shall be made after submission of Test Certificate issued by the Manufacturer]	Sqm	340.00	53.30	18,122.00	12.28
11.0	Finishing walls with acrylic smooth exterior paint of required shade of approved brand and manufacture on new work ( two or more coats applied @ 1.67 litre/10 sqm ) over and including priming coat of exterior primer applied @ 2.20 kg/10 sqm complete. [Payment shall be made after submission of Test Certificate issued by the Manufacturer]	Sqm	1,684.00	92.90	156,443.60	12.3

SL NO	DESCRIPTION	UNIT	QTY.	RATE	AMOUNT	SOR 2017 ITEM NO
12.0	Wall painting with plastic emulsion paint (one or more coats ) of required colour of approved brand and manufacture on old work to give an even shade including preparation of surface as required complete as per direction of the Engineer in charge.	Sqm	5,744.00	62.20	357,276.80	13.5
<b>XII</b>	<b>ALUMINIUM WORK</b>					
1.0	Providing and fixing aluminium work for doors, windows, ventilators, stair railing including hand rail and partitions with extruded built up standard tubular sections/ appropriate Z sections and other sections of approved make conforming to IS: 733 and IS : 1285, fixed with rawl plugs and screws or with fixing clips, or with expansion hold fasteners including necessary filling up of gaps at junctions, at top, bottom and sides with required PVC/neoprene felt etc. aluminium sections shall be smooth, rust free, straight, mitred and jointed mechanically wherever required including cleat angle, aluminium snap beading for glazing / paneling, C.P. brass / stainless steel screws, all complete as per architectural drawing and the direction of Engineer-in-charge. (Glazing and paneling to be paid for separately) :-					16.1
	For fixed portion of approved quality:-					16.1.1
1.1	Polyester powder coated aluminium ( minimum thickness of polyester powder coating of 50 micron ).	Kg.	183.00	404.20	73,968.60	16.1.1.3
2.0	For shutters of doors, windows & ventilators including providing and fixing hinges / pivots and making provision for fixing fittings wherever required including the cost of EPDM rubber / neoprene gasket required ( Fittings shall be					16.1.2
2.1	Polyester powder coated aluminium ( minimum thickness of polyester powder coating of 50 micron ).	Kg.	148.00	464.80	68,790.40	16.1.2.3
3.0	Providing and fixing glazing of approved quality in aluminium doors, windows, ventilator, shutters and partition etc. with EPDM rubber / neoprene gasket etc. complete as per architectural drawing and the direction of Engineer-in-charge (Cost of snap beading shall be paid in basic item) :-					16.3
3.1	With glass/ float glass panes of 4.0 m thickness ( weight not less than 10.0 kg / sqm ).	Sqm.	35.00	881.40	30,849.00	16.3.1
3.2	With glass/ float glass panes of 5.5 m thickness (weight not less than 13.50 kg / sqm).	Sqm.	27.50	1,113.20	30,613.00	16.3.2

SL NO	DESCRIPTION	UNIT	QTY.	RATE	AMOUNT	SOR 2017 ITEM NO
4.0	<p>Providing, fitting &amp; fixing in position 4mm thick alluminium composite panel (ACP) cladding of approved make, fabricated to flat, smooth curved to required radius,circular ring cladding to shape as per requirement( exterior / interior surface), in metallic colours using prefabricated aluminium extruded profiles of alloy-6063 T6 in chromatized finish to withstand the design wind pressure of 200 Kg/ sqm. The fastening brackets of aluminium/ hot dip galvanised with SS-304 screws, fasteners and anchor bolts complete with nylon seperators to prevent bi-metallic contacts. ACP sheets will be fixed with both ways Norton tape and Dow coring 995 structured sealant, including necessary scaffolding complete, as per approved architectural drawing, design and direction of the Engineer -in charge.</p>	Sqm.	144.00	3,527.80	508,003.20	16.25.1
	<p><b>Note:-</b> Permissible deflection of the structural member shall be limited to L/175 ACP panel deflection, stiffner of 50x25 tube shall be attached to panel at the panel centre with the help of two sided adhesive tape and sealant. Minimum one stiffner per panel to be provided. 4mm thick ACP consists of 0.5mm outer skin of aluminium with kynar 500 based PVDF paint confirming to AAMA standard + 3mm fire resistant virgin core material + 0.5mm aluminium skin with service coat. The panel grooves shall be designed to receive non staining grade sealant of approved makes Silpruf black/ Dow coring ACP panel deflection. The design shall accommodate the building movements, thermal expansion and seismic movements. The non visible aluminium surface shall have minimum chromatizing treatment.</p>					



SL NO	DESCRIPTION	UNIT	QTY.	RATE	AMOUNT	SOR 2017 ITEM NO
5.0	Providing , fitting & fixing in position of semi utilised structural glazing with anodised or powder coated (of approved shade) aluminium section ( of a company of repute) in frame work, including fixing of 6mm thick pyrolithick on0line coated solar heat reflective toughened glass of approved colour & brand, glass fixing arrangement with aluminium structure with sub frame of appro[riate sections, structural silicone of approved make will be used for fixing glass to subframe, joining line of glasses should be filled up with polyurethane back up foam and weather sealant of approved make, GI coated MS bracket of suitable design shall be fixed to structural elements to hold main frame, including necessary fixtures complete, EPDM quality gasket will be used on all necessary points and SS nut bolts, GI fastners will be used for fixing clamps, including necessary scaffolding complete as per approved architectural drawing and design and direction of the Engineer in charge.	Sqm.	115.00	5,945.00	683,675.00	
<b>XII WATERPROOFING WORK</b>						
1.0	Providing and laying water proofing treatment to vertical and horizontal surfaces of depressed portions of W.C., kitchen and like as required as per direction of the Engineer-in-charge, consisting of :-					
	(i) 1st course of applying cement slurry @ 4.4 kg blended cement / sqm mixed with water proofing compound conforming to IS : 2645 in recommended proportions including rounding off junction of vertical and horizontal surface.					
	(ii) 2nd course of 20 mm cement plaster 1 : 3 ( 1 blended cement : 3 fine sand ) mixed with water proofing compound conforming to IS : 2645 in recommended proportions including rounding off junction of vertical and horizontal surface.					
	(iii) 3rd course of applying blown type petroleum or residual bitumen conforming to relevant IS code, applied hot @ 1.7 kg / sqm of area.					
	(iv) 4th course of 400 micron thick PVC sheet conforming to relevant IS code, (overlaps of joints of PVC sheet should be 100 mm wide and pasted to each other with blown type petroleum or residual bitumen applied hot @ 1.7 kg / sqm of area.	Sqm.	970.00	504.10	488,977.00	17.3
	[Payment shall be made after submission of the product performance shall carry guaranteed for 10 years against any leakage]					

SL NO	DESCRIPTION	UNIT	QTY.	RATE	AMOUNT	SOR 2017 ITEM NO
2.0	Providing and laying water proofing treatment in sunken portion of WCs, bathroom etc., by applying cement slurry mixed with water proofing cement compound, as directed by Engineer-in-Charge and consisting of applying :					
	(a) First layer of slurry of cement @ 0.488 kg/sqm mixed with water proofing cement compound @ 0.253 kg/ sqm. This layer will be allowed to air cure for 4 hours.					
	(b) Second layer of slurry of cement @ 0.242 kg/sqm mixed with water proofing cement compound @ 0.126 kg/sqm. This layer will be allowed to air cure for 4 hours followed with water curing for 48 hours. The rate includes preparation of surface, treatment and sealing of all joints, corners, junctions of pipes and masonry with polymer mixed slurry. [Payment shall be made after submission of the product performance shall carry guaranteed for 5 years against any leakage]	Sqm.	319.00	289.90	92,478.10	17.5
4.0	Providing and laying 1st quality ceramic glazed floor tiles of approved size conforming to IS : 15622 (thickness to be specified by the manufacturer) of approved make in all colours, shades as approved by Engineer-in-charge over 20 mm thick bed of cement mortar 1 : 4 (1 cement : 4 fine sand) jointed with ordinary cement slurry including pointing with white cement mixed with pigment of matching shade complete.					10.39
	Ceramic Glazed Tiles 1st quality 300 x 300mm in all shades and designs	Sqm.	970.00	670.40	650,288.00	10.39.1
<b>XV SANITARY FIXTURES &amp; FITTINGS</b>						
1.0	Providing and fixing water closet squatting pan (Indian type W.C. pan ) with 100mm sand cast Iron P or S trap, 10 litre low level white P.V.C. flushing cistern with manually controlled device (handle lever) conforming to IS : 7231, with all fittings and fixtures complete including cutting and making good the walls and floors wherever required :					18.1
1.1	White Vitreous china Orrisa pattern W.C. pan of size 580x440 mm with integral type foot rests.	No	14.00	3,842.50	53,795.00	18.1.1
2.0	Providing and fixing white vitreous china pedestal type water closet (European type W.C. pan) with seat and lid, 10 litre low level white P.V.C. flushing cistern with manually controlled device (handle lever), conforming to IS : 7231, with all fittings and fixtures complete including cutting and making good the walls and floors wherever					18.2
2.1	W.C. pan with ISI marked white solid plastic seat and lid	Nos.	21.00	3,778.60	79,350.60	18.2.1

SL NO	DESCRIPTION	UNIT	QTY.	RATE	AMOUNT	SOR 2017 ITEM NO
3.0	Providing and fixing wash basin with C.I. brackets, 15 mm C.P. brass pillar taps, 32 mm C.P. brass waste of standard pattern, including painting of fittings and brackets, cutting and making good the walls wherever require :					18.7
3.1	White Vitreous China Wash basin size 630x450 mm with a single 15 mm C.P. brass pillar taps.	Nos.	32.00	2,231.80	71,417.60	18.7.1
4.0	Providing and fixing Stainless Steel AISI 304 (18/8) kitchen sink as per IS 13983 with C.I. brackets and stainless steel plug 40 mm including painting of fittings and brackets, cutting and making good the walls wherever required:					18.10
4.1	Kitchen sink with drain board					18.10.1
4.2	510x1040 mm bowl depth 250mm.	Nos.	12.00	4,595.80	55,149.60	18.10.1.1
5.0	Providing and Fixing one piece construction white vitreous china squatting plate with an integral longitudinal flushing pipe, white P.V.C. Automatic flushing cistern, with fittings, standard size G.I. flush pipe for back and front flush with standard spreader pipes with fittings, G.I clamps and C.P. brass coupling complete including painting of fittings and cutting and making good the walls and floors etc. wherever required :					18.6
5.1	Range of four squatting plates with 10 litre P.V.C. automatic flushing cistern.	Nos	50.00	9,125.60	456,280.00	18.6.4
5.2	Providing and fixing G.I. inlet connection for flush pipe connecting with W.C. pan.	Nos	25.00	107.20	2,680.00	18.22
6.0	Providing and fixing P.V.C. waste pipe for sink or wash basin including P.V.C. waste fittings complete.					18.28
	<b>Flexible pipe</b>					18.28.2
6.1	40 mm dia	Nos.	57.00	82.50	4,702.50	18.28.2.2
7.0	Providing and fixing toilet paper holder :					18.34
7.1	C.P. brass	Nos.	34.00	363.30	12,352.20	18.34.1
8.0	Providing and fixing PTMT liquid soap container 109mm wide, 125mm high and 112mm distance from wall of standard shape with bracket of the same materials with snap fittings of approved quality and colours weighing not less than 105 gms.	Nos.	43.00	188.50	8,105.50	18.71
9.0	Providing and fixing PTMT towel ring trapezoidal shape 215mm long, 200mm wide with a minimum distances of 37mm from wall face with concealed fittings arrangement of approved quality and colours weighing not less than 80 gms	Nos.	37.00	217.50	8,047.50	18.72

SL NO	DESCRIPTION	UNIT	QTY.	RATE	AMOUNT	SOR 2017 ITEM NO
10.0	Providing and fixing trap of self cleansing design with screwed down or hinged grating with or without vent arm complete, including cost of cutting and making good the walls and floors:					18.60
10.1	100 mm inlet and 100 mm outlet					18.60.1
10.2	Sand cast iron S&S as per IS: 3989.	Nos.	56.00	828.90	46,418.40	18.60.1.1
11.0	Providing and fixing C.P. brass bib cock of approved quality conforming to IS:8931					19.49
	15 mm nominal bore	Nos.	36.00	472.60	17,013.60	19.49.1
<b>XVI</b>	<b>INTERNAL &amp; VERTICAL DOWNTAKE DRAINAGE</b>					
	<b>(SOIL &amp; WASTE PIPES &amp; FITTINGS)</b>					
1.0	Providing, fixing, testing and commissioning in position 3 Rmt SWR PVC PIPE TYPE-B(6Kg/cm2.) self fit pipe conforming to IS:13592 including all fittings such as bends, junctions, inspection doors, offsets, cowl, access pieces/plugs, including all vertical and horizontal heavy duty MS pipe supports & clamps, wall etc. jointing with PVC Adhesive joints including cutting holes in walls and making good the same. (Make : Supreme/ Finolex/ Astral Makes)					
1.1	110 mm dia.	Rmt	68.00	675.00	45,900.00	
1.2	75 mm dia.	Rmt	132.00	500.00	66,000.00	
1.3	50 mm dia.	Rmt	37.00	375.00	13,875.00	
1.4	40 mm dia.	Rmt	84.00	250.00	21,000.00	
<b>XVII</b>	<b>INTERNAL WATER SUPPLY WORK</b>					
1.0	Providing and fixing Chlorinated Polyvinyl Chloride (CPVC) pipes, having thermal stability for hot & cold water supply including all CPVC plain & brass threaded fittings including fixing the pipe with clamps at 1.00 m spacing. This includes jointing of pipes & fittings with one step CPVC solvent cement and testing of joints complete as per direction of Engineer in Charge.					19.7
	<b>Internal work - Exposed on wall</b>					
1.1	25 mm nominal outer dia .Pipes.	Rmt	28.00	231.90	6,493.20	19.7.3
1.2	32 mm nominal outer dia .Pipes.	Rmt	46.00	304.50	14,007.00	19.7.4
1.3	40 mm nominal outer dia .Pipes.	Rmt	23.00	360.30	8,286.90	19.7.5
1.4	50 mm nominal outer dia .Pipes.	Rmt	18.00	543.90	9,790.20	19.7.6

SL NO	DESCRIPTION	UNIT	QTY.	RATE	AMOUNT	SOR 2017 ITEM NO
2.0	Providing and fixing Chlorinated Polyvinyl Chloride (CPVC) pipes, having thermal stability for hot & cold water supply including all CPVC plain & brass threaded fittings i/c fixing the pipe with clamps at 1.00 m spacing. This includes jointing of pipes & fittings with one step CPVC solvent cement and the cost of cutting chases and making good the same including testing of joints complete as per direction of Engineer					19.8
	<b>Concealed work including cutting chases and making good the walls etc.</b>					
2.1	15 mm nominal outer dia .Pipes.	Rmt	208.00	277.80	57,782.40	19.8.1
2.2	20 mm nominal outer dia .Pipes.	Rmt	132.00	315.00	41,580.00	19.8.2
2.3	25 mm nominal outer dia .Pipes.	Rmt	96.00	350.50	33,648.00	19.8.3
3.0	Providing and fixing gun metal gate valve with C.I. wheel of approved quality (screwed end):					19.17
3.1	25 mm dia	Nos	26.00	413.90	10,761.40	19.17.1
3.2	32 mm dia	Nos	14.00	522.30	7,312.20	19.17.2
3.3	40mm dia	Nos	9.00	582.70	5,244.30	19.17.3
3.4	50mm dia	Nos	6.00	843.00	5,058.00	19.17.4
4.0	Providing and placing on terrace (at all floor levels) polyethylene water storage tank ISI : 12701 marked with cover and suitable locking arrangement and making necessary holes for inlet, outlet and overflow pipes but without fittings and the base support for tank.	Ltr	6,000.00	9.50	57,000.00	19.48
			<b>GRAND TOTAL =</b>		<b>47,829,946.80</b>	

**TIRUPURA INDUSTRIAL DEVELOPMENT CORPORATION**

**LCS MUHURIGHAT AT BELONIA**

**COMPOUND WALL**

<b>SL NO</b>	<b>DESCRIPTION</b>	<b>UNIT</b>	<b>QTY.</b>	<b>RATE</b>	<b>AMOUNT</b>	<b>SOR 2017 Ref No.</b>
<b>A</b>	<b>EARTHWORK</b>					
A1	Earth work in excavation by mechanical means (Hydraulic excavator) / manual means in foundation trenches or drains (not exceeding 1.5 m in width or 10 sqm on plan) including dressing of sides and ramming of bottoms, lift upto 1.5 m, including getting out the excavated soil and disposal of surplus excavated soil as directed, within a lead of 50 m.					
	All kinds of soil	Cum	482.63	150.10	72442.01	12.13
A2	Filling available excavated earth (excluding rock) in trenches, plinth, sides of foundations etc. in layers not exceeding 20cm in depth, consolidating each deposited layer by ramming and watering, lead up to 50 m and lift upto 1.5 m.					
	-All kinds of soil	Cum	160.88	116.40	18725.85	12.16
A3	Supplying and filling in plinth, under floor, foundations etc.with sand (fine) from local quarry with all lifts including spreading in horizontal layers, watering, grading to required slope, ramming, consolidating and compacting each layer by using plate compactor or by any suitable method complete	Cum	34.50	615.70	21241.65	12.18
<b>B</b>	<b>PLAIN &amp; CEMENT CONCRETE WORKS</b>					
B1	Providing and laying in position cement concrete of specified grade excluding the cost of centring and shuttering -					4.1
	-All work upto plinth level:					
i)	1:3:6 ( 1 Cement: 3 fine sand : 6 graded stone aggregate 20 mm nominal size)	Cum	48.26	7567.60	365231.30	4.1.5
B2	Centering shuttering including struttings, propping etc. and removal of form work for:					4.3
	Foundations, footings, bases for columns.	Sqm	145.00	234.30	33973.50	4.3.1

SL NO	DESCRIPTION	UNIT	QTY.	RATE	AMOUNT	SOR 2017 Ref No.
<b>C</b>	<b>REINFORCED CEMENT CONCRETE WORKS</b>					
C1	Providing and laying in position specified grade of reinforced cement concrete excluding the cost of centring, shuttering, finishing and reinforcement-					5.1
	-All work upto plinth level:					
i)	1:1½:3 ( 1 Cement: 1½ fine sand : 3 graded stone aggregate 20 mm nominal size)	Cum	102.96	8439.60	868941.22	5.1.2
C2	In plinth and skirting courses, fillets, columns, pillars, posts and struts					5.2.2
i)	1:1½:3 ( 1 Cement: 1½ fine sand : 3 graded stone aggregate 20 mm nominal size)	Cum	37.50	8967.30	336273.75	5.2.2.2
C3	RCC work in beams, lintels, bands, plain window sills, staircases and spiral staircases excluding precast spiral staircase.					5.3.2
	1:1½:3 ( 1 Cement: 1½ fine sand : 3 graded stone aggregate 20 mm nominal size)	Cum	45.00	8807.50	396337.50	5.3.2.2
C4	Centering shuttering including struttings, propping etc. and removal of form work for:					5.9
i)	Foundations, footings, bases for columns etc. for mass concrete with timber plank	Sqm	346.50	226.10	78343.65	5.9.1.1
ii)	Lintels, beams, plinth beams, girders, bressumers and cantilevers with shuttering ply	Sqm	438.00	327.70	143532.60	5.9.5.1
iii)	Columns, Pillars, Piers, Abutments, Posts and Struts with shuttering ply	Sqm	463.50	429.30	198980.55	5.9.6.1
C5	Reinforcement for R.C.C. work including straightening, cutting, bending, placing in position and binding all complete upto floor five level.					5.20
i)	Thermo-Mechanically Treated bars/ Cold twisted deformed steel bars	MT	11535.43	59.70	688665.33	5.20.4
<b>E</b>	<b>MASONRY WORK</b>					
E1	First class brick work in superstructure above plinth level & upto floor-five level including cost of all materials as required complete:-					6.3
	In cement mortar 1:4 ( 1 cement : 4 fine sand ).	Cum	245.78	5930.80	1457679.44	6.3.3
E2	Half brick masonry work with first class bricks in superstructure upto floor five level including cost of all materials as required complete:-					6.12
	In cement mortar 1:4 ( 1 cement : 4 fine sand ).	Sqm	35.00	787.30	27555.50	6.12.3

SL NO	DESCRIPTION	UNIT	QTY.	RATE	AMOUNT	SOR 2017 Ref No.
<b>F PLASTERING AND POINTING</b>						
F1	12 mm cement plaster of mix					12.1
	In cement mortar 1 : 4 ( 1 cement : 4 fine sand )	Sqm	2257.50	150.50	339753.75	12.1.2
<b>G PAINTING</b>						
G1	Finishing walls with water proofing cement paint of required shade of approved brand and manufacture on new work ( two or more coats applied @ 3.84 kg/10 sqm) complete. [Payment shall be made after submission of Test Certificate issued by the Manufacturer]	Sqm	2257.50	53.30	120324.75	12.28
<b>TOTAL =</b>					<b>5168002.34</b>	



## LCS MUHURIGHAT AT BELONIA

### ROAD WORK

SL NO	DESCRIPTION	UNIT	QTY.	RATE	AMOUNT	Reference SOR'2017
1	Excavation in Roadway cutting in soil by using manual means including loading in truck and carrying of cut earth to embankment site with all lifts and lead upto 1000 metre as per MoRT&H Technical Specification clauses of section 300	Cum	1919.25	170.30	326848.28	3.1
2	Removal of unsuitable soil including excavation, loading and disposal upto 1000 m lead with all lifts but excluding compaction ground supporting embankment / subgrade, replacement by suitable soil, which shall be paid separately as per MoRT&H Technical Specification clauses of section 300.	Cum	475.00	43.60	20710.00	3.11
3	Construction of subgrade and earthen shoulders with approved material obtained from borrow pits with all lifts and leads, transporting to site , spreading, grading to required slope and compacted to meet requirement of Table 300.2 as per MoRT&H Technical Specification clauses of section 300.	Cum	550.00	167.00	91850.00	3.18
4	Furnishing and laying of the live sods of perennial turf forming grass on embankment slope , verges or other locations shown on the drawing or as directed by the Engineer including preparation of ground, fetching of sods and watering as per MoRT&H Technical Specification clauses of section 300.	Sqm	435.00	41.00	17835.00	3.22
5	Granular Sub-Base with Well Graded Material(using jhama brick aggregate) (Table: 400.1)					
	A. By Mix in Place Method					
	Construction of granular sub-base by providing well graded material (Jhama Brick Aggregate, as per Table:- 400.1, Grading-I), spreading in uniform layers with tractor with attachments or motor grader on prepared surface, mixing by mix in place method with rotavator at OMC, applying and brooming sand to fill up the interstices of coarse aggregate, wheel roller to achieve the desired density, complete as per MoRT&H Technical Specification Clause 401.					4.17
i)	For Grading- I Material (Jhama brick aggregate)	Cum	639.75	4955.10	3170025.23	i
6	Water Bound Macadam Sub-Base / Base using Jhama Brick Aggregate					

SL NO	DESCRIPTION	UNIT	QTY.	RATE	AMOUNT	Reference SOR'2017
1)	<b>WBM Grading- 2</b>					
	Providing, laying, spreading and compacting jhama brick aggregates of specific sizes to water bound macadam specification including spreading in uniform thickness, hand packing, rolling with three wheel 80-100 kN static roller / vibratory roller in stages to proper grade and camber, applying and brooming and binding materials to fill up the interstices of coarse aggregate, watering and compacting to the required density Grading-2 as per MoRT&H Technical Specification Clause					4.18
	By Manual Means	Cum	639.75	4617.50	2954045.63	1A
2)	<b>WBM Grading- 3</b>					
	Providing, laying, spreading and compacting jhama brick aggregates of specific sizes to water bound macadam specification including spreading in uniform thickness, hand packing, rolling with three wheel 80-100 kN static roller / vibratory roller in stages to proper grade and camber, applying and brooming and binding materials to fill up the interstices of coarse aggregate, watering and compacting to the required density Grading-3 as per MoRT&H Technical Specification Clause					4.18
	By Manual Means	Cum	319.88	4591.00	1468546.13	2A
7	Providing and applying primer coat with bitumen emulsion (SS-1) on prepared surface of granular base including cleaning of road surface and spraying primer at the rate of 0.6 kg/sqm using mechanical means as per MoRT&H Technical Specification Clause 502.	Sqm	4265.00	29.10	124111.50	5.1
8	Providing and applying tack coat with bitumen emulsion (RS-1) using emulsion pressure distributor at the rate of 0.20 kg per sqm on the prepared bituminous / granular surface cleaned with Hydraulic broom as per MoRT&H Technical Specification Clause 503.	Sqm	4265.00	9.50	40517.50	5.2

SL NO	DESCRIPTION	UNIT	QTY.	RATE	AMOUNT	Reference SOR'2017
9	Dense Graded Bituminous Macadam					
	Providing and laying dense graded bituminous macadam with 100-120 TPH batch type HMP producing an average output of 75 tonnes per hour using crushed aggregates of specified grading, premixed with bituminous binder @ 4.0 to 4.5 per cent by weight of total mix and filler, transporting the hot mix to work site, laying with a hydrostatic paver finisher with sensor control to the required grade, level and alignment, rolling with smooth wheeled, vibratory and tandem rollers to achieve the desired compaction as per MoRT&H specification clause No. 507 complete in all respects.					
B	Grading-II	Cum	396.00	11921.20	4720795.20	5.6 B i
10	Semi-Dense Bituminous Concrete					
	Providing and laying semi-dense bituminous concrete with 100-120 TPH batch type HMP producing an average output of 75 tonnes per hour using crushed aggregates of specified grading, premixed with bituminous binder @ 4.5 to 5.0 per cent by weight of total mix and filler, transporting the hot mix to work site, laying with a hydrostatic paver finisher with sensor control to the required grade, level and alignment, rolling with smooth wheeled, vibratory and tandem rollers to achieve the desired compaction as per MoRT&H specification clause No. 508 complete in all respects.					
B	Grading II					
ii	With Viscosity Graded Bitumen of VG-20.	Cum	132.00	12178.00	1607496.00	5.7 B ii
11	Seal Coat					
	Case - I : Type A					
	Providing and laying seal coat sealing the voids in a bituminous surface laid to the specified levels, grade and cross fall using Type A seal coats as per MoRT&H Technical Specification Clause 513.					
i)	Bitumen of VG-30	Sqm	4265.00	83.50	356127.50	5.12 A i

SL NO	DESCRIPTION	UNIT	QTY.	RATE	AMOUNT	Reference SOR'2017
12	Painting Lines, Dashes, Arrows etc on Roads in Two Coats on New Work					
	Painting lines, dashes, arrows etc on roads in two coats on new work with ready mixed road marking paint conforming to IS:164 on bituminous surface, including cleaning the surface of all dirt, dust and other foreign matter, demarcation at site and traffic control as per MoRT&H Technical Specification Clause 803.					
i)	Over 10 cm in width	Sqm	225.00	113.80	25605.00	8.11 i
13	Providing and laying of hot applied thermoplastic compound 2.5 mm thick including reflectorising glass beads @ 250 gms per sqm area, thickness of 2.5 mm is exclusive of surface applied glass beads as per IRC:35 . The finished surface to be level, uniform and free from streaks and holes. as per MoRT&H Technical Specification Clause 803.	Sqm	98.25	2168.40	213045.30	
14	Providing and fixing of retro-reflectorised cautionary, mandatory and informatory sign as per IRC:67 made of high intensity grade sheeting vide MoRT&H technical specification Clause 801.3, fixed over aluminium sheeting, 1.5 mm thick supported on a mild steel angle iron post 75 mm x 75 mm x 6 mm firmly fixed to the ground by means of properly designed foundation with M 15 grade cement concrete 450 mm x 450 mm x 600 mm, 600 mm below ground level as per drawings and MoRT&H Technical Specification Clause 801.					8.4
a	with 900 mm equilateral triangle	Nos	10.00	2301.10	23011.00	i)
b	with 600 mm circular	Nos	10.00	2241.10	22411.00	iii)
c	with 800 x 600 mm rectangular	Nos	10.00	2417.60	24176.00	iv)
d	with 600 x 600 mm square	Nos	10.00	2310.10	23101.00	vi)
e	with 900 mm octagon	Nos	10.00	2589.70	25897.00	vii)
15	Direction and Place Identification Signs upto 0.9 sqm Size Board.					
	Providing and erecting direction and place identification retro-reflectorised sign as per IRC:67 made of high intensity grade sheeting vide clause 801.3, fixed over aluminium sheeting, 2 mm thick with area not exceeding 0.9 sqm supported on a mild steel single angle iron post 75 x 75 x 6 mm firmly fixed to the ground by means of properly designed foundation with M15 grade cement concrete 450 x 450 x 600 mm, 600 mm below ground level as per approved drawing and MoRT&H Technical Specification Clause 801.	Each	12.00	2950.20	35402.40	8.5
<b>GRAND TOTAL =</b>					<b>15291556.65</b>	

## LCS MUHURIGHAT AT BELONIA

### DRAIN WORKS

SL NO	DESCRIPTION	UNIT	QTY.	RATE	AMOUNT	SOR-2017 ITEM NO
<b>A</b>	<b>EARTH WORK &amp; METAL PACKING</b>					
1	Earth work in excavation by mechanical means (Hydraulic excavator) / manual means in foundation trenches or drains (not exceeding 1.5 m in width or 10 sqm on plan) including dressing of sides and ramming of bottoms, lift upto 1.5 m, including getting out the excavated soil and disposal of surplus excavated soil as directed, within a lead of 50 m.					
	All kinds of soil	Cum	810.00	150.10	121581.00	2.13
2	Filling available excavated earth (excluding rock) in trenches, plinth, sides of foundations etc. in layers not exceeding 20cm in depth, consolidating each deposited layer by ramming and watering, lead up to 50 m and lift upto 1.5 m.					
	All kinds of soil	Cum	270.00	116.40	31428.00	2.16
3	Supplying and filling in plinth, under floor, foundations etc. with sand (fine) from local quarry with all lifts including spreading in horizontal layers, watering, grading to required slope, ramming, consolidating and compacting each layer by using plate compactor or by any suitable method complete.	Cum	54.00	615.7	33247.80	2.18
4	Providing and laying dry brick on edge flooring in required pattern complete.	Sqm	540.00	628.10	339174.00	10.4
<b>B</b>	<b>PLAIN CEMENT CONCRETE</b>					
1	Providing and laying in position cement concrete of specified grade excluding the cost of centring and shuttering -					
	-All work upto plinth level:					
	1:3:6 (1 Cement: 3 fine sand : 6 graded stone aggregate 20 mm nominal size)	Cum	88.50	7567.60	669732.60	4.1.5
2	Centering shuttering including struttings, propping etc. and removal of form work for:					4.3
	Foundations, footings, bases for columns.	Sqm	75.00	234.30	17572.50	4.3.1
<b>C</b>	<b>REINFORCED CEMENT CONCRETE</b>					
1	Providing and laying in position specified grade of reinforced cement concrete excluding the cost of centring, shuttering, finishing and reinforcement-					5.1
	-All work upto plinth level:					
i)	1:1½:3 ( 1 Cement: 1½ fine sand : 3 graded stone aggregate 20 mm nominal size)	Cum	240.00	8439.60	2025504.00	5.1.2

SL NO	DESCRIPTION	UNIT	QTY.	RATE	AMOUNT	SOR-2017 ITEM NO
2	Centering shuttering including struttings, propping etc. and removal of form work for:					5.9
i)	Foundations, footings, bases for columns etc. for mass concrete with steel formwork	Sqm	1320.00	262.50	346500.00	5.9.1.2
3	Reinforcement for R.C.C. work including straightening, cutting, bending, placing in position and binding all complete upto floor five level.					5.2
i)	Thermo-Mechanically Treated bars/ Cold twisted deformed steel bars	Kg	21600	59.70	1289520.00	5.20.4
<b>D PLASTERING &amp; PONTING</b>						
9	12 mm cement plaster of mix					12.1
	In cement mortar 1 : 4 ( 1 cement : 4 fine sand )	Sqm	960.00	150.500	144480.00	12.1.2
			<b>GRAND TOTAL =</b>		<b>5018739.90</b>	
			<b>GRAND TOTAL OF ROAD WORKS =</b>		<b>15291556.65</b>	
			<b>GRAND TOTAL OF DRAIN WORKS =</b>		<b>5018739.90</b>	
			<b>GRAND TOTAL OF ROAD AND DRAIN WORKS =</b>		<b>20310296.55</b>	

**LCS MUHURIGHAT AT BELONIA**  
**SUMMARY OF WARE HOUSE**

<b>SL NO</b>	<b>DESCRIPTION</b>	<b>AMOUNT</b>	<b>REMARKS</b>
1	1 NOS WEIGH BRIDGE	1500000.00	Lum Sum
2	BAGGAGE CHECKING MACHINE AND OTHER MACHINERY	1500000.00	Lum Sum
	<b>GRAND TOTAL =</b>	<b>3000000.00</b>	

**LCS MUHURIGHAT AT BELONIA**

**SITE DEVELOPMENT WORK**

SL NO	DESCRIPTION	UNIT	QUANTITY	RATE	AMOUNT	SOR-2017 ITEM NO
<b>I</b>	<b>SITE CLEARANCE</b>					
1.0	Clearing grass and removal of the rubbish upto a distance of 50 m outside the periphery of the area cleared.	Sqm	7500.00	3.50	26250.00	2.2
<b>II</b>	<b>EARTH WORK</b>					
2.0	Banking excavated earth in layers not exceeding 20 cm. in depth, breaking clods, watering, rolling each layer with ½ tonne roller, or wooden or steel rammers, and rolling every 3rd and top-most layer with power roller of minimum 8 tonnes and dressing up, in embankments for roads, flood banks, marginal banks, and guide banks etc., lead upto 50 m and lift upto 1.5 m.					
	All kinds of soil	Cum	12000.00	224.90	2698800.00	2.9
			<b>GRAND TOTAL =</b>		<b>2725050.00</b>	



**LCS MUHURIGHAT AT BELONIA**

**WARE HOUSE - 2 NOS WITH TOILET**

**S U M M A R Y**

<b>BILL NO</b>	<b>DESCRIPTION</b>	<b>AMOUNT</b>
1	Civil Works	15352261.27
2	PEB Works	5411451.68
	<b>SUB-TOTAL =</b>	<b>20763712.95</b>
3	Construction of 2 nos Toilet & 2 nos Septic tank	1031857.33
	<b>SUB-TOTAL =</b>	<b>21795570.28</b>

## LCS MUHURIGHAT AT BELONIA

### ABSTRACT OF CIVIL WORKS

SL NO	DESCRIPTION	UNIT	QTY.	RATE (SOR-17)	AMOUNT	SOR ITEM NO
<b>1</b>	<b><u>EARTH WORK</u></b>					
1.01	Surface dressing of the ground including removing vegetation and in-equalities not exceeding 15 cm deep and disposal of rubbish, lead upto 50 m and lift upto 1.5 m.					2.4
	-All kinds of soil	Sqm	1200.00	12.10	14520.00	
1.02	Earth work in excavation by mechanical means (Hydraulic excavator) / manual means in foundation trenches or drains (not exceeding 1.5 m in width or 10 sqm on plan) including dressing of sides and ramming of bottoms, lift upto 1.5 m, including getting out the excavated soil and disposal of surplus excavated soil as directed, within a lead of 50 m.					
	-All kinds of soil	Cum	1105.00	150.10	165860.50	2.13
1.03	Filling available excavated earth (excluding rock) in trenches, plinth, sides of foundations etc. in layers not exceeding 20cm in depth, consolidating each deposited layer by ramming and watering, lead up to 50 m and lift upto 1.5 m.					
	-All kinds of soil	Cum	590.00	116.40	68676.00	2.16
1.05	Supplying and filling in plinth, under floor, foundations etc. with sand (fine) from local quarry with all lifts including spreading in horizontal layers, watering, grading to required slope, ramming, consolidating and compacting each layer by using plate compactor or by any suitable method complete.	Cum	195.00	615.70	120061.50	2.18
1.06	Supplying chemical emulsion in sealed containers including delivery as specified.					2.19
	Chlorpyriphos/Lindane emulsifiable concentrate of 20%	Ltr.	95.00	287.60	27322.00	2.19.1
1.07	Treatment of soil under plinth filling using chemical emulsion @ 1 litre per hole 300 mm apart including drilling 12mm dia holes and plugging with sand filling.					2.20.3
	With Chlorpyriphos/Lindane E.C. 20% with 1% concentration.	Sqm	750.00	48.80	36600.00	2.20.3.1

SL NO	DESCRIPTION	UNIT	QTY.	RATE (SOR-17)	AMOUNT	SOR ITEM NO
<b>2</b>	<b>PLAIN CEMENT CONCRETE WORK.</b>					
2.01	Providing and laying in position cement concrete of specified grade excluding the cost of centring and shuttering - -All work upto plinth level:					4.1
a)	1:3:6 ( 1 Cement: 3 fine sand : 6 graded stone aggregate 20 mm nominal size)	Cum	414.00	7567.60	3132986.40	4.1.5
2.02	Providing and laying damp-proof course with cement concrete 1:2:4 (1 cement: 2 coarse sand : 4 graded stone aggregate 12.5mm/20mm nominal size).					4.5.1
a)	D.P.C 50mm thick	Sqm	70.00	460.40	32228.00	4.5.1.2
2.03	Centering shuttering including struttings, propping etc. and removal of form work for:					4.3
a)	Foundations, footings, bases for columns etc. for mass concrete with steel formwork.	Sqm	905.00	234.30	212041.50	4.3.1
<b>3</b>	<b>R.C.C WORKS</b>					
3.01	Providing and laying in position specified grade of reinforced cement concrete excluding the cost of centring, shuttering, finishing and reinforcement. -All work upto plinth level:					5.1
a)	1:1½:3 ( 1 Cement: 1½ fine sand : 3 graded stone aggregate 20 mm nominal size).	Cum	157.00	8439.60	1325017.20	5.1.2
3.02	Reinforced cement concrete work in walls (any thickness), including attached pilasters, buttresses, plinth and skirting courses, fillets, columns, pillars, piers, abutments, posts and struts etc. upto floor five level excluding cost of centring, shuttering, finishing and reinforcement.					5.2
	In walls (any thickness), including attached pilasters, buttresses, piers, abutments etc.					5.2.1
	1:1½:3 ( 1 Cement: 1½ fine sand : 3 graded stone aggregate 20 mm nominal size)	Cum	38.00	8708.70	330930.60	5.2.1.2
3.03	In plinth and skirting courses, fillets, columns, pillars, posts and struts.					5.2.2
	1:1½:3 ( 1 Cement: 1½ fine sand : 3 graded stone aggregate 20 mm nominal size)	Cum	22.50	8967.30	201764.25	5.2.2.2
3.04	Reinforced cement concrete work in beams, suspended floors, roofs having slope upto 15° landings, balconies, shelves, chajjas, lintels, bands, plain window sills, staircases and spiral stair cases upto floor five level excluding the cost of centring, shuttering, finishing and reinforcement-					5.3
	RCC work in suspended floors, roofs having slope upto 15° landings, balconies, shelves and chajjas.					5.3.1
	1:1½:3 ( 1 Cement: 1½ fine sand : 3 graded stone aggregate 20 mm nominal size)	Cum	77.00	8841.00	680757.00	5.3.1.2

SL NO	DESCRIPTION	UNIT	QTY.	RATE (SOR-17)	AMOUNT	SOR ITEM NO
3.05	Reinforcement for R.C.C. work including straightening, cutting, bending, placing in position and binding all complete upto floor five level.					5.20
a)	Thermo-Mechanically Treated bars/ Cold twisted deformed steel bars.	Kg	63050.00	59.70	3764085.00	5.20.4
3.06	Centering shuttering including struttings, propping etc. and removal of form work for:					5.9
a)	Foundations, footings, bases for columns etc. for mass concrete with Timber Plank	Sqm	243.00	226.10	54942.30	5.9.1.1
b)	Walls (any thickness), including attached pilasters, buttresses, plinth and string courses etc. using shuttering ply	Sqm	132.25	327.80	43351.55	5.9.3
c)	Lintels, beams, plinth beams, girders, bressumers and cantilevers with shuttering ply.	Sqm	184.00	327.70	60296.80	5.9.5.1
d)	Columns, Pillars, Piers, Abutments, Posts and Struts with shuttering ply.	Sqm	225.50	429.30	96807.15	5.9.6.1
<b>4</b>	<b>BRICK WORK</b>					
4.01	First class brick work in foundation and plinth including cost of all materials as required complete:-					6.1
i)	In Cement mortar 1:5 ( 1 cement : 5 fine sand )	Cum	300.00	5278.50	1583550.00	6.1.4
4.02	First class brick work in superstructure above plinth level & upto floor-five level including cost of all materials as required complete:-					6.3
i)	In Cement mortar 1:5 ( 1 cement : 5 fine sand )	Cum	171.00	5800.20	991834.20	6.3.4
4.03	Half brick masonry work with first class bricks in foundation and plinth including cost of all materials as required complete:-					6.10
	In Cement mortar 1:4 ( 1 cement : 4 fine sand )	Sqm	125.00	717.70	89712.50	6.10.3
<b>5.0</b>	<b>WOOD WORK</b>					
5.01	Providing wood work in frames of Door, Ventilator, Clerestory window and other frame, wrought framed and fixed in position:					8.1
a)	Local teak wood	Cum	1.20	54568.30	65481.96	8.1.3
5.02	Providing and fixing panelled / or panelled and glazed shutters for doors, windows and clerestory windows including ISI marked bright finished / black enamelled M.S butt hinges with necessary screws excluding panelling and or glazing, which will be paid for separately but including the wooden beading of 20 × 12 mm for fixing panelling and or glazing as per direction of Engineer-In-Charge.					8.5
	Local teak wood					8.5.1
a)	35 mm thick shutters	Sqm	5.00	1319.00	6595.00	8.5.1.1

SL NO	DESCRIPTION	UNIT	QTY.	RATE (SOR-17)	AMOUNT	SOR ITEM NO
<b>6</b>	<b>STEEL WORK &amp; ALUMINIUM WORK;</b>					
6.01	Supplying and fixing rolling shutters of approved make, made of required size M.S. laths interlocked together through their entire length and jointed together at the end by end locks mounted on specially designed pipe shaft with brackets, side guides and arrangements for inside and outside locking with push and pull operation complete including the cost of providing and fixing necessary 275mm long wire springs grade No.2 and M.S. top cover of required thickness for rolling shutters & with handles, hold fast including embedding in cement concrete of required grade required for fixing in position, all necessary fittings, including applying of approved steel primer etc. complete as required:-					9.6
	a) 80x1.25mm M.S. laths with 1.25 mm thick top cover.	Sqm	115.00	2420.30	278334.50	9.6.1
6.02	Providing and fixing ball bearing for rolling shutters ( exceeding 10 sqm area ) of approved make complete as required.	Nos	2.00	407.00	814.00	9.7
6.04	Providing and fixing aluminium work for doors, windows, ventilators and partitions with extruded built up standard tubular sections/ appropriate Z sections and other sections of approved make conforming to IS:733 and IS : 1285, fixing with dash fasteners of required dia and size, including necessary filling up of gaps at junctions, i.e. at top, bottom and sides with required EPDM rubber/neoprene gasket etc. Aluminium sections shall be smooth, rust free, straight, mitred and jointed mechanically wherever required including cleat angle, aluminium snap beading for glazing / paneling, C.P. brass/stainless steel screws, all complete as per architectural drawing and the direction of Engineer incharge.(Glazing and paneling and dash					16.1
	For fixed portion of approved quality:-					16.1.1
a)	Powder coated aluminium ( minimum thickness of powder coating of 50 micron ).	Kg	352.51	396.80	139876.76	16.1.1.2
6.05	Providing and fixing glazing of approved quality in aluminium doors, windows, ventilator, shutters and partition etc. with EPDM rubber / neoprene gasket etc. complete as per architectural drawing and the direction of Engineer-in-charge (Cost of snap beading shall be paid in basic item) :-					16.13
	With glass/ float glass panes of 4.0 m thickness (weight not less than 10.0 kg /sqm).	Sqm	750.00	881.40	661050.00	16.13.1

SL NO	DESCRIPTION	UNIT	QTY.	RATE (SOR-17)	AMOUNT	SOR ITEM NO
<b>7</b>	<b>FLOORING</b>					
7.01	Providing and laying cement concrete 1:2:4 (1 cement: 2 fine sand : 4 graded stone aggregate) flooring finished with a floating coat of neat cement including cement slurry, rounding of edges and strips and cost of glass strips etc. complete.					10.5
i)	40 mm thick	Sqm	750.00	481.50	361125.00	10.5.1
7.02	Providing and fixing precast chequered terrazo tiles 22 mm thick with graded marble chips of size upto 6 mm, laid on floors, footpath & courtyard on 20 mm thick bed of cement mortar 1 : 4 ( 1 cement : 4 fine sand ) jointed with neat cement slurry mixed with pigment to match the shade of tiles including rubbing and polishing complete.	Sqm	600.00	727.50	436500.00	10.55
<b>9</b>	<b>FINISHING WORKS</b>					
9.01	12mm Cement plaster of mix					12.1
i)	In cement mortar 1 : 5 ( 1 cement : 5 fine sand )	Sqm	480.00	142.90	68592.00	12.1.3
9.02	15mm Cement plaster of mix					12.2
i)	In cement mortar 1 : 5 ( 1 cement : 5 fine sand )	Sqm	1070.00	165.60	177192.00	12.2.3
9.03	Neat cement punning.	Sqm	144.00	44.30	6379.20	12.5
9.04	Distempering with oil bound washable distemper of approved brand and manufacture and of required shade on new work ( two or more coats ), over and including water thinable priming coat to give an even shade. (Payment shall be made after submission of Test Certificate issued by Manufacturer)	Sqm	1070.00	92.60	99082.00	12.24
9.05	Finishing walls with premium acrylic smooth exterior paint of required shade of approved brand and manufacture on new work ( two or more coats applied @ 1.43 kg/10 sqm ) over and including priming coat of exterior primer applied @ 2.20 kg/10 sqm complete. (Payment shall be made after submission of Test Certificate issued by Manufacturer)	Sqm	192.00	93.20	17894.40	12.31
<b>GRAND TOTAL =</b>					<b>15352261.27</b>	

## LCS MUHURIGHAT AT BELONIA

### PEB Works

SL NO	DESCRIPTION	UNIT	QTY.	RATE	AMOUNT	SOR Ref No.
1	Construction of PEB buildings by using the built up sections are made from hot rolled platers conforming to ASTM A - 572 GR 50 (345 MPa) and other sections except beams are mill sections complying with IS : 2062 and the section should be provided with 2 coats of Zinc Chromate Red Oxide Paint after sand blasting and 2 coats of synthetic enamel paints as per the approved colour. Bracing rods and sag rods are made of steel bars conforming to IS 2062 with a minimum yield strength of 240 MPa. All the fasteners should be confirmed as per the IS 3757 specifications. The roofing and Fascia board should be ZINC Aluminium alloy coated (Galvalume) colour roof sheet of 0.47mm nominal thickness, cold roll formed from a cold rolled coil confirming to ASTM A 792 M Grade 80 with a minimum yield strength of 550 MPa. The eves gutter should be provided with Zinc Aluminium alloy coated steel sheet with GI Gutter hangers. Downspouts are should be provided with 100mm size of Zinc aluminium coated shees with GI Leader straps. The quoted price should include the supply and fixing chares of MS inserts, base plate, anchor bolt in the concrete. And also the quoted rate should include all necessary labour charges and material and machinery charges including all works related the PEB structures excluding Civil works as per the detailed drawing and instructions of engineer in charge.	No	2.00	2705725.84	5411451.68	
				<b>TOTAL =</b>	<b>5411451.68</b>	
				<b>GRAND TOTAL =</b>	<b>5411451.68</b>	

## LCS MUHURIGHAT AT BELONIA

### ABSTRACT OF TOILET & SEPTIC TANK

SL NO	DESCRIPTION	UNIT	QTY.	RATE (SOR-17)	AMOUNT	SOR ITEM NO
<b>1</b>	<b>EART WORK</b>					
1.1	Earth work in excavation by mechanical means (Hydraulic excavator) / manual means in foundation trenches or drains (not exceeding 1.5 m in width or 10 sqm on plan) including dressing of sides and ramming of bottoms, lift upto 1.5 m, including getting out the excavated soil and disposal of surplus excavated soil as directed, within a lead of					2.13
	-All kinds of soil	Cum	86.217	150.10	12941.17	
1.2	Filling available excavated earth (excluding rock) in trenches, plinth, sides of foundations etc. in layers not exceeding 20cm in depth, consolidating each deposited layer by ramming and watering, lead up to 50 m and lift upto 1.5 m.					2.16
	-All kinds of soil	Cum	36.461	116.40	4244.06	
<b>2</b>	<b>PLAIN CEMENT CONCRETE</b>					
2.1	Providing and laying in position cement concrete of specified grade excluding the cost of centring and shuttering -					4.1
	-All work upto plinth level:					
	1:3:6 ( 1 Cement: 3 fine sand : 6 graded stone aggregate 20 mm nominal size)	Cum	22.318	7567.6	168891.80	4.1.5
<b>3</b>	<b>RCC WORKS</b>					
3.1	Providing and laying in position specified grade of reinforced cement concrete excluding the cost of centring, shuttering, finishing and reinforcement-					5.1
	-All work upto plinth level:					
	1:1½:3 ( 1 Cement: 1½ fine sand : 3 graded stone aggregate 20 mm nominal size) - cover slab and perforated slab	Cum	9.978	8439.60	84210.33	5.1.2
3.2	Reinforced cement concrete work in walls (any thickness), including attached pilasters, buttresses, plinth and skirting courses, fillets, columns, pillars, piers, abutments, posts and struts etc. upto floor five level excluding cost of centring, shuttering, finishing and reinforcement					5.20
	In plinth and skirting courses, fillets, columns, pillars, posts and struts.					5.2.2
	1:1½:3 ( 1 Cement: 1½ fine sand : 3 graded stone aggregate 20 mm nominal size).	Cum	1.575	8967.30	14123.50	5.2.2.2



SL NO	DESCRIPTION	UNIT	QTY.	RATE (SOR-17)	AMOUNT	SOR ITEM NO
3.3	Reinforced cement concrete work in beams, suspended floors, roofs having slope upto 15° landings, balconies, shelves, chajjas, lintels, bands, plain window sills, staircases and spiral stair cases upto floor five level excluding the cost of centring, shuttering, finishing and reinforcement-					5.3
	RCC work in suspended floors, roofs having slope upto 15° landings, balconies, shelves and chajjas.					5.3.1
	1:1½:3 ( 1 Cement: 1½ fine sand : 3 graded stone aggregate 20 mm nominal size)	Cum	5.872	8841.00	51915.46	5.3.1.2
3.4	Centering shuttering including struttings, propping etc. and removal of form work for:					5.9
a)	Foundations, footings, bases for columns etc. for mass concrete with timber plank	Sqm	10.305	226.10	2329.96	5.9.1.1
b)	Suspended floors, roofs, landings, balconies and access platform with 12 mm thick shuttering ply	Sqm	52.1475	452.10	23575.88	5.9.4.2
c)	Lintels, beams, plinth beams, girders, bressumers and cantilevers with shuttering ply	Sqm	13.68	327.70	4482.94	5.9.5.1
d)	Columns, Pillars, Piers, Abutments, Posts and Struts with shuttering ply	Sqm	6.30	429.30	2704.59	5.9.6.1
<b>3.5</b>	<b>REINFORCEMENT</b>					
3.5.1	Reinforcement for R.C.C. work including straightening, cutting, bending, placing in position and binding all complete upto floor five level.					5.20
a)	Thermo-Mechanically Treated bars/ Cold twisted deformed steel bars.	Kg	1655.38	59.70	98825.89	5.20.4
<b>4</b>	<b>MASONRY WORK</b>					
4.1	First class brick work in foundation and plinth including cost of all materials as required complete:-					6.1
a.	In cement mortar 1:5 ( 1 cement : 5 fine sand ).	Cum	14.706	5278.50	77626.94	6.1.4
4.2	First class brick work in superstructure above plinth level & upto floor-five level including cost of all materials as required complete:-					6.3
	In cement mortar 1:5 ( 1 cement : 5 fine sand ).	Cum	12.1875	5800.20	70689.94	6.3.4
4.3	Half brick masonry work with first class bricks in foundation and plinth including cost of all materials as required complete:-					6.10
	In cement mortar 1:5 ( 1 cement : 5 fine sand ).	Sqm	27.615	717.70	19819.29	6.10.3

SL NO	DESCRIPTION	UNIT	QTY.	RATE (SOR-17)	AMOUNT	SOR ITEM NO
<b>5</b>	<b>WOOD &amp; PVC WORK</b>					
5.1	Providing and fixing factory made UPVC door frame made of UPVC extruded, section having an overall dimension, as below (tolerance +/- 1mm) with wall thickness 2.0mm+/- 02mm. corners of the door frame to be jointed with galvanized brackets and stainless screws, joint mitred and plastic wilded. The hinge side vertical of the frames reinforced by galvanized MS tube of size 19 × 19 mm and 1 mm +/- 0.1 mm wall thickness and 3 nos stainless steel hinges fixed to the frame complete as per manufacturers specification and direction of Engineer-In-Charge.					8.114
a)	Extruded section Profile size 48x40 mm.	Rmt	19.800	246.50	4880.70	8.114.1
5.2	24 mm thick factory made PVC door shutters made of styles and rails of a UPVC hollow section of size 59x24 mm and wall thickness 2 mm ± 0.2 mm with inbuilt edging on both sides. The styles and rails mitred and joined at the corners by means of M.S. galvanised /plastic brackets of size 75×220 mm having wall thickness 1.0 mm and stainless steel screws. The styles of the shutter reinforced by inserying galvanised MS tube of size 20×20 mm and 1 mm ± 0.1 mm wall thickness. The lock rail made up of "H" Section, a UPVC hollow section of size 100×24 mm and 2 mm ± 0.2 mm wall thickness fixed to the shutter styles by means of plastic /galvanised MS "U" cleats. The shutter frame filled with a UPVC multi-chambered single panel of size not less than 620 mm, having overall thickness of 20 mm and 1 mm ± 0.1 mm wall thickness. The panels filled vertically and tie bar at two places by inserting horizontaly 6 mm galvanised MS rod and fastened with nuts and washers, complete as per manufacturer's specification and direction of Engineer-In-Charge. (for W.C. and Bathroom door shutter).	Sqm	6.300	1815.60	11438.28	8.115.1
<b>6</b>	<b>FINISHING WORK</b>					
6.1	12mm Cement plaster of mix					12.1
i)	In cement mortar 1 : 5 ( 1 cement : 5 fine sand )	Sqm	46.975	142.90	6712.73	12.1.3
6.2	15mm Cement plaster of mix					12.2
i)	In cement mortar 1 : 5 ( 1 cement : 5 fine sand )	Sqm	53.21	165.60	8811.58	12.2.3
6.3	6 mm cement plaster of mix :					12.4
i)	In cement mortar 1 : 4 ( 1 cement : 4 fine sand )	Sqm	27.24	135.30	3685.57	12.4.2
6.4	Neat cement punning.	Sqm	46.185	44.30	2046.00	12.50

SL NO	DESCRIPTION	UNIT	QTY.	RATE (SOR-17)	AMOUNT	SOR ITEM NO
6.5	Distempering with oil bound washable distemper of approved brand and manufacture and of required shade on new work ( two or more coats ), over and including water thinable priming coat to give an even shade. (Payment shall be made after submission of Test Certificate issued by Manufacturer)	Sqm	18.02	92.60	1668.65	12.24
6.6	Finishing walls with acrylic smooth exterior paint of required shade of approved brand and manufacture on new work ( two or more coats applied @ 1.67 kg/10 sqm ) over and including base coat water proofing cement paint applied @ 2.20 kg/10 sqm complete.	Sqm	122.43	93.20	11410.01	12.31
<b>7</b>	<b>FLOORING</b>					
7.1	Providing and laying polished vitrified floor tiles in different sizes (thickness to be specified by the manufacturer) with water absorption less than 0.08 % and conforming to IS : 15622 of approved make in all colours, shades over 20 mm thick bed of cement mortar 1 : 4 ( 1 cement : 4 fine sand ) jointed with ordinary cement slurry including pointing with white cement mixed with pigment of matching shade complete.					10.42
a)	Size of tile 50x50 cm	Sqm	8.58	979.40	8403.25	10.42.1
7.2	Providing and fixing 1st quality ceramic glazed wall tiles conforming to IS : 15622 ( thickness to be specified by the manufacturer ) of approved make in all colours, shades of any size as approved by Engineer-in-charge in skirting, risers of steps and dados over 12 mm thick bed of cement mortar 1 : 3 ( 1 cement : 3 fine sand ) jointed with ordinary cement slurry including pointing with white cement mixed with pigment of matching shade complete.	Sqm	17.40	677.5	11788.50	10.38
<b>8</b>	<b>WATERPROOFING</b>					
	Providing and laying water proofing treatment to vertical and horizontal surfaces of depressed portions of W.C., kitchen and the like as required as per direction of the Engineer-in-charge,consisting of :	Sqm	77.200	504.10	38916.52	17.3
	(i) 1st course of applying cement slurry @ 4.4 kg/sqm mixed with water proofing compound conforming to IS 2645 in recommended proportions including rounding off junction of vertical and horizontal surface.					
	(ii) 2nd course of 20 mm cement plaster 1:3 (1 cement : 3 fine sand) mixed with water proofing compound in recommended proportion including rounding off junction of vertical and horizontal surface.					

SL NO	DESCRIPTION	UNIT	QTY.	RATE (SOR-17)	AMOUNT	SOR ITEM NO
	(iii) 3rd course of applying blown or residual bitumen applied hot at 1.7 kg. per sqm of area.					
	(iv) 4th course of 400 micron thick PVC sheet. (Overlaps at joints of PVC sheet should be 100 mm wide and pasted to each other with bitumen @ 1.7 kg/ sqm). [Payment shall be made after submission of the product performance shall carry guaranteed for 10 years against any leakage]					
<b>9</b>	<b>PLUMBING AND SANITARY</b>					
9.1	Providing and fixing water closet squatting pan (Indian type W.C. pan ) with 100mm sand cast Iron P or S trap, 10 litre low level white P.V.C. flushing cistern with manually controlled device (handle lever) conforming to IS : 7231, with all fittings and fixtures complete including cutting and making good the walls and floors wherever required :					18.1
	White Vitreous china Orrisa pattern W.C. pan of size 580x440 mm with integral type foot rests.	Nos	4.000	3842.50	15370.00	18.1.1
9.2	Providing and fixing wash basin with C.I. brackets, 15 mm C.P. brass pillar taps,32 mm C.P. brass waste of standard pattern, including painting of fittings and brackets, cutting and making good the walls wherever require :					18.7
	White Vitreous China Wash basin size 630x450 mm with a single 15 mm C.P. brass pillar taps.	Nos	4.000	1897.30	7589.20	18.7.2
9.3	Providing and fixing G.I. inlet connection for flush pipe connecting with W.C. pan.	Nos	4.000	107.20	428.80	18.22
9.4	Providing and fixing Chlorinated Polyvinyl Chloride (CPVC) pipes, having thermal stability for hot & cold water supply including all CPVC plain & brass threaded fittings i/c fixing the pipe with clampsat 1.00 m spacing. This includes jointing of pipes & fittings with one step CPVC solvent cement and the cost of cutting chases and making good the same including testing of joints complete as per direction of Engineer in					19.8
	<i>Concealed work including cutting chases and making good the walls etc.</i>					
a)	15 mm nominal outer dia. Pipes	Mtr.	16.000	277.80	4444.80	19.8.1
b)	25 mm nominal outer dia. Pipes	Mtr.	16.000	350.50	5608.00	19.8.3
9.5	Providing and fixing PTMT bib cock of approved quality and colour.					19.54
i)	15 mm nominal bore, 122 mm long, weighing not less than 99 gms.	Nos	4.000	192.80	771.20	19.54.2
9.6	Providing and fixing PTMT stop cock of approved quality and colour.					19.55
i)	15 mm nominal bore, 86mm long, weighing not less than 88 grams.	Nos	4.000	131.50	526.00	19.55.1

SL NO	DESCRIPTION	UNIT	QTY.	RATE (SOR-17)	AMOUNT	SOR ITEM NO
9.7	Providing and fixing PTMT pillar cock of approved quality and colour.					19.56
i)	15mm nominal bore, 107mm long, weighing not less than 110 grams.	Nos	4.000	185.50	742.00	19.56.1
9.8	Providing and placing on terrace (at all floor levels) polyethylene water storage tank ISI : 12701 marked with cover and suitable locking arrangement and making necessary holes for inlet, outlet and overflow pipes but without fittings and the base support for	Ltr.	4000.00	9.50	38000.00	19.48
9.9	Providing and fixing on wall face unplasticised Rigid PVC rain water pipes (working pressure 4 kg / cm <sup>2</sup> ) conforming to IS : 13592 Type A including jointing with seal ring conforming to IS : 5382 leaving 10 mm gap for thermal expansion:					18.82
a)	Single socketed pipe - 75 mm OD	Mtr.	10.000	142.30	1423.00	18.82.1
b)	Single socketed pipe - 110 mm OD	Mtr.	10.000	239.00	2390.00	18.82.2
9.10	Providing and fixing on wall face unplasticised - PVC moulded fittings/ accessories for unplasticised Rigid PVC rain water pipes conforming to IS : 13592 Type A including jointing with seal ring conforming to IS : 5382 leaving 10 mm gap for thermal					18.84
a)	<b>Coupler</b>					18.84.1
i)	75 mm	Nos	4.000	57.9	231.60	18.84.1.1
ii)	110 mm	Nos	4.000	99.00	396.00	18.84.1.2
b)	<b>Single equal tee without door</b>					18.84.3
i)	75 mm	Nos	4.000	107.40	429.60	18.84.3.1
ii)	110 mm	Nos	4.000	175.10	700.40	18.84.3.2
c)	<b>Single equal tee with door</b>					18.84.4
i)	75 mm	Nos	4.000	125.60	502.40	18.84.4.1
ii)	110 mm	Nos	4.000	190.80	763.20	18.84.4.2
d)	<b>Bend 87.5°</b>					18.84.5
i)	75 mm	Nos	4.000	70.00	280.00	18.84.5.1
ii)	110 mm	Nos	4.000	109.80	439.20	18.84.5.2

SL NO	DESCRIPTION	UNIT	QTY.	RATE (SOR-17)	AMOUNT	SOR ITEM NO
<b>10</b>	<b>Sewage and Drainage</b>					
10.1	Constructing brick masonry chamber for underground C.I. inspection chamber and bends with 1st class bricks in cement mortar 1:4 (1 cement : 4 fine sand) C.I. cover with frame (light duty) 455x610 mm internal dimensions, total weight of cover with frame to be not less than 38 kg (weight of cover 23 kg and weight of frame 15 kg) R.C.C. top slab with 1:2:4 mix (1 cement :2 fine sand : 4 graded stone aggregate 20 mm nominal size) foundation concrete 1:5:10 (1 cement: 5 fine sand : 10 graded stone aggregate 40 mm nominal size), inside plastering 12 mm thick with cement mortar 1:3 (1 cement: 3 fine sand) finished smooth with a floating coat of neat cement on walls and bed concrete etc. complete as per standard design :					20.8
10.1.1	Inside dimensions 455x610 mm and 45 cm deep for single pipe line	Each	4.000	6073.60	24294.40	20.8.1
10.2	Making soak pit 2.5 m diameter 3.0 metre deep with 45 x 45 cm dry brick honey comb shaft with well burnt 2nd class bricks and S.W. drain pipe 100 mm diameter, 1.8 m long complete as per standard design	Each	4.000	45096.00	180384.00	20.1
			<b>GRAND TOTAL =</b>		<b>1031857.33</b>	

**LCS MUHURIGHAT AT BELONIA**  
**SUMMARY WATER SUPPLY WORKS**

<b>SL NO</b>	<b>DESCRIPTION</b>	<b>ESTIMATE VALUE</b>	<b>REMARKS</b>
1	Water Supply Distribution Network	1729929.15	
2	Construction of UG Sump - 330 KL	2066631.01	
3	Iron Removal Plant	894200.00	
4	Pump house Plumbing work	130596.25	
5	Construction of Pump House	758148.56	
6	Pump House Submersible pump	25000.00	
7	Deep tube well	528469.46	
8	Pump House	398916.00	
	<b>GRAND TOTAL =</b>	<b>6531890.43</b>	

## LCS MUHURIGHAT AT BELONIA

### SINKING OF 1 NO.300MM X 200MM DIA DEEP TUBE WELL BY REVERSE ROTARY RIG METHOD

SL NO	DESCRIPTION	UNIT	QTY.	RATE	AMOUNT	DWS-2015 ITEM NO
1	Drilling and boring pilot hole in any soil strata by Drilling rig, collection of soil samples of different strata met with during drilling at various suitable levels, preservation of samples in polythene bags/sample boxes and disposal of excess soil or mud, including the cost for bentonite, water etc. as required to maintain the pilot hole properly as per specification (IS:2800 (Part-I) and direction of the Engineer-in-charge.					(6B) 6.1
	ii) 200 mm dia	Mtr	40	1163.7	1203.70	A i
2	Reaming of pilot hole to an enlarged bore hole in any soil strata by drilling rig, disposal of excess soil or mud, including the cost for bentonite, water etc. as required to maintain the bore hole properly as per specification (IS : 2800 (Part- I) and direction of the Engineer- in -charge.					6.2
A	with contractors rig					A
i	From 200 mm dia pilot hole to 550 mm	Mtr	15	1225.3	18379.50	i
ii	From 200 mm dia pilot hole to 460 mm	Mtr	25	783.3	19582.50	ii
3	Washing of enlarged bore hole of 460-550 mm dia in any soil strata by drilling rig, disposal of excess soil or mud, including the cost for bentonite, water etc. as required to maintain the bore hole properly including lifting of drill piper as per specification (IS: 2800 (Part-I) and direction of the Engineer-in-charge					6.3
A	with contractors rig	Mtr	40	92.20	3688.00	A
4	Lowering of ERW pipe with drilling rig including painting with anti-corrosive bitumastic paints, fixing of M.S ring, welding of all joints etc. complete after washing of the bore hole as per specification (IS : 2800 (Part-I) and direction of the Engineer-in- charge.					6.4
A	with contractors rig					A
a)	300 mm dia ERW Housing Pipe	Mtr	15	416.10	6241.50	i
b)	200 mm dia ERW Blind Pipe	Mtr	15	328.00	4920.00	ii
c)	200mm dia ERW Slotted pipe	Mtr	10	328.00	3280.00	iii



SL NO	DESCRIPTION	UNIT	QTY.	RATE	AMOUNT	DWS-2015 ITEM NO
5	Providing and fixing of bail plug (made with 8 mm thick MS Sheet ) by welding with blind pipe including applying of anti-corrosive bitumastic paint as per specification (IS:2800 (Part-I) and direction of the Engineer-in-charge.					6.5
i)	For 200 mm dia ERW	Nos	1	1070.00	1070.00	i
6	Providing and fixing of reducing socket (made with 8 mm thick MS sheet ) by welding with blind pipe including applying of anticorrosive bitumastic paint as per specification (IS: 2800 (PartI) and direction of the Engineer -in-charge.					6.6
A	with contractors rig					A
i)	300 x 200 mm dia	No	1	4837.50	4837.50	i
7	Providing and shrouding of the deep tube well assembly with washed pea gravels (2.0-4.75 mm effective size) as per specification (IS: 4097) and direction of the Engineer -in-charge.					6.7
A	with contractors rig					A
i)	with pea gravels obtained from Golaghat, Assam	Cum	30	10048.70	301461.00	ii
8	Providing and fixing of housing clamp (made with 12 mm thick MS Sheet) by welding with blind pipe including applying of anti-corrosive bitumastic paintas per specification (IS: 2800 (PartI) and direction of the Engineer -in-charge.					6.9
i)	300 mm dia	No	1	2358.70	2358.70	i
9	Washing and development of tube well by using air compressor, and testing of the well as per specification (IS : 11189) and direction of the Engineer -in-charge.					6.10
A	with contractors Air Compressor					A
i)	Using Air Compressor of 300-450 CFM output for DTW	No	1	41089.60	41089.60	i
10	Providing and fixing of well cap (made with 8 mm thick MS Sheet) by welding with blind pipe including applying of anti-corrosive bitumastic paint as per specification (IS:2800 (Part-I) and direction of the Engineer-in-charge.					6.11
i)	For 300 mm dia ERW Pipes	No	1	2249.90	2249.90	i
11	Loading and unloading of materials by manual means					
a)	Loading of steel pipes like ERW/GI in/c specials & fittings etc by manual means including a lead upto 30 m					
	300 mm dia ERW Pipe					
	(36.6 mts.) - 2.69ton					

SL NO	DESCRIPTION	UNIT	QTY.	RATE	AMOUNT	DWS-2015 ITEM NO
	200 mm dia ERW Pipe					
	(103.70 mts - 3.79 ton					
	200 mm dia ERW slotted Pipe					
	(36.6 mts) - 1.34 ton					
		Ton	7.82	91.60	716.31	
b)	Unloading of steel pipes like ERW/GI in/c specials & fittings etc by manual means including a lead upto 50 m					
	300 mm dia ERW Pipe					
	(36.6 mts.) - 2.69ton					
	200 mm dia ERW Pipe					
	(103.70 mts - 3.79 ton					
	200 mm dia ERW slotted Pipe					
	(36.6 mts) - 1.34 ton					
		Ton	7.82	95.60	747.59	
c)	Haulage of materials by mechanical means excluding loading & Unloading.					
	i) Surface road	t.km	391.59	2.30	900.66	
12	Loading and unloading of materials of manual means.					
a)	Loading of stone aggregate, brick aggregate, Gravels etc. by manual means within a lead upto 50m.					
	Pea Gravels	Cum	30	56.80	1704.00	
b)	Unloading of stone aggregate, brick aggregate, Gravels etc. by manual means within a lead upto 50m.					
	Pea Gravels	Cum	30	29.90	897.00	
c)	Haulage of materials by mechanical means excluding loading & Unloading.					
	i) Surface road	t.km	2190	2.30	5037.00	

SL NO	DESCRIPTION	UNIT	QTY.	RATE	AMOUNT	DWS-2015 ITEM NO
<b>B)</b>	<b>COST OF MATERIALS</b>					
	<b>i) <u>ERW Pipe</u> : ERW pipe should be of FE 410 mild steel casing/housing/slotted pipes.Heavy grade, screwed and socketed, automatic fusion of electrical resistance of high frequency induction welded, IS marked</b>					
1	Cost of 300 mm dia ERW Housing pipe	Mts.	15	3770.00	56550.00	
2	Cost of 200 mm dia ERW Blind pipe	Mts.	15	1851.00	27765.00	
3	Cost of 200 mm dia ERW Slotted pipe	Mts.	10	2379.00	23790.00	
				<b>TOTAL =</b>	<b>528469.46</b>	

**LCS MUHURIGHAT AT BELONIA**  
**UNDERGROUND SUMP**

SL NO	DESCRIPTION	UNIT	QTY.	RATE	AMOUNT	SOR 2017 ITEM NO
1	Earth work in excavation by mechanical means (Hydraulic excavator) / manual means in foundation trenches or drains (not exceeding 1.5 m in width or 10 sqm on plan) including dressing of sides and ramming of bottoms, lift upto 1.5 m, including getting out the excavated soil and disposal of surplus excavated soil as directed, within a lead of 50 m.					2.13
	All kinds of soil	Cum	435.00	150.10	65293.50	
2	Filling available excavated earth (excluding rock) in trenches, plinth, sides of foundations etc. in layers not exceeding 20cm in depth, consolidating each deposited layer by ramming and watering, lead up to 50 m and lift upto 1.5 m					2.16
	All kinds of soil	Cum	145.00	116.40	16878.00	
3	Providing and laying in position cement concrete of specified grade excluding the cost of centring and shuttering -					4.1
	-All work upto plinth level:					
	1 : 2 : 4 ( 1 cement : 2 fine sand : 4 graded stone aggregate of 20 mm nominal size)	Cum	23.00	8086.90	185998.70	4.1.3
4	Providing and laying in position machine batched, machine mixed and machine vibrated design mix cement concrete of specified grade for reinforced cement concrete work including pumping of concrete to site of laying but excluding the cost of centring, shuttering, finishing and reinforcement, including admixtures in recommended proportions as per IS 9103 to accelerate, retard setting of concrete, improve workability without impairing strength and durability as per the direction of Engineer-in-Charge.					5.31
4.1	All works upto plinth level					5.31.1
	Reinforced cement concrete grade M-25 using 410 kg of cement per cum	Cum	46.00	7370.50	339043.00	5.31.1.1
4.2	All works upto Floor five level					5.31.2
	Reinforced cement concrete grade M-25 using 410 kg of cement per cum	Cum	43.00	8941.50	384484.50	5.31.2.1
4.3	Add or deduct for providing richer or leaner mixes respectively at all levels.					5.34
	Providing M-30 grade of concrete instead of M-25 grade of concrete B.M.C/R.M.C	Cum	89.00	184.00	16376.00	5.34.1
5	Centering shuttering including struttings, propping etc. and removal of form work for:					5.9

SL NO	DESCRIPTION	UNIT	QTY.	RATE	AMOUNT	SOR 2017 ITEM NO
a)	Foundations, footings, bases for columns etc. for mass concrete with timber plank	Sqm	38.50	226.10	8704.85	5.9.1.1
b)	Walls (any thickness) including attached pilasters, buttresses, plinth and string courses etc. using shuttering ply.	Sqm	185.00	327.80	60643.00	5.9.3
c)	Suspended floors, roofs, landings, balconies and access platform with 12 mm thick shuttering ply.	Sqm	60.00	452.10	27126.00	5.9.4.2
6	Reinforcement for R.C.C. work including straightening, cutting, bending, placing in position and binding all complete upto floor five level.					5.20
	Thermo-Mechanically Treated bars/ Cold twisted deformed steel bars.	Kg	14378.00	59.70	858366.60	5.20.4
7	12 mm cement plaster of mix					12.1
	Cement mortar 1:4 ( 1 cement : 4 fine sand )	Sqm	242.60	150.50	36511.30	12.1.2
8	15 mm cement plaster on the rough side of single or half brick wall of mix:					12.2
	Cement mortar 1:4 ( 1 cement : 4 fine sand )	Sqm	84.70	174.80	14805.56	12.2.2
9	Supply, delivery & fixing of heavy duty CI manhole of 600x600mm size as per drawing and as directed by Engineer in Charge	No.	2.00	1500.00	3000.00	
10	Supply and Fixing of MS ladder with anti corrosive paint including hand rail of approved material of required length from Ground level to tank top slab of required slope as per drawing and approved by Engineer in charge.	No.	1.00	6000.00	6000.00	
11	Supplying and fixing fibre coated MS rungs of approved make at suitable spacing for entering into the tank for cleaning purpose including all material, manpower etc as directed by Engineer in charge.	No.	12.00	700.00	8400.00	
12	Supplying & Fixing of Water level Indicator of approved quality as per drawing and as directed by Engineer in charge.	No.	1.00	5000.00	5000.00	
13	Supplying & Fixing of G.I Handrail of approved material including priming and two coat of approved enamel painting as per drawing and as directed by Engineer in Charge	LS	1.00	25000.00	25000.00	
14	Providing and fixing puddle pipe/ vent pipe as per drawing and as directed by Engineer in charge	LS	1.00	5000.00	5000.00	
				<b>TOTAL =</b>	<b>2066631.01</b>	

## LCS MUHURIGHAT AT BELONIA

### IRON REMOVAL PLANT

S.NO.	DESCRIPTION OF ITEM	UNIT	QUANTITY	RATE	AMOUNT	DWS 2015 ITEM NO
1	Supply, installation and commissioning of package type Iron Removal Plant comprising of Iron Removal Filter of dual media filter with anthracite coal, filter gravel, polypropelene double hexagonal nut stainer etc., mixing chamber for coagulants like sodium, metering pump for coagulant dosing, air compressor of suitable capacity with motor, back washing arrangements, disinfection with sodium hypochlorite solution through metering pump, all necessary pipes for raw water collection, interconnecting all the chambers, delivery outlet of 150 mm dia along with all related civil, mechanical and Electrical works etc. complete as per approved drawing, process flow, technical specification and direction of the engineer-in-charge.					11.1
	5000 G.P.H capacity.	No	1.00	894200.00	894200.00	C
				<b>TOTAL =</b>	<b>894200.00</b>	

## LCS MUHURIGHAT AT BELONIA

### PUMP HOUSE

SL NO	DESCRIPTION	UNIT	QTY.	RATE	AMOUNT	SOR 2017 ITEM NO
<b>1.0</b>	<b>EARTH WORK</b>					
1.01	Earth work in excavation by mechanical means (Hydraulic excavator) / manual means in foundation trenches or drains (not exceeding 1.5 m in width or 10 sqm on plan) including dressing of sides and ramming of bottoms, lift upto 1.5 m, including getting out the excavated soil and disposal of surplus excavated soil as directed, within a lead of 50 m.					2.13
	All kinds of soil	Cum	36.00	150.10	5403.60	
1.02	Filling available excavated earth (excluding rock) in trenches, plinth, sides of foundations etc. in layers not exceeding 20cm in depth, consolidating each deposited layer by ramming and watering, lead up to 50 m and lift upto 1.5 m					2.16
	All kinds of soil	Cum	12.00	35.50	426.00	
1.03	Supplying and filling in plinth, under floor, foundations etc. with sand (fine) from local quarry with all lifts including spreading in horizontal layers, watering, grading to required slope, ramming, consolidating and compacting each layer by using plate compactor or by any suitable method complete.	Cum	9.50	615.70	5849.15	2.18
1.04	Supplying chemical emulsion in sealed containers including delivery as specified.					2.19
	Chlorpyriphos/Lindane emulsifiable concentrate of 20%	Ltr	28.00	287.60	8052.80	2.19.1
1.05	Treatment of soil under plinth filling using chemical emulsion @ one litre per hole, 300 mm apart including drilling 12 mm diameter holes and plugging with sand filling:					2.20.3
	With Chlorpyriphos/Lindane E.C. 20% with 1% concentration.	Sqm	42.00	48.80	2049.60	2.20.3.1
<b>2</b>	<b>PLAIN AND REINFORCED CEMENT CONCRETE WORK.</b>					
2.01	Providing and laying in position cement concrete of specified grade excluding the cost of centring and shuttering -					4.1
	-All work upto plinth level:					
i)	1:3:6 ( 1 Cement: 3 fine sand : 6 graded stone aggregate 20 mm nominal size)	Cum	8.50	7567.60	64324.60	4.1.5
2.02	Providing and laying damp-proof course with cement concrete 1:2:4 (1 cement: 2 coarse sand : 4 graded stone aggregate 12.5mm/20mm nominal size).					4.5.1

SL NO	DESCRIPTION	UNIT	QTY.	RATE	AMOUNT	SOR 2017 ITEM NO
i)	D.P.C. 50 mm thick	Sqm	11.50	460.40	5294.60	4.5.1.2
2.03	Providing and laying in position specified grade of reinforced cement concrete excluding the cost of centring, shuttering, finishing and reinforcement-					5.1
	-All work upto plinth level:					
i)	1:1½:3 ( 1 Cement: 1½ fine sand : 3 graded stone aggregate 20 mm nominal size)	Cum	6.15	8439.65	51903.85	5.1.2
2.04	Reinforced cement concrete work in walls (any thickness), including attached pilasters, buttresses, plinth and skirting courses, fillets, columns, pillars, piers, abutments, posts and struts etc. upto floor five level excluding cost of centring, shuttering, finishing and reinforcement-					5.2
	In plinth and skirting courses, fillets, columns, pillars, posts and struts.					5.2.2
i)	1:1½:3 ( 1 Cement: 1½ fine sand : 3 graded stone aggregate 20 mm nominal size)	Cum	2.30	8967.30	20624.79	5.2.2.2
2.05	Reinforced cement concrete work in beams, suspended floors, roofs having slope upto 15° landings, balconies, shelves, chajjas, lintels, bands, plain window sills, staircases and spiral stair cases upto floor five level excluding the cost of centring, shuttering, finishing and reinforcement-					5.3
a)	RCC work in suspended floors, roofs having slope upto 15° landings, balconies, shelves and chajjas.					5.3.1
	1:1½:3 ( 1 Cement: 1½ fine sand : 3 graded stone aggregate 20 mm nominal size)	Cum	5.45	8841.00	48183.45	5.3.1.2
b)	RCC work in beams, lintels, bands, plain window sills, staircases and spiral staircases excluding precast spiral staircase.					5.3.2
	1:1½:3 ( 1 Cement: 1½ fine sand : 3 graded stone aggregate 20 mm nominal size)	Cum	6.75	8807.50	59450.63	5.3.2.2
2.06	Centering shuttering including struttings, propping etc. and removal of form work for:					5.9
a)	Foundations, footings, bases for columns etc. for mass concrete with timber plank.	Sqm	18.00	226.10	4069.80	5.9.1.1
b)	Suspended floors, roofs, landings, balconies and access platform with 12 mm thick shuttering ply.	Sqm	28.00	452.10	12658.80	5.9.4.2
c)	Lintels, beams, plinth beams, girders, bressumers and cantilevers with shuttering ply.	Sqm	36.00	327.70	11797.20	5.9.5.1
d)	Columns, Pillars, Piers, Abutments, Posts and Struts with shuttering ply	Sqm	21.00	429.30	9015.30	5.9.6.1
2.07	Reinforcement for R.C.C. work including straightening, cutting, bending, placing in position and binding all complete upto floor five level.					5.20
	Thermo-Mechanically Treated bars/ Cold twisted deformed steel bars	Kg	1755.25	59.70	104788.43	5.20.4



SL NO	DESCRIPTION	UNIT	QTY.	RATE	AMOUNT	SOR 2017 ITEM NO
<b>3</b>	<b>BRICK WORK</b>					
3.01	First class brick work in foundation and plinth including cost of all materials as required complete:-					6.1
	In cement mortar 1:5 ( 1 cement : 5 fine sand ).	Cum	4.50	5278.50	23753.25	6.1.4
3.02	First class brick work in superstructure above plinth level & upto floor-five level including cost of all materials as required complete:-					6.3
	In cement mortar 1:5 ( 1 cement : 5 fine sand ).	Cum	11.50	5800.20	66702.30	6.3.4
3.03	Half brick masonry work with first class bricks in superstructure upto floor five level including cost of all materials as required complete:-					6.12
	In Cement mortar 1:4 ( 1 cement : 4 fine sand )	Sqm	16.50	787.30	12990.45	6.12.3
<b>4</b>	<b>ALUMINIUM WORK</b>					
4.01	Supplying and fixing rolling shutters of approved make, made of required size M.S. laths interlocked together through their entire length and jointed together at the end by end locks mounted on specially designed pipe shaft with brackets, side guides and arrangements for inside and outside locking with push and pull operation complete including the cost of providing and fixing necessary 275mm long wire springs grade No.2 and M.S. top cover of required thickness for rolling shutters & with handles, hold fast including embedding in cement concrete of required grade required for fixing in position, all necessary fittings, including applying of approved steel primer etc. complete as required:-					9.6
	i) 80 x 1.25 mm MS laths with 1.25 mm thick top cover	Sqm	7.50	2420.30	18152.25	9.6.1
4.02	Providing and fixing ball bearing for rolling shutters ( exceeding 10 sqm area ) of approved make complete as required.	Each	1.00	407.00	407.00	9.7
4.03	Extra providing and fixing mechanical device chain and crank operation for operating rolling shutter of approved make, as per clauses of chapter-10 of CPWD specification.					
	a) Exceeding 10 sqm and upto 16.80 sqm in area	Sqm	QRO			
4.04	Providing and fixing M.S. grills of required pattern in frames of windows etc. with M.S. flats, square or round bars etc. all complete					8.46
	Fixed to openings /wooden frames with rawl plugs screws etc.	Kg	375.00	101.60	38100.00	8.46.2

SL NO	DESCRIPTION	UNIT	QTY.	RATE	AMOUNT	SOR 2017 ITEM NO
	Providing and fixing aluminium work for doors, windows, ventilators and partitions with extruded built up standard tubular sections/ appropriate Z sections and other sections of approved make conforming to IS:733 and IS : 1285, fixing with dash fasteners of required dia and size, including necessary filling up of gaps at junctions, i.e. at top, bottom and sides with required EPDM rubber/neoprene gasket etc. Aluminium sections shall be smooth, rust free, straight, mitred and jointed mechanically wherever required including cleat angle, aluminium snap beading for glazing / paneling, C.P. brass / stainless steel screws, all complete as per architectural drawing and the direction of Engineer incharge. (Glazing and paneling and dash fasteners to be paid for separately) :-					16.1
	For fixed portion of approved quality:-					16.1.1
	Powder coated aluminium ( minimum thickness of powder coating of 50 micron ).	Kg	250.00	396.80	99200.00	16.1.1.2
4.06	For shutters of doors, windows & ventilators including providing and fixing hinges / pivots and making provision for fixing fittings wherever required including the cost of EPDM rubber / neoprene gasket required ( Fittings shall be paid for separately ):-					16.1.2
	Powder coated aluminium ( minimum thickness of powder coating of 50 micron ).	Sqm	27.00	457.30	12347.10	16.1.2.2
4.07	Providing and fixing glazing of approved quality in aluminium doors, windows, ventilator, shutters and partition etc. with EPDM rubber / neoprene gasket etc. complete as per architectural drawing and the direction of Engineer-in-charge (Cost of snap beading shall be paid in basic item) :-					16.3
	a) With glass panes of 4.0 m thickness ( weight not less than 10.0 kg / sqm )	Sqm	27.00	881.40	23797.80	16.3.1
4.08	Providing and fixing factory made UPVC door frame made of UPVC extruded, section having an overall dimension, as below (tolerance +/- 1mm) with wall thickness 2.0mm+/- 0.2mm. corners of the door frame to be jointed with galvanized brackets and stainless screws, joint mitred and plastic welded. The hinge side vertical of the frames reinforced by galvanized MS tube of size 19 × 19 mm and 1 mm +/- 0.1 mm wall thickness and 3 nos stainless steel hinges fixed to the frame complete as per manufacturers specification and direction of Engineer-In-Charge.					8.114
	a) Extruded section Profile size 48x40 mm.	Rmt	4.200	246.50	1035.30	8.114.1

SL NO	DESCRIPTION	UNIT	QTY.	RATE	AMOUNT	SOR 2017 ITEM NO
4.09	24 mm thick factory made PVC door shutters made of styles and rails of a UPVC hollow section of size 59x24 mm and wall thickness 2 mm ± 0.2 mm with inbuilt edging on both sides. The styles and rails mitred and joined at the corners by means of M.S. galvanised /plastic brackets of size 75x220 mm having wall thickness 1.0 mm and stainless steel screws. The styles of the shutter reinforced by inserying galvanised MS tube of size 20x20 mm and 1 mm ± 0.1 mm wall thickness. The lock rail made up of "H" Section, a UPVC hollow section of size 100x24 mm and 2 mm ± 0.2 mm wall thickness fixed to the shutter styles by means of plastic /galvanised MS "U" cleats. The shutter frame filled with a UPVC multi-chambered single panel of size not less than 620 mm, having overall thickness of 20 mm and 1 mm ± 0.1 mm wall thickness. The panels filled vertically and tie bar at two places by inserting horizontaly 6 mm galvanised MS rod and fastened with nuts and washers, complete as per manufacturer's specification and direction of Engineer-In-Charge. (for W.C. and Bathroom door shutter).	Sqm	1.575	1815.60	2859.57	8.115.1
<b>5</b>	<b>FLOORING</b>					
5.01	Providing and laying cement concrete 1:2:4 (1 cement: 2 fine sand : 4 graded well burnt brick aggregate) flooring finished with a floating coat of neat cement including cement slurry, rounding of edges and strips and cost of glass strips etc. complete.					10.6
	40mm thick.	Sqm	24.50	439.00	10755.50	10.6.1
<b>6</b>	<b>ROOFING</b>					
6.01	Providing and fixing on wall face unplasticised rigid PVC ( working pressure 4 kgf per sqcm ) rain water pipes conforming to IS : 13592 Type A including jointing with seal ring conforming to IS : 5382 leaving 10 mm gap for thermal expansion.					11.42
	Single socketed pipe -110 mm dia OD	RM.	6.50	239.00	1553.50	11.42.2
6.02	Providind 75 mm dia. PVC. Spout set in cement mortar 1 : 3 (1 cement : 3 coarse sand) complete for all sunsheds.	Each	5.00	50.00	250.00	
<b>7</b>	<b>FINISHING</b>					
7.01	12 mm cement plaster of mix					12.1
	In cement mortar 1 : 4 ( 1 cement : 4 fine sand )	Sqm	32.00	150.50	4816.00	12.1.2
7.02	15 mm cement plaster on the rough side of single or half brick wall of mix:					12.2
	In cement mortar 1 : 4 ( 1 cement : 4 fine sand )	Sqm	50.00	174.80	8740.00	12.2.2
7.03	20 mm cement plaster of mix :					12.3

SL NO	DESCRIPTION	UNIT	QTY.	RATE	AMOUNT	SOR 2017 ITEM NO
	In cement mortar 1 : 5 ( 1 cement : 5 fine sand )	Sqm	52.00	197.70	10280.40	12.3.3
7.04	Colour washing such as green, blue or buff with whiting to give an even shade on new work (two or more coats ) complete.					12.22
	With a base coat of white washing with lime	Sqm	37.50	23.40	877.50	12.22.1
7.05	Finishing walls with water proofing cement paint of required shade of approved brand and manufacture on new work ( two or more coats applied @ 3.84 kg/10 sqm) complete. [Payment shall be made after submission of Test Certificate issued by the Manufacturer]	Sqm	61.50	53.30	3277.95	12.28
7.06	Painting with synthetic enamel paint ( two or more coats ) of required colour of approved brand and manufacture on new work to give an even shade. [Payment shall be made after submission of Test Certificate issued by the Manufacturer]	Sqm	59.00	73.90	4360.10	12.47
		<b>GRAND TOTAL =</b>			<b>758148.56</b>	

## LCS MUHURIGHAT AT BELONIA

### PLUMBING WORKS FOR PUMP HOUSE TOILET

SL NO	DESCRIPTION	UNIT	QTY.	RATE	AMOUNT	SOR 2017 ITEM NO
<b>1</b>	<b>Earth Work &amp; Refilling</b>					
	Earth work in excavation by mechanical means (Hydraulic excavator) / manual means in foundation trenches or drains (not exceeding 1.5 m in width or 10 sqm on plan) including dressing of sides and ramming of bottoms, lift upto 1.5 m, including getting out the excavated soil and disposal of surplus excavated soil as directed, within a lead of 50 m.					2.13
a.	All kinds of soil	Cum	15.00	150.10	2251.50	
<b>2</b>	<b>Pipe Laying (4 Kg/cm<sup>2</sup>)</b>					
	Providing and fixing on wall face unplasticised Rigid PVC rain water pipes (working pressure 4 kg/cm <sup>2</sup> ) conforming to IS : 13592 Type A including jointing with seal ring conforming to IS : 5382 leaving 10 mm gap for thermal expansion:					11.42
a	Pumping & Delivery Line - 75mm OD - PVC pipe	Rmt	12.50	142.30	1778.75	11.42.1
b	Sok pit line ( Toilet to Soak pit ) - 110mm OD - PVC pipe	Rmt	18.00	239.00	4302.00	11.42.2
c	Waste Water Soak pit Chamber - 75mm OD - PVC pipe	Rmt	14.00	100.40	1405.60	11.42.1
<b>3</b>	<b>FITTINGS:-</b>					
	Providing and fixing on wall face unplasticised - PVC moulded fittings/ accessories for unplasticised Rigid PVC rain water pipes conforming to IS : 13592 Type A including jointing with seal ring conforming to IS : 5382 leaving 10 mm gap for thermal expansion:					11.43
a	<b>Bend 87.5°</b>					11.43.5
i)	110mm	Each	12.00	109.80	1317.60	11.43.5.2
ii)	75mm	Each	12.00	70.00	840.00	11.43.5.1
b	<b>Single equal tee with door</b>					11.43.4
i)	110mm x 110mm x 110mm	Each	10.00	190.80	1908.00	11.43.4.2
ii)	75mm x 75mm x 75mm	Each	10.00	125.60	1256.00	11.43.4.1
c	<b>Coupler</b>					11.43.1
i)	110mm	Each	14.00	99.00	1386.00	11.43.1.2
ii)	75mm	Each	14.00	57.90	810.60	11.43.1.1

SL NO	DESCRIPTION	UNIT	QTY.	RATE	AMOUNT	SOR 2017 ITEM NO
d	Providing and fixing to the inlet mouth of rain water pipe PTMT grating with thickness of 8mm and weighing not less than 100gm. Complete					11.45
i)	75 mm	Each	2.00	90.30	180.60	11.45.1
ii)	100 mm	Each	2.00	100.00	200.00	11.45.2
<b>4</b>	<b>EWC</b>					
	Providing and fixing white vitreous china pedestal type water closet (European type) with seat and lid, 10 litre low level white vitreous china flushing cistern & C.P. flush bend with fittings & C.I.brackets, 40mm flush bend, overflow arrangement with specials of standard make and mosquito proof coupling of approved municipal design complete including painting of fittings and brackets, cutting and making good the walls and floors wherever					18.3
	W.C. pan with ISI marked white solid plastic seat and lid.	Nos	2.00	4958.70	9917.40	18.3.1
<b>5</b>	<b>Urinals</b>					
	Providing and Fixing white vitreous china flat back or wall corner type lipped front urinal basin of 430x260x350mm and 340x410x265mm sizes respectively with automatic flushing cistern with standard flush pipe and C.P. brass spreaders with brass unions and G.I clamps complete, including painting of fittings and brackets, cutting and making good the walls and floors wherever required :					18.4
a	One urinal basin with 5 litre white P.V.C. automatic flushing cistern	Nos	2.00	3658.60	7317.20	18.4.1
<b>6</b>	<b>Wash Basin</b>					
	Providing and fixing wash basin with C.I. brackets, 15 mm C.P. brass pillar taps,32 mm C.P. brass waste of standard pattern, including painting of fittings and brackets, cutting and making good the walls wherever require :					18.7
	White Vitreous China Wash basin size 630x450 mm with a pair of 15 mm C.P. brass pillar taps	Nos	2.00	2231.80	4463.60	18.7.1
<b>7</b>	<b>15mm brass Stop Cock</b>					
	Providing and fixing brass stop cock of approved quality :					19.16
a.	15 mm dia nominal bore	Nos	2.00	278.50	557.00	19.16.1
<b>8</b>	<b>15mm brass bib cock</b>					
	Providing and fixing brass Bib cock of approved quality :					19.15
a.	15 mm dia nominal bore	Nos	4.00	267.40	1069.60	19.15.1

SL NO	DESCRIPTION	UNIT	QTY.	RATE	AMOUNT	SOR 2017 ITEM NO
<b>9</b>	<b>Sintex Tank</b>					
	Providing and placing on terrace (at all floor levels) polyethylene water storage tank ISI : 12701 marked with cover and suitable locking arrangement and making necessary holes for inlet, outlet and overflow pipes but without fittings and the base support for tank.	Ltr.	2000.00	9.50	19000.00	19.48
<b>11</b>	<b>Gate Valve -50mm dia nominal bore</b>					
	Providing and fixing gun metal gate valve with C.I. Wheel of approved quality ( screwed ) complete as per clauses of Chapter - 20 of CPWD specification.					
a.	50mm dia nominal bore	Nos	2.00	622.20	1244.40	
<b>12</b>	<b>Chamber</b>					
	Constructing brick masonry chamber for underground C.I. inspection chamber and bends with 1st class bricks in cement mortar 1:4 (1 cement : 4 fine sand) C.I. cover with frame (light duty) 455x610 mm internal dimensions, total weight of cover with frame to be not less than 38 kg (weight of cover 23 kg and weight of frame 15 kg) R.C.C. top slab with 1:2:4 mix (1 cement : 2 fine sand : 4 graded stone aggregate 20 mm nominal size) foundation concrete 1:5:10 (1 cement: 5 fine sand : 10 graded stone aggregate 40 mm nominal size), inside plastering 12 mm thick with cement mortar 1:3 (1 cement: 3 fine sand) finished smooth with a floating coat of neat cement on walls and bed concrete etc. complete as per standard design :					20.8
10.1.1	Inside dimensions 455x610 mm and 45 cm deep for single pipe line	Each	4.000	6073.60	24294.40	20.8.1
<b>13</b>	<b>Circular Soak Pit</b>					
	Making soak pit 2.5 m diameter 3.0 metre deep with 45 x 45 cm dry brick honey comb shaft with well burnt 2nd class bricks and S.W. drain pipe 100 mm diameter, 1.8 m long complete as per standard design	Each	1.000	45096.00	45096.00	20.1
				<b>TOTAL =</b>	<b>130596.25</b>	

## LCS MUHURIGHAT AT BELONIA

### WATER DISTRIBUTION NETWORK

SL NO	DESCRIPTION	UNIT	QTY.	RATE	AMOUNT	DWS 2015 ITEM NO
1	Earth work in excavation in foundation trenches or drains including dressing of sides and ramming of bottoms, lift up to 2.0 Mtr. including taking out the excavated soil and depositing and refilling with watering & ramming and disposal of surplus excavated soil within the site boundary and the location as approved by Engineer in charge. Complete etc.					TSR 2017 2.13
	All kinds of soil	Cum	550.00	150.10	82555.00	
	Excavating trenches of required width for pipes, cables etc. including excavation for sockets, dressing of sides where required, ramming of bottoms, depth upto 1500 mm including getting out the excavated soil and backfilling of soil as required after laying of pipeline, in layers not exceeding 200 mm in depth including consolidating each deposited layer by ramming, watering etc. and disposing of surplus excavated soil with all required leads as per Chapter - 2 of CPWD specification and direction of the Engineer - in - charge.					4.1
A	For UPVC pipes in new work					A.
	In all kinds of soil					a.
	For pipes exceeding 90 mm dia but not exceeding 300 mm dia	Mt	785.00	61.30	48120.50	ii.
2	Providing, fixing and laying UPVC pipes conforming to IS:4985 jointing with couplers of same class conforming to IS:10124 (Pt-2) with solvent cement conforming to IS:14182 including testing of joints complete ( but excluding the cost of specials like bend,tees etc. which will be paid separately) as per CPWD specification and direction of the Engineer-in-charge.					2.1
A	Class-3 ( working pressure 6.0 kg/cm <sup>2</sup>					A
	a) 63 mm	Rmt	42.00	110.50	4641.00	iii
	b) 75 mm	Rmt	154.00	138.70	21359.80	iv
	c) 90 mm	Rmt	183.00	166.20	30414.60	v
	d) 110 mm	Rmt	315.00	238.80	75222.00	vi
	e) 140 mm	Rmt	21.00	396.50	8326.50	vii
	f) 160 mm	Rmt	21.00	587.40	8326.50	B i



SL NO	DESCRIPTION		UNIT	QTY.	RATE	AMOUNT	DWS 2015 ITEM NO
	g)	110 mm from Borewell to IRP	Rmt	46.50	370.00	17205.00	vi
	h)	110 mm from IRP to UG Sump	Rmt	46.50	370.00	17205.00	vi
	i)	110 mm from UG Sump to Distribution System	Rmt	46.50	370.00	17205.00	vi
3	Supplying and filling in plinth, under floor, foundations etc. with sand (fine) from local quarry with all lifts including spreading in horizontal layers, watering, grading to required slope, ramming, consolidating and compacting each layer by using plate compactor or by any suitable method complete.		Cum	35.00	615.70	21549.50	TSR2017 2.18
4	Filling available excavated earth (excluding rock) in trenches, plinth, sides of foundations etc. in layers not exceeding 20cm in depth, consolidating each deposited layer by ramming and watering, lead up to 50 m and lift upto 1.5 m.						TSR2017 2.16
	All Kinds of soil		cum	268.00	116.40	31195.20	
5	Supply and delivery of following CID/F Valves conforming to IS 14846/2000 with amdt: NO: 1 & 2 heavy duty with CI grade as per IS:210. Two coats of primer suitable for epoxy paints finish shall be applied to all metal surface. Including Transportation central exise duty and sales tax, levies etc., complete. The valves shall be tested for (closed and open) against Hydrostatic test requirement. ISI Marked with Hand Wheel. The cost including cost of transportation, taxes and other levis etc complete.						
	<b>Sluice Valves</b>						
	a)	65 mm dia sluice valves P.N.10	Nos.	3.00	2030.00	6090.00	
	b)	80 mm dia sluice valves P.N.10	Nos.	5.00	2700.00	13500.00	
	c)	100 mm dia sluice valves P.N.10	Nos.	5.00	3200.00	16000.00	
	<b>Scour Valves</b>						
	a)	65 mm dia Sluice valve for scour valves P.N.10	Nos.	1.00	2100.00	2100.00	
	b)	80 mm dia Sluice valve for scour valves P.N.10	Nos.	1.00	2200.00	2200.00	
	Providing and fixing C.I. sluice valves ( with cap ) complete with bolts, nuts, rubber insertions etc. ( the tail pieces if required will be paid separately ) as per chapter 20 of CPWD specification and direction of the Engineer - in - charge.						2.26
	<b>Sluice Valves</b>						
	a)	80 mm dia sluice valves P.N.1.0	Each	4.00	3450.80	13803.20	iii B
	b)	100 mm dia sluice valves P.N.1.0	Each	4.00	4688.20	18752.80	iv B
	c)	150 mm dia sluice valves P.N.1.0	Each	4.00	7231.90	28927.60	vi B

SL NO	DESCRIPTION	UNIT	QTY.	RATE	AMOUNT	DWS 2015 ITEM NO
	Providing and fixing C.I. double action air valve of approved quality with bolts, nuts, rubber insertions etc. complete as per CPWD specification and direction of the Engineer in - charge. ( The tail pieces, tapers etc if required will be paid separately ).					2.30
	b) 50mm dia Double Air Valve	Each	4.00	3092.90	12371.60	i
	Providing and fixing gun metal gate valve with C.I. wheel of approved quality(screwed end)					TSR2017 19.17
	80mm nominal bore	Each	4.00	2005.60	8022.40	19.17.6
6	Supply and delivery of CI D/F Kinetic Air valve Heavy Duty suitable for working pressure upto 16kg/Cm2 without isolating valve, conforming to IS 14845. Rates include freight charges, inspection charges, loading and unloading, transportation charges upto the site and stacking including all Taxes and other levis etc complete as directed by the Engineer-in-charge					
	a) 20mm dia Single Air Valve	Nos	6.00	2000.00	12000.00	
7	Labour charges for lowering and fixing in position of CI valves and jointing including cost and conveyance of packing, sheets, bolts, nuts etc. complete					
	<b>Sluice valve</b>					
	a) 65mm dia sluice valves P.N.10	Nos.	3.00	220.00	660.00	
	b) 80mm dia sluice valves P.N.10	Nos.	6.00	220.00	1320.00	
	c) 100mm dia sluice valves P.N.10	Nos.	6.00	220.00	1320.00	
	<b>Sluice valve for Scour valve</b>					
	a) 65mm dia scour valves PN 10 including scour outlet installation as per drawing	Nos.	1.00	220.00	220.00	
	b) 80mm dia scour valves PN 10 including scour outlet installation as per drawing	Nos.	1.00	220.00	220.00	
8	Labour charges for fixing Air Valves including boring the mains, threading the bore and fixing nipple etc. including cost of saddle piece and jointing materials such as bolts, nuts and rubber insertion sheet etc., complete as directed by the engineer in-charge					
	a) 20mm dia Single Air Valve	Nos.	8.00	220.00	1760.00	

SL NO	DESCRIPTION	UNIT	QTY.	RATE	AMOUNT	DWS 2015 ITEM NO
9	Constructing brick masonry chamber for underground inspection chamber and bends with 1st class bricks in cement mortar 1 : 5 ( 1 cement : 5 fine sand) C.I. cover with frame ( light duty ) ( 455 x 610 ) mm internal dimensions total weight of cover with frame to be not less than 38 kg ( weight of cover 23 kg and weight of frame 15 kg ) R.C.C. top slab with 1 : 2 : 4 mix ( 1 cement : 2 fine sand : 4 graded well burnt brick aggregate 20 mm nominal size ) including reinforcement and formwork as required, foundation concrete 1 : 5 : 10 ( 1 cement : 5 fine sand : 10 graded well burnt brick aggregate 40 mm nominal size ) inside plastering 12mm thick with cement mortar 1 : 3 ( 1 cement : 3 fine sand ) finished smooth with a floating coat of neat cement on walls and bed concrete etc. complete as per standard design as per clauses of Chapter - 21 of CPWD specification.					
	Inside dimensions 455 mm x 610 mm and 1000 mm deep for single pipeline	Nos.	23.00	8500.00	195500.00	
10	Supply, delivery and fixing to the industrial units including fixing water meter (Domestic), isolation valves, water meter protection chamber etc and connection from mainline to individual unit upto a length of 5mt. The quoted rate should include all material and labour etc complete.					
	25mm dia	Nos.	2.00	14000.00	28000.00	
11	Providing and fixing G.I. pipes complete with G.I. fittings including trenching, dewatering and refilling etc.					2.10
	<b>External work</b>					
	125 mm dia	Mtr.	R.O.	984.70		x
	100 mm dia	Mtr.	R.O.	781.60		ix
	80mm dia	Mtr.	R.O.	565.80		viii
	65mm dia	Mtr.	R.O.	430.40		vii
	50 mm dia	Mtr.	R.O.	390.20		vi
	40 mm dia	Mtr.	R.O.	341.40		v
	32 mm dia	Mtr.	R.O.	300.50		iv
	25 mm dia	Mtr.	R.O.	247.30		iii
	20 mm dia	Mtr.	R.O.	186.40		ii

SL NO	DESCRIPTION	UNIT	QTY.	RATE	AMOUNT	DWS 2015 ITEM NO
12	Constructing masonry Chamber 75x 75 x 75 cm and up to 1.0mtr depth , inside with 75 second class designation brick work in cement mortar 1:5 (1 cement :5 fine sand) for sluice valve and ball valve, with C.I. surface box 100mm. top diameter, 160 mm bottom diameter and 180 mm deep ( inside) for sluze valve and medium duty RCC manhole cover of 550mm dia. size with RCC precast fram for gun metal valve with chained lid and Rcc top slab 1:2:4 mix (1 cement:2 coarse sand : 4 graded stone aggregate 20mm nominal size) necessary excavation foundation concrete 1:5:10 (1 cement :5 fine sand : 10 graded stone aggregate 40 mm nominal size) and inside plastering with cement mortar 1:3 ( 1 cement :3 coarse sand) 12mm thick finished with a floating coat of neat cement complete as per standard design: (Valve Chamber).	Each	1.00	7000.00	7000.00	
13	Providing RCC in M-20 thrust block at all specials using trap metal sand and cements with sutable foam work finishing and curring etc. compl. as per the requirment.	Cum	4.00	7296.40	29185.60	
	<b>STORM WATER WORK:-</b>					
14	Providing and laying non-pressure NP2 class (light duty) R.C.C. pipes with collars jointed with stiff mixture of cement mortar in the proportion of 1:2 (1 sand:cement: 2 fine ) including testing of joints etc. complete.					TSR 2017 20.5
	150mm	Mtr.	138.00	654.70	90348.60	20.5.2
	250mm	Mtr.	87.00	821.40	71461.80	20.5.3
	300mm	Mtr.	74.00	1096.90	81170.60	20.5.4
15	Constructing masonry Chamber 60x60x75 cm, inside in brick work in cement mortar 1:4 (1 cement : 4 fine sand) for sluice valve, with C.I. surface box 100mm. top diameter, 160 mm bottom diameter and 190 mm deep ( inside) with chained lid and RCC top slab 1:2:4 mix (1 cement :2 coarse sand : 4 graded stone aggregate 20mm nominal size ) necessary excavation foundation concrete 1:5:10 (1 cement : 5 fine sand : 10 graded stone aggregate 40 mm nominal size) and inside plastering with cement mortar 1:3 (1 cement : 3 coarse sand) 12 mm thick finished with a floating coat of neat cement complete as per standard design :					TSR 2017 19.33
	With Second Class bricks	Each	4.00	7488.40	29953.60	

SL NO	DESCRIPTION	UNIT	QTY.	RATE	AMOUNT	DWS 2015 ITEM NO
16	Making connection either through existing storm water line / drain point including bracking them in a systematic way with suitable excavation, dewatering, dismantling of the RCC or masonry wall or pipe line, passing the plumbing storm water line in the existing structure either through masonry or CC and providing suitable "Y" tee to the connect to existing pipe line, Reconstructions of dismantled existing structure according to the original one to bring to the working conditions tasting etc. comp., work to be done in the prasions of municipal eng. including all laicizing cost.	Job	1.00	12000.00	12000.00	
17	Providing, fixing and laying rigid UPVC pipes conforming to IS : 4985 jointing with couplers, of same class conforming to IS : 10124 ( Pt-II ) with solvent cement conforming to IS : 14182 including testing of joints complete ( but excluding the cost of specials like bend, tees etc. which will be paid separately ) as per chapter 20 of CPWD specification and direction of the Engineer - in - charge.					2.1
	i   110 mm OD	Mt	456.00	238.80	108892.80	vi
	ii   140 mm OD	Mt	267.00	396.50	105865.50	vii
18	Providing, fixing and laying fabricated UPVC bend of required degree conforming to IS : 10124 ( part 8 / 9 / 10 / 11 / 12 / 13 ) with solvent cement conforming to IS : 14182 including testing of joints complete as per chapter 20 of CPWD specification and direction of the Engineer - in - charge.					2.2
	i   110 mm OD	No	18.00	276.80	4982.40	vi
	ii   140 mm OD	No	24.00	362.00	8688.00	vii
19	Providing, fixing and laying fabricated UPVC end cap conforming to IS : 10124 ( Part 4 ) with solvent cement conforming to IS : 14182 including testing of joints complete as per chapter 20 of CPWD specification and direction of the Engineer - in - charge					2.3
	i   110 mm OD	No	10.00	125.70	1257.00	vi
	ii   140 mm OD	No	12.00	186.50	2238.00	vii
20	Providing, fixing and laying fabricated UPVC equal tee conforming to IS : 10124 ( Part 5 ) with solvent cement conforming to IS : 14182 including testing of joints complete as per chapter 20 of CPWD specification and direction of the Engineer - in - charge.					2.4
	i   110 x 110 mm dia	No	5.00	444.70	2223.50	vi
	ii   140 x 140 mm dia	No	7.00	638.10	4466.70	vii

SL NO	DESCRIPTION	UNIT	QTY.	RATE	AMOUNT	DWS 2015 ITEM NO
21	Providing and fixing C.I. sluice valves ( with cap ) complete with bolts, nuts, rubber insertions etc. ( the tail pieces if required will be paid separately ) as per chapter 20 of CPWD specification and direction of the Engineer - in - charge.					2.26
	<b>i 125 mm dia</b>					<b>v</b>
	A PN - 1.6	No	4.00	6091.80	24367.20	A
	B PN - 1.0	No	6.00	6113.80	36682.80	B
	<b>ii 150 mm dia</b>					<b>vi</b>
	A PN - 1.6	No	3.00	7354.00	22062.00	A
	B PN - 1.0	No	4.00	7231.90	28927.60	B
22	Constructing masonry Chamber 300 x 300 x 500 mm, inside with brick work in cement mortar 1:4 ( 1 cement: 4 fine sand ) for stop cock, with C. I. surface box 100 x 100 x 75 mm ( inside ) with hinged cover fixed in cement concrete slab 1:2:4 mix ( 1 cement: 2 fine sand : 4 graded stone aggregate 20 mm nominal size ) necessary excavation including refilling as necessary, foundation concrete 1:5:10 ( 1 cement : 5 fine sand : 10 graded stone aggregate 40 mm nominal size ) and inside plastering with cement mortar 1:3 ( 1 cement : 3 fine sand ) 12 mm thick finished with a floating coat of neat cement complete as per standard design ,					TSR 2017 19.32
	With 2nd class bricks.	No	5.00	1621.60	8108.00	19.32.1
23	Constructing masonry Chamber 90 x 90 x 100 cm, inside with brick work in cement mortar 1 : 4 ( 1 cement : 4 fine sand ) for sluice valve, with C.I. surface box 100 mm top diameter, 160 mm bottom diameter and 180 mm deep ( inside ) with chained lid and RCC top slab 1 : 2 : 4 mix ( 1 cement : 2 fine sand : 4 graded stone aggregate 20 mm nominal size ) necessary excavation foundation concrete 1 : 5 : 10 ( 1 cement : 5 fine sand : 10 graded stone aggregate 40 mm nominal size ) and inside plastering with cement mortar 1 : 3 ( 1 cement : 3 fine sand ) 12 mm thick finished with a floating coat of neat cement complete as per standard design, CPWD specification and direction of the Engineer - in - charge.					TSR 2017 19.34
	With 1st class bricks.	No	2.00	12647.30	25294.60	19.34.1
24	Providing and fixing C.I. double action air valve of approved quality with bolts, nuts, rubber insertions etc. complete as per chapter 20 of CPWD specification and direction of the Engineer - in - charge. ( The tail pieces, tapers etc if required will be paid separately ).					2.30

SL NO	DESCRIPTION		UNIT	QTY.	RATE	AMOUNT	DWS 2015 ITEM NO
	i	100 mm dia	No	2.00	6975.90	13951.80	iii
	ii	125 mm dia	No	2.00	8101.10	16202.20	iv
	iii.	150 mm dia	No	2.00	9274.50	18549.00	v
25	Providing and laying D.I. specials of class K - 12 suitable for mechanical jointing as per IS : 9523 as per chapter 20 of CPWD specification and direction of the Engineer - in - charge.						2.36
	i.	Upto 300 mm dia.	t	0.00	175262.30	0.00	i
26	Charges for push-on ( Tyton ) joints to centrifugally ( Spun ) cast iron pipes or ductile iron pipes including testing of joints and including the cost of rubber gasket as per CPWD specification and direction of the Engineer - in - charge.						2.37
	i	150 mm dia	Joints	5.00	98.90	494.50	iv
27	Providing and laying S & S Centrifugally Cast ( Spun ) Ductile Iron Class K-9 Pipes conforming to IS : 8329 as per CPWD specification and direction of the Engineer - in - charge.						2.41
	iii.	150 mm dia Ductile Iron Class K-9 pipes.	Metre	45.00	2058.30	92623.50	iii
28	Providing and fixing UPVC moulded 45 / 90 degree Elbow conforming to IS : 7834 (Part - 2 / 3 ) complete as per CPWD specification and direction of the Engineer - in - charge.						2.59
	i	110 mm dia	No.	6.00	373.30	2239.80	ii
	ii	140 mm dia	No.	6.00	474.30	2845.80	iii
29	Providing and fixing UPVC moulded 90 /45 degree Tee conforming to IS : 7834 (Part - 4 / 5 ) complete as per CPWD specification and direction of the Engineer - in - charge.						2.60
	i	110 mm dia	No.	4.00	561.00	2244.00	ii
	ii	140 mm dia	No.	4.00	786.70	3146.80	iii
30	Providing and fixing DI specials as per CPWD specification and direction of the Engineer - in - charge.						2.62
	A.	D.I. all socketted Bend 90 degree					A
	iii.	150 mm dia	No.	2.00	1804.80	3609.60	iii
31	Providing and laying S&S Centrifugally Cast (Spun) / Ductile Iron Pipes conforming to IS : 8329 as per CPWD specification and direction of the Engineer - in - charge.						2.41
	100 mm dia Ductile Iron Class K-7 pipes		Mtr.	26.50	1408.80	37333.20	ii
	150 mm dia Ductile Iron Class K-7 pipes		Mtr.	41.50	2058.30	85419.45	iii
					<b>TOTAL =</b>	<b>1729929.15</b>	

**LCS MUHURIGHAT AT BELONIA**

**PUMP HOUSE**

<b>SL NO</b>	<b>DESCRIPTION</b>	<b>UNIT</b>	<b>QUANTITY</b>	<b>RATE</b>	<b>AMOUNT</b>
1	Supply, delivery and fixing of Submersible pumps of 5 HP in bore wells including all specials for inlet and outlet to bore wells etc, installing and Erection of Pumps with all electrical, plumbing and Mechanical Items.	Nos	1.00	25000.00	25000.00
				<b>TOTAL =</b>	<b>25000.00</b>



## TRIPURA INDUSTRIAL DEVELOPMENT CORPORATION LIMITED

Name of work :- Extension of 3 phase, 4 wire under ground line from sub-station, supplying, installation of feeder pillars, LED Lights fitting, brackets etc. for providing of street lights in LCS Muhurighat, Belonia.

Sl. No.	Description of supply/ works	Unit	Qty.	Rate in Rs.	Amount in Rs.	Remarks
1	2	3	4	5	6	7
1.	Laying of one number PVC insulated and PVC sheathed / XLPE power cable of 1.1 KV grade of following size direct in ground including excavation, sand cushioning, protective covering and refilling the trench etc. as required.					
a)	Upto 35 sqmm.	Meter	2000	167.00	334000.00	DSR-2012
b)	Upto 95 sqmm.	-do-	500	173.00	86500.00	-do-
2.	Supplying and embedding following dia G.I. pipe (medium class) in pole collar/foundation (during casting)for cable entry including bending the pipe to the required shape complete as required.	-do-				
a)	40 mm dia	-do-	600	274.00	1,64,400.00	-do-
3.	Supplying and making indoor end termination with brass compression gland and aluminium lugs for following size of PVC insulated and PVC sheathed /XLPE aluminium conductor cable of 1.1kv grade as required.	No	400	262.00	1,04,800.00	-do-
4.	Earthing with G.I.earth pipe 4.5 metre long, 40mm dia including accessories and providing masonry enclosure with cover plate having locking arrangement and watering pipe etc. with charcoat/ coke and salt as required.	Set	3	3385.00	10,155.00	-do-
5.	Supplying of 650/1100 volts XLPE insulated aluminium conductor cable armoured/Un-armoured					
a)	4C, 16 sqmm. (Armoured)	Meter	1500	316.00	474000.00	Analysis Rate
b)	3.5C, 50 sqmm. (Armoured)	-do-	500	664.00	332000.00	-do-
c)	3.5C, 70 sqmm. (Armoured)	-do-	60	863.00	51,780.00	-do-
6.	Supplying of 650/1100volts XLPE insulated copper conductor cable unarmoured 3 core, 4 sqmm cable.	-do-	1000	231.00	231000.00	-do-

Contd....P/2.

1	2	3	4	5	6	7
7.	Supplying and fixing with existing pole bracket, testing and commissioning 45 watt LED Street light fitting with lamps, driver and all accessories including necessary connection as required with clamps for fixing the wires and pipe with existing ST/PCC poles but excluding the cost of connecting cable	No	80	9980.00	798400.00	
8.	Supplying and fixing with existing pole bracket, testing and commissioning 45 watt LED Street light fitting with lamps, driver and all accessories including necessary connection as required with clamps for fixing the wires and pipe with existing ST/PCC poles but excluding the cost of connecting cable	No	20	22,173.00	443460.00	
9.	Supplying and fixing of sintex equivalent junction box of 300 x 200 x 105 mm with 8 way connector & 2 Nos. 6 A DP MCB (b) supplying and laying of 3 Nos. 38 mm dia. PVC pipe suitable for XLPE cable entry and exit to junction box as required with necessary civil work for grouting of ST/PCC pole (600x600x600mm) i/c excavation and back filling, earthing etc. as required	No	80	3100.00	248000.00	
10.	Feeder pillar	No	1	49,276.00	49276.00	
11.	Supplying and fixing of street light bracket with two pairs MS clamps for fixing of LED light fixture made of 40mm dia, 3mtrs. Long G.I. pipe i/c supplying MS clamps, nuts, bolts, washers etc. as required.	No	80	1,655.00	132400.00	
				<b>Grand Total</b>	<b>3460171.00</b>	

**TRIPURA INDUSTRIAL DEVELOPMENT CORPORATION LIMITED (TIDCL)**

**Name of work :- Installation of 1 no 500 KVA,11/0433 KV Sub-station at LCS Muhurighat, Belonia, Tripura.**

Sl. No.	Description	Unit	Quantity	Rate in Rs.	Amount in Rs	Remark
1.	Supplying of :- Outdoor type 500 KVA,11/0.433-0.250, "ONAN" type transformer. Standard = (a) system voltage – 12 KV, (b) Rated voltage (HV) 11 kv, (c) Rated voltage (LV)0.433-0.250, (d) Phase- 3 phase, (e) Frequency – 50HZ subjected to fluctuation of + -5 % (f) Rated short circuit level- 13.1KV Fw 3 sec at 11 Kv, (g) Vector group- Dyn-11. The transformer materials shall confirming in all respect to the relevant Indian/ International standard specification with all latest amendments thereof.	No	1	579507.00	579507.00	
2.	11 kv, 200 amps, single brake G.O.S(one set of 3 units)	Set	1	7899.00	7899.00	-do-
3.	12 kv, D.O. fuse unit with fuse carrier system (one set of 3 units)	Set	1	5221.00	5221.00	-do-
4.	11 kv lightning arrester.	No	3	369.00	1107.00	-do-
5.	11 kv, 45 KM Disc isolator (ball & socket type)	No	3	240.60	722.00	-do-
6.	Fittings for 11 kv, 45 kn Dise isolator (ball & socket type)	No	6	349.58	2097.00	-do-
7.	11 kv pin isolator	No	6	52.98	318.00	-do-
8.	G.l. pin for 11 kv pin isolator	No	6	82.48	495.00	-do-
9.	75x40x6mm M.S. channel	Kg.	52	54.73	2846.00	-do-
10.	65x65x6mm M.S. angle	Kg.	38	54.73	2080.00	-do-
11.	M.S. clamp for fixing of cross arm made of 50x6mm M.S. flat	No	12	70.00	840.00	-do-
12.	11mtrs. Long S.T. pole	No	2	13582.65	27165.00	-do-
13.	Stay set complete with straining screw, stay isolater, stay road, stay plate etc.	Set	2	828.98	1658.00	-do-
14.	Nuts and bolts 16 mm dia, 90 mm long	Kg.	5	68.71	344.00	-do-
15.	1.1kv , 240sq mm pvc isolater and pvc sheathed aluminium conductor cable	Mtr.	75	192.95	14471.00	-do-
16.	1.1kv, 70 sqmm pvc isolated and pvc sheathed aluminium conductor cable	Mtr.	30	65.62	1969.00	-do-

Contd...P/2

Sl. No.	Description	Unit	Quantity	Rate in Rs.	Amount in Rs	Remark
17.	G.I standard wire 7/2.5mm	Kg.	10	81.37	814.00	Rate approved by TIDC
				Sub-total(A)	649563.00	
18.	Earthing with G.I. pipe 4.5 mtrs long, 40 mm dia. Including accessories, and providing masonry enclosure with cover plate having locking arrangement and watering pipe etc. with charcoal and salt as required.	Set	4	3385	13540.00	-do-
19.	Supplying, insulation, testing & commissioning of free standing, floor mounted out door type, air insulated, totally enclosed vermin proof dead front, compartmentalized, cubicle type, 2mm thick sheet steel enclosure panel suitable for use on 415 v, 3 phase,4 wire, 50 hz A.C. system, including circuit breaker/ S.F. unit, high conductivity TP & N Aluminium bus-bars, risers, extended bush-bars for cable connections, outgoing circuits breakers instrument panel, CTs outgoing feeder terminals and incoming cable compartment. The incoming and outgoing functional units shall be arranged in multi tier formation to provide a complete with switches & circuit breakers of following ratings, interconnections, G.I. earth bus bar of adequate size covering the entire length of switch board with drilled holes, G.I. bolts, nuts, washers, etc. The cubicle should be painted with two (2) Coats of synthetic paint over two(2) coats of zinc chromate primer. The complete fabricated construction shall be done as per detailed specification and conforming to relevant name plate of panels, danger board, incoming and outgoing feeders with ampere rating of switches/MCCBs/MCBs are to be fixed fix up on front doors above or below respective switches. Approval of manufacturers drawings from consultants /employers is required before commencing manufacture and panel should tested in presence of consultants/employers engineer at manufacturers premises before dispatch to the site including base.	No	1	435413.00	435413.00	-do-

Sl. No.	Description	Unit	Quantity	Rate in Rs.	Amount in Rs	Remark
	<p>Main Power Panel</p> <p>Incoming : 415 v, 800A, 36 KA, 4 pole MCCB (Relay range 320-400 (A) – 1 No.</p> <p>Multifunction metre with selector switches to observe current and voltage, energy PF etc. with set of 400/1A CTs as required.</p> <p>3 Nos phase indication lamps (RYB)</p> <p>3 Nos of Protective fuses.</p> <p>SLEEVED TPN ALUMINIUM BUS BARS :-</p> <p>(1) 100 mm x 10 mm for phases.</p> <p>(2) 50 mm x 6 mm for neutral.</p> <p>G.I. Earth bus-bar</p> <p>25 mm x6 mm covering the length of the panel.</p> <p>OUT GOING :-</p> <p>415 V, 250 A, 36 KA, 4 pole MCCBs with relay range 200-250A-4 nos ( L&amp;T/ LEGRAND make ).</p> <p>415 volt, 100A, 25KA, 4 Pole MCCB with realy range 80-100A-2 nos ( L&amp;T/ LEGRAND make ).</p> <p>Multifunctional digital weather proof time switch Astorex – D-22- 1 no (LEGRANDE or equivalent make)</p>					
				Sub-total(B)	1098516.00	
				Adding 35 % for erection testing & commissioning on Sub-Total(A)	227348.00	
				<b>Grand Total</b>	<b>13,25,864.00</b>	

**Rupees Thirteen Lac twenty five thousand eight hundred sixty four only.**

**TRIPURA INDUSTRIAL DEVELOPMENT CORPORATION LIMITED (TIDCL)**

**NAME OF WORK :- PROVIDING ELECTRICAL INSTALLATION IN THE ADMINSTRATIVE BUILDING OF LCS MUHURIGHAT,BELONIA,TRIPURA**

Sl. No.	DSR	Description	Make	Unit	Qty.	Rate in Rs.		Amount in Rs.		Remarks
						DSR	Non - DSR	DSR	Non - DSR	
1.	1.8	Wring for light point / Fan point/ Exhaust fan / Call bell point with1.5 sq.mm FR PVC insulated copper conductor single core cable in surface/recessed medium class PVC conduit, with piano type switch, phenolic laminated sheet, suitable size M.S. box and earthing the point with 1.5 sq.mm FR PVC insulated copper conductor single core cable etc. as required.	Phenolex/ Havels/ Policab/ Mescab							
	1.8.1	Group-C		Point	240	619.00		148560.00		DSR-2012
2.	1.12	Wring for light /power plug with 2x4 sq.mm FR PVC insulated copper conductor single core cable in surface/recessed medium class PVC conduit along with 1 no. 4 sq.mm FR PVC insulated copper conductor single core cable for loop earthing as required.	-do-	Meter	80	162.00		12960.00		DSR-2012
3.	1.14	Wring for circuit /submain wring along with earth wire with the following size of FR PVC insulated copper conductor single core cable in surface/ recessed medium class PVC conduit as required.	-do-	Meter						-do-
	1.14.2	2x2.5 sqmm + 1x2.5 sqmm earth wire		Meter	1200	198.00		237600.00		
	1.14.3	2x4 sqmm + 1x4 sqmm earth wire		Meter	360	228.00		82080.00		
	1.14.9	4x6 sqmm + 1x6 sqmm earth wire		Meter	180	483.00		86940.00		
	1.14.10	4x10 sqmm + 1x10 sqmm earth wire		Meter	160	774.00		123840.00		
4	1.23	Supplying and fixing following pino type switch/ socket on the existing switchbox/ cover including connection etc. as required.	L & T/ Anchere/ Havelle							-do-
	1.23.1	5/6 amps switch	-do-	Each	40	29.50		1100.80		-do-
	1.23.4	3 pin 5/6 amp socket outlet	-do-	Each	40	35.50		1400.20		-do-
5.	1.24	Supplying and fixing following modular switch/ socket on the existing modular plate & switchbox including connection but excluding modular plate etc. as required.								-do-
	1.24.6	Telephone socket outlet	-do-	Each	16	89.00		1424.00		-do-
	1.24.8	Bell push	-do-	Each	16	98.50		1576.00		-do-
6.	1.25	Supplying and fixing stepped type electronic fan regulator on the existing modular plate & switchbox including connections but excluding modular plate etc. as required.	L & T/ Anchere/ Havelle	Each	80	322.00		25760.00		DSR-2012

Contd...P/2.

Sl. No.	DSR	Description	Make	Unit	Qty.	Rate in Rs.		Amount in Rs.		Remarks
						DSR	Non - DSR	DSR	Non - DSR	
7.	1.22	Supplying and fixing metal box of following sizes(nominal size) on surface or recess with suitable sizeof phenolic laminated sheet cover in front including painting etc. as required.	-do-							
	1.22.1	75 mm x 75mm x60mm deep		Each	160	72.00		11520.00		DSR-2012
	1.22.5	180mm x 100 mm x 60mm deep		Each	80	108.00		8640.00		
	1.22.12	200mm x 250mm x 100 mm deep		Each	40	239.00		9560.00		
	1.22.16	250mm x 300mm x 100 mmdeep		Each	24	310.00		4440.00		
8.	1.30	Supplying and fixing metal box of 180mm x 100 mm x 60 mm deep (normal size) on surface or in recess with suitable size of phenolic laminated sheet cover in front including providing and fixing 6 pin and 15/16 amps socket outlet and 15/16 amps pino type switch, connection, painting etc. as required.		Each	16	225.00		3600.00		
9.	1.33	Supplying and fixing 3 pin,5 amps celling rose on theexisting junction box / wooden blok including connection etc. as required.		Each	160	34.00		5440.00		
10.	1.34	Supplying and fixing brass batten/ angle holder including connection etc. as required.		Each	40	63.00		2520.00		
11.	1.38	Supplying and fixing call bell/ buzzer suitable for single phase 230 volts, complete as required.	Approved make	Each	16	54.00		864.00		
12.	1.41	Installation, testing and commissioning of pre-wired, fluorescent fitting/ compect fluorescent fitting of all types, with all accessories and tube etc. directly oncelling/ wall, including connection with 1.5 sq mm FR PVC insulated, copper conductor, single core cable and earthing etc. as required.	-do-	Each	80	69.5		5560.00		
13.	1.42	Installation, testing and commissioning of pre-wired, fluorescent fitting/ compect fluorescent fitting of all types, with all accessories and tube etc.including supply and fixing ball and socket arrangement 2 no. Down rods of 20mm diax 1.6mm thick stell conduit up to 30cm length,painting and wiring the down roads and connection with 1.5 sq mm FR PVC insulated, copper conductor, single core cable and earthing etc. as required.	Approved make	Each	80	195		15600.00		DSR-2012

Sl. No.	DSR	Description	Make	Unit	Qty.	Rate in Rs.		Amount in Rs.		Remarks
						DSR	Non - DSR	DSR	Non - DSR	
14.	1.44	Installation, testing and commissioning of ceiling Fan , including wiring the down rods of standard length (upto 30cm) with 1.5 sq mm FR PVC insulated, copper conductor, single core cable and earthing etc. as required.		Each	50	1300		65000.00		-do-
15.	1.45	Installation, testing and commissioning of ceiling Fan , including wiring the down rods of standard length (upto 30cm) with 1.5 sq mm FR PVC insulated, copper conductor, single core cable including providing and fixing phenolic laminated sheet cover on the fan box etc. as required.		Each	20	2400		48000.00		-do-
16.	1.50	Installation exhaust fan in the existing opening, including making good the damage, connection, testing,commissioning etc. as required.								-do-
	1.50.1	Upto 450 mm sweep		Each	16	163.00		2608.00		
17.	1.51	Extra for fixing thelouvers / shutters complete with frame for a exhaust fan of all sizes.		Each	16	68.50		1096.00		-do-
18.	2.2	Providing and fixing following rating and breaking capacity TPK MCCB in existing cubicle panel board including drilling holes in cubicle panel making connections etc. as required.	L & T Legrand							-do-
	2.2.1	100 Amp 16 / KA		Each	4	2801.00		11204.00		
19.	2.4	Supplying and fixing following way, horizontal type three pole and neutral, sheet, MCB distribution board, 415 volts, on surface/ recess, complete with tinned copper bus bar, netural bus bar, earth bar, din bsr, interconnections, powder painted including earthing etc. as required ( But without MCB/RCCB/Isolator)	-do-							-do-
	2.4.4	4 way ( 4 + 12 ), double door		Each	8	1654.00		13232.00		
20.	2.10	Supplying and fixing 5 amps to 32 amps rating, 240/415 volts, "C" curve, mainiature circuit breker suitable for inductive load offollowing poles in the existing MCB DB complete with connections, testing and commissioning etc.as required.	L & T Legrand							DSR-2012
	2.10.1	Single pole		Each	96	141.00		13536.00		
21.	2.13	Supplying and fixing following rating four pole 415 volts, isolator in the existing MCB DB complete with connections, testing and commissioning etc. as required.	Any approved make							



2.13.1	40 amps		Each	4	554.00		2216.00		
2.13.2	63 amps		-do-	4	563.00		2252		

Contd...P/4.

Page/4.

Sl. No.	DSR	Description	Make	Unit	Qty.	Rate in Rs.		Amount in Rs.		Remarks
						DSR	Non - DSR	DSR	Non - DSR	
22.	2.18	Supplying and fixing 20 amps 240 volts, TPN industrial type, socket outlet, with 2 pole and earth, metal enclosed plug top along with 20 amps "C" curve, SP, MCB, in sheet steel enclosure, on surface or in recess, with chained metal cover for the socket outlet complete with connections, testing and commissioning etc.as required.	L & T Legrand	-do-	16	693.00		11088.00		-do-
23.	2.21	Providing and fixing MV. Danger notice plate of 200 mm x 150 mm, made of mild steel, at least 2mm thick and vitreous enameled white on both sides and with inscription in single red colour on front side as required.	Any approved make	-do-	4	121.00		484.00		-do-
24.	5.2	Earthing with G.I. earth pipe 4.5 metre long, 40mm dia including accessories and providing masonry enclosure with cover plate having locking arrangement and watering pipe etc. with charcoal/coke and salt as required.	TATA/ Zindal	-do-	8	3385.00		27080.00		-do-
25.	5.9	Supplying and laying 25mm x 5mm G.I. strip at 0.50 meter below ground as strips earthelectrode, including connection/ terminating with G.I. nut, bolt, spring, washer etc. as required ( jointing shall be done by overlapping and with 2 sets of G.I. nut bolt & spring washer spaced at 50mm )	TISCO/ ISCO/ SAIL	-do-	80	97.50		7800		-do-
26.	7.1	Laying of one number PVC insulated and PVC sheated / x LPE power cable of 1.1kv grade of following size direct in ground including excavation, sand cushion in, protective covering and refilling the trench etc.as required.	Gloster/ Neeco/ Havels							DSR-2012
	7.1.1	Upto 35sq. mm		Metre	240	177.00		42480.00		
27.	Non shedule	Supply of 4 core, 1.1kv grade 16 amps x LPE Aluminium conductor cable.		-do-	240		234.00		56160.00	Market price
28.	-d0-	Supply and fixing of G.I. pipe with S.T. Pole and other point by necessary clamps, nuts & bolts etc. as required (Medium)	TATA/ ZINDAL	-do-	32.22		151.30		5026.00	-do-

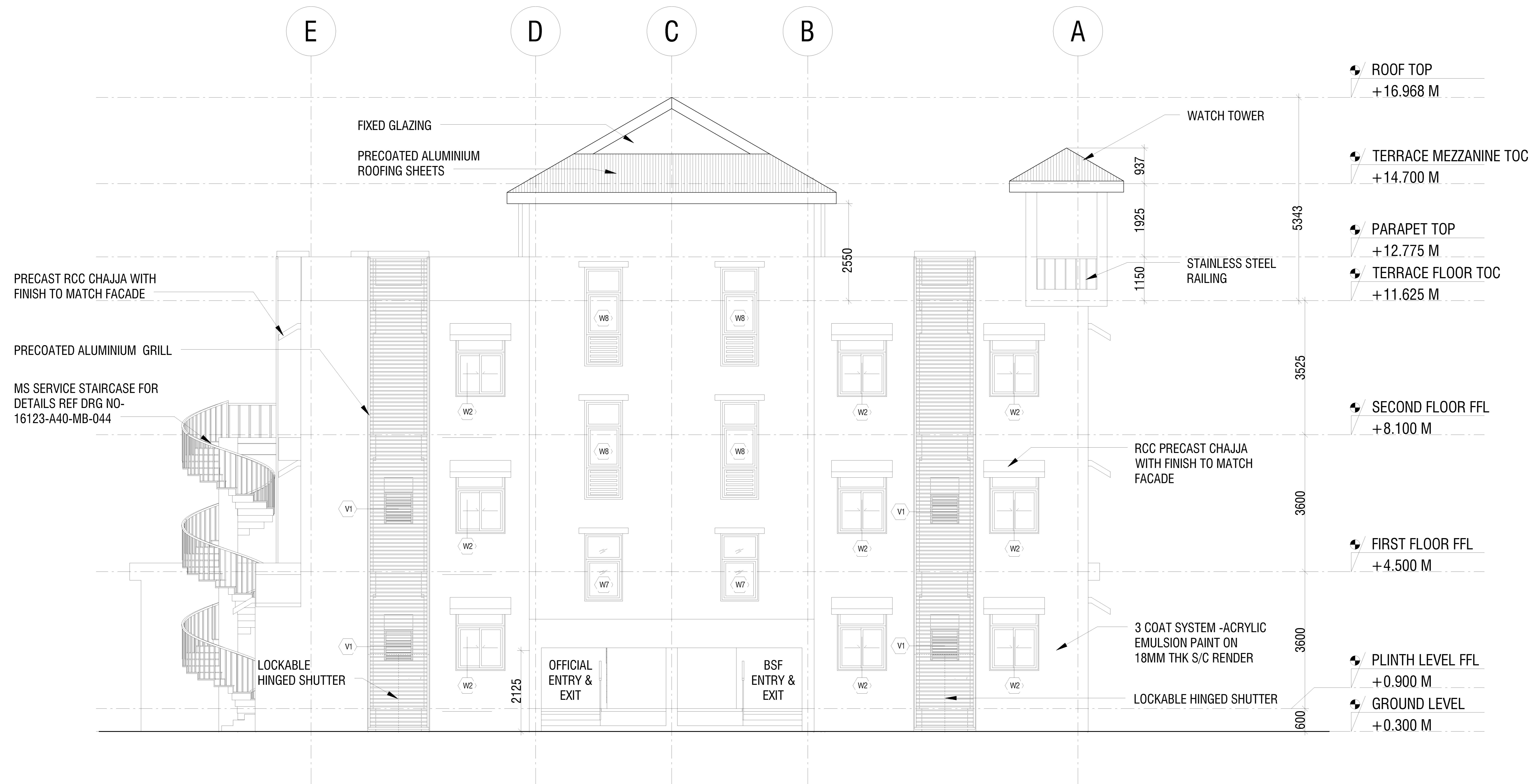
29.	-do-	Supply of 1400 mm sweep A.C ceiling Fan	CGL/Havels/ Bajaj	Each	80		2000.00		1,60,000.00	-do-
30.	- Non shedule do-	Supply of Exhaust Fan 300 mm sweep including making arrangement for hole etc. (Excluding fitting & fixing )	CGL or its equivalent	-do-	16		2675		42800.00	-do-

Contd...P/5.

Page/5.

Sl. No.	DSR	Description	Make	Unit	Qty.	Rate in Rs.		Amount in Rs.		Remarks
						DSR	Non - DSR	DSR	Non - DSR	
31.	-do-	Supplying of decorative compact energy efficient luminarie with CRCT body and replaceable electronics balast 1x 28 wall TSFTL code No. LHDT0U28039 of Havells	CGL/Havels/ Philips	-do-	80		590.00		47200.00	- Market price
32.	-do-	Fabrication, Supplying, Installation, testing of 4' x 3' wall mounted, indoor type air insulated totally enclosed vimin proof dead front, cubical type made of 1.6mm thick sheet steel enclose for covering MCCB, Bus-bar and ACDB etc. with earthing and locking arrangement etc. as reqd. As per direction and approved by the Engineer-in-charge before fabrication and approval of drawing.		-do-	4		3500.00		14000.00	-do-
33.	-do-	Supplying and fitting and TPN Bus bar 4 way 100 Amps with spray printing local made as direction and approved and direction of Engineer-in-charge Cat No. :- IHBB010004 of Havells	Havels or equivalent	-do-	4		8590.00		34360.00	Market price
34.	-do-	Supplying and fixing of round shaped recessed compact horizontal, adjustment lamps holder down lighter with centre frosted lense suitable for 1x15 watt retrofit CFL with lamp code no. LHOC49115399 of Havels or equivalent.	Havels/ Philips/ CGL	-do-	20		510.00		10200.00	Market price
35.		Supplying , instillation, testing and commissioning of 1.5 Ton air conditioner	Voltage/Godreg / Sumsung	No	5		45650.00		228250.00	-do-
36.		Supplying , installation, testing and commissioning of 20 Ltrs. Gezer	Havels/CGL	No	4		8500.00		34000.00	-do-
37.		Supplying , installation, testing and commissioning of L.T. panel	Local fabricated with provision of renown Co. Like L&T/ Legrand	No	1		2,80,600/-		2,80,600.00	-do-
				Total					1022952.00	9,08,596.00

Grand total = DSR + Non DSR = Rs. 1022952.00+ Rs. 908596.00 = Rs. 19,31,548.00



# NORTH SIDE ELEVATION

**FOR TENDER**

LEGEND

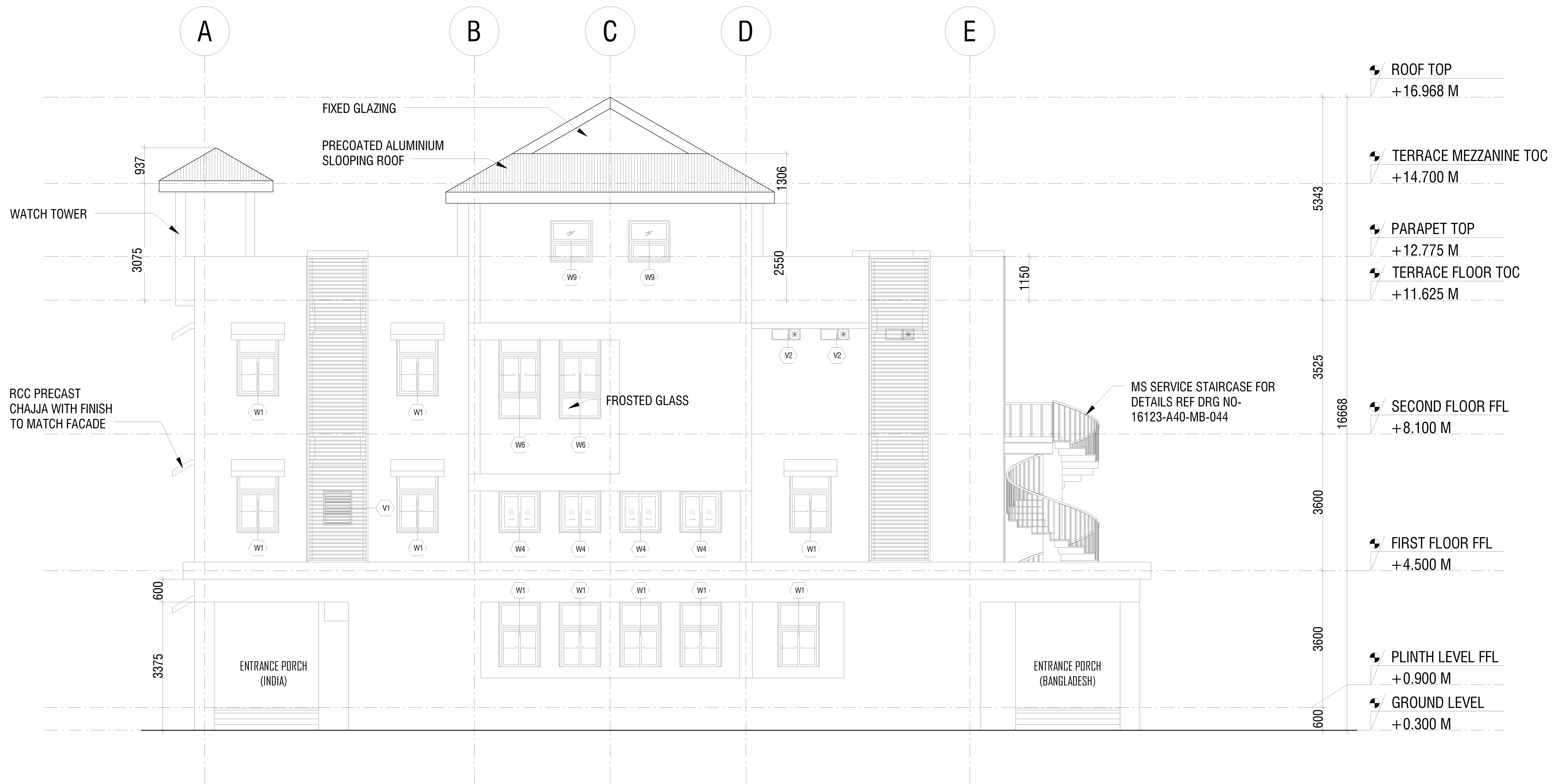
NOTES

NOTES	
This Drawing is the property of IL&FS CDI Ltd and is not to be produced, copied or handed over to a third party or used for any purpose other than for which it is meant	
<b>SCALE</b>	
NTS ~A2	

DRAWING DETAILS	
Designed ...:	Date
Drawn .....	11-10-2018
Checked .....	Sheet Size
Approved :	A2

Client	TRIPURA INDUSTRIAL DEVELOPMENT CORPORATION	
Project	LAND CUSTOMS STATION - MUHURIGHAT	
Drawing Title	MAIN BUILDING,GA- NORTH SIDE ELEVATION	
Drawing Number	ICDI/TIDC/2018/LCS-NS-ELE/006	Rev 00

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# SOUTH SIDE ELEVATION

**FOR TENDER**

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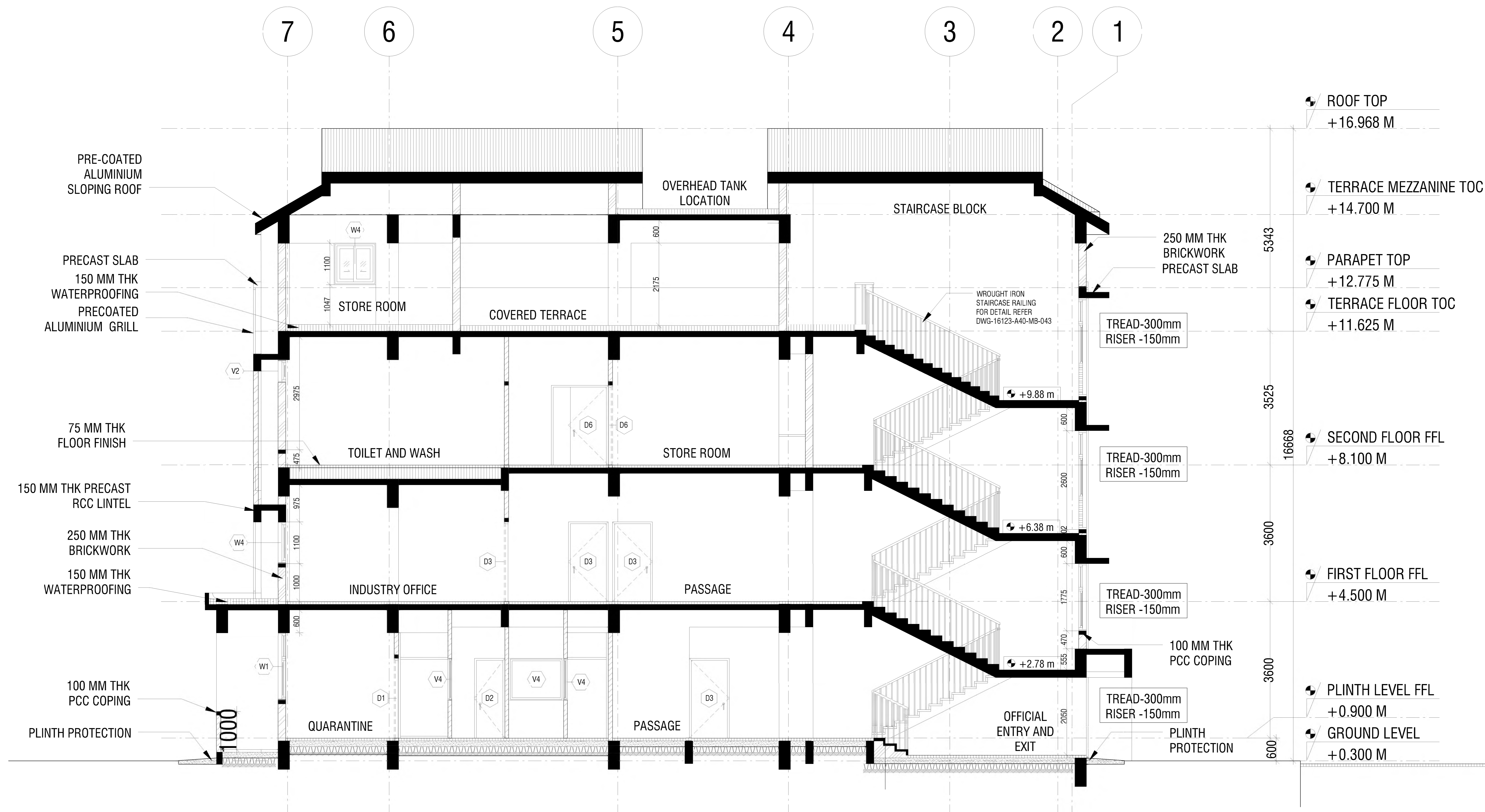
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<b>SCALE</b> NTS ~A2

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Client	TRIPURA INDUSTRIAL DEVELOPMENT CORPORATION	
Project	LAND CUSTOMS STATION - MUHURIGHAT	
Drawing Title	MAIN BUILDING,GA- SOUTH SIDE ELEVATION	
Drawing Number	ICDI/TIDC/2018/LCS-SS-ELE/005	Rev 00

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# SECTION -AA'

**FOR TENDER**

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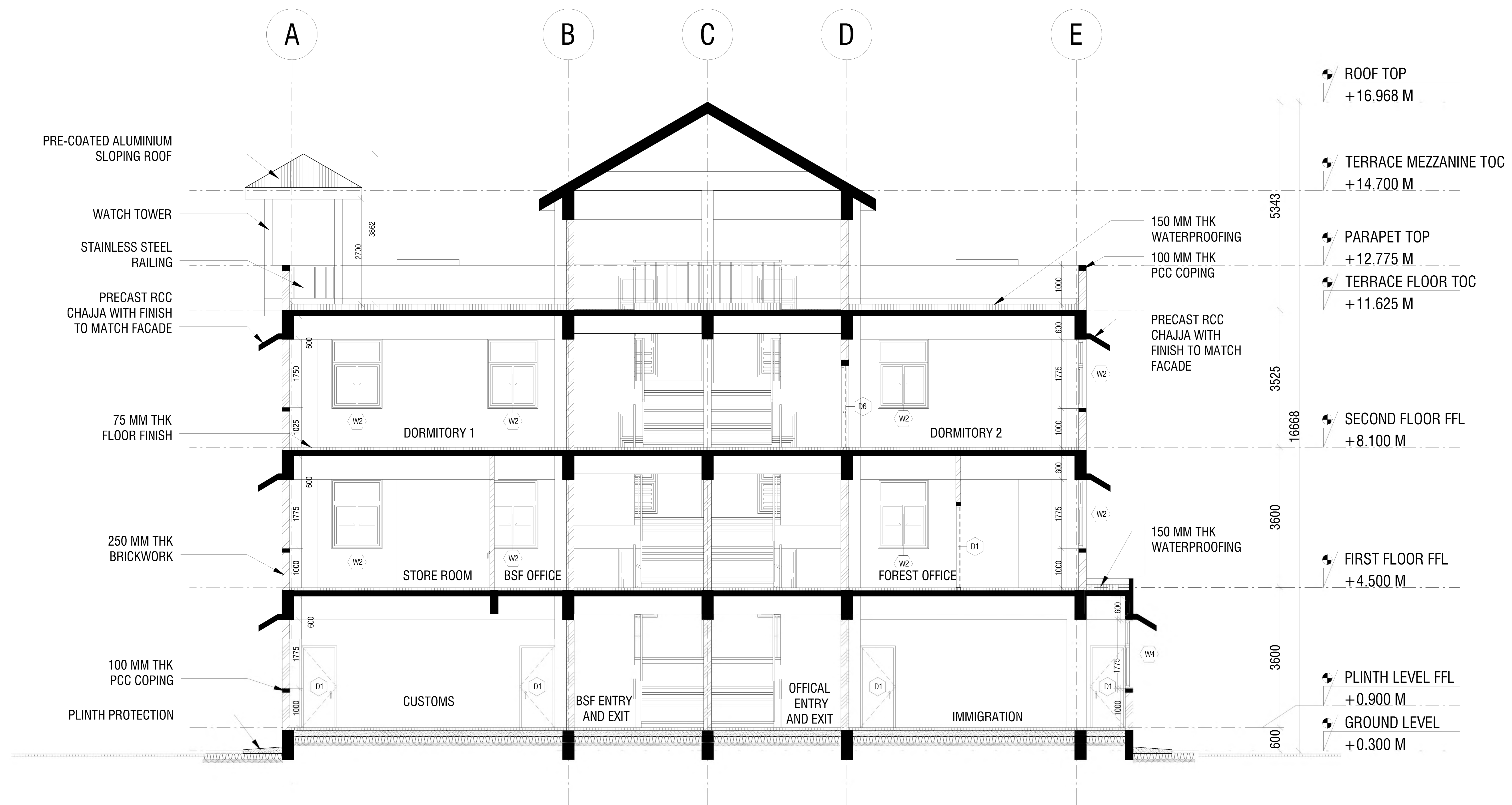
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<b>SCALE</b> NTS ~A2

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Client	TRIPURA INDUSTRIAL DEVELOPMENT CORPORATION
Project	LAND CUSTOMS STATION - MUHURIGHAT
Drawing Title	MAIN BUILDING,GA- SECTION -AA'
Drawing Number	ICDI/TIDC/2018/LCS-SEC-AA/007
Rev	00

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# SECTION -BB'

**FOR TENDER**

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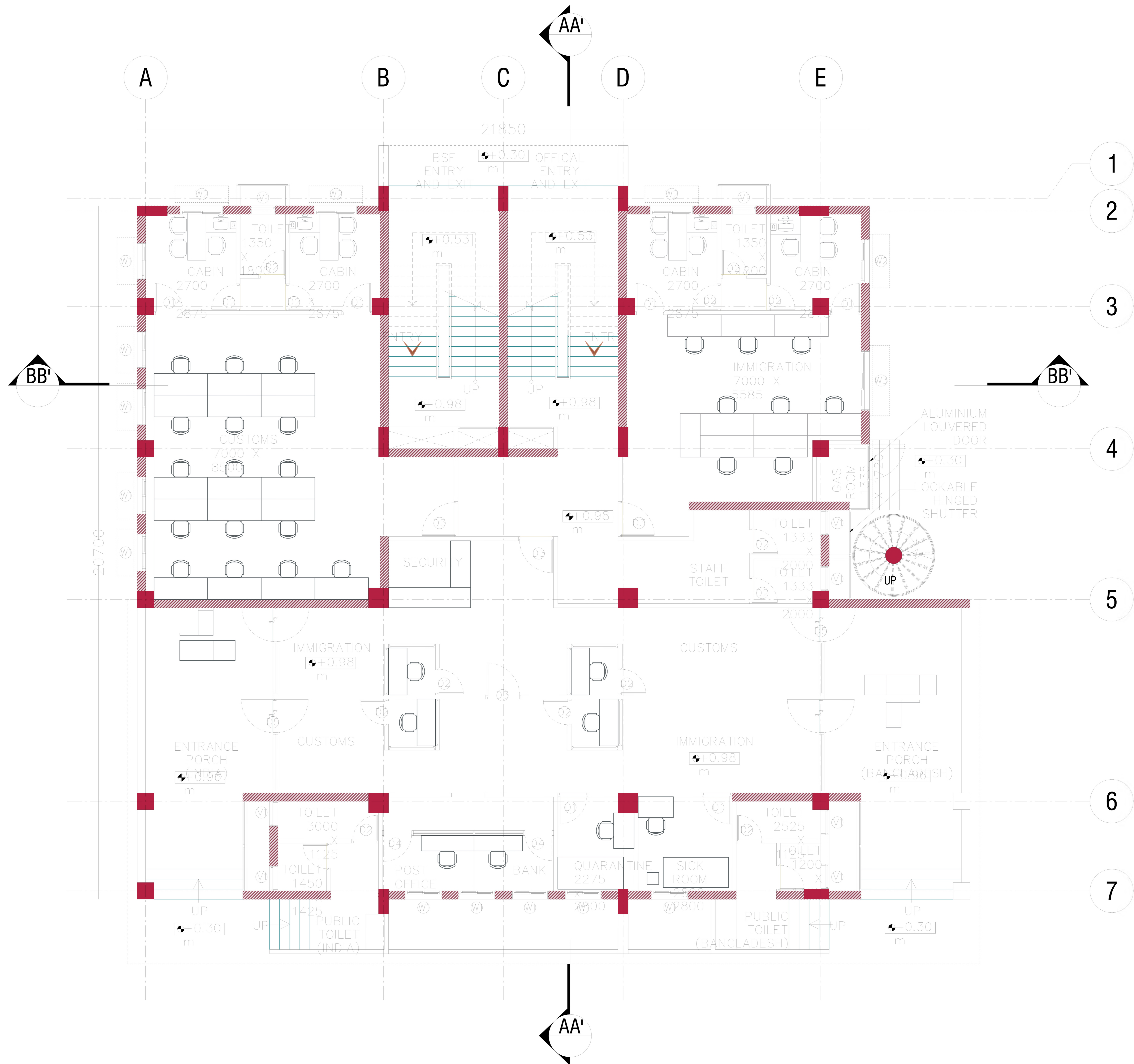
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Client	TRIPURA INDUSTRIAL DEVELOPMENT CORPORATION
Project	LAND CUSTOMS STATION - MUHURIGHAT
Drawing Title	MAIN BUILDING,GA- SECTION -BB'
Drawing Number	ICDI/TIDC/2018/LCS-SEC-BB'/008
Rev	00

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**FOR TENDER**

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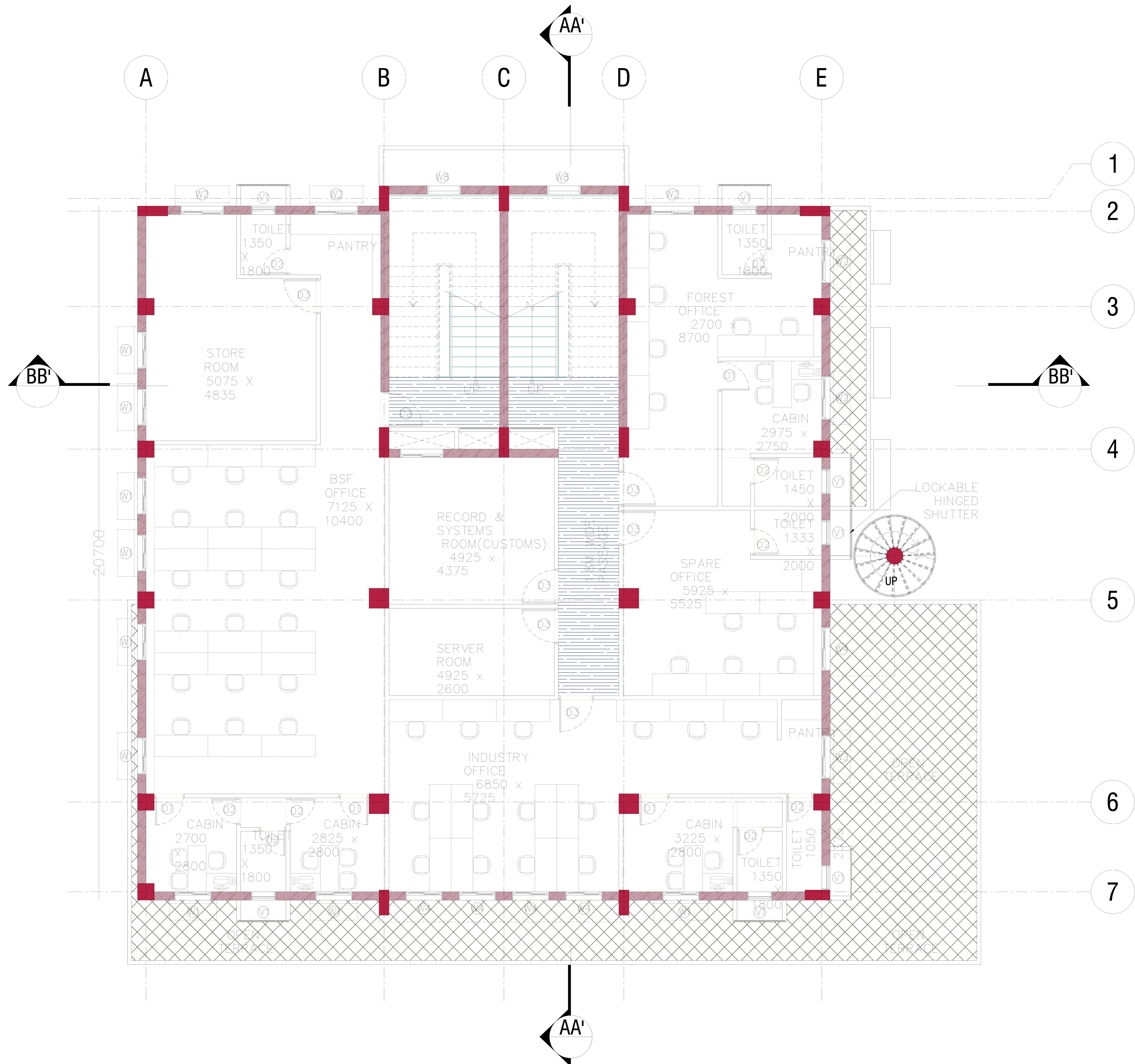
NOTES
1.MAIN WALL _ 250MM THICK
2.PARTITION WALL _ 125MM THICK

NOTES
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Client	TRIPURA INDUSTRIAL DEVELOPMENT CORPORATION	
Project	LAND CUSTOMS STATION - MUHURIGHAT	
Drawing Title	MAIN BUILDING,GA-GROUND FLOOR PLAN	
Drawing Number	ICDI/TIDC/2018/LCS-GF-PL/001	Rev 00


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**FOR TENDER**

LEGEND

NOTES
1.MAIN WALL _ 250MM THICK
2.PARTITION WALL _ 125MM THICK

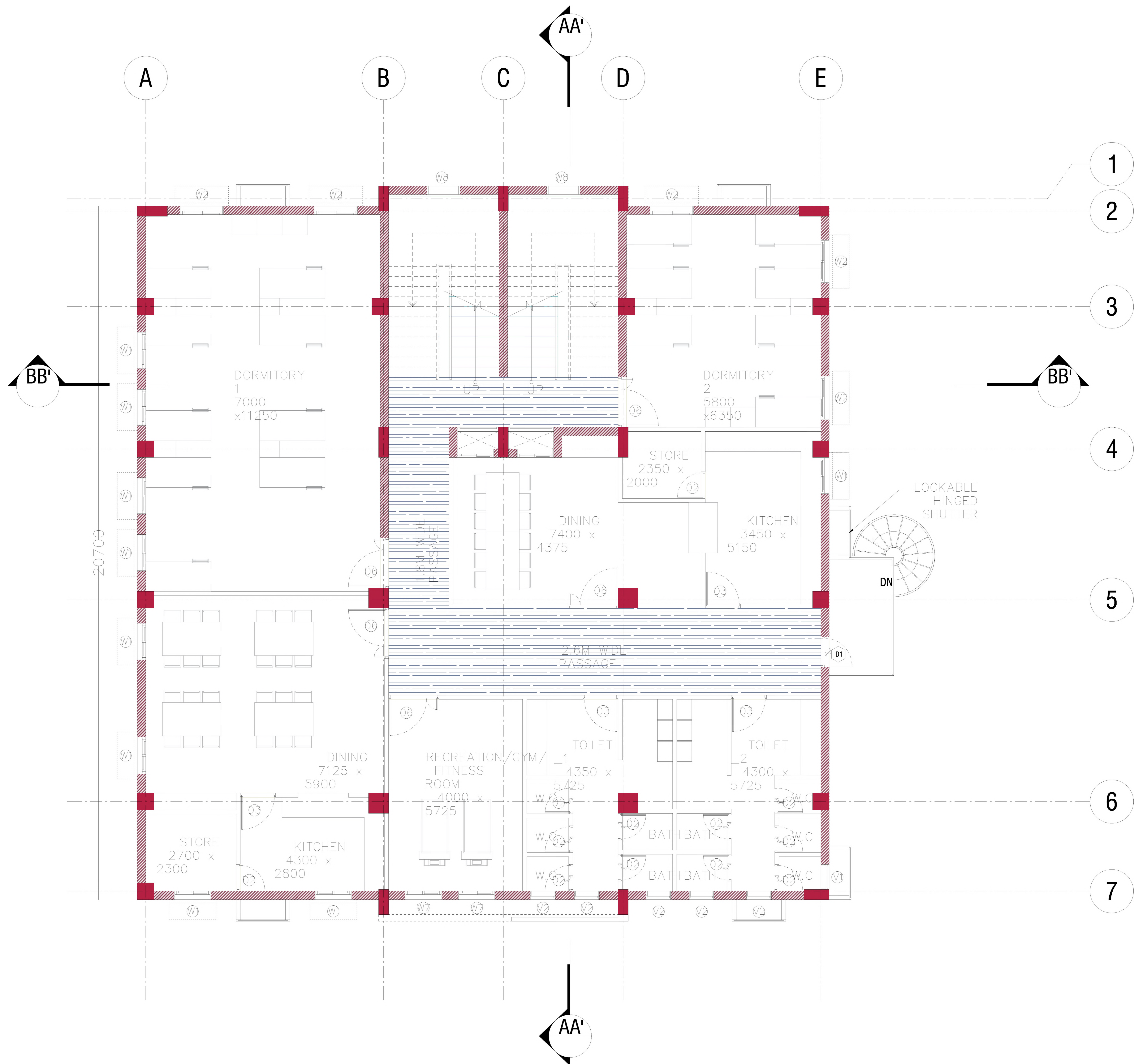
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Approved :	A2

Client	TRIPURA INDUSTRIAL DEVELOPMENT CORPORATION	
Project	LAND CUSTOMS STATION - MUHURIGHAT	
Drawing Title	MAIN BUILDING,GA-FIRST FLOOR PLAN	
Drawing Number	ICDI/TIDC/2018/LCS-FF-PL/002	Rev 00

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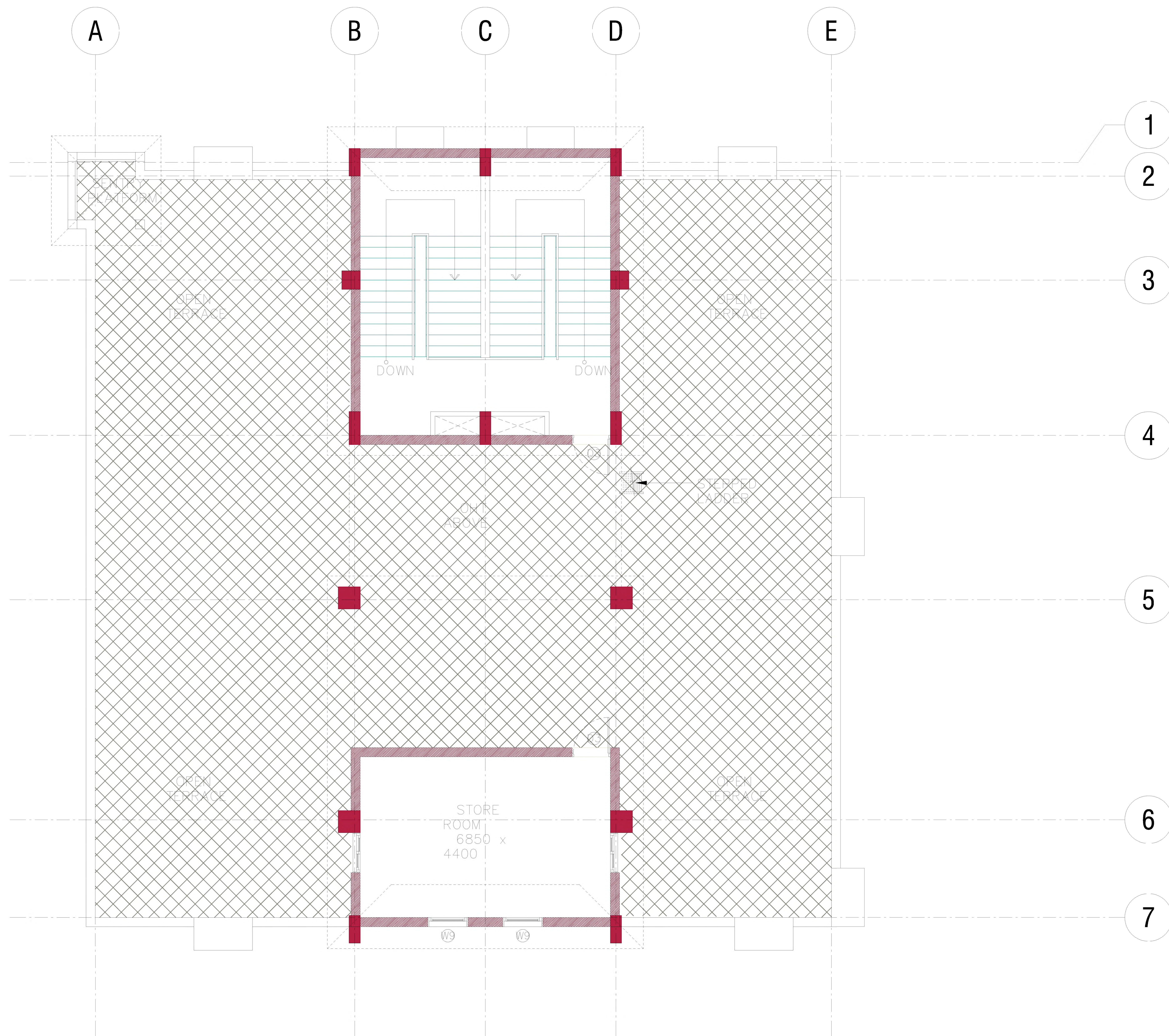
NOTES
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2.PARTITION WALL _ 125MM THICK

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<b>SCALE</b> NTS ~A2

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Approved :	A2

Client	TRIPURA INDUSTRIAL DEVELOPMENT CORPORATION	
Project	LAND CUSTOMS STATION - MUHURIGHAT	
Drawing Title	MAIN BUILDING,GA-SECOND FLOOR PLAN	
Drawing Number	ICDI/TIDC/2018/LCS-SF-PL/003	Rev 00


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**FOR TENDER**

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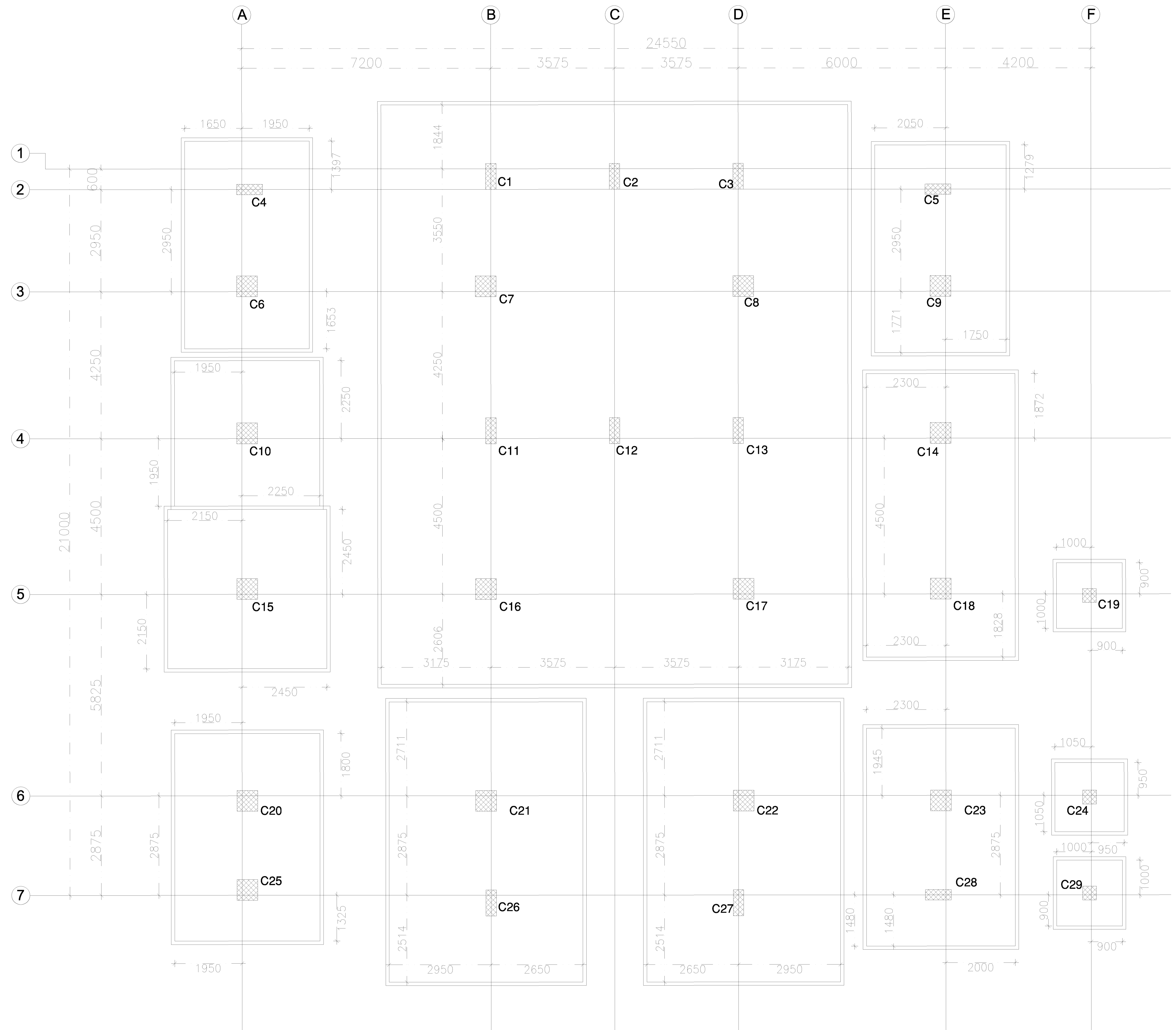
NOTES
1.MAIN WALL _ 250MM THICK
2.PARTITION WALL _ 125MM THICK

NOTES
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<b>SCALE</b> NTS ~A2


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Approved :	A2

Client	TRIPURA INDUSTRIAL DEVELOPMENT CORPORATION	
Project	LAND CUSTOMS STATION - MUHURIGHAT	
Drawing Title	MAIN BUILDING,GA-TERRACE FLOOR PLAN	
Drawing Number	ICDI/TIDC/2018/LCS-TF-PL/004	Rev 00

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FOOTING LAYOUT

FOOTING SCHEDULE:

FOOTING NUMBERS	COLUMN NUMBERS	FOOTING TYPE	FOOTING DIMENSION			FOOTING REINFORCEMENT			
			L	B	D	BOTTOM		TOP	
						ALONG B	ALONG L	ALONG B	ALONG L
CF1	C20,C25	Pad	6000	3600	600	T10@150 C/C	T10@150 C/C	T10@150 C/C	T10@150 C/C
CF2	C1,C2,C3,C7,C8,C11,C12,C13,C16,C17	Pad	13500	16750	750	T12@100 C/C	T12@100 C/C	T10@150 C/C	T10@150 C/C
CF3	C5,C9	Pad	6000	3800	550	T10@100 C/C	T10@100 C/C	T10@150 C/C	T10@150 C/C
CF4	C14,C18	Pad	8200	4300	600	T12@140 C/C	T12@140 C/C	T10@150 C/C	T10@150 C/C
CF5	C20,C25	Pad	6000	4200	600	T12@150 C/C	T12@150 C/C	T10@150 C/C	T10@150 C/C
CF6	C21,C26	Pad	8100	5600	600	T12@125 C/C	T12@125 C/C	T10@150 C/C	T10@150 C/C
CF7	C22,C27	Pad	8100	5600	600	T12@125 C/C	T12@125 C/C	T10@150 C/C	T10@150 C/C
F1	C10	Pad	4200	4200	600	T10@120 C/C	T10@110 C/C	--	--
F2	C15	Pad	4600	4600	600	T12@100 C/C	T12@125 C/C	--	--
F3	C19	Pad	1900	1900	475	T10@150 C/C	T10@150 C/C	T10@150 C/C	T10@150 C/C
F4	C24	Pad	2000	2000	450	T10@150 C/C	T10@150 C/C	T10@150 C/C	T10@150 C/C
F5	C29	Pad	1900	1900	450	T10@150 C/C	T10@150 C/C	T10@150 C/C	T10@150 C/C

- NOTES:**
- All Dimensions are in 'mm' & Levels are in meters.
  - Grade of Concrete shall be M25
  - Clear cover to main reinforcement shall be as follows:  
a) Walls = 20 mm, b) Slab = 20 mm, c) Footings = 50 mm  
d) Beams = 25 mm e) Column = 40mm.
  - All Laps Shall be 50 times Ø of bar & shall be staggered, unless otherwise specified
  - P.C.C leveling Course M10(1:3:6) bellow Footings and Plinth Beam
  - 'T' denotes HYSD Bars (Fe500)
  - 70kN/sq.m SBC is considered at a depth of 2.0m below existing Ground Level ensure the same before execution.

This Drawing is the property of Das Consultants and is not to be produced, copied or handed over to a third party or used for any purpose other than for which it is meant

Scale 1:100

**STRUCTURAL CONSULTANTS:**  
**M/s. DAS CONSULTANTS**  
FLAT NO.:1, NO.:30, 6TH MAIN ROAD,  
LAKSHMI NAGAR EXTENSION  
PORUR, CHENNAI - 600 116  
TELEFAX - +91-44-24764416  
email - dasconsultants@gmail.com  
web - dasconsultants.net

**DRAWING DETAILS**  
Designed .....:VENU  
Date 11-10-2018  
Drawn .....:VENKAT  
Sheet Size A3  
Checked .....:DAS  
Approved :-DAS

**Client**  
**TRIPURA INDUSTRIAL DEVELOPMENT CORPORATION**  
Project **LAND CUSTOMS STATION - MUHURIGHAT**  
Drawing Title **FOOTING LAYOUT DETAILS**  
Drawing Number **ICDI/STR-019** Rev 00

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IL&FS Cluster Development Initiative Limited

FOR TENDER



**COLUMN LAYOUT**

FOR TENDER

**NOTES:**  
 1. All Dimensions are in 'mm' & Levels are in meters.  
 2. Grade of Concrete shall be M25  
 3. Clear cover to main reinforcement shall be as follows:  
 a) Walls = 20 mm, b) Slab = 20 mm, C) Footings = 50 mm  
 d) Beams = 25 mm e) Column = 40mm.  
 4. All Laps Shall be 50 times  $\phi$  of bar & shall be staggered, unless otherwise specified  
 5. P.C.C leveling Course M10(1:3:6) bellow Footings and Plinth Beam  
 6. 'T' denotes HYSD Bars (Fe500)  
 7. 70kN/sq.m SBC is considered at a depth of 2.0m below existing Ground Level ensure the same before execution

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 Scale 1:100

**STRUCTURAL CONSULTANTS:**  
**M/s. DAS CONSULTANTS**  
 FLAT NO.:1, NO.:30, 6TH MAIN ROAD, LAKSHMI NAGAR EXTENSION PORUR, CHENNAI - 600 116 TELEFAX - +91-44-24764416 email - dasconsultants@gmail.com web - dasconsultants.net

**DRAWING DETAILS**  
 Designed ....:VENU  
 Drawn ....:MLS  
 Checked ....:DAS  
 Approved :-DAS  
 Date 10-10-2018  
 Sheet Size A3

**Client**  
**TRIPURA INDUSTRIAL DEVELOPMENT CORPORATION**  
**Project**  
**LAND CUSTOMS STATION - MUHURIGHAT**  
**Drawing Title**  
**COLUMN LAYOUT**  
**Drawing Number**  
**ICDI/STR-003**  
 Rev 00

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16.968M										
	LINKS T8 @ 175	LINKS T8 @ 175	LINKS T8 @ 175				LINKS T8 @ 175	LINKS T8 @ 175		
10.8M										
	4-T16 + 12-T12 300 750 * T16 ○ T12	10-T20 + 6-T16 300 750 ○ T20 * T16	14-T16 + 2-T12 300 750 * T16 ○ T12				16-T16 600 * T16	16-T16 600 * T16		
10.8M										
	LINKS T8 @ 175	LINKS T8 @ 175	LINKS T8 @ 175	LINKS T8 @ 175	LINKS T8 @ 175	LINKS T8 @ 175	LINKS T8 @ 175	LINKS T8 @ 175	LINKS T8 @ 175	LINKS T8 @ 175
7.2M										
	4-T20 + 12-T16 300 750 ○ T20 * T16	10-T20 + 6-T16 300 750 ○ T20 * T16	14-T16 + 2-T12 300 750 * T16 ○ T12	4-T16 + 12-T12 300 750 * T16 ○ T12	4-T16 + 12-T12 300 750 * T16 ○ T12	4-T20 + 12-T16 600 ○ T20 * T16	12-T20 + 4-T16 600 ○ T20 * T16	12-T20 + 4-T16 600 ○ T20 * T16	4-T20 + 12-T16 600 ○ T20 * T16	12-T20 + 4-T16 600 ○ T20 * T16
7.2M										
	LINKS T8 @ 175	LINKS T8 @ 175	LINKS T8 @ 175	LINKS T8 @ 175	LINKS T8 @ 175	LINKS T8 @ 175	LINKS T8 @ 175	LINKS T8 @ 175	LINKS T8 @ 175	LINKS T8 @ 175
3.6M										
	4-T20 + 12-T16 300 750 ○ T20 * T16	10-T25 + 6-T20 300 750 ○ T25 ○ T20	10-T20 + 6-T16 300 750 ○ T20 * T16	4-T16 + 12-T12 300 750 * T16 ○ T12	4-T16 + 12-T12 300 750 * T16 ○ T12	4-T20 + 12-T16 600 ○ T20 * T16	16-T20 600 ○ T20	16-T20 600 ○ T20	4-T20 + 12-T16 600 ○ T20 * T16	12-T20 + 4-T16 600 ○ T20 * T16
3.6M										
	LINKS T8 @ 175	LINKS T8 @ 175	LINKS T8 @ 175	LINKS T8 @ 175	LINKS T8 @ 175	LINKS T8 @ 175	LINKS T8 @ 175	LINKS T8 @ 175	LINKS T8 @ 175	LINKS T8 @ 175
0M										
	4-T20 + 12-T16 300 750 ○ T20 * T16	10-T25 + 6-T20 300 750 ○ T25 ○ T20	10-T20 + 6-T16 300 750 ○ T20 * T16	4-T20 + 12-T16 300 750 ○ T20 * T16	14-T16 + 2-T12 300 750 * T16 ○ T12	12-T20 + 4-T16 600 ○ T20 * T16	16-T20 600 ○ T20	16-T20 600 ○ T20	12-T20 + 4-T16 600 ○ T20 * T16	12-T20 + 4-T16 600 ○ T20 * T16
0M										
	LINKS T8 @ 175	LINKS T8 @ 175	LINKS T8 @ 175	LINKS T8 @ 175	LINKS T8 @ 175	LINKS T8 @ 175	LINKS T8 @ 175	LINKS T8 @ 175	LINKS T8 @ 175	LINKS T8 @ 175
-2M										
	10-T20 + 6-T16 300 750 ○ T20 * T16	10-T25 + 6-T20 300 750 ○ T25 ○ T20	10-T20 + 6-T16 300 750 ○ T20 * T16	6-T20 + 10-T16 300 750 ○ T20 * T16	10-T20 + 6-T16 300 750 ○ T20 * T16	4-T25 + 12-T20 600 ○ T25 ○ T20	16-T20 600 ○ T20	4-T25 + 12-T20 600 ○ T25 ○ T20	4-T25 + 12-T20 600 ○ T25 ○ T20	16-T20 600 ○ T20
COLUMN MARKED	C1	C2	C3	C4	C5	C6	C7	C8	C9	C10

COLUMN SCHEDULE

- NOTES:**
- All Dimensions are in 'mm' & Levels are in meters.
  - Grade of Concrete shall be M25
  - Clear cover to main reinforcement shall be as follows:  
a) Walls = 20 mm, b) Slab = 20 mm, c) Footings = 50 mm  
d) Beams = 25 mm e) Column = 40mm.
  - All Laps Shall be 50 times  $\phi$  of bar & shall be staggered, unless otherwise specified
  - P.C.C leveling Course M10(1:3:6) below Footings and Plinth Beam
  - 'T' denotes HYSD Bars (Fe500)
  - 70kN/sq.m SBC is considered at a depth of 2.0m below existing Ground Level ensure the same before execution

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Scale  
1:100

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10-10-2018

Sheet Size  
A2

**Client**  
**TRIPURA INDUSTRIAL DEVELOPMENT CORPORATION**

**Project**  
**LAND CUSTOMS STATION - MUHURIGHTAT**

**Drawing Title**  
**COLUMN SCHEDULE (1 OF 3)**

**Drawing Number**  
**ICDI/STR-004**

Rev  
00

**Project Development & Advisory**

**IL&FS Clusters**  
**IL&FS Cluster Development Initiative Limited**

FOR TENDER

16.968M	M25 : Fe500 , COVER = 40MM	M25 : Fe500 , COVER = 40MM	M25 : Fe500 , COVER = 40MM			M25 : Fe500 , COVER = 40MM	M25 : Fe500 , COVER = 40MM			
TO	LINKS T8 @ 175	LINKS T8 @ 175	LINKS T8 @ 175			LINKS T8 @ 175	LINKS T8 @ 175			
10.8M										
10.8M	M25 : Fe500 , COVER = 40MM	M25 : Fe500 , COVER = 40MM	M25 : Fe500 , COVER = 40MM	M25 : Fe500 , COVER = 40MM	M25 : Fe500 , COVER = 40MM	M25 : Fe500 , COVER = 40MM	M25 : Fe500 , COVER = 40MM	M25 : Fe500 , COVER = 40MM		M25 : Fe500 , COVER = 40MM
TO										
7.2M										
7.2M	M25 : Fe500 , COVER = 40MM	M25 : Fe500 , COVER = 40MM	M25 : Fe500 , COVER = 40MM	M25 : Fe500 , COVER = 40MM	M25 : Fe500 , COVER = 40MM	M25 : Fe500 , COVER = 40MM	M25 : Fe500 , COVER = 40MM	M25 : Fe500 , COVER = 40MM		M25 : Fe500 , COVER = 40MM
TO										
3.6M										
3.6M	M25 : Fe500 , COVER = 40MM	M25 : Fe500 , COVER = 40MM	M25 : Fe500 , COVER = 40MM	M25 : Fe500 , COVER = 40MM	M25 : Fe500 , COVER = 40MM	M25 : Fe500 , COVER = 40MM	M25 : Fe500 , COVER = 40MM	M25 : Fe500 , COVER = 40MM		M25 : Fe500 , COVER = 40MM
TO										
0M										
0M	M25 : Fe500 , COVER = 40MM	M25 : Fe500 , COVER = 40MM	M25 : Fe500 , COVER = 40MM	M25 : Fe500 , COVER = 40MM	M25 : Fe500 , COVER = 40MM	M25 : Fe500 , COVER = 40MM	M25 : Fe500 , COVER = 40MM	M25 : Fe500 , COVER = 40MM	M25 : Fe500 , COVER = 40MM	M25 : Fe500 , COVER = 40MM
TO										
-2M										
COLUMN MARKED	C11	C12	C13	C14	C15	C16	C17	C18	C19	C20

COLUMN SCHEDULE

FOR TENDER

**NOTES:**  
 1. All Dimensions are in 'mm' & Levels are in meters.  
 2. Grade of Concrete shall be M25  
 3. Clear cover to main reinforcement shall be as follows:  
 a) Walls = 20 mm, b) Slab = 20 mm, c) Footings = 50 mm  
 d) Beams = 25 mm e) Column = 40mm.  
 4. All Laps Shall be 50 times Ø of bar & shall be staggered, unless otherwise specified  
 5. P.C.C leveling Course M10(1:3:6) below Footings and Plinth Beam  
 6. 'T' denotes HYSD Bars (Fe500)  
 7. 70kN/sq.m SBC is considered at a depth of 2.0m below existing Ground Level ensure the same before execution

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 Scale  
 1:100

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 A2

**Client**  
**TRIPURA INDUSTRIAL DEVELOPMENT CORPORATION**  
**Project**  
**LAND CUSTOMS STATION - MUHURIGHTHAT**  
**Drawing Title**  
**COLUMN SCHEDULE (2 OF 3)**  
**Drawing Number**  
**ICDI/STR-005**  
 Rev  
 00

**Project Development & Advisory**  
  
**IL&FS Cluster Development Initiative Limited**

16.968M									
	LINKS T8 @ 175	LINKS T8 @ 175			LINKS T8 @ 175	LINKS T8 @ 175			
10.8M									
	LINKS T8 @ 175	LINKS T8 @ 175	LINKS T8 @ 175		LINKS T8 @ 175	LINKS T8 @ 175	LINKS T8 @ 175	LINKS T8 @ 175	
10.8M									
	LINKS T8 @ 175	LINKS T8 @ 175	LINKS T8 @ 175		LINKS T8 @ 175	LINKS T8 @ 175	LINKS T8 @ 175	LINKS T8 @ 175	
7.2M									
	LINKS T8 @ 175	LINKS T8 @ 175	LINKS T8 @ 175		LINKS T8 @ 175	LINKS T8 @ 175	LINKS T8 @ 175	LINKS T8 @ 175	
7.2M									
	LINKS T8 @ 175	LINKS T8 @ 175	LINKS T8 @ 175		LINKS T8 @ 175	LINKS T8 @ 175	LINKS T8 @ 175	LINKS T8 @ 175	
3.6M									
	LINKS T8 @ 175	LINKS T8 @ 175	LINKS T8 @ 175	LINKS T8 @ 175	LINKS T8 @ 175	LINKS T8 @ 175	LINKS T8 @ 175	LINKS T8 @ 175	
3.6M									
	LINKS T8 @ 175	LINKS T8 @ 175	LINKS T8 @ 175	LINKS T8 @ 175	LINKS T8 @ 175	LINKS T8 @ 175	LINKS T8 @ 175	LINKS T8 @ 175	
0M									
	LINKS T8 @ 175	LINKS T8 @ 175	LINKS T8 @ 175	LINKS T8 @ 175	LINKS T8 @ 175	LINKS T8 @ 175	LINKS T8 @ 175	LINKS T8 @ 175	
0M									
	LINKS T8 @ 175	LINKS T8 @ 175	LINKS T8 @ 175	LINKS T8 @ 175	LINKS T8 @ 175	LINKS T8 @ 175	LINKS T8 @ 175	LINKS T8 @ 175	
-2M									
	LINKS T8 @ 175	LINKS T8 @ 175	LINKS T8 @ 175	LINKS T8 @ 175	LINKS T8 @ 175	LINKS T8 @ 175	LINKS T8 @ 175	LINKS T8 @ 175	
COLUMN MARKED	C21	C22	C23	C24	C25	C26	C27	C28	C29

COLUMN SCHEDULE

FOR TENDER

- NOTES:**
- All Dimensions are in 'mm' & Levels are in meters.
  - Grade of Concrete shall be M25
  - Clear cover to main reinforcement shall be as follows:  
a) Walls = 20 mm, b) Slab = 20 mm, c) Footings = 50 mm  
d) Beams = 25 mm e) Column = 40mm.
  - All Laps Shall be 50 times  $\phi$  of bar & shall be staggered, unless otherwise specified
  - P.C.C leveling Course M10(1:3:6) below Footings and Plinth Beam
  - 'T' denotes HYSD Bars (Fe500)
  - 70kN/sq.m SBC is considered at a depth of 2.0m below existing Ground Level ensure the same before execution, it is meant

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Scale  
1:100

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Date  
10-10-2018

Sheet Size  
A2

**Client**  
**TRIPURA INDUSTRIAL DEVELOPMENT CORPORATION**

**Project**  
**LAND CUSTOMS STATION - MUHURIGHAT**

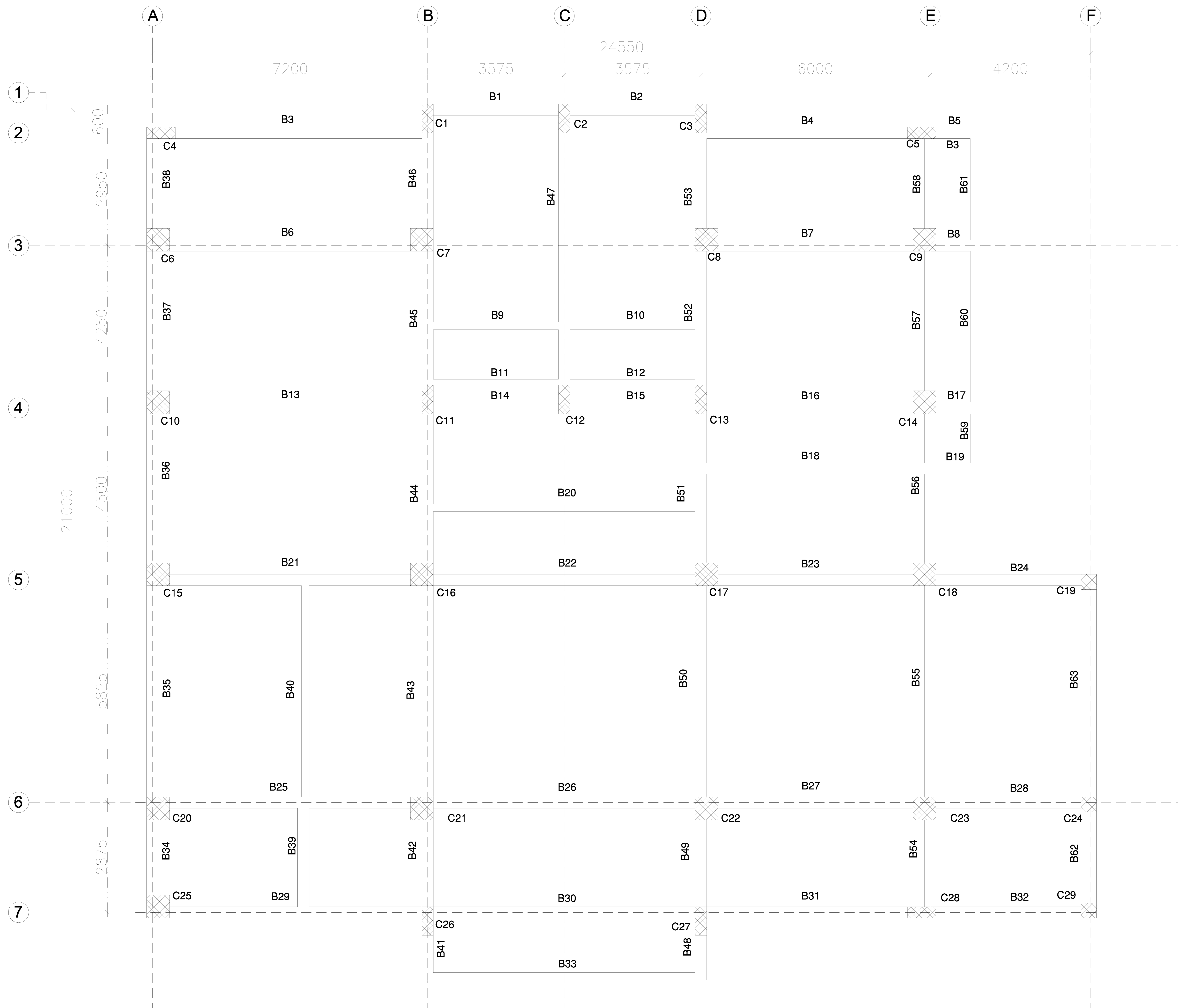
**Drawing Title**  
**COLUMN SCHEDULE (3 OF 3)**

**Drawing Number**  
**ICDI/STR-006**

Rev  
00

**Project Development & Advisory**

**IL&FS Clusters**  
**IL&FS Cluster Development Initiative Limited**



PLINTH BEAM LAYOUT

FOR TENDER

NOTES:	
1. All Dimensions are in 'mm' & Levels are in meters.	6. 'T' denotes HYSD Bars (Fe500)
2. Grade of Concrete shall be M25	7. 70kN/sq.m SBC is considered at a depth of 2.0m below existing Ground Level ensure the same before execution.
3. Clear cover to main reinforcement shall be as follows: a) Walls = 20 mm, b) Slab = 20 mm, c) Footings = 50 mm d) Beams = 25 mm e) Column = 40mm.	
4. All Laps Shall be 50 times $\phi$ of bar & shall be staggered, unless otherwise specified	
5. P.C.C leveling Course M10(1:3:6) bellow Footings and Plinth Beam	

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Scale	1:100

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Client	<b>TRIPURA INDUSTRIAL DEVELOPMENT CORPORATION</b>
Project	<b>LAND CUSTOMS STATION - MUHURIGHTAT</b>
Drawing Title	<b>PLINTH BEAM FRAMING</b>
Drawing Number	<b>ICDI/STR-001</b>
Rev	00

Project Development & Advisory
<b>IL&amp;FS</b> Clusters
IL&FS Cluster Development Initiative Limited



PLINTH BEAM SCHEDULE:-

BEAM NUMBERS	SIZE		BOTTOM REINFORCEMENT			TOP REINFORCEMENT			SHEAR STIRRUPS			SFR
	B	D	LEFT	MID SPAN	RIGHT	LEFT	MID SPAN	RIGHT	LEFT	MID SPAN	RIGHT	
B1	300	600	4-T16 + 4-T12	4-T16	4-T16	3-T20 + 3-T16	3-T20	3-T25	9-2L-T8@155C/C	5-2L-T8@200C/C	10-2L-T8@135C/C	1-T12EF
B2	300	600	4-T16	4-T16	4-T16 + 4-T12	3-T25	3-T20	3-T20 + 3-T20	9-2L-T8@145C/C	5-2L-T8@200C/C	9-2L-T8@155C/C	1-T12EF
B3	300	600	4-T16	4-T16 + 2-T12	4-T16	3-T20 + 3-T20	3-T12	3-T12	13-2L-T8@200C/C	11-2L-T8@200C/C	13-2L-T8@200C/C	1-T12EF
B4	300	600	4-T16	4-T16	4-T16	3-T12	3-T20	3-T20 + 3-T20	11-2L-T8@200C/C	9-2L-T8@200C/C	11-2L-T8@200C/C	1-T12EF
B5	300	600	3-T12	3-T12	3-T12	3-T20 + 3-T20	3-T20 + 3-T20	3-T20 + 3-T20	3-2L-T8@200C/C	1-2L-T8@200C/C	3-2L-T8@200C/C	-
B6	300	600	4-T16 + 4-T16	4-T16	4-T16 + 4-T12	3-T20 + 3-T20	3-T20	3-T25 + 3-T16	13-2L-T8@200C/C	11-2L-T8@200C/C	12-2L-T8@200C/C	1-T12EF
B7	300	600	3-T20 + 3-T20	3-T20	3-T20 + 2-T20	3-T25 + 3-T16	3-T20	3-T25 + 3-T20	11-2L-T8@200C/C	9-2L-T8@200C/C	10-2L-T8@200C/C	1-T12EF
B8	300	600	3-T20	3-T20	3-T20	3-T25 + 3-T20	3-T25 + 3-T20	3-T25 + 3-T20	3-2L-T8@200C/C	1-2L-T8@200C/C	3-2L-T8@200C/C	-
B9	200	450	2-T16	2-T16 + 2-T12	2-T16	2-T12	2-T12	2-T12	9-2L-T8@140C/C	7-2L-T8@140C/C	9-2L-T8@140C/C	-
B10	200	450	2-T16	2-T16 + 2-T12	2-T16	2-T12	2-T12	2-T12	9-2L-T8@140C/C	7-2L-T8@140C/C	9-2L-T8@140C/C	-
B11	200	450	2-T12	2-T12	2-T12	2-T12	2-T12	2-T12	9-2L-T8@140C/C	7-2L-T8@140C/C	9-2L-T8@140C/C	-
B12	200	450	2-T12	2-T12	2-T12	2-T12	2-T12	2-T12	9-2L-T8@140C/C	7-2L-T8@140C/C	9-2L-T8@140C/C	-
B13	300	600	4-T16 + 2-T12	4-T16	4-T16	3-T20 + 3-T20	3-T16	3-T25	13-2L-T8@200C/C	11-2L-T8@200C/C	13-2L-T8@200C/C	-
B14	300	600	4-T16 + 2-T12	4-T16	4-T16 + 2-T12	3-T25	3-T25	3-T25	7-2L-T8@200C/C	5-2L-T8@200C/C	7-2L-T8@200C/C	1-T12EF
B15	300	600	4-T16 + 2-T12	4-T16	4-T16 + 2-T12	3-T25	3-T25	3-T25	7-2L-T8@200C/C	5-2L-T8@200C/C	7-2L-T8@200C/C	1-T12EF
B16	300	600	4-T16 + 2-T12	4-T16	4-T16 + 4-T12	3-T25	3-T20	3-T25 + 3-T16	11-2L-T8@200C/C	9-2L-T8@200C/C	11-2L-T8@200C/C	1-T12EF
B17	300	600	3-T16	3-T16	3-T16	3-T25 + 3-T16	3-T25 + 3-T16	3-T25 + 3-T16	3-2L-T8@200C/C	1-2L-T8@200C/C	3-2L-T8@200C/C	-
B18	300	600	4-T16	4-T16	4-T16	3-T12	3-T12	3-T12	11-2L-T8@200C/C	9-2L-T8@200C/C	11-2L-T8@200C/C	1-T12EF
B19	300	600	3-T12	3-T12	3-T12	3-T12	3-T12	3-T12	4-2L-T8@150C/C	2-2L-T8@150C/C	4-2L-T8@150C/C	1-T12EF
B20	200	450	2-T16	2-T16 + 2-T12	2-T16	2-T12	2-T12	2-T12	18-2L-T8@140C/C	11-2L-T8@200C/C	18-2L-T8@140C/C	-
B21	300	600	3-T20	3-T20	3-T20	3-T25 + 3-T20	3-T20	3-T25 + 3-T20	13-2L-T8@200C/C	11-2L-T8@200C/C	12-2L-T8@200C/C	1-T12EF
B22	300	600	4-T16 + 2-T12	4-T16	4-T16 + 4-T12	3-T25 + 3-T20	3-T16	3-T20 + 3-T20	12-2L-T8@200C/C	10-2L-T8@200C/C	12-2L-T8@200C/C	-
B23	300	600	4-T16 + 4-T16	4-T16	4-T16 + 4-T16	3-T20 + 3-T20	3-T20	3-T25 + 3-T16	11-2L-T8@200C/C	9-2L-T8@200C/C	10-2L-T8@200C/C	1-T12EF
B24	300	600	3-T20 + 3-T20	3-T20	3-T20 + 2-T20	3-T25 + 3-T16	3-T20	3-T20 + 3-T20	9-2L-T8@165C/C	7-2L-T8@175C/C	9-2L-T8@155C/C	1-T12EF
B25	300	600	4-T16	4-T16	4-T16	3-T25 + 3-T20	3-T16	3-T25 + 3-T20	13-2L-T8@200C/C	11-2L-T8@200C/C	13-2L-T8@190C/C	1-T12EF
B26	300	600	4-T16	4-T16	4-T16 + 2-T12	3-T25 + 3-T20	3-T16	3-T20 + 3-T20	12-2L-T8@200C/C	10-2L-T8@200C/C	12-2L-T8@200C/C	1-T12EF
B27	300	600	4-T16 + 4-T12	4-T16	4-T16 + 4-T12	3-T20 + 3-T20	3-T16	3-T20 + 3-T20	11-2L-T8@200C/C	9-2L-T8@200C/C	10-2L-T8@200C/C	1-T12EF
B28	300	600	4-T16 + 4-T16	4-T16	4-T16 + 4-T16	3-T20 + 3-T20	3-T16	3-T20 + 3-T20	8-2L-T8@200C/C	6-2L-T8@200C/C	8-2L-T8@200C/C	1-T12EF
B29	300	600	4-T16	4-T16	4-T16	3-T20 + 3-T20	3-T12	3-T20 + 3-T20	13-2L-T8@200C/C	11-2L-T8@200C/C	13-2L-T8@200C/C	1-T12EF
B30	300	600	4-T12	4-T12	4-T12	3-T20 + 3-T20	3-T12	3-T25	13-2L-T8@200C/C	11-2L-T8@200C/C	13-2L-T8@200C/C	-

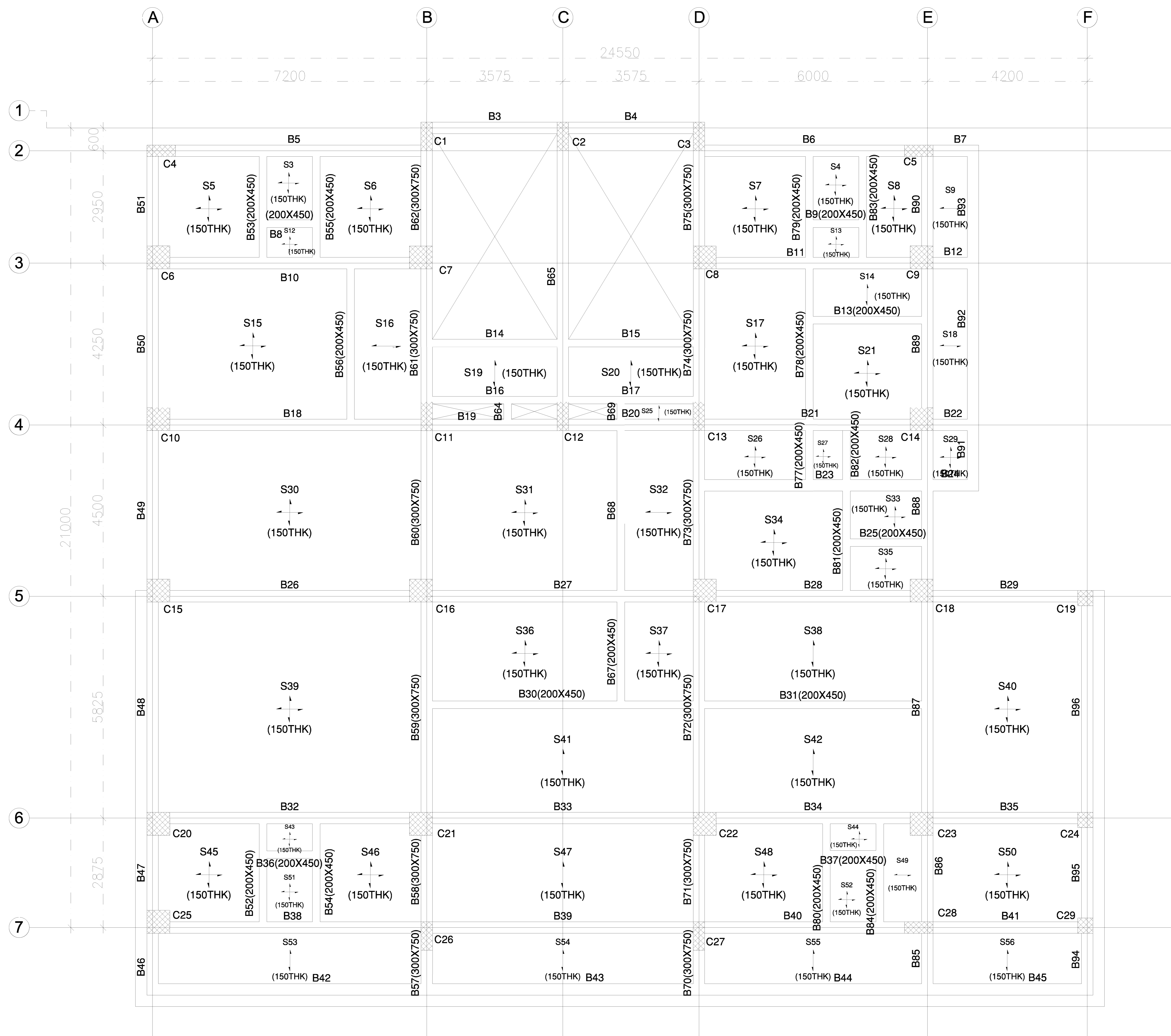
PLINTH BEAM SCHEDULE:-

BEAM NUMBERS	SIZE		BOTTOM REINFORCEMENT			TOP REINFORCEMENT			SHEAR STIRRUPS			SFR
	B	D	LEFT	MID SPAN	RIGHT	LEFT	MID SPAN	RIGHT	LEFT	MID SPAN	RIGHT	
B31	300	600	4-T16	4-T16	4-T16	3-T25	3-T16	3-T20 + 3-T20	11-2L-T8@200C/C	9-2L-T8@200C/C	11-2L-T8@200C/C	1-T12EF
B32	300	600	4-T16 + 4-T16	4-T16	4-T16 + 4-T12	3-T20 + 3-T20	3-T16	3-T20 + 3-T16	8-2L-T8@200C/C	6-2L-T8@200C/C	8-2L-T8@200C/C	1-T12EF
B33	200	450	2-T16	2-T16 + 2-T16	2-T16	2-T12	2-T12	2-T12	13-2L-T8@200C/C	11-2L-T8@200C/C	13-2L-T8@200C/C	-
B34	300	600	4-T16 + 4-T12	4-T16	4-T16 + 4-T12	3-T25	3-T25	3-T25	6-2L-T8@180C/C	3-2L-T8@200C/C	6-2L-T8@165C/C	1-T12EF
B35	300	600	4-T12	4-T12	4-T12	3-T25	3-T12	3-T25	10-2L-T8@200C/C	8-2L-T8@200C/C	10-2L-T8@200C/C	1-T12EF
B36	300	600	4-T16	4-T16	4-T16	3-T25	3-T16	3-T25	8-2L-T8@200C/C	6-2L-T8@200C/C	8-2L-T8@200C/C	1-T12EF
B37	300	600	4-T16	4-T16	4-T16	3-T25	3-T16	3-T25	8-2L-T8@200C/C	6-2L-T8@200C/C	8-2L-T8@200C/C	1-T12EF
B38	300	600	4-T16	4-T16	4-T16	3-T25	3-T20	3-T20	6-2L-T8@200C/C	4-2L-T8@200C/C	6-2L-T8@200C/C	1-T12EF
B39	300	600	3-T12	3-T12	3-T12	3-T12	3-T12	3-T12	6-2L-T8@200C/C	4-2L-T8@200C/C	6-2L-T8@200C/C	1-T12EF
B40	200	450	2-T16	2-T16 + 2-T12	2-T16	2-T12	2-T12	2-T12	15-2L-T8@140C/C	9-2L-T8@200C/C	15-2L-T8@140C/C	-
B41	300	600	3-T12	3-T12	3-T12	3-T25 + 3-T16	3-T25 + 3-T16	3-T25 + 3-T16	4-2L-T8@200C/C	2-2L-T8@200C/C	4-2L-T8@200C/C	-
B42	300	600	3-T20 + 3-T20	3-T20	3-T20 + 3-T16	3-T25 + 3-T16	3-T25	3-T25 + 3-T16	8-2L-T8@110C/C	6-2L-T8@110C/C	8-2L-T8@115C/C	1-T12EF
B43	300	600	4-T16 + 2-T12	4-T16	4-T16 + 2-T12	3-T25 + 3-T16	3-T16	3-T25 + 3-T16	10-2L-T8@200C/C	8-2L-T8@200C/C	10-2L-T8@200C/C	1-T12EF
B44	300	600	4-T16 + 4-T12	4-T16	4-T16 + 4-T12	3-T25 + 3-T16	3-T20	3-T20 + 3-T20	9-2L-T8@175C/C	6-2L-T8@195C/C	8-2L-T8@185C/C	1-T12EF
B45	300	600	4-T16 + 4-T12	4-T16	4-T16 + 4-T12	3-T20 + 3-T20	3-T20	3-T25 + 3-T16	10-2L-T8@140C/C	7-2L-T8@165C/C	9-2L-T8@150C/C	1-T12EF
B46	300	600	3-T20 + 2-T20	3-T20 + 2-T20	3-T20 + 3-T20	3-T25 + 3-T16	3-T25	3-T25 + 3-T16	9-2L-T8@120C/C	6-2L-T8@140C/C	12-2L-T8@95C/C	1-T12EF
B47	300	600	4-T16 + 2-T12	4-T16 + 2-T12	4-T16	3-T25 + 3-T20	3-T16	3-T25 + 3-T16	25-2L-T8@100C/C	11-2L-T8@200C/C	13-2L-T8@200C/C	-
B48	300	600	3-T12	3-T12	3-T12	3-T25 + 3-T16	3-T25 + 3-T16	3-T25 + 3-T16	4-2L-T8@200C/C	2-2L-T8@200C/C	4-2L-T8@200C/C	-
B49	300	600	3-T20 + 3-T20	3-T20	3-T20 + 3-T20	3-T25 + 3-T16	3-T20	3-T20 + 3-T20	9-2L-T8@100C/C	7-2L-T8@100C/C	8-2L-T8@110C/C	1-T12EF
B50	300	600	4-T16 + 2-T12	4-T16	4-T16 + 2-T12	3-T20 + 3-T20	3-T16	3-T25 + 3-T16	10-2L-T8@200C/C	8-2L-T8@200C/C	10-2L-T8@200C/C	1-T12EF
B51	300	600	4-T16 + 4-T12	4-T16	4-T16 + 2-T12	3-T25 + 3-T16	3-T20	3-T25 + 3-T16	9-2L-T8@175C/C	8-2L-T8@145C/C	10-2L-T8@145C/C	1-T12EF
B52	300	600	4-T16 + 4-T12	4-T16	4-T16 + 4-T12	3-T25 + 3-T16	3-T20	3-T25 + 3-T16	10-2L-T8@145C/C	6-2L-T8@180C/C	9-2L-T8@160C/C	1-T12EF
B53	300	600	3-T20 + 2-T20	3-T20 + 2-T20	3-T20 + 3-T20	3-T25 + 3-T16	3-T25	3-T25 + 3-T16	9-2L-T8@125C/C	6-2L-T8@145C/C	11-2L-T8@105C/C	1-T12EF
B54	300	600	4-T16	4-T16	4-T16 + 2-T12	4-T16	4-T16	4-T20	6-2L-T8@200C/C	4-2L-T8@200C/C	6-2L-T8@200C/C	1-T12EF
B55	300	600	3-T16	3-T16	3-T16	4-T20	4-T12	4-T25	10-2L-T8@200C/C	8-2L-T8@200C/C	10-2L-T8@200C/C	1-T12EF
B56	300	600	4-T16	4-T16	4-T16	4-T25	4-T12	4-T25	8-2L-T8@200C/C	8-2L-T8@160C/C	10-2L-T8@150C/C	1-T12EF
B57	300	600	4-T16 + 2-T12	4-T16	4-T16 + 2-T12	4-T25	4-T12	4-T20	8-2L-T8@200C/C	6-2L-T8@200C/C	8-2L-T8@200C/C	1-T12EF
B58	300	600	4-T16 + 2-T12	4-T16	4-T16	4-T20	3-T16	4-T16	6-2L-T8@200C/C	4-2L-T8@200C/C	6-2L-T8@200C/C	1-T12EF
B59	300	600	3-T12	3-T12	3-T12	3-T12	3-T12	3-T12	4-2L-T8@200C/C	2-2L-T8@200C/C	4-2L-T8@200C/C	1-T12EF
B60	300	600	3-T12	3-T12	3-T12	3-T12	3-T12	3-T12	8-2L-T8@200C/C	6-2L-T8@200C/C	8-2L-T8@200C/C	1-T12EF
B61	300	600	3-T12	3-T12	3-T12	3-T12	3-T12	3-T12	6-2L-T8@200C/C	4-2L-T8@200C/C	6-2L-T8@200C/C	1-T12EF
B62	300	600	3-T12	3-T12	3-T12	4-T12	4-T12	4-T12	6-2L-T8@200C/C	4-2L-T8@200C/C	6-2L-T8@200C/C	-
B63	300	600	3-T12	3-T12	3-T12	4-T12	4-T12	4-T12	11-2L-T8@200C/C	9-2L-T8@200C/C	11-2L-T8@200C/C	1-T12EF

FOR TENDER

<b>NOTES:</b> 1. All Dimensions are in 'mm' & Levels are in meters. 2. Grade of Concrete shall be M25 3. Clear cover to main reinforcement shall be as follows: a) Walls = 20 mm, b) Slab = 20 mm, c) Footings = 50 mm d) Beams = 25 mm e) Column = 40mm. 4. All Laps Shall be 50 times Ø of bar & shall be staggered, unless otherwise specified 5. P.C.C leveling Course M10(1:3:6) bellow Footings and Plinth Beam 6. 'T' denotes HYSD Bars (Fe500) 7. 70kN/sq.m SBC is considered at a depth of 2.0m below existing Ground Level ensure the same before execution	This Drawing is the property of Das Consultants and is not to be produced, copied or handed over to a third party or used for any purpose other than for which it is meant Scale 1:100	<b>STRUCTURAL CONSULTANTS:</b> <b>M/s. DAS CONSULTANTS</b> FLAT NO.:1, NO.30, 6TH MAIN ROAD, LAKSHMI NAGAR EXTENSION PORUR, CHENNAI - 600 116 TELEFAX - +91-44-24764416 email - dasconsultants@gmail.com web - dasconsultants.net	<b>DRAWING DETAILS</b>		Client <b>TRIPURA INDUSTRIAL DEVELOPMENT CORPORATION</b> Project <b>LAND CUSTOMS STATION - MUHURIGHAT</b> Drawing Title <b>PLINTH BEAM SCHEDULE</b> Drawing Number <b>ICDI/STR-002</b>	Project Development & Advisory <b>IL&amp;FS Cluster Development Initiative Limited</b>	
			Designed .....:VENU Drawn .....:MLS Checked .....:DAS Approved :-DAS	Date 10-10-2018 Sheet Size A2			Rev 00
			Client <b>TRIPURA INDUSTRIAL DEVELOPMENT CORPORATION</b>				





**FIRST FLOOR BEAM FRAMING**

- Notes:
1. Beam numbers B1,B2,B63,B66,B76 are not used.
  2. Slab numbers S1,2,10,11,22,23,24 are not used.

**NOTES:**

1. All Dimensions are in 'mm' & Levels are in meters.
2. Grade of Concrete shall be M25
3. Clear cover to main reinforcement shall be as follows:  
a) Walls = 20 mm, b) Slab = 20 mm, c) Footings = 50 mm  
d) Beams = 25 mm e) Column = 40mm.
4. All Laps Shall be 50 times  $\phi$  of bar & shall be staggered, unless otherwise specified
5. P.C.C leveling Course M10(1:3:6) bellow Footings and Plinth Beam
6. 'T' denotes HYSD Bars (Fe500)
7. 70kN/sq.m SBC is considered at a depth of 2.0m below existing Ground Level ensure the same before execution

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Scale	1:100

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<b>DRAWING DETAILS</b>	
Designed :- VENU	Date 10-10-2018
Drawn :- MLS	Sheet Size A3
Checked :- DAS	
Approved :- DAS	

<b>Client</b>	<b>TRIPURA INDUSTRIAL DEVELOPMENT CORPORATION</b>
<b>Project</b>	<b>LAND CUSTOMS STATION - MUHURIGHTAT</b>
<b>Drawing Title</b>	<b>FIRST FLOOR BEAM FRAMING</b>
<b>Drawing Number</b>	<b>ICDI/STR-007</b>
	Rev 00

Project Development & Advisory

**IL&FS** Clusters  
IL&FS Cluster Development Initiative Limited

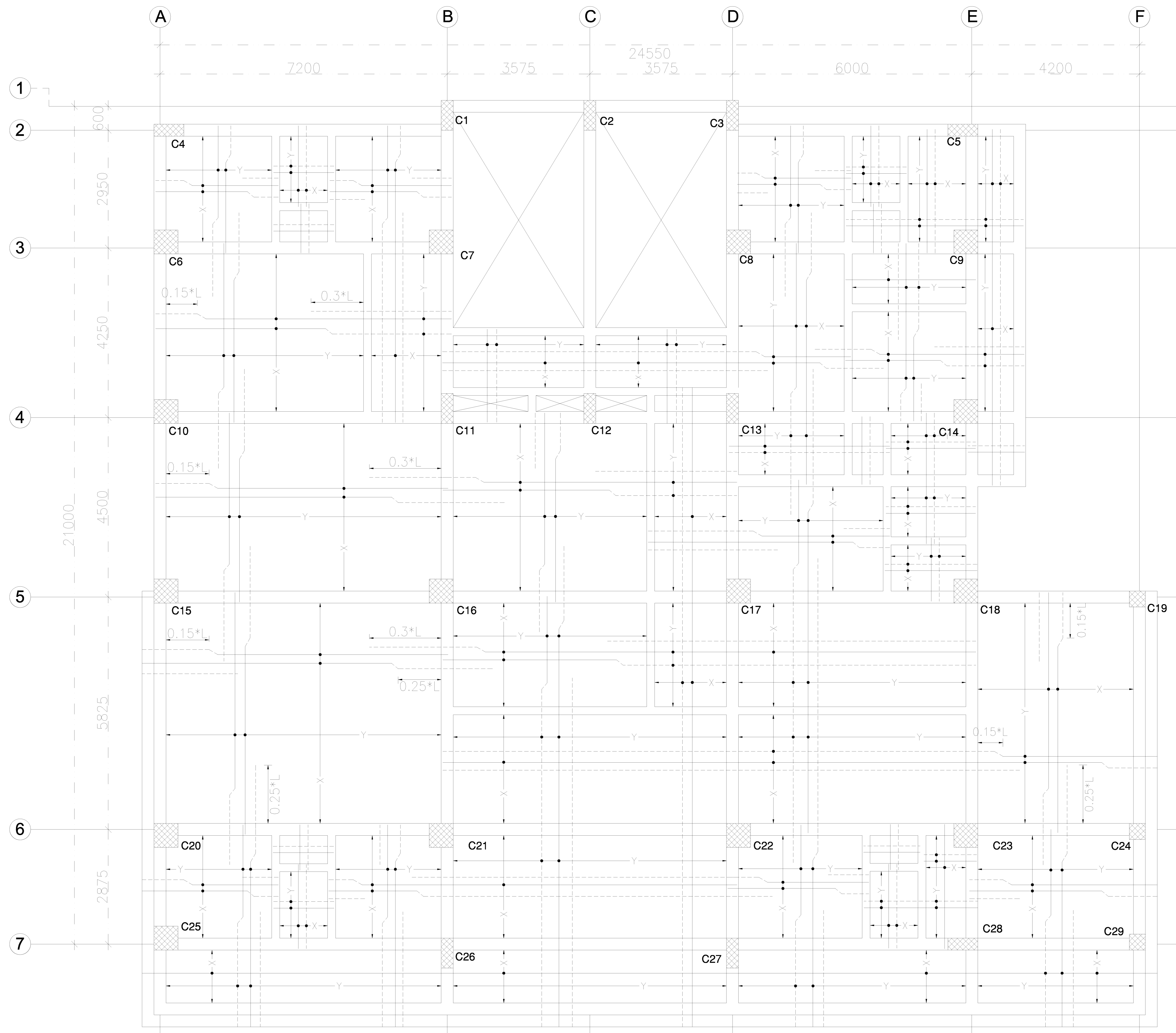
FOR TENDER

FIRST BEAM SCHEDULE

BEAM NUMBERS	SIZE		BOTTOM REINFORCEMENT			TOP REINFORCEMENT			SHEAR STIRRUPS			SFR
	B	D	LEFT	MID SPAN	RIGHT	LEFT	MID SPAN	RIGHT	LEFT	MID SPAN	RIGHT	
B1	300	600	3-T12	3-T12	3-T12	3-T12	3-T12	3-T12	7-2L-T8@200C/C	5-2L-T8@200C/C	7-2L-T8@200C/C	1-T12EF
B2	300	600	3-T12	3-T12	3-T12	3-T12	3-T12	3-T12	7-2L-T8@200C/C	5-2L-T8@200C/C	7-2L-T8@200C/C	1-T12EF
B3	300	600	3-T20 + 3-T20	3-T20 + 3-T20	3-T20 + 3-T20	3-T25 + 3-T20	3-T20	3-T20	13-2L-T8@95C/C	8-2L-T8@125C/C	14-2L-T8@85C/C	1-T12EF
B4	300	600	3-T20 + 2-T20	3-T20 + 3-T20	3-T20 + 3-T20	3-T20 + 3-T20	3-T20	3-T25 + 3-T20	14-2L-T8@90C/C	8-2L-T8@130C/C	14-2L-T8@90C/C	1-T12EF
B5	300	600	3-T20 + 2-T20	3-T20 + 3-T20	3-T20 + 2-T20	3-T25 + 3-T25	3-T20	3-T12	16-2L-T8@150C/C	11-2L-T8@200C/C	13-2L-T8@200C/C	1-T12EF
B6	300	600	4-T16 + 4-T16	4-T16 + 4-T16	4-T16 + 4-T16	3-T12	3-T25	3-T25 + 3-T25	11-2L-T8@200C/C	9-2L-T8@200C/C	14-2L-T8@150C/C	1-T12EF
B7	300	600	3-T12	3-T16	3-T16	3-T25 + 3-T25	3-T25 + 3-T25	3-T25 + 3-T25	3-2L-T8@200C/C	1-2L-T8@200C/C	3-2L-T8@200C/C	-
B8	200	450	2-T12	2-T12	2-T12	2-T12	2-T12	2-T12	4-2L-T8@140C/C	2-2L-T8@140C/C	4-2L-T8@140C/C	-
B9	200	450	2-T12	2-T12	2-T12	2-T12	2-T12	2-T12	4-2L-T8@140C/C	2-2L-T8@140C/C	4-2L-T8@140C/C	-
B10	300	600	3-T25 + 2-T25	3-T25 + 2-T25	3-T25 + 3-T25	3-T25 + 3-T25	3-T25	3-T25 + 3-T25	18-2L-T8@130C/C	15-2L-T8@145C/C	22-2L-T8@105C/C	1-T12EF
B11	300	600	3-T25 + 2-T25	3-T25 + 3-T25	3-T25 + 3-T25	3-T25 + 3-T25	3-T20 + 3-T20	3-T25 + 3-T25	22-2L-T10@90C/C	20-2L-T10@90C/C	20-2L-T10@95C/C	1-T12EF
B12	300	600	3-T25	3-T25	3-T25	3-T25 + 3-T25	3-T25 + 3-T25	3-T25 + 3-T25	3-2L-T8@200C/C	1-2L-T8@200C/C	3-2L-T8@200C/C	-
B13	200	450	2-T16	2-T16	2-T16	2-T12	2-T12	2-T12	8-2L-T8@140C/C	6-2L-T8@140C/C	8-2L-T8@140C/C	-
B14	200	450	2-T16	2-T16 + 2-T12	2-T16	2-T12	2-T12	2-T12	9-2L-T8@140C/C	7-2L-T8@140C/C	9-2L-T8@140C/C	-
B15	200	450	2-T16	2-T16 + 2-T12	2-T16	2-T12	2-T12	2-T12	9-2L-T8@140C/C	7-2L-T8@140C/C	9-2L-T8@140C/C	-
B16	200	450	2-T16	2-T16	2-T16	2-T12	2-T12	2-T12	9-2L-T8@140C/C	7-2L-T8@140C/C	9-2L-T8@140C/C	-
B17	200	450	2-T16	2-T16	2-T16	2-T12	2-T12	2-T12	9-2L-T8@140C/C	7-2L-T8@140C/C	9-2L-T8@140C/C	-
B18	300	600	3-T20 + 3-T20 + 3-T12	3-T20 + 2-T20	3-T20 + 2-T20	3-T25 + 3-T25 + 3-T16	3-T20	3-T20 + 3-T20	18-2L-T8@135C/C	12-2L-T8@180C/C	20-2L-T8@120C/C	1-T12EF
B19	300	600	4-T16 + 2-T16	4-T16	4-T16 + 4-T16	3-T20 + 3-T20	3-T20	3-T16 + 3-T16	11-2L-T8@115C/C	9-2L-T8@115C/C	9-2L-T8@150C/C	1-T12EF
B20	300	600	4-T16 + 4-T16	4-T16	4-T16 + 4-T16	3-T16 + 3-T16	3-T20	3-T20 + 3-T20	11-2L-T8@120C/C	9-2L-T8@110C/C	12-2L-T8@105C/C	1-T12EF
B21	300	600	3-T20 + 2-T20	3-T20 + 2-T20	3-T20 + 3-T20	3-T20 + 3-T20	3-T16 + 3-T16	3-T25 + 3-T25	16-2L-T8@130C/C	12-2L-T8@145C/C	18-2L-T8@115C/C	1-T12EF
B22	300	600	3-T20	3-T20	3-T20	3-T25 + 3-T25	3-T25 + 3-T25	3-T25 + 3-T16	3-2L-T8@200C/C	1-2L-T8@200C/C	3-2L-T8@200C/C	-
B23	300	600	4-T16 + 4-T16	4-T16 + 4-T16	4-T16 + 2-T16	3-T12	3-T12	3-T12	11-2L-T8@200C/C	9-2L-T8@200C/C	11-2L-T8@200C/C	1-T12EF
B24	300	600	3-T12	3-T12	3-T12	3-T12	3-T12	3-T12	4-2L-T8@165C/C	2-2L-T8@165C/C	4-2L-T8@165C/C	1-T12EF
B25	200	450	2-T12	2-T12	2-T12	2-T12	2-T12	2-T12	6-2L-T8@140C/C	4-2L-T8@140C/C	6-2L-T8@140C/C	-
B26	300	600	3-T20 + 3-T20 + 2-T12	3-T20 + 2-T20	3-T20 + 3-T20	3-T25 + 3-T25	3-T25	3-T25 + 3-T25	15-2L-T8@160C/C	11-2L-T8@200C/C	16-2L-T8@155C/C	1-T12EF
B27	300	600	3-T20 + 3-T20 + 2-T12	3-T20 + 2-T20	3-T20 + 2-T16	3-T25 + 3-T25	3-T25	3-T25 + 3-T16	18-2L-T8@130C/C	12-2L-T8@180C/C	22-2L-T8@105C/C	1-T12EF
B28	300	600	3-T20 + 3-T20 + 2-T16	3-T20 + 2-T20	3-T20 + 3-T20	3-T25 + 3-T25	3-T25	3-T25 + 2-T12	13-2L-T8@160C/C	12-2L-T8@145C/C	14-2L-T8@140C/C	1-T12EF
B29	300	600	3-T25 + 2-T25	3-T25	3-T25	3-T25 + 3-T25	3-T25	3-T16 + 3-T16	10-2L-T8@150C/C	8-2L-T8@150C/C	10-2L-T8@145C/C	1-T12EF
B30	200	450	2-T25 + 2-T25	2-T25 + 2-T25	2-T25 + 2-T25	2-T20 + 2-T12	2-T25 + 2-T25	2-T25 + 2-T12	19-2L-T8@130C/C	11-2L-T8@200C/C	22-2L-T8@110C/C	-
B31	200	450	2-T25	2-T25 + 2-T20	2-T25	2-T20	2-T25	2-T20	12-2L-T8@180C/C	9-2L-T8@200C/C	12-2L-T8@180C/C	-
B32	300	600	3-T25 + 3-T20	3-T25	3-T25 + 3-T20	3-T25 + 3-T16	3-T20	3-T25 + 3-T16	21-2L-T8@115C/C	16-2L-T8@130C/C	21-2L-T8@115C/C	1-T12EF
B33	300	600	4-T16 + 4-T16	4-T16 + 4-T16	4-T16 + 4-T16	3-T25 + 3-T25	3-T20	3-T25 + 3-T25	12-2L-T8@200C/C	10-2L-T8@200C/C	12-2L-T8@200C/C	1-T12EF
B34	300	600	4-T16 + 4-T16 + 2-T12	4-T16 + 4-T16	4-T16 + 4-T16	3-T25 + 3-T25	3-T25	3-T25 + 2-T12	15-2L-T8@130C/C	10-2L-T8@170C/C	20-2L-T8@95C/C	1-T12EF
B35	300	600	4-T16 + 4-T16 + 4-T12	4-T16 + 2-T16	4-T16 + 2-T16	3-T25 + 3-T25	3-T20	3-T25	9-2L-T8@170C/C	7-2L-T8@170C/C	9-2L-T8@165C/C	1-T12EF
B36	200	450	2-T12	2-T12	2-T12	2-T12	2-T12	2-T12	4-2L-T8@200C/C	2-2L-T8@200C/C	3-2L-T8@200C/C	-
B37	200	450	2-T12	2-T12	2-T12	2-T12	2-T12	2-T12	4-2L-T8@140C/C	2-2L-T8@200C/C	4-2L-T8@140C/C	-
B38	300	600	4-T16 + 4-T16	4-T16 + 4-T16	4-T16 + 2-T16	3-T25 + 3-T25	3-T16	3-T25 + 2-T25	19-2L-T8@130C/C	11-2L-T8@200C/C	19-2L-T8@125C/C	1-T12EF
B39	300	600	3-T16	3-T16	3-T16	3-T25 + 2-T25	3-T12	3-T25 + 3-T20	13-2L-T8@200C/C	11-2L-T8@200C/C	13-2L-T8@200C/C	1-T12EF
B40	300	600	4-T16 + 4-T12	4-T16 + 4-T12	4-T16 + 4-T12	3-T25 + 3-T20	3-T20	3-T25 + 3-T25	15-2L-T8@140C/C	9-2L-T8@200C/C	18-2L-T8@110C/C	1-T12EF
B41	300	600	3-T20 + 3-T20	3-T20 + 2-T20	3-T20 + 2-T20	3-T25 + 3-T25	3-T20	3-T25	8-2L-T8@200C/C	6-2L-T8@200C/C	8-2L-T8@200C/C	1-T12EF
B42	300	600	3-T16	3-T16	3-T16	3-T12	3-T12	3-T12	13-2L-T8@200C/C	11-2L-T8@200C/C	13-2L-T8@200C/C	-
B43	300	600	3-T16	3-T16	3-T16	3-T12	3-T12	3-T12	13-2L-T8@200C/C	11-2L-T8@200C/C	13-2L-T8@200C/C	-
B44	300	600	4-T12	4-T12	4-T12	3-T12	3-T12	3-T12	11-2L-T8@200C/C	9-2L-T8@200C/C	11-2L-T8@200C/C	1-T12EF
B45	300	600	3-T12	3-T12	3-T12	3-T12	3-T12	3-T12	8-2L-T8@200C/C	6-2L-T8@200C/C	8-2L-T8@200C/C	1-T12EF

FIRST BEAM SCHEDULE

BEAM NUMBERS	SIZE		BOTTOM REINFORCEMENT			TOP REINFORCEMENT			SHEAR STIRRUPS			SFR
	B	D	LEFT	MID SPAN	RIGHT	LEFT	MID SPAN	RIGHT	LEFT	MID SPAN	RIGHT	
B46	300	600	3-T12	3-T12	3-T12	3-T25 + 3-T16	3-T25 + 3-T16	3-T25 + 3-T16	4-2L-T8@200C/C	2-2L-T8@200C/C	4-2L-T8@200C/C	-
B47	300	600	4-T16 + 4-T16	4-T16	4-T16 + 4-T16	3-T25 + 3-T16	3-T20	3-T20 + 3-T20	8-2L-T8@110C/C	6-2L-T8@115C/C	8-2L-T8@125C/C	1-T12EF
B48	300	600	3-T16	3-T16	3-T16	3-T20 + 3-T20	3-T16	3-T20 + 3-T20	10-2L-T8@200C/C	8-2L-T8@200C/C	10-2L-T8@200C/C	1-T12EF
B49	300	600	4-T16 + 2-T12	4-T16	4-T16 + 2-T12	3-T20 + 3-T20	3-T16	3-T20 + 3-T20	8-2L-T8@200C/C	6-2L-T8@200C/C	8-2L-T8@200C/C	1-T12EF
B50	300	600	4-T16 + 2-T12	4-T16	4-T16 + 2-T12	3-T20 + 3-T20	3-T16	3-T20 + 3-T20	8-2L-T8@200C/C	6-2L-T8@200C/C	8-2L-T8@200C/C	1-T12EF
B51	300	600	4-T16 + 4-T12	4-T16	4-T16 + 4-T12	3-T20 + 3-T20	3-T20	3-T20	7-2L-T8@165C/C	4-2L-T8@180C/C	6-2L-T8@180C/C	1-T12EF
B52	200	450	2-T16	2-T16	2-T16	2-T12	2-T12	2-T12	8-2L-T8@140C/C	4-2L-T8@200C/C	8-2L-T8@140C/C	-
B53	200	450	2-T16	2-T16	2-T16	2-T12	2-T12	2-T12	8-2L-T8@140C/C	4-2L-T8@140C/C	8-2L-T8@140C/C	-
B54	200	450	2-T16	2-T16	2-T16	2-T12	2-T12	2-T12	8-2L-T8@140C/C	6-2L-T8@140C/C	8-2L-T8@140C/C	-
B55	200	450	2-T16	2-T16	2-T16	2-T12	2-T12	2-T12	8-2L-T8@140C/C	6-2L-T8@140C/C	8-2L-T8@140C/C	-
B56	200	450	2-T20	2-T20 + 2-T12	2-T20	2-T12	2-T12	2-T12	11-2L-T8@140C/C	6-2L-T8@200C/C	11-2L-T8@140C/C	-
B57	300	750	4-T12	4-T12	4-T12	3-T25 + 3-T25	3-T25 + 3-T25	3-T25 + 3-T25	4-2L-T8@200C/C	2-2L-T8@200C/C	4-2L-T8@200C/C	-
B58	300	750	3-T25 + 3-T25	3-T25	3-T25 + 3-T25	3-T25 + 3-T25	3-T25	3-T25 + 3-T25	8-2L-T10@115C/C	6-2L-T10@115C/C	8-2L-T10@115C/C	2-T10EF
B59	300	750	3-T25	3-T25	3-T25	3-T25 + 3-T25	3-T20	3-T25 + 3-T25	15-2L-T8@130C/C	12-2L-T8@135C/C	15-2L-T8@130C/C	2-T10EF
B60	300	750	3-T25 + 2-T16	3-T25	3-T25 + 3-T16	3-T25 + 3-T25	3-T20	3-T25 + 3-T20	14-2L-T8@105C/C	12-2L-T8@105C/C	12-2L-T8@120C/C	2-T10EF
B61	300	750	3-T25 + 3-T16	3-T25	3-T25 + 2-T16	3-T25 + 3-T25	3-T25	3-T25 + 3-T25	13-2L-T8@100C/C	11-2L-T8@100C/C	15-2L-T8@90C/C	2-T10EF
B62	300	750	3-T25 + 2-T25	3-T25 + 2-T25	3-T25 + 3-T25	3-T25 + 3-T25	3-T25	3-T25 + 3-T25	10-2L-T10@110C/C	8-2L-T10@110C/C	12-2L-T10@95C/C	2-T10EF
B63	300	750	4-T12	4-T12	4-T12	3-T25 + 3-T25	3-T25 + 3-T25	3-T25 + 3-T25	3-2L-T8@200C/C	1-2L-T8@200C/C	3-2L-T8@200C/C	-
B64	200	450	2-T12	2-T12	2-T12	2-T12	2-T12	2-T12	2-2L-T8@140C/C	2-2L-T8@140C/C	2-2L-T8@140C/C	-
B65	300	600	4-T16 + 4-T12	4-T16 + 4-T12	4-T16 + 4-T12	3-T25 + 3-T25	3-T20	3-T20 + 3-T20	33-2L-T8@75C/C	11-2L-T8@200C/C	14-2L-T8@195C/C	1-T12EF
B66	300	600	3-T12	3-T12	3-T12	3-T20 + 3-T20	3-T20 + 3-T20	3-T20 + 3-T20	3-2L-T8@200C/C	1-2L-T8@200C/C	3-2L-T8@200C/C	-
B68	200	450	2-T20	2-T20 + 2-T16	2-T20	2-T12	2-T16	2-T12	12-2L-T8@140C/C	10-2L-T8@140C/C	11-2L-T8@140C/C	-
B69	200	450	2-T12	2-T12	2-T12	2-T12	2-T12	2-T12	2-2L-T8@140C/C	2-2L-T8@140C/C	2-2L-T8@140C/C	-
B70	300	750	4-T12	4-T12	4-T12	3-T25 + 3-T25	3-T25 + 3-T25	3-T25 + 3-T25	4-2L-T8@200C/C	2-2L-T8@200C/C	4-2L-T8@200C/C	-
B71	300	750	3-T25 + 3-T20	3-T25	3-T25 + 3-T20	3-T25 + 3-T25	3-T25	3-T25 + 3-T25	8-2L-T10@115C/C	6-2L-T10@115C/C	8-2L-T10@120C/C	2-T10EF
B72	300	750	3-T25	3-T25	3-T25	3-T25 + 3-T25	3-T20	3-T25 + 3-T25	17-2L-T8@110C/C	15-2L-T8@110C/C	17-2L-T8@110C/C	2-T10EF
B73	300	750	3-T20 + 3-T20	3-T20 + 2-T20	3-T20 + 3-T20	3-T25 + 3-T25	3-T20	3-T25 + 3-T20	14-2L-T8@105C/C	12-2L-T8@100C/C	14-2L-T8@100C/C	2-T10EF
B74	300	750	3-T20 + 3-T20	3-T20 + 3-T20								



FIRST FLOOR BEAM STEEL LAYOUT

FOR TENDER

**NOTES:**  
 1. All Dimensions are in 'mm' & Levels are in meters.  
 2. Grade of Concrete shall be M25  
 3. Clear cover to main reinforcement shall be as follows:  
 a) Walls = 20 mm, b) Slab = 20 mm, C) Footings = 50 mm  
 d) Beams = 25 mm e) Column = 40mm.  
 4. All Laps Shall be 50 times  $\phi$  of bar & shall be staggered, unless otherwise specified  
 5. P.C.C leveling Course M10(1:3:6) bellow Footings and Plinth Beam  
 6. 'T' denotes HYSD Bars (Fe500)  
 7. 70kN/sq.m SBC is considered at a depth of 2.0m below existing Ground Level ensure the same before execution

This Drawing is the property of Das Consultants and is not to be produced, copied or handed over to a third party or used for any purpose other than for which it is meant  
 Scale 1:100

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 Sheet Size A3

**Client**  
**TRIPURA INDUSTRIAL DEVELOPMENT CORPORATION**  
**Project**  
**LAND CUSTOMS STATION - MUHURIGHTAT**  
**Drawing Title**  
**FIRST FLOOR SLAB STEEL LAYOUT**  
**Drawing Number**  
**ICDI/STR-009**  
 Rev 00

Project Development & Advisory  
  
 IL&FS Cluster Development Initiative Limited

### FIRST SLAB SCHEDULE

SLAB NUMBERS	THK	TYPE	BOTTOM REINFORCEMENT		TOP REINFORCEMENT		DISTRIBUTION
			SHORT SPAN (BENT UP)	LONG SPAN (BENT UP)	SS CONT.	LS CONT.	
S3	150	2-Way	T8 @ 150	T8 @ 150	T8 @ 150	T8 @ 150	T8 @ 150
S4	150	2-Way	T8 @ 150	T8 @ 150	T8 @ 150	T8 @ 150	T8 @ 150
S5	150	2-Way	T8 @ 150	T8 @ 150	T8 @ 150	T8 @ 150	T8 @ 150
S6	150	2-Way	T8 @ 150	T8 @ 150	T8 @ 150	T8 @ 150	T8 @ 150
S7	150	2-Way	T8 @ 150	T8 @ 150	T8 @ 150	T8 @ 150	T8 @ 150
S8	150	2-Way	T8 @ 150	T8 @ 150	T8 @ 150	T8 @ 150	T8 @ 150
S9	150	1-Way	T8 @ 150	T8 @ 150	T8 @ 150	--	T8 @ 150
S12	150	2-Way	T8 @ 150	T8 @ 150	T8 @ 150	T8 @ 150	T8 @ 150
S13	150	2-Way	T8 @ 150	T8 @ 150	T8 @ 150	T8 @ 150	T8 @ 150
S14	150	1-Way	T8 @ 150	T8 @ 150	T8 @ 150	--	T8 @ 150
S15	150	2-Way	T8 @ 150	T8 @ 150	T8 @ 150	T8 @ 150	T8 @ 150
S16	150	1-Way	T8 @ 150	T8 @ 150	T8 @ 150	--	T8 @ 150
S17	150	2-Way	T8 @ 150	T8 @ 150	T8 @ 150	T8 @ 150	T8 @ 150
S18	150	1-Way	T8 @ 150	T8 @ 150	T8 @ 150	--	T8 @ 150
S19	150	1-Way	T8 @ 150	T8 @ 150	T8 @ 150	--	T8 @ 150
S20	150	1-Way	T8 @ 150	T8 @ 150	T8 @ 150	--	T8 @ 150
S21	150	2-Way	T8 @ 150	T8 @ 150	T8 @ 150	T8 @ 150	T8 @ 150
S25	150	1-Way	T8 @ 150	T8 @ 150	T8 @ 150	--	T8 @ 150
S26	150	2-Way	T8 @ 150	T8 @ 150	T8 @ 150	T8 @ 150	T8 @ 150
S27	150	2-Way	T8 @ 150	T8 @ 150	T8 @ 150	T8 @ 150	T8 @ 150
S28	150	2-Way	T8 @ 150	T8 @ 150	T8 @ 150	T8 @ 150	T8 @ 150
S29	150	2-Way	T8 @ 150	T8 @ 150	T8 @ 150	T8 @ 150	T8 @ 150
S30	150	2-Way	T8 @ 150	T8 @ 150	T8 @ 150	T8 @ 150	T8 @ 150

### FIRST SLAB SCHEDULE

SLAB NUMBERS	THK	TYPE	BOTTOM REINFORCEMENT		TOP REINFORCEMENT		DISTRIBUTION
			SHORT SPAN (BENT UP)	LONG SPAN (BENT UP)	SS CONT.	LS CONT.	
S31	150	2-Way	T10 @ 150	T8 @ 150	--	T8 @ 150	T8 @ 150
S32	150	1-Way	T8 @ 150	T8 @ 150	T8 @ 150	--	T8 @ 150
S33	150	2-Way	T8 @ 150	T8 @ 150	T8 @ 150	T8 @ 150	T8 @ 150
S34	150	2-Way	T8 @ 150	T8 @ 150	T8 @ 150	T8 @ 150	T8 @ 150
S35	150	2-Way	T8 @ 150	T8 @ 150	T8 @ 150	T8 @ 150	T8 @ 150
S36	150	2-Way	T8 @ 150	T8 @ 150	T8 @ 150	T8 @ 150	T8 @ 150
S37	150	2-Way	T8 @ 150	T8 @ 150	T8 @ 150	T8 @ 150	T8 @ 150
S38	150	1-Way	T8 @ 150	T8 @ 150	T8 @ 150	--	T8 @ 150
S39	150	2-Way	T12 @ 150	T10 @ 150	T8 @ 150	T8 @ 150	T8 @ 150
S40	150	2-Way	T8 @ 150	T8 @ 150	T8 @ 150	T8 @ 150	T8 @ 150
S41	150	1-Way	T8 @ 150	T8 @ 150	T8 @ 150	--	T8 @ 150
S42	150	1-Way	T8 @ 150	T8 @ 150	T8 @ 150	--	T8 @ 150
S43	150	2-Way	T8 @ 150	T8 @ 150	T8 @ 150	T8 @ 150	T8 @ 150
S44	150	2-Way	T8 @ 150	T8 @ 150	T8 @ 150	T8 @ 150	T8 @ 150
S45	150	2-Way	T8 @ 150	T8 @ 150	T8 @ 150	T8 @ 150	T8 @ 150
S46	150	2-Way	T8 @ 150	T8 @ 150	T8 @ 150	T8 @ 150	T8 @ 150
S47	150	1-Way	T8 @ 150	T8 @ 150	T8 @ 150	--	T8 @ 150
S48	150	2-Way	T8 @ 150	T8 @ 150	T8 @ 150	T8 @ 150	T8 @ 150
S49	150	1-Way	T8 @ 150	T8 @ 150	T8 @ 150	--	T8 @ 150
S50	150	2-Way	T8 @ 150	T8 @ 150	T8 @ 150	T8 @ 150	T8 @ 150
S51	150	2-Way	T8 @ 150	T8 @ 150	T8 @ 150	T8 @ 150	T8 @ 150
S52	150	2-Way	T8 @ 150	T8 @ 150	T8 @ 150	T8 @ 150	T8 @ 150
S53	150	1-Way	T8 @ 150	T8 @ 150	T8 @ 150	--	T8 @ 150
S54	150	1-Way	T8 @ 150	T8 @ 150	T8 @ 150	--	T8 @ 150
S55	150	1-Way	T8 @ 150	T8 @ 150	T8 @ 150	--	T8 @ 150
S56	150	1-Way	T8 @ 150	T8 @ 150	T8 @ 150	--	T8 @ 150

Notes:

1.Slab numbers S1,2,10,11,22,23,24 are not used.

FOR TENDER


**NOTES:**  
 1. All Dimensions are in 'mm' & Levels are in meters.  
 2. Grade of Concrete shall be M25  
 3. Clear cover to main reinforcement shall be as follows:  
 a) Walls = 20 mm, b) Slab = 20 mm, c) Footings = 50 mm  
 d) Beams = 25 mm e) Column = 40mm.  
 4. All Laps Shall be 50 times Ø of bar & shall be staggered, unless otherwise specified  
 5. P.C.C leveling Course M10(1:3:6) bellow Footings and Plinth Beam

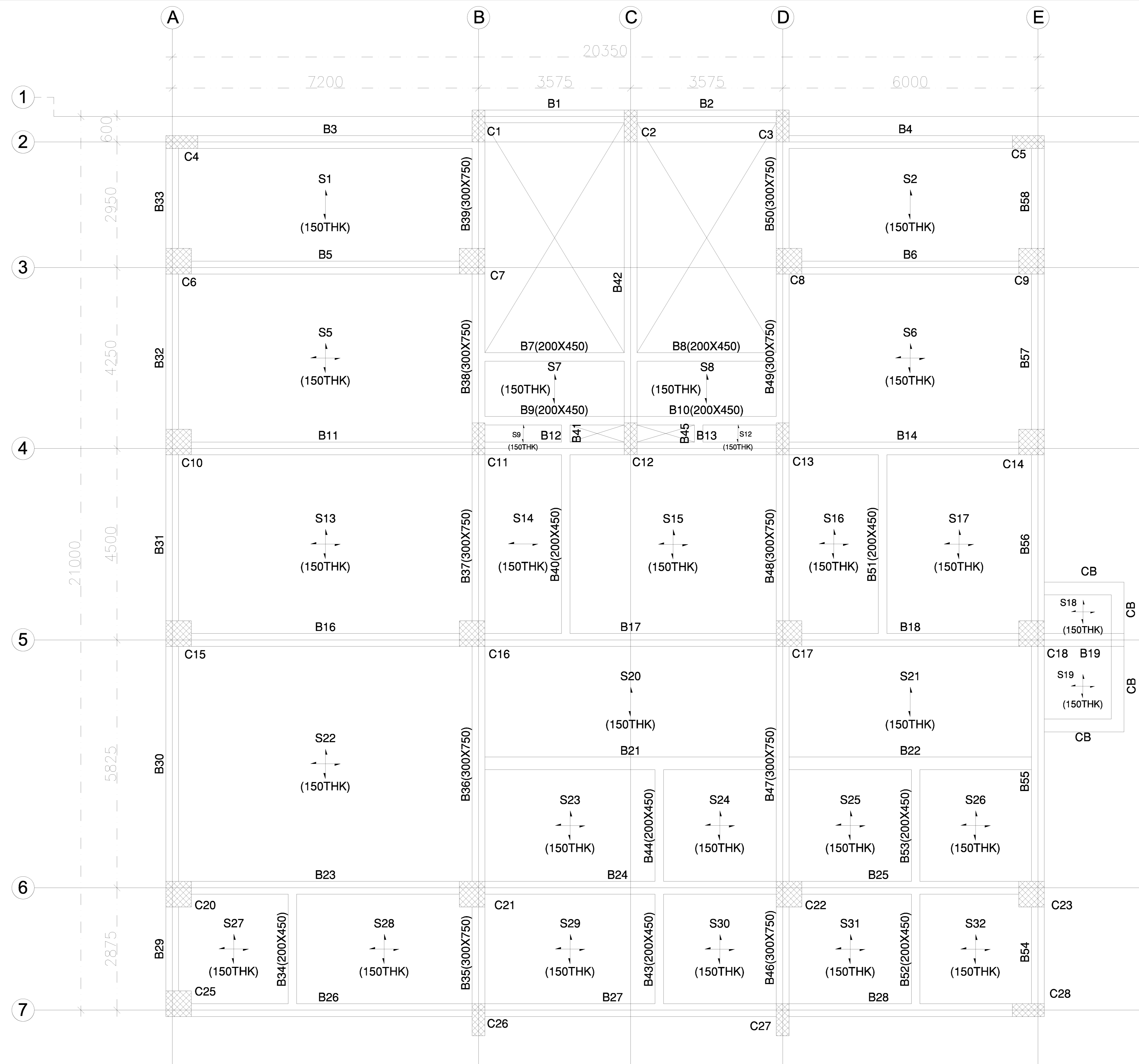
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 Scale 1:100

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**Client**  
**TRIPURA INDUSTRIAL DEVELOPMENT CORPORATION**  
**Project**  
**LAND CUSTOMS STATION - MUHURIGHAT**  
**Drawing Title**  
**FIRST FLOOR SLAB STEEL SCHEDULE**  
**Drawing Number**  
**ICDI/STR-0010**  
 Rev 00

**Project Development & Advisory**  
  
**IL&FS Cluster Development Initiative Limited**



**SECOND FLOOR BEAM FRAMING**

Notes:

1. Beam numbers 15,20,59,60 are not used.
2. Slab numbers S3,4,10,11 are not used.

FOR TENDER

<b>NOTES:</b>	
1. All Dimensions are in 'mm' & Levels are in meters.	6. 'T' denotes HYSD Bars (Fe500)
2. Grade of Concrete shall be M25	7. 70kN/sq.m SBC is considered at a depth of 2.0m below existing Ground Level ensure the same before execution.
3. Clear cover to main reinforcement shall be as follows: a) Walls = 20 mm, b) Slab = 20 mm, c) Footings = 50 mm d) Beams = 25 mm e) Column = 40mm.	
4. All Laps Shall be 50 times Ø of bar & shall be staggered, unless otherwise specified	
5. P.C.C leveling Course M10(1:3:6) bellow Footings and Plinth Beam	

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Scale	1:100

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Client	<b>TRIPURA INDUSTRIAL DEVELOPMENT CORPORATION</b>	
Project	<b>LAND CUSTOMS STATION - MUHURIGHTAT</b>	
Drawing Title	<b>SECOND FLOOR BEAM FRAMING</b>	
Drawing Number	<b>ICDI/STR-0011</b>	Rev 00

Project Development & Advisory	
IL&FS Cluster Development Initiative Limited	

SECOND FLOOR BEAM SCHEDULE

BEAM NUMBERS	SIZE		BOTTOM REINFORCEMENT			TOP REINFORCEMENT			SHEAR STIRRUPS			SFR
	B	D	LEFT	MID SPAN	RIGHT	LEFT	MID SPAN	RIGHT	LEFT	MID SPAN	RIGHT	
B1	300	600	4-T16 + 4-T16	4-T16 + 2-T16	4-T16 + 2-T16	3-T25 + 3-T16	3-T20	3-T20 + 3-T20	12-2L-T8@105C/C	7-2L-T8@150C/C	12-2L-T8@100C/C	1-T12EF
B2	300	600	4-T16 + 2-T16	4-T16 + 2-T16	4-T16 + 4-T16	3-T20 + 3-T20	3-T20	3-T25 + 3-T16	12-2L-T8@105C/C	7-2L-T8@140C/C	13-2L-T8@95C/C	1-T12EF
B3	300	600	4-T16 + 2-T16	4-T16 + 4-T16	4-T16	3-T25 + 3-T20	3-T16	3-T12	13-2L-T8@200C/C	11-2L-T8@200C/C	13-2L-T8@200C/C	1-T12EF
B4	300	600	4-T16	4-T16 + 4-T12	4-T16 + 2-T12	3-T12	3-T25	3-T25 + 3-T20	11-2L-T8@200C/C	9-2L-T8@200C/C	11-2L-T8@200C/C	1-T12EF
B5	300	600	3-T20 + 3-T20	3-T20 + 2-T20	3-T20 + 3-T20	3-T25 + 3-T25	3-T25	3-T25 + 3-T25	13-2L-T8@200C/C	11-2L-T8@200C/C	13-2L-T8@190C/C	1-T12EF
B6	300	600	3-T25 + 3-T20	3-T25	3-T25 + 3-T20	3-T25 + 3-T25	3-T25	3-T25 + 3-T25	12-2L-T8@165C/C	9-2L-T8@200C/C	12-2L-T8@165C/C	1-T12EF
B7	200	450	2-T16	2-T16 + 2-T12	2-T16	2-T12	2-T12	2-T12	9-2L-T8@140C/C	7-2L-T8@140C/C	9-2L-T8@140C/C	-
B8	200	450	2-T16	2-T16 + 2-T12	2-T16	2-T12	2-T12	2-T12	9-2L-T8@140C/C	7-2L-T8@140C/C	9-2L-T8@140C/C	-
B9	200	450	2-T16	2-T16	2-T16	2-T12	2-T12	2-T12	9-2L-T8@140C/C	7-2L-T8@140C/C	9-2L-T8@140C/C	-
B10	200	450	2-T16	2-T16 + 2-T12	2-T16	2-T12	2-T12	2-T12	9-2L-T8@140C/C	7-2L-T8@140C/C	9-2L-T8@140C/C	-
B11	300	600	4-T16 + 4-T16 + 2-T12	4-T16 + 2-T16	4-T16 + 2-T16	3-T25 + 3-T25 + 2-T12	3-T20	3-T20 + 3-T20 + 3-T12	13-2L-T8@200C/C	11-2L-T8@200C/C	13-2L-T8@200C/C	1-T12EF
B12	300	600	4-T16 + 4-T12	4-T16 + 2-T12	4-T16 + 4-T12	3-T20 + 3-T20 + 3-T12	3-T20	3-T16 + 3-T16 + 3-T16	12-2L-T8@105C/C	9-2L-T8@115C/C	11-2L-T8@110C/C	1-T12EF
B13	300	600	4-T16 + 4-T12	4-T16	4-T16 + 2-T12	3-T16 + 3-T16 + 3-T16	3-T20	3-T20 + 3-T20 + 3-T16	9-2L-T8@145C/C	8-2L-T8@135C/C	10-2L-T8@125C/C	1-T12EF
B14	300	600	3-T20 + 2-T20	3-T20 + 2-T20	3-T20 + 3-T20 + 2-T12	3-T20 + 3-T20 + 3-T16	3-T25	3-T25 + 3-T25 + 3-T16	16-2L-T8@130C/C	11-2L-T8@165C/C	16-2L-T8@130C/C	1-T12EF
B15	300	150	3-T12	3-T12	3-T12	3-T12	3-T12	3-T12	7-2L-T8@110C/C	5-2L-T8@110C/C	9-2L-T8@90C/C	-
B16	300	600	3-T20 + 3-T20 + 3-T12	3-T20 + 2-T20	3-T20 + 3-T20 + 3-T12	3-T25 + 3-T25 + 3-T16	3-T25	3-T25 + 3-T25 + 3-T16	19-2L-T8@125C/C	11-2L-T8@195C/C	20-2L-T8@120C/C	1-T12EF
B17	300	600	4-T16 + 4-T16 + 4-T12	4-T16 + 2-T16	4-T16 + 4-T16 + 4-T12	3-T25 + 3-T25 + 3-T16	3-T25	3-T25 + 3-T25 + 3-T16	18-2L-T8@130C/C	10-2L-T8@200C/C	17-2L-T8@140C/C	1-T12EF
B18	300	600	3-T25 + 2-T25	3-T25	3-T25 + 3-T25	3-T25 + 3-T25 + 3-T16	3-T16 + 3-T16 + 3-T12	3-T25 + 3-T25 + 3-T20	19-2L-T8@105C/C	15-2L-T8@120C/C	19-2L-T8@105C/C	1-T12EF
B19	300	600	3-T12	3-T12	3-T12	3-T25 + 3-T25 + 3-T20	3-T25 + 3-T25 + 3-T20	3-T25 + 3-T25 + 3-T20	5-2L-T8@180C/C	3-2L-T8@190C/C	4-2L-T8@200C/C	1-T12EF
B20	300	150	4-T12	4-T12	4-T12	3-T12	3-T12	3-T12	10-2L-T8@75C/C	8-2L-T8@80C/C	10-2L-T8@80C/C	-
B21	300	600	3-T25	3-T25 + 3-T20	3-T25	4-T12	4-T16	4-T12	13-2L-T8@200C/C	11-2L-T8@200C/C	15-2L-T8@175C/C	1-T12EF
B22	300	600	3-T20	3-T20 + 3-T20	3-T20	3-T12	3-T12	3-T12	11-2L-T8@200C/C	9-2L-T8@200C/C	11-2L-T8@200C/C	1-T12EF
B23	300	600	3-T20 + 3-T20	3-T20 + 2-T20	3-T20 + 3-T20	3-T25 + 3-T25 + 2-T12	3-T20	3-T25 + 3-T25 + 2-T12	18-2L-T8@135C/C	13-2L-T8@165C/C	17-2L-T8@140C/C	1-T12EF
B24	300	600	3-T20 + 3-T20	3-T20 + 2-T20	3-T20 + 3-T20 + 2-T12	3-T25 + 3-T25 + 2-T12	3-T20	3-T25 + 3-T25 + 3-T16	17-2L-T8@140C/C	12-2L-T8@180C/C	22-2L-T8@105C/C	1-T12EF
B25	300	600	3-T20 + 3-T20 + 2-T16	3-T20 + 2-T20	3-T20 + 3-T20 + 3-T16	3-T25 + 3-T25 + 3-T16	3-T25	3-T25 + 3-T25 + 3-T16	22-2L-T8@90C/C	15-2L-T8@120C/C	21-2L-T8@90C/C	1-T12EF
B26	300	600	4-T16 + 2-T12	4-T16 + 2-T12	4-T16	3-T25 + 3-T25	3-T16	3-T25 + 2-T20	13-2L-T8@200C/C	11-2L-T8@200C/C	14-2L-T8@180C/C	1-T12EF

SECOND FLOOR BEAM SCHEDULE

BEAM NUMBERS	SIZE		BOTTOM REINFORCEMENT			TOP REINFORCEMENT			SHEAR STIRRUPS			SFR
	B	D	LEFT	MID SPAN	RIGHT	LEFT	MID SPAN	RIGHT	LEFT	MID SPAN	RIGHT	
B27	300	600	4-T16	4-T16	4-T16	3-T25 + 2-T20	3-T12	3-T25 + 3-T20	13-2L-T8@200C/C	11-2L-T8@200C/C	13-2L-T8@200C/C	1-T12EF
B28	300	600	4-T16	4-T16 + 2-T16	4-T16 + 4-T16	3-T25 + 3-T25	3-T25	3-T25 + 3-T25	15-2L-T8@140C/C	9-2L-T8@200C/C	13-2L-T8@155C/C	1-T12EF
B29	300	600	4-T16 + 4-T12	4-T16	4-T16 + 2-T12	3-T25	3-T25	3-T25	6-2L-T8@180C/C	3-2L-T8@200C/C	6-2L-T8@180C/C	1-T12EF
B30	300	600	4-T12	4-T12	4-T12	3-T25	3-T12	3-T25	10-2L-T8@200C/C	8-2L-T8@200C/C	10-2L-T8@200C/C	1-T12EF
B31	300	600	4-T16	4-T16	4-T16	3-T25	3-T16	3-T25	8-2L-T8@200C/C	6-2L-T8@200C/C	8-2L-T8@200C/C	1-T12EF
B32	300	600	4-T16	4-T16	4-T16	3-T25	3-T16	3-T25	8-2L-T8@200C/C	6-2L-T8@200C/C	8-2L-T8@200C/C	1-T12EF
B33	300	600	4-T16	4-T16	4-T16	3-T25	3-T20	3-T20	6-2L-T8@200C/C	4-2L-T8@200C/C	6-2L-T8@200C/C	1-T12EF
B34	200	450	2-T16	2-T16	2-T16	2-T12	2-T12	2-T12	8-2L-T8@140C/C	4-2L-T8@200C/C	8-2L-T8@140C/C	-
B35	300	750	3-T25 + 2-T20	3-T25	3-T25 + 2-T12	3-T25 + 3-T16	3-T25	3-T25 + 3-T25	8-2L-T8@110C/C	8-2L-T8@90C/C	10-2L-T8@90C/C	2-T10EF
B36	300	750	3-T25	3-T25	3-T25	3-T25 + 3-T25	3-T20	3-T25 + 3-T25	14-2L-T8@135C/C	12-2L-T8@140C/C	14-2L-T8@140C/C	2-T10EF
B37	300	750	3-T20 + 2-T20	3-T20	3-T20 + 3-T20	3-T25 + 3-T25	3-T20	3-T25 + 2-T20	11-2L-T8@135C/C	8-2L-T8@145C/C	10-2L-T8@150C/C	2-T10EF
B38	300	750	3-T20 + 3-T20	3-T20	3-T20 + 2-T20	3-T25 + 3-T25	3-T25	3-T25 + 3-T25	11-2L-T8@120C/C	10-2L-T8@110C/C	13-2L-T8@100C/C	2-T10EF
B39	300	750	3-T25 + 2-T12	3-T25	3-T25 + 2-T20	3-T25 + 3-T25	3-T25	3-T25 + 3-T20	12-2L-T8@90C/C	10-2L-T8@95C/C	13-2L-T8@85C/C	2-T10EF
B40	200	450	2-T20	2-T20 + 2-T16	2-T20	2-T12	2-T12	2-T12	12-2L-T8@140C/C	10-2L-T8@140C/C	11-2L-T8@140C/C	-
B41	200	450	2-T12	2-T12	2-T12	2-T12	2-T12	2-T12	2-2L-T8@140C/C	2-2L-T8@140C/C	2-2L-T8@140C/C	-
B42	300	600	4-T16 + 4-T16	4-T16 + 4-T16	4-T16 + 4-T16	3-T25 + 3-T25	3-T16	3-T25 + 3-T20	31-2L-T8@80C/C	11-2L-T8@200C/C	13-2L-T8@200C/C	1-T12EF
B43	200	450	2-T16	2-T16	2-T16	2-T12	2-T12	2-T12	8-2L-T8@140C/C	4-2L-T8@200C/C	8-2L-T8@140C/C	-
B44	200	450	2-T16	2-T16	2-T16	2-T12	2-T12	2-T12	8-2L-T8@140C/C	6-2L-T8@140C/C	8-2L-T8@140C/C	-
B45	200	450	2-T12	2-T12	2-T12	2-T12	2-T12	2-T12	2-2L-T8@140C/C	2-2L-T8@140C/C	2-2L-T8@140C/C	-
B46	300	750	3-T25 + 3-T16	3-T25	3-T25	3-T25 + 3-T16	3-T25	3-T25 + 3-T25	8-2L-T8@105C/C	8-2L-T8@90C/C	10-2L-T8@90C/C	2-T10EF
B47	300	750	4-T16 + 2-T16	4-T16 + 4-T16	4-T16 + 2-T16	3-T25 + 3-T25	3-T20	3-T25 + 3-T25	21-2L-T8@90C/C	15-2L-T8@110C/C	17-2L-T8@110C/C	2-T10EF
B48	300	750	3-T20 + 2-T20	3-T20	3-T20 + 3-T20	3-T25 + 3-T25	3-T20	3-T25 + 3-T16	10-2L-T8@145C/C	8-2L-T8@145C/C	8-2L-T8@185C/C	2-T10EF
B49	300	750	3-T20 + 3-T20	3-T20 + 2-T20	3-T20 + 2-T20	3-T25 + 3-T16	3-T25	3-T25 + 3-T25	13-2L-T8@105C/C	11-2L-T8@105C/C	13-2L-T8@100C/C	2-T10EF
B50	300	750	3-T25 + 2-T12	3-T25	3-T25 + 3-T16	3-T25 + 3-T25	3-T25	3-T25 + 3-T20	12-2L-T8@95C/C	10-2L-T8@95C/C	12-2L-T8@90C/C	2-T10EF
B51	200	450	2-T20	2-T20 + 2-T12	2-T20	2-T12	2-T12	2-T12	9-2L-T8@200C/C	7-2L-T8@200C/C	8-2L-T8@200C/C	-
B52	200	450	2-T16	2-T16	2-T16	2-T12	2-T12	2-T12	8-2L-T8@140C/C	4-2L-T8@200C/C	8-2L-T8@140C/C	-
B53	200	450	2-T16	2-T16	2-T16	2-T12	2-T12	2-T12	8-2L-T8@140C/C	6-2L-T8@140C/C	8-2L-T8@140C/C	-
B54	300	600	4-T16	4-T16	4-T16	3-T20	3-T20	3-T25 + 3-T16	6-2L-T8@200C/C	4-2L-T8@200C/C	6-2L-T8@200C/C	1-T12EF
B55	300	600	4-T16	4-T16 + 4-T12	4-T16	3-T25 + 3-T16	3-T16	3-T25 + 3-T16	15-2L-T8@125C/C	8-2L-T8@195C/C	15-2L-T8@130C/C	1-T12EF
B56	300	600	4-T16	4-T16	4-T16	3-T25 + 3-T16	3-T16	3-T25	8-2L-T8@200C/C	6-2L-T8@200C/C	8-2L-T8@200C/C	1-T12EF
B57	300	600	4-T16 + 2-T12	4-T16	4-T16	3-T25	3-T16	3-T25	8-2L-T8@200C/C	6-2L-T8@200C/C	8-2L-T8@200C/C	1-T12EF
B58	300	600	4-T16	4-T16	4-T16	3-T25	3-T20	3-T20	6-2L-T8@200C/C	4-2L-T8@200C/C	6-2L-T8@200C/C	1-T12EF
B59	300	150	3-T25	3-T25	3-T25	3-T12	3-T16	3-T20	7-2L-T8@110C/C	6-2L-T8@90C/C	8-2L-T8@90C/C	-
B60	300	150	3-T12	3-T12	3-T12	3-T20	3-T12	3-T12	5-2L-T8@110C/C	3-2L-T8@90C/C	5-2L-T8@110C/C	-

**NOTES:**  
 1. All Dimensions are in 'mm' & Levels are in meters.  
 2. Grade of Concrete shall be M25  
 3. Clear cover to main reinforcement shall be as follows:  
 a) Walls = 20 mm, b) Slab = 20 mm, c) Footings = 50 mm  
 d) Beams = 25 mm e) Column = 40mm.  
 4. All Laps Shall be 50 times Ø of bar & shall be staggered, unless otherwise specified  
 5. P.C.C leveling Course M10(1:3:6) bellow Footings and Plinth Beam  
 6. 'T' denotes HYSD Bars (Fe500)  
 7. 70kN/sq.m SBC is considered at a depth of 2.0m below existing Ground Level ensure the same before execution.

This Drawing is the property of Das Consultants and is not to be produced, copied or handed over to a third party or used for any purpose other than for which it is meant  
 Scale 1:100

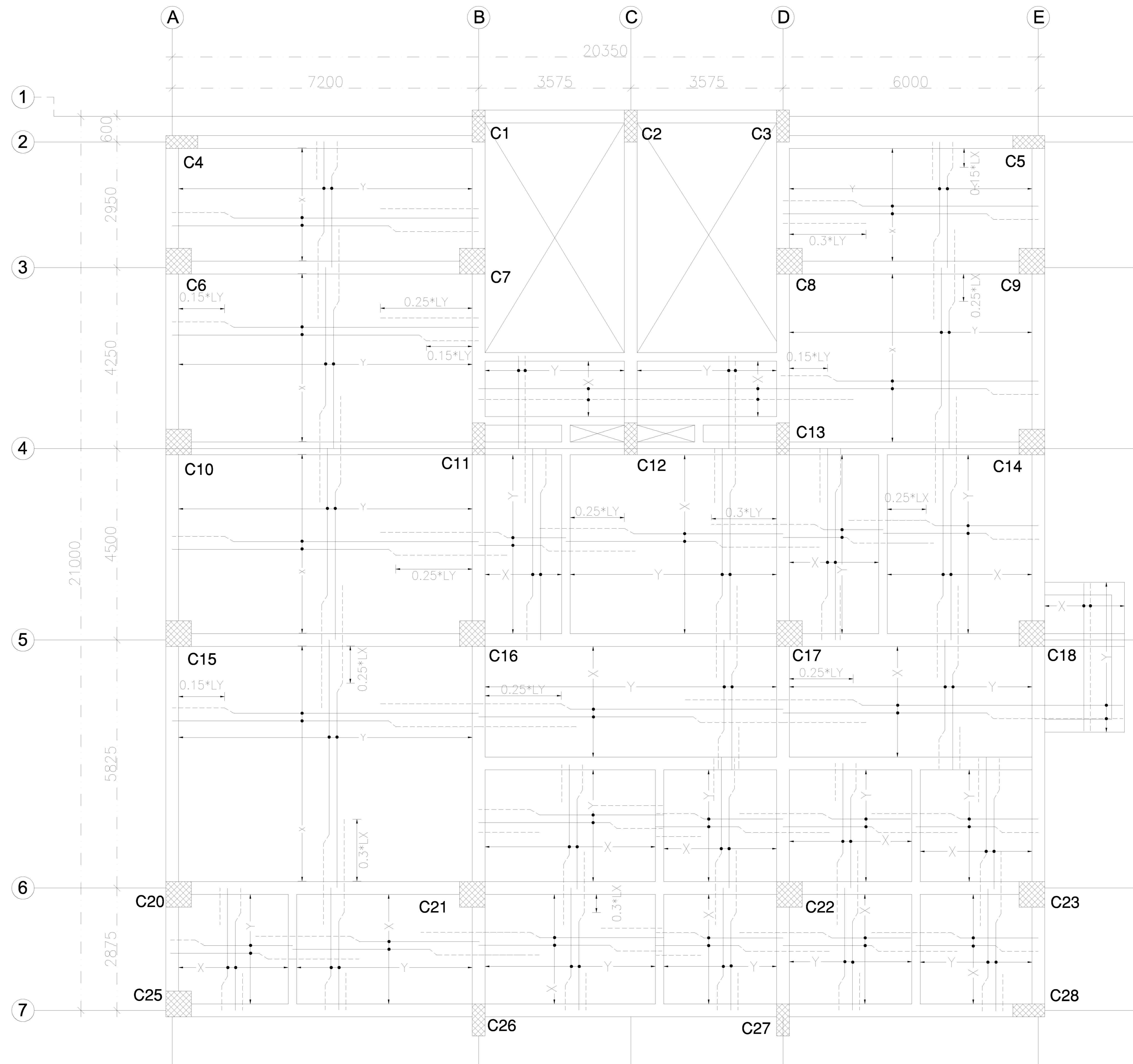
**STRUCTURAL CONSULTANTS:**  
**M/s. DAS CONSULTANTS**  
 FLAT NO.:1, NO..30, 6TH MAIN ROAD, LAKSHMI NAGAR EXTENSION PORUR, CHENNAI - 600 116 TELEFAX - +91-44-24764416 email - dasconsultants@gmail.com web - dasconsultants.net

**DRAWING DETAILS**  
 Designed ....: VENU  
 Date 10-10-2018  
 Drawn ....: MLS  
 Checked ....: DAS  
 Approved :-DAS  
 Sheet Size A2

**Client**  
**TRIPURA INDUSTRIAL DEVELOPMENT CORPORATION**  
**Project**  
**LAND CUSTOMS STATION - MUHURIGHAT**  
**Drawing Title**  
**SECOND FLOOR BEAM SCHEDULE**  
**Drawing Number**  
**ICDI/STR-0012**  
 Rev 00

**Project Development & Advisory**  
  
**IL&FS Cluster Development Initiative Limited**

**FOR TENDER**



**SECOND FLOOR BEAM FRAMING**

Notes:  
1. Slab numbers S3,4,10,11 are not used.

FOR TENDER

NOTES:	
1. All Dimensions are in 'mm' & Levels are in meters.	6. 'T' denotes HYSD Bars (Fe500)
2. Grade of Concrete shall be M25	7. 70kN/sq.m SBC is considered at a depth of 2.0m below existing Ground Level ensure the same before execution.
3. Clear cover to main reinforcement shall be as follows: a) Walls = 20 mm, b) Slab = 20 mm, c) Footings = 50 mm d) Beams = 25 mm e) Column = 40mm.	
4. All Laps Shall be 50 times $\phi$ of bar & shall be staggered, unless otherwise specified	
5. P.C.C leveling Course M10(1:3:6) bellow Footings and Plinth Beam	

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Scale	1:100

<b>STRUCTURAL CONSULTANTS:</b> <b>M/s. DAS CONSULTANTS</b> FLAT NO.:1, NO.30, 6TH MAIN ROAD, LAKSHMI NAGAR EXTENSION PORUR, CHENNAI - 600 116 TELEFAX - +91-44-24764416 email - dasconsultants@gmail.com web - dasconsultants.net
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DRAWING DETAILS	
Designed :- VENU	Date
Drawn :- MLS	10-10-2018
Checked :- DAS	Sheet Size
Approved :- DAS	A3

Client	<b>TRIPURA INDUSTRIAL DEVELOPMENT CORPORATION</b>
Project	<b>LAND CUSTOMS STATION - MUHURIGHTAT</b>
Drawing Title	<b>SECOND FLOOR SLAB STEEL LAYOUT</b>
Drawing Number	<b>ICDI/STR-0013</b>
Rev	00

Project Development & Advisory
<b>IL&amp;FS</b> Clusters IL&FS Cluster Development Initiative Limited



SECOND FLOOR SLAB SCHEDULE


SLAB NUMBERS	THK	TYPE	BOTTOM REINFORCEMENT		TOP REINFORCEMENT		DISTRIBUTION
			SHORT SPAN (BENT UP)	LONG SPAN (BENT UP)	SS CONT.	LS CONT.	
S1	150	1-Way	T8 @ 150	T8 @ 150	T8 @ 150	--	T8 @ 150
S2	150	1-Way	T8 @ 150	T8 @ 150	T8 @ 150	--	T8 @ 150
S5	150	2-Way	T8 @ 150	T8 @ 150	T8 @ 150	--	T8 @ 150
S6	150	2-Way	T8 @ 150	T8 @ 150	T8 @ 150	--	T8 @ 150
S7	150	1-Way	T8 @ 150	T8 @ 150	T8 @ 150	--	T8 @ 150
S8	150	1-Way	T8 @ 150	T8 @ 150	T8 @ 150	--	T8 @ 150
S9	150	1-Way	T8 @ 150	T8 @ 150	T8 @ 150	--	T8 @ 150
S12	150	1-Way	T8 @ 150	T8 @ 150	T8 @ 150	--	T8 @ 150
S13	150	2-Way	T8 @ 150	T8 @ 150	T8 @ 150	T8 @ 150	T8 @ 150
S14	150	1-Way	T8 @ 150	T8 @ 150	T8 @ 150	--	T8 @ 150
S15	150	2-Way	T8 @ 150	T8 @ 150	T8 @ 150	T8 @ 150	T8 @ 150
S16	150	2-Way	T8 @ 150	T8 @ 150	T8 @ 150	T8 @ 150	T8 @ 150
S17	150	2-Way	T8 @ 150	T8 @ 150	T8 @ 150	T8 @ 150	T8 @ 150
S18	150	2-Way	T8 @ 150	T8 @ 150	T8 @ 150	T8 @ 150	T8 @ 150
S19	150	2-Way	T8 @ 150	T8 @ 150	T8 @ 150	T8 @ 150	T8 @ 150
S20	150	1-Way	T8 @ 150	T8 @ 150	T8 @ 150	--	T8 @ 150
S21	150	1-Way	T8 @ 150	T8 @ 150	T8 @ 150	--	T8 @ 150
S22	150	2-Way	T12 @ 150	T10 @ 150	T8 @ 150	T8 @ 150	T8 @ 150
S23	150	2-Way	T8 @ 150	T8 @ 150	T8 @ 150	T8 @ 150	T8 @ 150
S24	150	2-Way	T8 @ 150	T8 @ 150	--	--	T8 @ 150
S25	150	2-Way	T8 @ 150	T8 @ 150	--	--	T8 @ 150
S26	150	2-Way	T8 @ 150	T8 @ 150	--	--	T8 @ 150
S27	150	2-Way	T8 @ 150	T8 @ 150	T8 @ 150	T8 @ 150	T8 @ 150
S28	150	2-Way	T8 @ 150	T8 @ 150	T8 @ 150	T8 @ 150	T8 @ 150
S29	150	2-Way	T8 @ 150	T8 @ 150	T8 @ 150	T8 @ 150	T8 @ 150
S30	150	2-Way	T8 @ 150	T8 @ 150	--	--	T8 @ 150
S31	150	2-Way	T8 @ 150	T8 @ 150	--	--	T8 @ 150
S32	150	2-Way	T8 @ 150	T8 @ 150	--	--	T8 @ 150

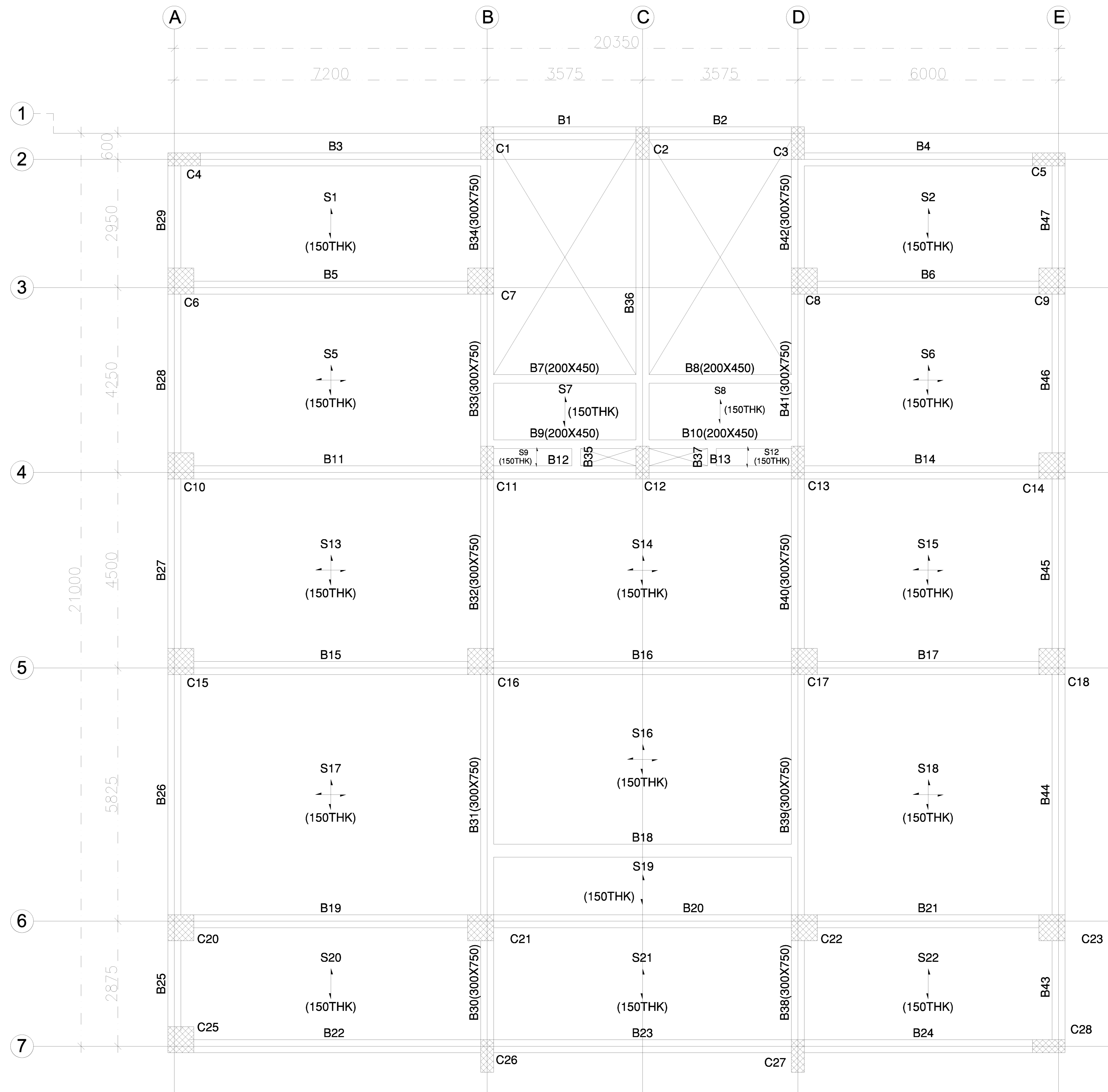
Notes:

1.Slab numbers S3,4,10,11 are not used.

FOR TENDER

<b>NOTES:</b> 1. All Dimensions are in 'mm' & Levels are in meters. 2. Grade of Concrete shall be M25 3. Clear cover to main reinforcement shall be as follows: a) Walls = 20 mm, b) Slab = 20 mm, C) Footings = 50 mm d) Beams = 25 mm e) Column = 40mm. 4. All Laps Shall be 50 times Ø of bar & shall be staggered, unless otherwise specified 5. P.C.C leveling Course M10(1:3:6) bellow Footings and Plinth Beam 6. 'T' denotes HYSD Bars (Fe500) 7. 70kN/sq.m SBC is considered at a depth of 2.0m below existing Ground Level ensure the same before execution.	This Drawing is the property of Das Consultants and is not to be produced, copied or handed over to a third party or used for any purpose other than for which it is meant Scale 1:100	<b>STRUCTURAL CONSULTANTS:</b> <b>M/s. DAS CONSULTANTS</b> FLAT NO.:1, NO.30, 6TH MAIN ROAD, LAKSHMI NAGAR EXTENSION PORUR, CHENNAI - 600 116 TELEFAX - +91-44-24764416 email - dasconsultants@gmail.com web - dasconsultants.net	<b>DRAWING DETAILS</b> Designed ....:VENU Drawn ....: MLS Checked ....:DAS Approved :-DAS Date 10-10-2018 Sheet Size A4	Client <b>TRIPURA INDUSTRIAL DEVELOPMENT CORPORATION</b> Project <b>LAND CUSTOMS STATION - MUHURIGHAT</b> Drawing Title <b>SECOND FLOOR SLAB STEEL SCHEDULE</b> Drawing Number <b>ICDI/STR-0014</b> Rev 00
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Project Development & Advisory  IL&FS Cluster Development Initiative Limited
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**TERRACE FLOOR BEAM FRAMING**

Notes:

1. SLAB NUMBERS S10,11,22,23,24 ARE NOT USED.

**FOR TENDER**

<b>NOTES:</b>	
1. All Dimensions are in 'mm' & Levels are in meters.	6. 'T' denotes HYSD Bars (Fe500)
2. Grade of Concrete shall be M25	7. 70kN/sq.m SBC is considered at a depth of 2.0m below existing Ground Level ensure the same before execution.
3. Clear cover to main reinforcement shall be as follows: a) Walls = 20 mm, b) Slab = 20 mm, c) Footings = 50 mm d) Beams = 25 mm e) Column = 40mm.	
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5. P.C.C leveling Course M10(1:3:6) bellow Footings and Plinth Beam	

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Scale	1:100

<b>STRUCTURAL CONSULTANTS:</b>
<b>M/s. DAS CONSULTANTS</b>
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<b>DRAWING DETAILS</b>	
Designed ...:- VENU	Date 10-10-2018
Drawn ...:- MLS	Sheet Size A3
Checked ...:- DAS	
Approved :-DAS	

Client	<b>TRIPURA INDUSTRIAL DEVELOPMENT CORPORATION</b>	
Project	<b>LAND CUSTOMS STATION - MUHURIGHAT</b>	
Drawing Title	<b>TERRACE FLOOR BEAM FRAMING</b>	
Drawing Number	<b>ICDI/STR-015</b>	Rev 00

Project Development & Advisory	
IL&FS Cluster Development Initiative Limited	

TERRACE BEAM SCHEDULE

BEAM NUMBERS	SIZE		BOTTOM REINFORCEMENT			TOP REINFORCEMENT			SHEAR STIRRUPS			SFR
	B	D	LEFT	MID SPAN	RIGHT	LEFT	MID SPAN	RIGHT	LEFT	MID SPAN	RIGHT	
B1	300	600	4-T16 + 4-T12	4-T16	4-T16 + 2-T12	4-T25	4-T16	4-T16	7-2L-T8@200C/C	5-2L-T8@200C/C	7-2L-T8@200C/C	1-T12EF
B2	300	600	4-T16 + 2-T12	4-T16	4-T16 + 4-T12	4-T16	4-T16	4-T25	7-2L-T8@200C/C	5-2L-T8@200C/C	7-2L-T8@200C/C	1-T12EF
B3	300	600	4-T16	4-T16 + 2-T12	4-T16	3-T20 + 3-T20	3-T12	3-T12	13-2L-T8@200C/C	11-2L-T8@200C/C	13-2L-T8@200C/C	1-T12EF
B4	300	600	4-T16	4-T16 + 2-T12	4-T16	4-T12	4-T16	4-T25	11-2L-T8@200C/C	9-2L-T8@200C/C	11-2L-T8@200C/C	1-T12EF
B5	300	600	4-T16 + 4-T12	4-T16 + 2-T12	4-T16 + 4-T12	3-T25 + 3-T20	3-T20	3-T25 + 3-T20	13-2L-T8@200C/C	11-2L-T8@200C/C	12-2L-T8@200C/C	1-T12EF
B6	300	600	4-T16 + 4-T16	4-T16 + 2-T16	4-T16 + 4-T16	3-T25 + 3-T20	3-T20	3-T25 + 3-T20	11-2L-T8@200C/C	9-2L-T8@200C/C	10-2L-T8@200C/C	1-T12EF
B7	200	450	2-T16	2-T16 + 2-T12	2-T16	2-T12	2-T12	2-T12	9-2L-T8@140C/C	7-2L-T8@140C/C	9-2L-T8@140C/C	-
B8	200	450	2-T16	2-T16 + 2-T12	2-T16	2-T12	2-T12	2-T12	9-2L-T8@140C/C	7-2L-T8@140C/C	9-2L-T8@140C/C	-
B9	200	450	2-T16	2-T16	2-T16	2-T12	2-T12	2-T12	9-2L-T8@140C/C	7-2L-T8@140C/C	9-2L-T8@140C/C	-
B10	200	450	2-T16	2-T16	2-T16	2-T12	2-T12	2-T12	9-2L-T8@140C/C	7-2L-T8@140C/C	9-2L-T8@140C/C	-
B11	300	600	4-T16 + 2-T12	4-T16 + 2-T12	4-T16	3-T25 + 3-T20	3-T12	3-T20	13-2L-T8@200C/C	11-2L-T8@200C/C	13-2L-T8@200C/C	1-T12EF
B12	300	600	4-T16	4-T16	4-T16 + 2-T12	3-T20 + 3-T20	3-T20	3-T25	9-2L-T8@145C/C	6-2L-T8@165C/C	7-2L-T8@200C/C	1-T12EF
B13	300	600	4-T16 + 2-T12	4-T16	4-T16	3-T25	3-T20	3-T20 + 3-T20	7-2L-T8@195C/C	6-2L-T8@180C/C	8-2L-T8@160C/C	1-T12EF
B14	300	600	4-T16 + 2-T12	4-T16 + 2-T12	4-T16 + 4-T12	3-T20 + 3-T20	3-T20	3-T25 + 3-T20	11-2L-T8@200C/C	9-2L-T8@200C/C	11-2L-T8@200C/C	1-T12EF
B15	300	600	3-T25	3-T25	3-T25	3-T25 + 3-T25	3-T20	3-T25 + 3-T25	13-2L-T8@195C/C	11-2L-T8@200C/C	14-2L-T8@180C/C	1-T12EF
B16	300	600	4-T16 + 4-T12	4-T16 + 2-T12	4-T16 + 2-T12	3-T25 + 3-T25	3-T20	3-T25 + 3-T25	12-2L-T8@200C/C	10-2L-T8@200C/C	12-2L-T8@200C/C	1-T12EF
B17	300	600	4-T16 + 4-T16	4-T16 + 2-T16	4-T16 + 4-T16	3-T25 + 3-T25	3-T20	3-T25 + 2-T25	11-2L-T8@190C/C	9-2L-T8@200C/C	11-2L-T8@180C/C	1-T12EF
B18	300	600	3-T25	3-T25 + 3-T16	3-T25	3-T12	3-T16	3-T12	13-2L-T8@200C/C	11-2L-T8@200C/C	13-2L-T8@200C/C	1-T12EF
B19	300	600	3-T20	3-T20	3-T20	3-T25 + 3-T20	3-T16	3-T25 + 3-T20	13-2L-T8@200C/C	11-2L-T8@200C/C	12-2L-T8@200C/C	1-T12EF
B20	300	600	4-T16 + 2-T12	4-T16	4-T16 + 2-T12	3-T25 + 3-T20	3-T16	3-T25 + 3-T16	12-2L-T8@200C/C	10-2L-T8@200C/C	12-2L-T8@200C/C	1-T12EF
B21	300	600	4-T16 + 4-T12	4-T16	4-T16 + 4-T12	3-T25 + 3-T16	3-T20	3-T25 + 3-T20	11-2L-T8@200C/C	9-2L-T8@200C/C	10-2L-T8@200C/C	1-T12EF
B22	300	600	4-T16	4-T16	4-T16	3-T20 + 3-T20	3-T12	3-T25	13-2L-T8@200C/C	11-2L-T8@200C/C	13-2L-T8@200C/C	1-T12EF
B23	300	600	3-T16	3-T16	3-T16	3-T25	3-T12	3-T25	13-2L-T8@200C/C	11-2L-T8@200C/C	13-2L-T8@200C/C	1-T12EF
B24	300	600	4-T16	4-T16	4-T16 + 2-T12	3-T25	3-T16	3-T20 + 3-T20	11-2L-T8@200C/C	9-2L-T8@200C/C	11-2L-T8@200C/C	1-T12EF
B25	300	600	3-T16	3-T16	3-T16	3-T16	3-T16	3-T20	5-2L-T8@200C/C	3-2L-T8@200C/C	5-2L-T8@200C/C	1-T12EF
B26	300	600	3-T12	3-T12	3-T12	3-T20	3-T12	3-T20	10-2L-T8@200C/C	8-2L-T8@200C/C	10-2L-T8@200C/C	1-T12EF
B27	300	600	3-T12	3-T12	3-T12	3-T20	3-T12	3-T20	6-2L-T8@200C/C	8-2L-T8@200C/C	8-2L-T8@200C/C	1-T12EF
B28	300	600	3-T12	3-T12	3-T12	3-T20	3-T12	3-T20	8-2L-T8@200C/C	6-2L-T8@200C/C	8-2L-T8@200C/C	1-T12EF
B29	300	600	3-T12	3-T12	3-T12	3-T20	3-T12	3-T12	6-2L-T8@200C/C	4-2L-T8@200C/C	6-2L-T8@200C/C	1-T12EF
B30	300	750	4-T16 + 4-T12	4-T16	4-T16	3-T25	3-T25	3-T25 + 3-T20	5-2L-T8@190C/C	4-2L-T8@170C/C	6-2L-T8@160C/C	2-T10EF
B31	300	750	4-T16	4-T16 + 2-T12	4-T16	3-T25 + 3-T20	3-T16	3-T25 + 3-T16	17-2L-T8@110C/C	8-2L-T8@200C/C	10-2L-T8@200C/C	2-T10EF
B32	300	750	4-T16 + 2-T12	4-T16	4-T16 + 4-T12	3-T25 + 3-T16	3-T16	3-T25	8-2L-T8@185C/C	6-2L-T8@185C/C	8-2L-T8@200C/C	2-T10EF
B33	300	750	4-T16 + 4-T16	4-T16	4-T16 + 2-T12	3-T25	3-T20	3-T25 + 3-T20	9-2L-T8@165C/C	9-2L-T8@130C/C	11-2L-T8@130C/C	2-T10EF
B34	300	750	4-T16 + 2-T12	4-T16 + 2-T12	4-T16 + 4-T12	3-T25 + 3-T20	3-T25	3-T25	8-2L-T8@145C/C	5-2L-T8@160C/C	9-2L-T8@135C/C	2-T10EF
B35	200	450	2-T12	2-T12	2-T12	2-T12	2-T12	2-T12	2-2L-T8@140C/C	2-2L-T8@140C/C	2-2L-T8@140C/C	-
B36	300	600	4-T16 + 2-T12	4-T16 + 4-T12	4-T16	3-T25 + 2-T25	3-T16	3-T25 + 3-T16	25-2L-T8@100C/C	11-2L-T8@200C/C	13-2L-T8@200C/C	1-T12EF
B37	200	450	2-T12	2-T12	2-T12	2-T12	2-T12	2-T12	2-2L-T8@140C/C	2-2L-T8@140C/C	2-2L-T8@140C/C	-
B38	300	750	4-T16 + 2-T12	4-T16	4-T16	3-T25	3-T25	3-T25 + 3-T20	6-2L-T8@175C/C	3-2L-T8@185C/C	6-2L-T8@175C/C	2-T10EF
B39	300	750	4-T16	4-T16 + 2-T12	4-T16	3-T25 + 3-T20	3-T16	3-T25 + 3-T16	17-2L-T8@115C/C	8-2L-T8@200C/C	10-2L-T8@200C/C	2-T10EF
B40	300	750	4-T16 + 2-T12	4-T16	4-T16 + 4-T12	3-T25 + 3-T16	3-T16	3-T25	8-2L-T8@200C/C	6-2L-T8@200C/C	8-2L-T8@200C/C	2-T10EF
B41	300	750	4-T16 + 4-T12	4-T16	4-T16 + 2-T12	3-T25	3-T20	3-T25 + 2-T20	9-2L-T8@165C/C	8-2L-T8@135C/C	11-2L-T8@130C/C	2-T10EF
B42	300	750	4-T16	4-T16 + 2-T12	4-T16 + 4-T12	3-T25 + 2-T20	3-T25	3-T25	8-2L-T8@145C/C	5-2L-T8@170C/C	8-2L-T8@155C/C	2-T10EF
B43	300	600	3-T12	3-T12	3-T12	3-T12	3-T12	3-T20	6-2L-T8@200C/C	4-2L-T8@200C/C	6-2L-T8@200C/C	1-T12EF
B44	300	600	3-T12	3-T12	3-T12	3-T20	3-T12	3-T20	10-2L-T8@200C/C	8-2L-T8@200C/C	10-2L-T8@200C/C	1-T12EF
B45	300	600	3-T12	3-T12	3-T12	3-T20	3-T12	3-T20	8-2L-T8@200C/C	6-2L-T8@200C/C	8-2L-T8@200C/C	1-T12EF
B46	300	600	4-T12	4-T12	4-T12	3-T20	3-T12	3-T20	8-2L-T8@200C/C	6-2L-T8@200C/C	8-2L-T8@200C/C	1-T12EF
B47	300	600	3-T12	3-T12	3-T12	3-T20	3-T12	3-T12	6-2L-T8@200C/C	4-2L-T8@200C/C	6-2L-T8@200C/C	1-T12EF

FOR TENDER


**NOTES:**  
 1. All Dimensions are in 'mm' & Levels are in meters.  
 2. Grade of Concrete shall be M25  
 3. Clear cover to main reinforcement shall be as follows:  
 a) Walls = 20 mm, b) Slab = 20 mm, c) Footings = 50 mm  
 d) Beams = 25 mm e) Column = 40mm.  
 4. All Laps Shall be 50 times Ø of bar & shall be staggered, unless otherwise specified  
 5. P.C.C leveling Course M10(1:3:6) bellow Footings and Plinth Beam  
 6. 'T' denotes HYSD Bars (Fe500)  
 7. 70kN/sq.m SBC is considered at a depth of 2.0m below existing Ground Level ensure the same before execution

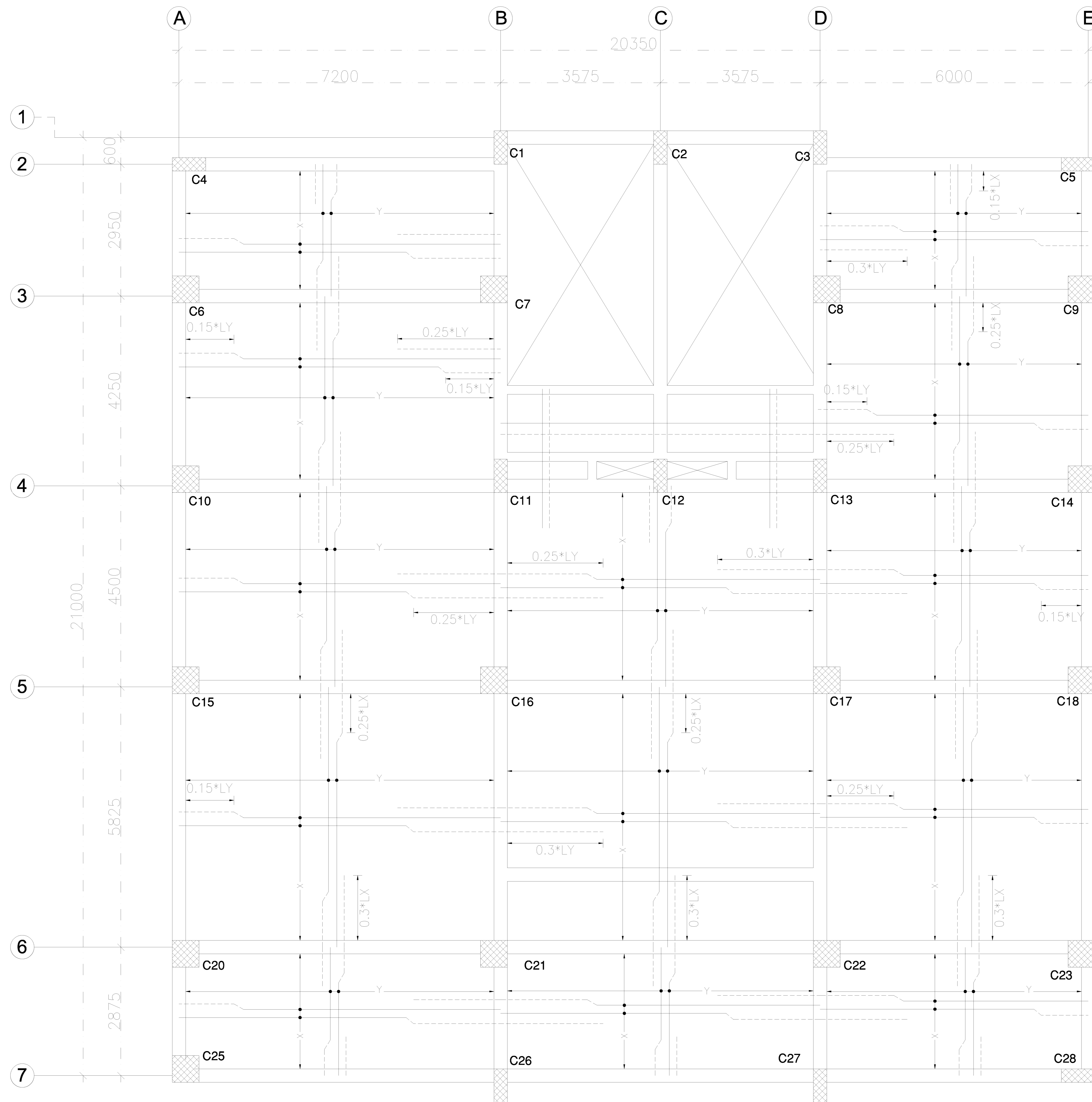
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 Scale 1:100

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 Drawn .....:MLS  
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 Approved :-DAS  
 Date 10-10-2018  
 Sheet Size A2

**Client**  
**TRIPURA INDUSTRIAL DEVELOPMENT CORPORATION**  
**Project**  
**LAND CUSTOMS STATION - MUHURIGHAT**  
**Drawing Title**  
**TERRACE FLOOR BEAM SCHEDULE**  
**Drawing Number**  
**ICDI/STR-016**  
 Rev 00

**Project Development & Advisory**  
  
**IL&FS Cluster Development Initiative Limited**



### TERRACE FLOOR SLAB STEEL LAYOUT

Notes:

1. SLAB NUMBERS S10,11,22,23,24 ARE NOT USED.

NOTES:	
1. All Dimensions are in 'mm' & Levels are in meters.	6. 'T' denotes HYSD Bars (Fe500)
2. Grade of Concrete shall be M25	7. 70kN/sq.m SBC is considered at a depth of 2.0m below existing Ground Level ensure the same before execution
3. Clear cover to main reinforcement shall be as follows: a) Walls = 20 mm, b) Slab = 20 mm, c) Footings = 50 mm d) Beams = 25 mm e) Column = 40mm.	
4. All Laps Shall be 50 times Ø of bar & shall be staggered, unless otherwise specified	
5. P.C.C leveling Course M10(1:3:6) bellow Footings and Plinth Beam	

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Scale	1:100

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Client	<b>TRIPURA INDUSTRIAL DEVELOPMENT CORPORATION</b>
Project	<b>LAND CUSTOMS STATION - MUHURIGHTAT</b>
Drawing Title	<b>TERRACE FLOOR SLAB STEEL LAYOUT</b>
Drawing Number	<b>ICDI/STR-0017</b>
Rev	00

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## TERRACE SLAB SCHEDULE

SLAB NUMBERS	THK	TYPE	BOTTOM REINFORCEMENT		TOP REINFORCEMENT		DISTRIBUTION
			SHORT SPAN (BENT UP)	LONG SPAN (BENT UP)	SS CONT.	LS CONT.	
S1	150	1-Way	T8 @ 150	--	T8 @ 150	--	T8 @ 150
S2	150	1-Way	T8 @ 150	--	T8 @ 150	--	T8 @ 150
S5	150	2-Way	T8 @ 150	T8 @ 150	T8 @ 150	--	T8 @ 150
S6	150	2-Way	T8 @ 150	T8 @ 150	T8 @ 150	--	T8 @ 150
S7	150	1-Way	T8 @ 150	--	T8 @ 150	--	T8 @ 150
S8	150	1-Way	T8 @ 150	--	T8 @ 150	--	T8 @ 150
S9	150	1-Way	T8 @ 150	--	T8 @ 150	--	T8 @ 150
S12	150	1-Way	T8 @ 150	--	T8 @ 150	--	T8 @ 150
S13	150	2-Way	T8 @ 150	T8 @ 150	T8 @ 150	T8 @ 150	T8 @ 150
S14	150	2-Way	T8 @ 150	T8 @ 150	T8 @ 150	T8 @ 150	T8 @ 150
S15	150	2-Way	T8 @ 150	T8 @ 150	T8 @ 150	T8 @ 150	T8 @ 150
S16	150	2-Way	T8 @ 150	T8 @ 150	T8 @ 150	T8 @ 150	T8 @ 150
S17	150	2-Way	T10 @ 150	T10 @ 150	T8 @ 150	T8 @ 150	T8 @ 150
S18	150	2-Way	T10 @ 150	T8 @ 150	T8 @ 150	T8 @ 150	T8 @ 150
S19	150	1-Way	T8 @ 150	--	T8 @ 150	--	T8 @ 150
S20	150	1-Way	T8 @ 150	--	T8 @ 150	--	T8 @ 150
S21	150	1-Way	T8 @ 150	--	T8 @ 150	--	T8 @ 150
S22	150	1-Way	T8 @ 150	--	T8 @ 150	--	T8 @ 150

Notes:

1.SLAB NUMBERS S10,11,22,23,24 ARE NOT USED.

FOR TENDER

**NOTES:**

- All Dimensions are in 'mm' & Levels are in meters.
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Scale  
1:100

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Sheet Size  
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**Client**

**TRIPURA INDUSTRIAL DEVELOPMENT CORPORATION**  
Project  
**LAND CUSTOMS STATION - MUHURIGHAT**  
Drawing Title  
**TERRACE FLOOR SLAB STEEL SCHEDULE**  
Drawing Number  
**ICDI/STR-0018**  
Rev  
00

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