

**CONSTRUCTION OF A PERMANENT MODERN BUS TERMINUS
AT G.T. ROAD NEAR ESI HOSPITAL WITH A
MULTI STORIED COMMERCIAL COMPLEX OF (B+G+5)
FLOORS ALONG WITH BASEMENT INCLUDING ALL CIVIL
WORKS, SANITARY & PLUMBING WORKS, ELECTRICAL
WORKS INCLUDING LIFT AND OTHER ANCILLARY WORKS
UNDER SERAMPORE MUNICIPALITY, HOOGHLY,
WEST BENGAL**

TENDER DOCUMENTS

(NIP NO. HRBC/PL. & DN./07 of 2013-2014, dt: 12.09.2013)

**BOOK -1
Volume I**

HOOGHLY RIVER BRIDGE COMMISSIONERS

(A Statutory Organisation under Government of West Bengal)

TRANSPORT DEPARTMENT

MUNSHI PREMCHAND SARANI

(ST. GEORGE'S GATE ROAD)

KOLKATA 700 021

OCTOBER 2013

**CONSTRUCTION OF A PERMANENT MODERN BUS
TERMINUS AT G.T. ROAD NEAR ESI HOSPITAL WITH A MULTI
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FOR

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BOOK – 1

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Volume I

HOOGHLY RIVER BRIDGE COMMISSIONERS
(A Statutory Organisation under Government of West Bengal)
TRANSPORT DEPARTMENT
MUNSHI PREMCHAND SARANI
(ST. GEORGE'S GATE ROAD)
KOLKATA – 700 021

OCTOBER 2013

Volume - I SECTION 1
Invitation for Bids

Letter for Invitation for Bids

No. HRBC/12C-181/2013/071013-5

Date: 07.10.2013

From: Sri S. Saha
Director (Pl. & Dn.)

To : _____

Sub: *Invitation for bids in connection with Construction of a permanent modern Bus Terminus at G.T. Road near ESI Hospital with a multi storied commercial complex of (B+G+6) floors along with basement including all civil works, sanitary & plumbing works, electrical works including lift and other ancillary works under Serampore Municipality, Hooghly, West Bengal.*

Ref: NIP NO. HRBC/PL. & DN./07 of 2013-2014, Dated: 12.09.2013.

Dear Sirs,

1. This is to inform you that you have been found eligible for submitting bid for the above work for which you have already conveyed your willingness.
2. You are now invited along with other eligible bidders to submit sealed bids for the above work.
3. The tender document can be downloaded from the website of HRBC i.e. www.hrbc.in shortly. The date of downloading of tender document will be intimated to you in due course.
4. Please confirm receipt of this letter immediately in writing by courier and/or by fax or e-mail. If you do not intend to bid, we would appreciate being so notified also in writing and/or by fax or e-mail at your earliest opportunity.

Yours truly,

Director (Pl. & Dn.), HRBC

Letter for Invitation for Bids (Contd...)

No. HRBC/12C-181/2013/101013-4

Date: 10.10.2013

From: Sri S. Saha
Director (Pl. & Dn.)

To : _____

Sub: Invitation for bids in connection with “Construction of a permanent modern Bus Terminus at G.T. Road near ESI Hospital with a multi storied commercial complex of (B+G+6) floors along with basement including all civil works, sanitary & plumbing works, electrical works including lift and other ancillary works under Serampore Municipality, Hooghly, West Bengal.

Ref: NIP NO. HRBC/PL. & DN./07 of 2013-2014, Dated: 12.09.2013

Dear Sirs,

In continuation to this office memo No. HRBC/12C-181/2013/071013-5, dt. 07.10.2013 the following informations are given to you for compliance from your end:

1. The tender document can be downloaded from the website of HRBC i.e. www.hrbc.in from **10.10.2013**. The bidder shall have to pay **Rs. 10,000/- (Rupees ten thousand only)** in the form of Bank Draft issued by any Nationalized or Scheduled Bank in India in favour of “**Hooghly River Bridge Commissioners**” payable at Kolkata as the cost of tender document which shall be enclosed with the offer at the time of submission of tender document.
2. All bids must be accompanied by the Bid Security in the form and amounts specified in the tender documents. The tender must be submitted in the tender box kept in the chamber of the Director (Pl. & Dn.), HRBC at Munshi Prem Chand Sarani, Kolkata – 700021 **at/or before 2.00 PM on 28.10.2013.**
3. The bids shall be in “**2 envelope**” format detailed in the “Instruction to Bidders”. The bids will be opened in two stages. Initially submission of technical proposal shall be reviewed and evaluated and subsequently only those bids which are considered responsive and technically qualified shall be subjected to financial review.
4. Technical Proposals will be opened on **28.10.2013 at 2.30 PM** and the date of opening of Financial Proposals of only the responsive technically eligible bidders will be informed later on.

Contd...

5. Please confirm receipt of this letter immediately in writing by courier and/or by fax or e-mail. If you do not intend to bid, we would appreciate being so notified also in writing and/or by fax or e-mail at your earliest opportunity.

Yours truly,

Director (Pl. & Dn.), HRBC

Volume - I SECTION 2
Instructions to Bidders

Vol. I Section 2. Instructions to Bidders

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Vol. I Section 2. Instructions to Bidders

A. General

1. Scope of Bid

1.1 Scope of work:

The scope of the work under these terms of reference would consist of – but not limited to the provisions laid down in the General Conditions of Contract, BOQ, Technical Specifications and other documents of the Contract.

Hooghly River Bridge Commissioners (HRBC) under Transport Department, Govt. of West Bengal proposes to undertake the construction of a permanent modern Bus Terminus at G.T. Road near ESI Hospital under Serampore Municipality with a view to provide uninterrupted bus service and other facilities and amenities for the people of Serampore, like Janata Canteen, Tea/Coffee Shops, Drivers Rest Room, Gents and Ladies Toilets, Passengers Lounge with a multi storied commercial complex.

The proposed New permanent modern Bus Terminus shall be built on a land of 4 bighas and 18 Cottahs (98 Cottahs) under Serampore Municipality in the district of Hooghly of West Bengal, the multistoried building of B+G+6 floors along with basement for parking of 50 cars and a provision of using ground floor for bus parking of 25 buses, the 1st floor for passenger amenities related activities and upper floors (2nd to 6th) for commercial purposes along with roads, drainage, water supply, sewerage, electricals including lift, landscaping and beautification etc.

The building are to be completed with all necessary fittings and fixtures as will be specified in BOQ with subsequent additions & alterations and as per specifications complete in all respect including water supply, sanitary & plumbing works and electrical fittings, fixtures, internal & external wiring/electrical lines/cabling as necessary as per BOQ and technical specifications. The project work shall consist of all other allied civil engineering works like erection of boundary wall with gates, internal roads with surface drain, external electrification works with service connection, generators, transformer, air-conditioning, pump room, deep tube well etc. The building shall be provided total fire fighting system including necessary water reservoir.

After completion, all work areas shall be rendered clean as directed by the Engineer.

2. Eligible Bidders

Eligible bidders are those who are declared prequalified after scrutiny of documents submitted by applicants in response to Notice Inviting Prequalification.

3. Qualification of the Bidder

3.1 To be qualified for award of Contract, bidders shall:

- (a) Submit a written power of attorney authorizing the signatory of the bid to commit the bidder

4. Bid per Bidder

Each bidder shall submit only one bid either by himself, or as a partner in a joint venture. A bidder who submits or participates in more than one bid will be disqualified.

5. Cost of Bidding

- 5.1 The bidder shall bear all costs associated with the preparation and submission of his bid and the Employer will in no case be responsible or liable for those costs.

6. Site Visit

- 6.1 The bidder is advised to visit and examine the Site of Works and its surroundings and obtain for himself on his own responsibility all information and data including all topographical and geo-technical data, that may be necessary for preparing the bid and entering into a contract for construction of the Works and if successful, for carrying out all the construction. The costs of visiting the Site and collection of information and data shall be at the bidder's own expense.
- 6.2 The bidder and any of his personnel or agents will be granted permission by the Employer to enter upon his premises and lands for the purpose of such inspection, but only upon the express condition that the bidder, his personnel and agents, will release and indemnify the Employer and his personnel and agents from and against all liability in respect thereof and will be responsible for death or personal injury, loss of or damage to property and any other loss, damage, costs and expenses incurred as a result of the inspection.

B. Bidding Documents

7. Content of Bidding Documents

- 7.1 The bidding documents shall comprise Technical Proposal and Financial Proposal which are to be submitted in separate envelopes. Bid security to be submitted will be a part of technical bid which is also to be submitted in separate sealed cover.
- 7.2 The bidder is expected to examine carefully the contents of the Bidding documents. Failure to comply with the requirements of bid submission will be at the bidder's own risk. Bids which as per opinion of the employer are not substantially responsive to the requirements of the bidding documents will be rejected.

8. Deleted

9. Amendment of Bidding Documents

At any time prior to the deadline for submission of tenders, the Engineer may, for any reason, whether at his own initiative or in response to a clarification or query

raised by a prospective tenderer, modify the tender documents by issuing addenda.

The said amendment in the form of an addendum will be sent to all prospective tenderers who have received the tender documents, on or prior to last date mentioned in Clause 19.1. This communication will be in writing or by telefax and the same shall be binding upon them. Prospective tenderers should promptly acknowledge receipt thereof by telefax or e-mail to the Engineer.

In order to afford prospective tenderers reasonable time for preparing their tenders after taking into account such amendments, the Engineer or the Employer may, at his discretion, extend the deadline for the submission of tenders in accordance with Sub-clause 19.2.

C. Preparation of Bids

10. Language of Bid

10.1 The bid, and all correspondence and documents, related to the bid, exchanged between the bidder and the Employer shall be written in English language. Supporting documents and printed literature furnished by the bidder may be in another language provided they are accompanied by an accurate translation of the relevant passages in the English language, in which case, for purposes of interpretation of the bid the English translation shall prevail.

11. Documents Comprising the Bid

11.1 The bid submitted by the bidder shall comprise the documents furnished under Sub-Clause 18.5 of Section 2 . The documents listed under Sub-Clause 18.5 of Section 2 shall be filled-in without exception as necessary, subject to extensions thereof in the same format.

11.2 The rates quoted by the bidder in the form of bid, Section 1A, Vol. IV shall inter-alia include all constructional plant, labour, supervision, materials, transport, temporary and ancillary works, erection, maintenance, insurance, overheads, profits, taxes and duties together with all general risks, liabilities and obligations set out or implied in the Contract.

11.3 Deleted

11.4 All the Documents comprising the Bid shall be signed on every page and submitted in the required number of copies to the Tender Inviting Authority by the date specified in Clause 19.1.

12. Bid Prices

12.1 Unless stated otherwise in the bidding documents, the Contract shall be for the whole Works as described in Sub-Clause 1.1, based on the Priced Bill of Quantities with the contractual rate offered by the bidder.

12.2 The Summary Sheet of Bill of Quantities has three parts.

Part A : Priced Bill of Quantities of a) Civil Works, b) Water Supply, Sanitary & Drainage Works and c) Electrical Works.

Part B: Non-Priced Bill of Quantities of d) Civil Works, e) Water Supply, Sanitary & Drainage Works f) Electrical Works, g) HVAC Works and h) Fire Protection System.

Part C : Provisional sum Items namely i) Escalation j) Supplementary works.

12.3 **The bidder is required to quote his rate in the following manner.**

i) For Part A : Priced Bill of Quantities - the bidder shall offer At PAR /.....% Above (both in figures and in words) /% Below (both in figures and in words) the priced bill of quantities at the place specified in the Summary Sheet of Bill of Quantities.

The amount of Part A after application of contractual percentage as quoted above shall be calculated and written in the place specified under Part A format of Summary Sheet.

ii) For Part B : Non-priced Bill of Quantities - the bidder shall fill in the rates and amounts for all items described in the detailed non-priced Bill of Quantities of Part B. All rates to be quoted both in figures and in words under rate columns of the Bill of Quantities.

Thereafter, amount of respective subheads like d) Civil Works, e) Water supply, Sanitary & Drainage works f) Electrical works, g) HVAC works and h) Fire Protection System shall be written in the place specified under Part B in the Summary Sheet of Bill of Quantities. Subtotal of Part B should be drawn and written in Part B format of the Summary Sheet.

iii) The aggregate value of Part A after application of contractual percentage and value of Part B shall be calculated and written in the column specified there under.

iv) In addition the bidder may also like to **offer a discount in percentage** on the aforesaid sum of aggregate value of Part A and Part B at the bottom of Part B format of Summary Sheet of Bill of Quantities to arrive at the final **contract price**.

v) Regarding **Part C : Provisional Sum**, for item i) Escalation (described in clause 37 of General Conditions of Contract), both contractual percentage rate and discount, if there be any, offered by the tenderer will be applicable. For the other Provisional Sum item namely (j) Supplementary Works payment shall be made as per clause 36 of General Conditions of Contract.

12.4 All duties, taxes and other levies including Educational Cess etc., as imposed by Govt. of India & Govt. of West Bengal valid on date of bidding, payable by the Contractor under the Contract, or for any other cause, shall be included in the rates. HRBC will not make any payments towards taxes, duties, levies etc for the entire contract period.

12.5 The rates quoted by the bidder are FIRM & not subjected to adjustment during the performance of the Contract for the period of contract including the period of extension.

12.6 The rates as per accepted Bill of Quantities shall hold good till completion of works and no additional claim or amount shall be admissible on account of fluctuations in market rates, increase in any taxes, levies, fees, royalties etc. barring adjustment to be made due to increase or decrease in the base prices of reinforcement steel and cement only. For further details Cl-52 of General Conditions of Contract is referred to.

13. Deleted

14. Bid Validity

14.1 Bids shall remain valid for a period of 120 (one hundred and twenty) days after the date of submission of bids.

14.2 In exceptional circumstances, prior to expiry of the original bid validity period, the Employer may request that the bidders extend the period of validity for a specified additional period. A bidder may refuse the request without forfeiting the bid security. A bidder agreeing to the request will not be required or permitted to modify his bid, but will be required to extend the validity of his bid security for the period of extension.

15. Bid Security

15.1 The bidder shall furnish, as part of his bid, a bid security of Rs.80,00,000.00 (Rupees eighty lacs only) at the time of submission of tender in the form of Bank Guarantee in favour of HRBC from Nationalised or Scheduled Bank of India to be acceptable to the Employer. The format of the Bank Guarantee shall be in accordance with the form of bid security included in Vol.- I, Section-3 of the Tender Document. Other formats may be permitted, subject to the prior approval of the Employer.

15.2 Deleted.

15.3 Any bid not accompanied by an acceptable bid security shall be rejected outright by the Employer as non-responsive

15.4 The bid securities of unsuccessful bidders will be returned as promptly as possible, after the performance of contract agreement.

15.5 The bid security of the successful bidder will be returned when the bidder has signed the Agreement and furnished the required performance security.

15.6 The bid security may be forfeited

- (a) if the bidder withdraws his bid during the period of bid validity;
- (b) if the bidder does not accept the correction of his bid price, pursuant to Clause 26
- (c) in the case a successful bidder fails within the specified time limit to
 - (i) sign the Agreement
 - (ii) furnish the required performance security

16. Format and Signing of Bid

- 16.1 The bidder shall prepare the Bid documents comprising the bid as described in Clause 11 of these Instructions to Bidders, with three bound volumes, viz, Book-1, Book-2 and Book-3 containing Technical Proposal, Financial Proposal and Contractor's Technical Submission respectively.
- 16.2 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, pursuant to Sub-clauses 3.1(a). All pages of the bid shall be initialed by the person or persons signing the bid.
- 16.3 The bid shall contain no alterations, omissions or additions, except those to comply with instructions issued by 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.

17. Deleted

D. Submission of Bids

18. Sealing and Marking of Bids

- 18.1 For submission, evaluation and selection of the Agency a "Two Stage" process will be adopted. The proposal should be submitted in two parts in two separate sealed envelopes. These two sealed envelopes shall be put together in one single outer sealed envelope. The two parts of the proposal are
- 1) Technical proposal
 - 2) Financial Proposal
- 18.2 The bidder shall seal and mark each of the two envelopes, i.e, Envelope-1: Technical proposal, Envelope-2: Financial proposal. These two sealed and marked envelopes along with the separate sealed envelope containing the Bank Guarantee for bid security and the Bank Draft for cost of tender document shall be put together in one single outer envelope which also shall be sealed. These two sealed and marked envelopes shall be put together in one single outer envelope which also shall be sealed. The bid security will be a part of Technical Proposal.
- 18.3 The sealed envelope shall
- (a) be addressed to:
Director (Pl. & Dn.)
Hooghly River Bridge Commissioners
HRBC Bhawan, 3rd Floor,
Munshi Prem Chand Sarani
(St. George's Gate Road),
Kolkata 700 021
 - (b) bear the following identification:

Name of the Work: Construction of a permanent modern Bus Terminus at G.T. Road near ESI Hospital with a multi storied commercial complex of (B+G+6) floors along with basement including all civil works, sanitary & plumbing works, electrical works including lift and other ancillary works under Serampore Municipality, Hooghly, West Bengal.

- i)
- ii) Name and Address of the bidder along with Telephone no, Mobile no, Fax no and Email address and the name of authorized agent delivering the sealed cover containing the offer, on the bottom left hand corner.

18.4 If the envelope is not properly sealed and marked as above, the Employer will assume no responsibility for the misplacement or premature opening of bid and all consequences shall rest on the bidder including rejection of the bid.

18.5 Contents of envelopes are detailed hereunder:

Single Outer Envelope	Envelope -1 Part - 1 Technical Proposal	Separate Sealed Envelope		i) Bank Guarantee for Bid Security ii) Bank Draft for cost of tender document
		BOOK-1	Volume -I	TECHNICAL PROPOSAL Section 1 Invitation for Bids Section 2 Instructions to Bidders Section 3 Section 3A Form of Agreement Section 3B Form of Performance B.G Section 3C Form of B.G for Advance Payment Section 3D Form of Bid Security (Bank Guarantee) Section 3E Declaration Section 4 General Conditions of Contract
			Volume II	Technical Specification
			Volume III	Contract Drawings
		BOOK-3	Volume V	Contractor's Technical Submission (in hard copy as well as in soft copy). Other documents as per sub clause 18.6.1 hereafter.
	Envelope -2 Part - 2 Financial Proposal	BOOK-2	Volume IV	FINANCIAL PROPOSAL Section 1 Section 1A Form of Bid Section 1B Appendix to Bid (if there be any) Section 2 Bill of Quantities

18.6 CONTENTS OF PROPOSALS

18.6.1 Technical Proposal

(a) Along with the Technical proposal (Book-1 : issued by HRBC), the Bank Guarantee for Bid Security as specified in Cl. 15 of Instructions to Bidder (Vol I, Sec -2) and the Bank Draft for cost of tender document as mentioned in Invitation for Bids (Vol I, Sec -1) shall be deposited in a separate sealed envelope and to be put in Envelope 1 along with the Contractor's Technical submission (Vol V in Book-3 : to be prepared and furnished by bidder). Besides a written power of Attorney authorizing the signatory of the bid to commit the bidder shall be furnished. Any other non financial data like Articles of Association etc. may be given in Envelope-1.

(b) Contractor's Technical submission (Vol V in Book-3 : to be furnished by bidder) of finally selected agency will become the part of the Agreement. Any failure to comply with the provision therein shall make the contractor liable for action in terms of Sub Cl. 49.1 of General Conditions of Contract.

(c) Contractor's Technical submission is designated as Volume - V in Book-3 and should cover in detail the following :

- (1) List of technical personnel identified by name, who will be assigned to the project implementation in different capacities. Their educational qualification, work experience, nature of employment (regular employee of the firm or on contract basis) etc. should be provided in the list.
- (2) List of all machineries to be deployed for execution of work of the project. List should indicate make, capacity, date of purchase (if owned), quantity or number of each type of machines, whether owned or to be taken on lease etc.
- (3) General approach and methodology proposed for carrying out different services like survey, planning, design, preparation of work drawings, as built drawings, target / milestone - achievement report of works, execution of different work items as per BOQ and scope of works etc. including all other related information as deemed relevant.
- (4) Work Program and Work Achievement : A detail work program indicating quantity, timing and duration of all major items of works under the Contract Package in the form of bar chart based on milestone format.
- (5) Quality Assurance Plan : The plan shall contain information elaborating the proposed method of achieving quality standards for each work items, generally as specified in Schedule of Rates of PWD, Govt. of W.B./CPWD/IS Codes, including materials & work specifications, provisions of field quality testing laboratory as well as central quality testing laboratory, frequency of quality testing as also quality control staff, management etc.
- (6) Adequate proposal ensuring any adverse environmental impact is minimized during construction.

18.6.2 Financial Proposal :

- (a) The Financial Proposal shall contain :-
- (1) The Financial bid which is to be quoted in Form of Bid (Vol. IV, Section 1A) of the tender document.
 - (2) The bound book of Tender Document, containing Vol IV in Book-2 issued by HRBC, and duly signed by the authorized representative of the bidder in all pages conforming to provision of tender conditions.
- (b) Financial proposals will be opened on the date and time as specified (Unless altered by issuing corrigenda notice) in presence of intending tenderers who have qualified after evaluation of Technical proposals.
- (c) Provided all other requirement as per provision of tender conditions is complied with. Final selection of the tenderer will be through evaluation of financial proposal and accepting normally the lowest contract price.

19. Deadline for Submission of Bids

- 19.1 Bids must be received only by Director (Pl. & Dn.), HRBC in his office Tender Box at the address specified above not later than on 28.10.2013 at 14.00 hours. No bid will be accepted if submitted in any other office or Receiving Section of HRBC.

At 14.30 hours on 28.10.2013, the Envelope –1 containing the bank guarantee for bid security, the bank draft for cost of tender document, technical proposal and non-financial document will be opened in presence of the participating bidders in the conference room of HRBC. After opening, only the details of bid security will be declared. Other documents of technical proposal will be evaluated by a constituted evaluation committee.

- 19.2 Director (Pl. & Dn.), HRBC may, at his discretion, extend the deadline for submission of bids, in which case all rights and obligations of the Employer and the bidders previously subject to the original deadline will thereafter be subject to the deadline as extended.

20. Late Bids

- 20.1 Any bid received by the Director (Pl. & Dn.), HRBC after the deadline for submission of bids prescribed in Clause 19 will be rejected and returned unopened to the bidder by Registered Post with A/D, which shall be treated as the fulfillment of obligation by the employer.

21. Modification and Withdrawal of Bids

- 21.1 The bidder may modify or withdraw his bid after bid submission, provided that written notice of the modification or withdrawal is received by the Employer prior to the deadline for submission of bids.

- 21.2 The bidder's modification or withdrawal notice shall be prepared, sealed, marked and delivered in accordance with the provisions of Clause 18, additionally marked "MODIFICATION" or "WITHDRAWAL" as appropriate.
- 21.3 No bid may be modified by the bidder after the deadline for submission of bids.
- 21.4 Withdrawal of a bid during the interval between the deadline for submission of bids and the expiration of the period of bid validity specified in the Form of Bid may result in the forfeiture of the bid security pursuant to Clause 15.

E. Bid Opening and Evaluation

22. Bid Opening

- 22.1 Director (Pl. & Dn.), HRBC will open each proposal in stages

Technical proposal would be first opened and evaluated and firms scoring the qualifying marks as mentioned would be considered for further evaluation. The date of opening of Financial Proposals of only the responsive technically eligible bidders will be informed later on. The financial proposal of only those firms, who score qualifying marks in the Technical Proposal would be opened and evaluated. The final selection of the firm will be the bidder who has offered the lowest evaluated bid price as in sub-clause 27.2 provided that his financial proposal is otherwise qualified as per provisions of the tender.

- 22.2 Envelopes marked "WITHDRAWAL" shall be opened and read out first, Bids for which an acceptable notice of withdrawal has been submitted pursuant to Clause 21 shall not be opened.

23. Process to be Confidential

- 23.1 Information relating to 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 bids or award decisions may result in the rejection of the bidder's bid.

24. Clarification of Bids

- 24.1 To assist in the examination, evaluation and comparison of bids, the Employer may, at his discretion, ask any bidder for clarification of his bid. The request for clarification and the response shall be in writing or by cable, 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 26.
- 24.2 The rate for each item shall be reasonable and not unbalanced. Should the Engineer/Employer come across any unbalanced rates, he may require the tenderer to furnish detailed analysis to justify the same. Should the tenderer fail to comply with this, his tender shall be liable to be rejected by the Employer, who may award the Contract to any other tenderer.

25. Examination of Bids and Determination of Responsiveness

- 25.1 Prior to the final evaluation of bids, the Employer will determine whether each bid (i) meets the eligibility criteria (ii) has been properly signed; (iii) is accompanied by the required securities; (iv) is substantially responsive to the requirements of the bidding documents; and (v) provides any clarification and/or substantiation that the Employer may require pursuant to Sub-Clause 24.1
- 25.2 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 (i) which affects in any substantial way the scope, quality or performance of the Works; (ii) which limits in any substantial way, inconsistent with the bidding documents, the Employer's rights or the bidder's obligations under the Contract; or (iii) whose rectification would affect unfairly the competitive position of other bidders presenting substantially responsive bids.
- 25.3 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 nonconforming deviation or reservation.
- 25.4 The criteria of non-responsiveness are as stated below but are not limited to them:
- i) The bids which do not incorporate obligatory parameters
 - ii) Failure to comply with the requirements of bid submission
 - iii) Failure to comply with the requirements of Clause 11 and does not enclose the documents as detailed therein
 - iv) Failure to submit Bid Security as per Clause 15
 - v) Failure of Bid to conform to all the terms, conditions and specifications of bidding, bidding documents
 - vi) A bid which materially deviates from the requirements of the bid documents or is a conditional offer
 - vii) Any other reason which in the opinion of the Employer / renders the bid non-responsive.
- The Employer's decision as to the non-responsiveness of any bid shall be final.

26. Correction of Errors in Financial Bids

- 26.1 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 amounts in figures and in words, the amount in words will govern; and
 - b) Where there is a discrepancy between the unit rate and the line item total resulting from multiplying the unit rate by the quantity, the unit rate as quoted will govern, unless in the opinion of the Employer there is an obviously gross misplacement of the decimal point in the unit rate, in which case the line item total as quoted will govern and the unit rate will be corrected.

26.2 The amount stated in the Form of Bid will be adjusted by the Employer in accordance with the above procedure for the correction of errors and shall be considered as binding upon the bidder, If the bidder does not accept the corrected amount of his bid, his bid will be rejected, and the bid security may be forfeited in accordance with Sub-Clause 15.6(b).

27. Evaluation and Comparison of Bids

27.1 For evaluation of Technical Proposal marks assigned to different items therein are as below.

Sl. No.	Description	Marks
1.	Exclusive Technical personnel to be assigned for project implementation	20
2.	Construction machineries compatible to work program to be deployed	20
3.	General approach and methodology proposed for carrying out different services for successful completion of the project.	20
4.	Achievable Work program and bar chart on milestone format preferably supported by material planning matching with desired progress	10
5.	Quality Assurance Plan including arrangement of quality testing and documentation.	25
6.	Proposal to minimize adverse environmental impact during construction.	5
	TOTAL	100

The firm should score at least 75 marks for qualifying in the next stage for opening of financial proposal provided deposit of Bid Security and other requirement are adequate as per tender conditions. Financial proposals of non-qualified bidders scoring less than 75 marks will not be opened.

27.2 For evaluation of Financial Proposal, comparison of rates offered by the bidders, who have qualified after evaluation of Technical Proposal, shall be made. The contract price will be evaluated on the basis of the cost of the full work at the rates quoted by the tenderer for different items included in the Part B of Bill of Quantities as also in the Summary Sheet of Bill of Quantities. The lowest contract price offered by the contractor will be normally accepted for final selection of the bidder, if there be no other discrepancy.

F. Award of Contract

28. Award

Subject to Clause 27, the Employer will award the Contract to the bidder whose bid has been determined to be substantially responsive to the bidding documents and who has offered the lowest contract price subject to Cl. 3.1.

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

Notwithstanding Clause 27, the Employer reserves the right to accept or reject any bid, and to annul the bidding process and reject all bids, at any time prior to 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. In any event right is also reserved to carry out negotiations with any or all contractors whose financial proposals had been opened and evaluated in accordance with sub clause 27.2 with a view to obtain bid price lower than those received in response to the invitation for competitive offers.

30. Notification of Award

Prior to expiration of the period of bid validity prescribed by the Employer, the Employer will notify the successful bidder in writing by registered letter/fax/e-mail that his bid has been accepted. This letter (hereinafter and in the Conditions of Contract called the "Letter of Acceptance") shall name the sum which 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 Conditions of Contract called "the Contract Price").

The notification of award will constitute the formation of the Contract.

Upon the furnishing by the successful bidder of a performance security, the Employer will promptly notify the other bidders that their bids have been unsuccessful.

31. Signing of Agreement

At the same time that he notifies the successful bidder that his bid has been accepted, the Employer will send the bidder the Form of Agreement provided in the bidding documents, incorporating all agreements between the parties.

Within seven days of receipt of the Form of Agreement, the successful bidder shall sign the Form and return it to the Employer.

32. Performance Security/Guarantee

Within seven days of receipt of the notification of award from the Employer, the successful bidder shall furnish to the Employer a performance security in the form of Bank Guarantee in favour of 'Hooghly River Bridge Commissioners' from Nationalised or Scheduled Banks of India to be acceptable to the Employer of an amount of 7.5% of the Contract Price in accordance with the Conditions of Contract. The form of Performance Bank Guarantee provided in Section 3B of the bidding documents may be used or some other form acceptable to the Employer which will have provision of extending the Bank Guarantee with extension of time approved by the Employer.

33. Annulment of the Award

Failure of the successful bidder to comply with the requirements of Clauses 31 or 32 shall constitute sufficient grounds for the annulment of the award and forfeiture of the bid security.

34. Issue of Notice to Commence

After receipt of Performance Security from the contractor as stipulated in Clause 32 of Instructions to Bidders and Clause 6 of General Conditions of Contract or even after award of the contract through issue of Letter of Acceptance, the Engineer will notify the contractor to commence work as soon as reasonably possible with due expedition and without delay. If the contractor fails to commence works physically at the site within 10(Ten) days form the date of issue of Notice to Commence Work, that will constitute a breach of contract and in that case the Employer will have right to annul the contract with forfeiture of Performance Security and if the same is not deposited forfeiture of Bid Security.

VOLUME I - SECTION 3

SECTION 3A FORM OF AGREEMENT

SECTION 3B FORM OF PERFORMANCE B.G

SECTION 3C FORM OF BG FOR ADVANCE PAYMENT

SECTION 3D FORM OF BID SECURITY

(BANK GUARANTEE)

SECTION 3E DECLARATION

Vol.I Section 3A. Form of Agreement

AGREEMENT

THIS AGREEMENT made the _____ day of _____ 201__ between The Vice Chairman of the Hooghly River Bridge Commissioners (hereinafter called "the Employer") of the one part and _____ of _____ (hereinafter called "the Contractor") of the other part.

WHEREAS the Employer is desirous that certain Works should be executed by the Contractor, viz. *"Construction of a permanent modern Bus Terminus at G.T. Road near ESI Hospital with a multi storied commercial complex of (B+G+6) floors along with basement including all civil works, sanitary & plumbing works, electrical works including lift and other ancillary works under Serampore Municipality, Hooghly, West Benga."* and has accepted a Bid by the Contractor for the execution and completion of such Works and the remedying of any defects therein.

NOW THIS AGREEMENT WITNESSETH as follows:

1. In this Agreement, words and expressions shall have the same meanings as are respectively assigned to them in the Conditions of Contract hereinafter referred to.
2. The following documents shall be deemed to form and be read and construed as part of this Agreement, viz.:
 - (a) Agreement
 - (b) Letter of Acceptance
 - (c) The offer submitted by the Contractor in the prescribed form and accepted by the Employer (Section 1A, Vol IV).
 - (d) Appendix to Bid (Section 1B, Vol IV)
 - (e) Addenda to Tender Documents, if any
 - (f) Invitation for Bid (Section 1, Vol I)
 - (g) Instructions to Bidders (Section 2, Vol I)
 - (h) General Conditions of Contract (Section 4, Vol I)
 - (i) Technical Specifications (Vol II)
 - (j) Bill of Quantities with Provisional Sums (Section 2, Vol IV)
 - (k) Contract Drawings (Vol III)
 - (l) Contractor's Technical Submission (Vol V)
 - (m) Other documents as agreed upon
3. 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 respects with the provisions of the Contract.
4. The Employer hereby covenants to pay the Contractor in consideration of the execution and completion of the Works and the remedying of defects therein the Contract Price or such other sum as may become payable under the provisions of the Contract at the times and in the manner prescribed by the Contract.

Contd...

Vol. I Section 3A - Form of Agreement (continued)

It is mutually agreed:-

- 5(1) That the Contractor will carry out the work in accordance with the provisions of the contract and remedy any defect therein at rates offered by him in the summary sheet of Bill of Quantities as also in the Part B of Bill of Quantities. The contract price comes to Rs. _____ (Rupees _____) _____ only (as derived in the Summary Sheet of Bill of Quantities)
- 5(2) That the implementation of this Agreement shall start upon issuance of the Notice to Commence by the Engineer to the Contractor.
- 5(3) That this Agreement shall extend and be binding upon the parties hereto, executors, successors and permitted assigns, who shall jointly and severally be entitled to the benefits of this Contract.

(Signed, sealed)

Binding Signature of Contractor

Binding Signature of Employer

Tenderers stamp, signature and date

Witness 1

Witness 2

Vol. I Section 3B - Form of Performance Bank Guarantee

THIS AGREEMENT is made on the _____ day of _____ 201__ between _____ [name of bank] of _____ [address of bank] (hereinafter called "the Guarantor") of the one part and _____ [name of Employer] of _____ [address of Employer] (hereinafter called "the Employer") of the other part.

WHEREAS

- (1) this Agreement is supplemental to a contract (hereinafter called "the Contract") made between _____ [name of Contractor] of _____ [address of Contractor] (hereinafter called "the Contractor") of the one part and the Employer of the other part whereby the Contractor agreed and undertook to execute the Works of _____ [name of Contract and brief description of the Works] for the sum of _____ [amount in Contract currency] being the Contract Price; and
- (2) the Guarantor has agreed to guarantee the due performance of the Contract in the manner hereinafter appearing.

NOW, THEREFORE, the Guarantor hereby agrees with the Employer as follows:

- (a) If the Contractor (unless relieved from the performance by any clause of the Contract or by statute or by the decision of a tribunal of competent jurisdiction) shall in any respect fail to execute the Contract or commit any breach of his obligations there under then the Guarantor will indemnify and pay the Employer the sum of[amount of Guarantee] _____ [in words], such sum being payable in the types and proportions of currencies in which the Contract Price is payable, provided that the Employer or his authorized representative has notified the Guarantor to that effect and has made a claim against the Guarantor before the issue of the Defects Liability Certificate.
- (b) The Guarantor shall not be discharged or released from his guarantee by an arrangement between the Contractor and the Employer, with or without the consent of the Guarantor, or by any alteration in the obligations undertaken by the Contractor, or by any forbearance on the part of the Contractor, whether as to the payment, time, performance, or otherwise, and any notice to the Guarantor of any such arrangement, alteration, or forbearance is hereby expressly waived.

This Guarantee shall be valid until a date 28 days from the date of issue of the Taking Over Certificate. If works are not completed within stipulated date of completion, it is understood that the Bank will extend this guarantee under the said conditions for the required time on demand by the Employer and at the cost of the Contractor.

Given under our hand on the date first mentioned above.

SIGNED BY _____
for and on behalf of the
Guarantor in the presence of

SIGNED BY _____
for and on behalf of the
Employer in the presence of

(Witness)

(Witness)

Tenderers stamp, signature and date

Vol. I Section 3C- Form of Bank Guarantee for Advance Payment

To
(Name of Employer)
(Address of Employer)

(Name of Contract)

Gentlemen:

In accordance with the provisions of the General Conditions of Contract, Clause 10 ("Advance Payment") of the above-mentioned Contract, _____ (name and address of Contractor) (hereinafter called "the Contractor") shall deposit with the (name of Employer) a bank guarantee to guarantee his proper and faithful performance under the said Clause of the Contract in an amount of _____ (amount of Guarantee) _____ (amount in words).

We, the _____(bank or financial institution), as instructed by the Contractor, agree unconditionally and irrevocably to guarantee as primary obligator and not as Surety merely, the payment to _____ (name of Employer) on his first demand without whatsoever right of objection on our part and without his first claim to the Contractor, in the amount not exceeding _____ (amount of Guarantee) _____ (amount in words), such amount to be reduced periodically by the amount recovered by you from the proceeds of the Contract.

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 _____ (name of Employer) and the Contractor, shall in any way release us from any liability under this guarantee, and we hereby waive notice of any such change, addition or modification.

No drawing may be made by you under this Guarantee until we have received notice in writing from you that an advance payment of the amount listed above has been paid to the Contractor pursuant to the Contract.

This guarantee shall remain valid and in full effect from the date of the advance payment under the Contract until _____ (name of Employer) receives full repayment of the same amount from the Contractor.

Yours truly,

SIGNATURE AND SEAL: Name of Signatory _____

Capacity of Signatory
Name of Bank or Financial Institution
Address _____
Date

Tenderers stamp, signature and date

Vol. I Section 3 D - FORM OF BID SECURITY (BANK GUARANTEE)

WHEREAS, (name of bidder) _____

(hereinafter called "the Bidder") has submitted his Bid dated (date) _____ for the execution of "Construction of a permanent modern Bus Terminus at G.T. Road near ESI Hospital with a multi storied commercial complex of (B+G+6) floors along with basement including all civil works, sanitary & plumbing works, electrical works including lift and other ancillary works under Serampore Municipality, Hooghly, West Bengal. (hereinafter called "the Bid").

KNOW ALL PEOPLE by these present that we (name of Bank) _____ of registered office at _____ (hereinafter called "the Bank") are bound unto _____ (hereinafter called "the Employer") in the sum of _____ for which payment well and truly to be made to the said Employer, the Bank binds himself, his successors, and assigns by these presents.

SEALED with the Common Seal of the said Bank this _____ day of _____ 201_____

THE CONDITIONS of this obligation are:-

- (1) if the Bidder withdraws his Bid during the period of Bid validity specified in the Instructions to Bidders; or
- (2) if the Bidder refuses to accept the correction of errors in his Bid; or
- (3) 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;

We undertake to pay to the Employer up to the above amount upon receipt of his first written demand, 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 both of the two conditions, specifying the occurred condition or conditions.

This Guarantee will remain in force up to and including the date 28 days after the date of expiration of the Bid Validity as 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.

SIGNATURE OF THE BANK _____
NAME _____
DESIGNATION _____
DATE _____

SEAL _____

SIGNATURE OF WITNESS _____
NAME _____
ADDRESS _____

The bidder should insert the amount of the guarantee in words and figures. This figure should be the same as shown in Clause 15.1 of Instruction to Bidder. The attention of joint venture bidders is drawn to Clause 15.3 of the Instructions to Bidders.

Vol. I Section 3 E

DECLARATION

It is to certify that

- 1) I/We have submitted the tenders in the proforma as downloaded directly from the website and there is no change in formatting, number of pages etc.
- 2) I/We have submitted tender documents which are same /identical as available in the website.
- 3) I/We have not made any modification/corrections/additions etc. in the tender documents downloaded from web by me/us.
- 4) I/We have checked that no page is missing and that all pages of tender documents submitted by us are clear and legible.
- 5) I/We have signed (with stamp) all the pages of the tender document before submitting the same.
- 6) I/We have ensured that the print out of tender document is taken on A-4 size of paper except some contract drawings which are to be taken on A-3 size of paper.
- 7) I/We have ensured that the downloaded tender documents is properly bound and sealed the tender documents properly before submitting the same.
- 8) I/We have submitted the cost of tender document along with the bid security.
- 9) In case at any stage later, it is found there is difference in our downloaded tender documents from the original as uploaded in HRBC website, HRBC shall have the absolute right to take any action as deemed fit without any prior intimation to me/us.

Dated :

.....
STAMP & SIGNATURE OF AUTHORIZED SIGNATORY

- NOTE:**
1. In case of JV/Consortium, the undertaking shall be submitted by each member of the JV/Consortium.
 2. The undertaking shall be signed by authorized signatory of the tenderer or constituent member in case of JV/Consortium.

Volume I - SECTION 4
General Conditions of Contract

I N D E X

TERMS AND CONDITIONS OF CONTRACT

Sl. No.	Item
1.0	DEFINITIONS:
2.0	PARTIES TO THE CONTRACT:
3.0	ENGINEER'S AUTHORITY TO DELEGATE
4.0	ASSIGNMENT AND SUB-CONTRACTING :
5.0	CONTRACT DOCUMENT:
6.0	PERFORMANCE SECURITY
7.0	CLAIMS UNDER PERFORMANCE SECURITY:
8.0	RETENTION MONEY:
9.0	PAYMENT OF RETENTION MONEY:
10.0	ADVANCE PAYMENT:
11.0	CONTRACT AGREEMENT:
12.0	SUFFICIENCY OF OFFER:
13.0	CONTRACTOR'S RATE TO INCLUDE ALL COSTS FOR COMPLETING WORKS
14.0	UNFORESEEN PHYSICAL OBSTRUCTIONS OR CONDITIONS:
15.0	PROGRAMME TO BE SUBMITTED :
16.0	CASH FLOW ESTIMATE TO BE SUBMITTED
17.0	SAFETY, SECURITY AND PROTECTION OF ENVIRONMENT:
18.0	SUPPLY OF WATER AND ELECTRICAL POWER
19.0	INSURANCE
20.0	POLICY IN JOINT NAMES OF CONTRACTOR AND EMPLOYER
21.0	COMPLIANCE WITH STATUTES OR REGULATIONS:
22.0	PATENT RIGHTS:
23.0	CONTRACTOR'S EMPLOYEES:
24.0	CONTRACTOR TO KEEP ROAD LANES CLEAR:
25.0	CONTRACTOR TO KEEP SITE CLEAR:
26.0	CLEARANCE OF SITE AFTER COMPLETION:
27.0	CONTRACT PERIOD:
28.0	LIQUIDATED DAMAGES:
29.0	LIMIT OF LIQUIDATED DAMAGES AND ITS REDUCTION:
30.0	QUALITY TEST OF MATERIALS AND WORKMANSHIP AND COST OF TEST:
31.0	INDEPENDENT INSPECTION:
32.0	COMMENCEMENT OF WORK:
33.0	SETTING OUT:
34.0	ACCESS ROAD
35.0	OPPORTUNITIES FOR OTHER CONTRACTORS:
36.0	SUPPLEMENTARY WORKS AND FIXATION OF RATES:
37.0	PROVISIONAL SUMS AND ITEMS:
38.0	MEASUREMENT:
39.0	ARBITRATION:

40.0	DESIGN, DRAWINGS AND AS-BUILT DRAWINGS:
41.0	INSPECTION OF OPERATION:
42.0	REMOVAL OF IMPROPER WORK MATERIALS OR PLANT:
43.0	CONTRACTOR'S SUPERINTENDENCE
44.0	TAKING OVER CERTIFICATE :
45.0	DEFECTS LIABILITY :
46.0	DEFECT LIABILITY CERTIFICATE:
47.0	HRBC'S RISK:
48.0	BRIBES AND COMMISSION:
49.0	TERMINATION:
50.0	PAYMENT UPON TERMINATION:
51.0	DISPUTES AND RESOLUTION ARISING OUT OF INTERPRETATION OF CONTRACT CONDITIONS:
52.0	PRICE ADJUSTMENT
53.0	SUBSEQUENT LEGISLATION
54.0	JOINT AND SEVERAL LIABILITY :
55.0	DETAILS TO BE CONFIDENTIAL:
56.0	MONTHLY PAYMENTS
57.0	REGISTRATION AND COLLECTION OF CESS
58.0	DELETED
59.0	TIME OF PAYMENT
60.0	CORRECTION OF CERTIFICATES
61.0	STATEMENT AT COMPLETION
62.0	FINAL STATEMENT
63.0	DISCHARGE
64.0	FINAL PAYMENT CERTIFICATE
65.0	CESSATION OF EMPLOYER'S LIABILITY
66.0	ENGINEER AT LIBERTY TO OBJECT
67.0	SHEDS, STORES, YARDS
68.0	ROADS AND WATER COURSES, ACCESS TO PREMISES AND SAFETY OF PUBLIC
69.0	CARE OF WORKS
70.0	FORCE MAJEURE
71.0	TEMPORARY WORKS
72.0	LABOUR CAMP
73.0	INDEMNITY

GENERAL CONDITIONS OF CONTRACT

1.0 DEFINITIONS:

- 1.1 The terms "**Contractor**" shall mean and include the person or persons, firm or company whose tender for the captioned work has been accepted by HOOGHLY RIVER BRIDGE COMMISSIONERS on its behalf as specified and in the case of natural persons, him/her, his/her heirs, executors and administrators and in the case of a partnership firm, the partner or partners for the time being of the firm.
- 1.2 The term "**Work**" shall mean the activities as stated in the contract.
- 1.3 The term "**Letter of Intent**" shall mean and include the terms and conditions of contract, Letter of acceptance, the Agreement and mutually accepted conditions in the authorized correspondence exchanged with the Bidder by the Commissioners and any other document forming part of the contract.
- 1.4 The term "**Contract Price**" shall mean the aggregate value of PART A : BOQ after application of Contractual percentage and PART B : BOQ as per rates quoted by the bidder with application of discount (if there be any) on the aggregate value excluding Provisional Sums as worked out in the Summary Sheet of Bill of Quantities.
- 1.5 The "**Authorized representative**" shall mean any officer authorized by the HRBC to act on behalf of the HRBC.
- 1.6 The term "**Government**" shall mean the Government of West Bengal and shall include the Governor of West Bengal.
- 1.7 The term "**Governor of West Bengal**" shall mean and include his successors and assigns.
- 1.8 The term "**Commissioner**" shall mean Hooghly River Bridge Commissioners (HRBC).
- 1.9 The term "**Employer**" shall mean the Vice Chairman, HRBC and include his successor and assign.
- 1.10 The term "**Site**" means the location provided by the HRBC where the stipulated work as per the scope of contract is to be carried out.
- 1.11 The term "**Engineer**" means the Chief Project Manager, HRBC appointed by the Employer to act as Engineer for the purposes of the Contract.
- 1.12 The term "**Engineer's Representative/Assistant**" means a person appointed from time to time by the Engineer who will be responsible to the engineer and shall carry out such duties and exercise such authority as may be delegated to him by the engineer.
- 1.13 The term "**Resident Engineer**" means a person appointed by HRBC on contract or through agency and deemed to be delegated by the Engineer as Engineer's Representative.
- 1.14 The term "**Field Engineer**" means a person appointed by HRBC through agency and deemed to be delegated by the Engineer as Engineer's Representative.

Any communication given by the engineer's representative/assistant to the contractor shall have the same effect as though it had been given by the engineer. If the contractor questions any communication of the engineer's representative/assistant he may refer the matter to the engineer who shall confirm, reverse or vary the contents of such communications.

- 1.15 **“Contract”** means this conditions, the specification the drawings, the bill of quantities, the tender, the letter of intent, the letter of acceptance, the contract agreement and such further documents as may be expressly incorporated in the letter of intent, letter of acceptance or contract agreement.
- 1.16 **“Specifications”** means the Technical specification of the works included in the contract and any modifications thereof or additions thereto submitted by the contractor and approved by the engineer.
- 1.17 **“Bill of quantities”** means the priced and completed bill of quantities forming part of the tender.
- 1.18 **Interpretation:** Words importing persons or parties shall include firms, companies and corporations and any other organization having legal capacity.
- 1.19 **Singular and Plural:** Words importing the singular only also include the plural and vice versa where the context so requires.
- 1.20 **Notices, Consents, Approvals, Certificates and Decisions:** Where ever in the contract provision is made for the giving or issue of any notice, consent or approval or certificate or determination by any person, unless otherwise specified such notice, consent, approval, certificate or determination shall be in writing and the words "notify", "certify" or "Decide" shall be construed accordingly. Any such consent, approval, certificate or determination shall not unreasonably be withheld or delayed.

Notices of any other action to be taken on behalf of the HRBC may be given/taken by the engineer/authorized representative duly authorized for the purpose on its behalf.

- 2.0 **PARTIES TO THE CONTRACT:** The parties to the contract shall be the offerer/bidder, whose bid is accepted by the HRBC and Hooghly River Bridge Commissioners (HRBC).
- 2.1 The persons signing the offer or any other document forming the part of contract on behalf of other persons of a firm shall be deemed to have due authority to bind such person/s or the firm as the case may be, in all matters pertaining to the contract. If it is found that the person concerned has no such authority, the HRBC may, without prejudice to any other Civil/Criminal remedies, terminate the Contract and hold the signatory and/or the firm liable for all costs and damages for such termination.

3.0 ENGINEER'S AUTHORITY TO DELEGATE

- 3.1 The Engineer may from time to time delegate to the Engineer's Representative / Assistant any of the duties and authorities vested in the Engineers and he may at any time revoke such delegation.

- 3.2 Any failure of the Engineer's Representative / Assistant to disapprove any work, materials or Plant shall not prejudice the authority of the Engineers to disapprove such work, materials or plant and to give instructions for the rectification thereof.
- 3.3 If the Contractor questions any communication of the Engineer's Representative / Assistant he may refer the matter to the Engineer who shall confirm, reverse or vary the contents of such communications.

4.0 ASSIGNMENT AND SUB-CONTRACTING :

- 4.1 The contractor shall not assign the Contract or any part thereof, or any benefit or interest therein or thereunder without the prior consent of the Employer.
- 4.2 The Contractor shall not subcontract any part of the works without the prior consent of the Employer. Any such consent shall not relieve the contractor from any liability or obligation under the contract and he shall be responsible for acts, defaults and neglects of any subcontractors, his agents or workmen as fully as if they were the acts, defaults or neglects of the contractor, his agents or workmen .

5.0 CONTRACT DOCUMENT:

- 5.1 **LANGUAGE:** The language of the contract is English.
- 5.2 **LAW:** The contract shall be governed and construed in accordance with the law of India. No suit or other proceedings relating to performance or breach of Contract shall be filed or taken by the contractor in any Court of Law except principal Court of Ordinary Civil Jurisdiction of the state of West Bengal.
The law in force is that of West Bengal, India within the jurisdiction of the High Court, Kolkata.
- 5.3 **PRIORITY OF CONTRACT DOCUMENTS:** The several contract document forming the Contract shall be taken as mutually explanatory of one another, but in case of ambiguities or discrepancies the same shall be explained and harmonized by the officer in charge who shall issue to the Contractor necessary instruction thereon and in such event unless otherwise provided in the Contract the priority of the documents forming the contract shall be as follows:
- (a) Agreement
 - (b) Letter of Acceptance
 - (c) The offer submitted by the Contractor in the prescribed form and accepted by the Employer (Section 1A, Vol IV).
 - (d) Appendix to Bid (Section 1B, Vol IV)
 - (e) Addenda to Tender Documents, if any
 - (f) Invitation for Bid (Section 1, Vol I)
 - (g) Instructions to Bidders (Section 2, Vol I)
 - (h) General Conditions of Contract (Section 4, Vol I)
 - (i) Technical Specifications (Vol II)
 - (j) Bill of Quantities with Provisional Sums (Section 2, Vol IV)
 - (k) Contract Drawings (Vol III)
 - (l) Contractor's Technical Submission (Vol V)
 - (m) Other documents as agreed upon

6.0 PERFORMANCE SECURITY:

6.1 The contractor shall submit performance security in the form of Bank Guarantee/s from the banks acceptable to Employer. Performance Security of 7.5% of the Contract Price (as defined in sub-clause 1.4 of General Conditions of Contract) may be in the form of bank guarantees initially valid for 19 months (i.e. up to 1 month beyond the stipulated period of contract (Eighteen months). Validity of Performance Security will be extended in both cases if extension of time is granted.

6.2 The performance security shall be refunded to the contractor within one month of issue of taking over certificate on taking over of completed works (provided there is no claim of the HRBC against the Contractor) after a specific written request is received from the contractor.

7.0 CLAIMS UNDER PERFORMANCE SECURITY:

The claims under performance security shall be made by the HRBC after notifying the contractor stating the nature of the default in which respect the claim is made.

8.0 RETENTION MONEY:

A retention amounting to 10% of the intermediate payment certificate subject to maximum of 5% of the contract price shall be made by the engineer from the first and following interim payment certificates.

9.0 PAYMENT OF RETENTION MONEY:

9.1 REFUND OF 50% :

Upon the issue of taking over certificate / completion certificate with respect to the whole of the works one half of the retention money shall be certified by the engineer for payment.

9.2 REFUND OF BALANCE 50% :

Upon the expiration of the defect liability period for the works, the other half of the retention money shall be certified by the engineer for payment to the contractor. Provided also that if at such time, there shall remain to be executed by the contractor any work instructed, in respect of the works, the engineer shall be entitled to withhold certification until completion of such work of so much of the balance of the retention money as shall, in the opinion of the engineer, represent the cost of the work remaining to be executed.

10.0 ADVANCE PAYMENT:

On written request of the contractor, the employer will make an interest free advance payment to the contractor amounting to 10(ten)% of the Contract Price exclusively for the costs of mobilization and will be disbursed in 2 (two) installments. Payment of such advance amount will be due under separate certification by the engineer after (a) execution of the Form of Agreement by the parties hereto, (b) provision by the contractor

of the performance security in accordance with provision in the contract and (c) provision by the contractor of an unconditional bank guarantee in a form and by a bank acceptable to the employer in amounts equal to the advance payment. Such bank guarantee shall remain effective until the advance payment has been repaid pursuant to the paragraph below, but the amount thereof shall be progressively reduced by the amount repaid by the contractor as indicated in Interim Payment Certificates issued in accordance with this Clause.

The advance payment shall be used by the Contractor exclusively for mobilization expenditures, including the acquisition of construction equipment in connection with the works. Should the Contractor misappropriate any portion of the advance payment, it shall become due and payable immediately by the contractor. In case of failure of the contractor to repay this sum, the engineer/employer shall be entitled to recover such sum from any of the contractor's dues or by encashment of the B.G furnished against this advance.

The advance mobilization loan shall be repaid through percentage deductions from the interim payments certified by the Engineer under the Contract.

The first installment of advance at the rate of 5% of the Contract Price shall be given after adequate mobilization of men, materials, machineries and setting up of labour camp at the project sites and remaining 5% shall be disbursed after completion of Milestone – 1 (MS -1) as given in Clause 28 of General Condition of Contract in Section 4, Vol I.

Deduction in respect of 1st installment of 5 (five) percent shall commence in the next Interim Payment Certificate following that in which the total of all such payments to the Contractor has reached 10 (ten) percent of the Contract price, and shall be made at a rate of 17 (seventeen) percent of the amount of monthly Interim Payment Certificate of the month from which the payment starts and so on, so that it is completely repaid prior to the time when 40 (forty) percent of the Contract Price for permanent works as per Bill of Quantities has been certified for payment.

Deduction in respect of 2nd installment of 5 (five) percent shall commence in the next Interim Payment Certificate following that in which the total of all such payments to the Contractor has reached 40 (forty) percent of the Contract price, and shall be made at a rate of 12.5 (twelve point five) percent of the amount of monthly Interim Payment Certificate of the month from which the payment starts and so on, so that it is completely repaid prior to the time when 80 (eighty) percent of the Contract Price for permanent works as per Bill of Quantities has been certified for payment.

11.0 CONTRACT AGREEMENT:

The contractor shall when called upon so to do, enter into and execute the contract agreement, to be prepared and completed at the cost of the contractor in the form annexed to these conditions with such modifications as may be necessary.

12.0 SUFFICIENCY OF OFFER:

The contractor shall be deemed to have satisfied himself as to correctness and sufficiency of the offer which shall, except in so far as it is otherwise provided in the contract, cover all his rights and obligations under the contract and all matters and things necessary for proper completion of the work.

13.0 CONTRACTOR'S RATE TO INCLUDE ALL COSTS FOR COMPLETING WORKS

- 13.1 The Contractor shall, with due care and diligence design (to the extent stated in the contract), execute and complete the works and remedy any defects therein as provided in the contract. The Contractor shall provide all superintendence, materials, plant, contractor's equipment and all other things required.
- 13.2 The rates and prices stated in the Bill of Quantities as well as for items under Provisional Sums shall be deemed to cover all his obligations under the contract including those stated above and also in respect of the supply of goods, materials, plants, services, contingencies and all matter and things necessary for proper execution and completion of each item of work in accordance with the Technical Specifications and remedying of any defects therein. The Contractor shall take into consideration of all such costs while quoting his rates. No separate payment shall be made by the Employer to the contractor on account of any allied work in respect of the BOQ as well as Provisional Sums for completing the works in all respects.

14.0 UNFORESEEN PHYSICAL OBSTRUCTIONS OR CONDITIONS:

During the period of the contract, if the contractor encounters physical obstructions or physical conditions other than climatic conditions which obstructions or conditions in his opinion not foreseeable by an experienced Entrepreneur, the contractor shall give notice to the Employer. The Employer in such cases may consider such measures as to extend the period of contract without any financial repercussions on either side save and except whatever has been specifically provided for in the contract. The decision of Employer shall be final and binding in such cases.

15.0 WORK PROGRAM AND WORK ACHIEVEMENT TO BE SUBMITTED:

A contractor shall, within 10 days from the date of issue of Engineer's notice to commence work, submit to the engineer for his consent a detail work program indicating quantity, timing and duration of all major items of works under the Contract Package in the form of bar chart based on milestone format. The contractor shall also provide, in writing, a general description of the arrangements and methods it proposes to adopt for timely execution of the works along with the program of execution. The work programme shall be prepared as per requirement outlined in sub-clause 18.6.1 (c) (4) of Instructions to Bidder.

During the period of construction, the contractor has to submit Work Achievement report vis-à-vis work program of all major items of works under the Contract Package every month or as per direction of the Engineer.

16.0 CASH FLOW ESTIMATE TO BE SUBMITTED

- 16.1 The Contractor shall within 10 (ten) days from the date of issue of Engineer's notice to commence work submit to the Engineer a detailed cash flow estimate in quarterly periods of all payments to which the Contractor will be entitled under the contract. The Contractor shall also submit revised cash flow estimates at quarterly intervals, if required to do so by the Engineer.

17.0 SAFETY, SECURITY AND PROTECTION OF ENVIRONMENT:

The contractor shall throughout the period of contract have full regard for safety of all persons entitled to be upon the site in an orderly state appropriate to the avoidance of danger to such persons specially from moving traffic.

- 17.1 The contractor shall provide all necessary safety equipment such as reflective vests, helmets to the persons.
- 17.2 The Contractor shall provide and maintain adequate lights, guards, warning signs when and where ever required.
- 17.3 The Contractor shall throughout the process of execution and remedying any defects thereafter during the Defect Liability Period 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. Among various steps, interalia, the following arrangement should be taken by the Contractor during execution of works as listed below :
- a) The construction area should be barricaded, in addition to usual barricading for safety of pedestrians and vehicles, by providing cover of polythene or hessian sheets to mitigate movement of dust outside the project area.
 - b) The wheels of all vehicles including those of machineries and equipments should be cleaned with water before leaving the project site so that no dust particles spreads from those vehicles.
 - c) All construction materials like sand, cement, stone chips, bricks etc. should be properly stored and provided with covers.
 - d) Everyday after the end of work activities the project site should be made clean and kept free from dust.
- 17.4 The Contractor shall take all steps to comply with the Central and West Bengal State Environmental Protection Acts and Rules thereunder. Cost for taking all such measures to prevent pollution are to be considered in their rates while offering the bids. No separate payment will be made in this regard.

18.0 SUPPLY OF WATER AND ELECTRICAL POWER

The Contractor shall be responsible for arrangements to obtain supply of water and electrical power necessary for the works.

19.0 INSURANCE

19.1 REQUIREMENTS

Before commencing execution of works, it shall be obligatory for the Contractor to obtain at his own cost stipulated insurance cover under the following requirements:

- a. Contractor's All Risk and Third Party Cover.
- b. Liability under the Workmen's Compensation Act, 1923, Minimum Wages Act, 1948 and Contract Labour (Regulation and Abolition) Act, 1970.
- c. Accidents to staff, Engineers, Supervisors and others who are not governed by workmen's Compensation Act.
- d. Damage to material, machinery and works due to fire, theft etc.
- e. Any other risk to be covered by insurance as may be specified by the Employer in the Special Conditions of Contract.

20.0 POLICY IN JOINT NAMES OF CONTRACTOR AND EMPLOYER

The policy referred to under sub-clause 19.1(a) above shall be obtained in the joint names of the Contractor and the Employer and shall inter-alia provide coverage against the following, arising out of or in connection with execution of works, their maintenance and performance of the Contract :

- Loss of life or injury involving public, employee of the Contractor, or that of Employer and Engineer, labour etc.
- Injury, loss or damage to the Works or property belonging to public, Government bodies, local authorities, utility organizations, contractors, Employer or others.

20.1 CURRENCY OF POLICY

The policies shall remain in the force throughout the period of execution of the Works and till the expiry of the maintenance period. The Contractor shall, whenever called upon, produce to the Engineer or his representative the various insurance policies obtained by him as also the rates of premia and the premia paid by him to ensure that the policies indeed continue to be in force. If the contractor fails to effect or keep in force or provide adequate cover in the Insurance policies mentioned in Sub-clause 19.1, or any other insurance he might be required to effect under the Contract, then in such cases, the Employer may effect and keep in force any such insurance or further insurance and the cost and expenses incurred by him in this regard shall be deductible from payments due to the Contractor or from the Contractor's Performance Security.

21.0 COMPLIANCE WITH STATUTES OR REGULATIONS:

The Contractor shall comply with all Central or State Statutes, Rules or other Regulations in all respects;

22.0 PATENT RIGHTS:

The Contractor shall save harmless and indemnify the HRBC from and against all claims and proceedings for or on account of infringement of any patent rights, design trade mark or name or other protected rights in respect of contractor's equipment material or plants used by Contractor in connection of the work.

23.0 CONTRACTOR'S EMPLOYEES:

23.1 The HRBC shall be at liberty to require the contractor to remove from the construction works such person who in the opinion of the HRBC misconducts himself or is incompetent or negligent in the proper performance of his duties or whose presence at the site is considered undesirable.

24.0 CONTRACTOR TO KEEP ROAD LANES CLEAR:

During the construction work the Contractor shall keep the other traffic lanes and adjoining area free from all unnecessary obstruction and shall see that the traffic flow is smooth and is not affected and the obstructions do not become a cause of accident or complaint from public.

25.0 CONTRACTOR TO KEEP SITE CLEAR

25.1 During the execution of the Works the Contractor shall keep the Site reasonably free from all unnecessary obstruction and shall store or dispose of any Contractor's Equipment and surplus materials and clear away and remove from the Site any wreckage, rubbish or Temporary Works no longer required at the earliest. If the contractor fails to remove such materials despite request from the Engineer, the same may be arranged to be removed by the Engineer and cost thereof will be recovered from the dues of the contractor.

26.0 CLEARANCE OF SITE AFTER COMPLETION

26.1 Upon the issue of any Taking-Over Certificate the Contractor shall clear away and remove from that part of the Site to which such Taking-Over Certificate relates all Contractor's Equipment, surplus material, rubbish and Temporary Works of every kind, and leave such part of the Site and Works clean and in a workmanlike conditions to the satisfaction of the Engineer. Provided that the Contractor shall be entitled to retain on Site, until the end of the Defects Liability Period, such materials, Contractor's Equipment and Temporary Works as are required by him for the purpose of fulfilling his obligations during the Defects Liability Period subject to approval of the Engineer. If the contractor fails to effect the above requirement, HRBC may take steps to effect the same and the cost involved will be recovered from any dues of the contractor.

27.0 CONTRACT PERIOD:

27.1 TIME FOR COMPLETION:

18 (Eighteen) months from the date of notice to commence work.

At the same time, the contractor should adhere to the time limit set for each milestone for the contract package.

27.2 EXTENSION OF TIME

Extension of time may be granted in the event of:

- a) the amount or nature of extra or additional work,

- b) any cause of delay referred to in these Conditions.
- c) any delay, impediment or prevention by the Employer, or
- d) other special circumstances which may occur, other than through a default of or breach of contract by the Contractor or for which he is responsible, being such as fairly to entitle the Contractor to an extension of the Time for Completion of the Works, or any Section or part thereof. The Engineer shall, after due consultation with the Employer and the Contractor, determine the amount of such extension without any price variation and shall notify the Contractor accordingly, with a copy to the Employer. For any extension of time granted for delays due to Employer or due to Contractor or for any other reason, that will in no way affect or vitiate the contract or alter the character thereof or entitle the contractor to any kind of damages or compensation.

28.0 LIQUIDATED DAMAGES:

The time allowed for carrying out the work as entered in the tender shall be strictly observed by the contractor and shall be reckoned from the date of notice to commence work. The work shall throughout the stipulated period of the contract be proceeded with all due diligence (time being deemed to be of the essence of the contract on the part of the contractor). The contractor shall commence works within 10 (ten) days from the date of notice to commence work and ensure good progress conforming to the milestones achievement of the programme as below:

Sl.	Milestone marked as	Progressive target of achievement in percentage of the value of Contract Price	Progressive time period for achievement in months
a)	MS - 1	20	5
b)	MS - 2	40	9
c)	MS - 3	60	13
d)	MS - 4	80	16
e)	MS - 5	100	18

If the contractor fails to comply to achieve the milestones of targets stated above within specified time period, for such default or delay in execution, the contractor shall be liable to pay a sum of 1 (one) percent of Contract Price as Liquidated Damages for every week or part of the week for elapse of time to achieve milestones of targets. This sum to be recovered not as a penalty but from the monies due from the contractor for such default.

29.0 LIMIT OF LIQUIDATED DAMAGES AND ITS REDUCTION

The liquidated damage shall be subject to the applicable limit of 10% of the contract price.

30.0 QUALITY TEST OF MATERIALS AND WORKMANSHIP AND COST OF TEST

All materials and workmanship shall be of respective kinds described in the contract and in accordance with the Engineer’s instructions and shall be subjected from time to time to quality checking tests as required per technical specification and Indian Standards. The cost of making any test shall be borne by the Contractor and no separate payment shall be made in this regard

31.0 INDEPENDENT INSPECTION

31.1 The Engineer may delegate inspection and testing of materials or works to any Independent Inspector who shall be considered as an assistant to the Engineer in accordance with Cl. 3.0 of General Condition of Contract in Section 4, Vol I.

32.0 COMMENCEMENT OF WORKS

32.1 The Contractor shall commence the works within 10 (ten) days from the date of issue of Engineer's notice to commence work failing which action under Sub Cl. 49.1 may be resorted to by the Employer.

33.0 SETTING-OUT

33.1 The Contractor shall be responsible for :

- (a) the accurate setting-out of the Works in relation to original points, lines and levels of reference given by the Engineer in writing.
- (b) the correctness, subject as above mentioned, of the position, levels, dimensions and alignment of all parts of the Works, and
- (c) the provisions of all necessary instruments, appliances and labour in connection with the foregoing responsibilities.

33.2 If, at any time during the execution of the Works, any error appears in the position, levels, dimensions or alignment of any part of the Works, the Contractor, on being required so to do by the Engineer, shall, at his own cost, rectify such error to the satisfaction of the Engineer.

33.3 The checking of any setting-out or of any line or level by the Engineer shall not in any way relieve the Contractor of his responsibility for the accuracy thereof and the Contractor shall carefully protect and preserve all bench-marks, sight – rails, pegs and other things used in setting-out the Works.

34.0 ACCESS ROAD

The contractor shall provide necessary access roads to the site of work from the nearest public through fare and right of way at his cost unless otherwise provided for in the contract.

35.0 OPPORTUNITIES FOR OTHER CONTRACTORS

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

- (a) any other contractors employed by the Employer and their workmen,
- (b) the workmen of the Employer, and
- (c) the workmen of any duly constituted authorities who may be employed in the execution on or near the Site of any work not included in the Contract or of any contract which the Employer may enter into in connection with or ancillary to the Works.
- (d) Any agency or the Employer by allowing use of any roads or ways for the development and maintenance of which the contractor is responsible. For

affording all such opportunities mentioned above no additional payment or compensation shall be made by the Employer to the Contractor.

36.0 SUPPLEMENTARY WORKS AND FIXATION OF RATES

36.1 The Engineer shall have power to make any alteration in, omissions from, additions to or substitutions for, the original specifications, drawings, design and instruction, that may appear to him to be necessary or advisable during the progress of the work and the contractor shall be bound to carry out the work in accordance with any instructions which may be given to him in writing signed by the Engineer and such alterations, omissions, additions or substitutions, shall not invalidate the contract but shall be deemed to have formed as work included in the original tender and any altered, additional or substituted work which the contractor may be directed to do in the manner above specified as part of the work shall be carried out by the contractor on the same condition in all respects on which they agreed to do the main work and at the same rates, if any, may be specified in the tender for the main work with application of contractual percentage rate and discount, if there be any specified in the tender for the main work. The time for the completion of the work shall be extended in the proportion that the altered, additional or substituted work bears to the original contract work and the certificate of the Engineer shall be conclusive as to such proportion. And if the altered additional or substituted work includes any class of work, for which no rate is specified in this contract, then such class of work shall be carried out at the rates entered in the Specifications for PWD (WB) schedule of rates for Building and S&P Works(effective from 01.08.2010) with the latest corrigendum (4th Corrigendum dated 10.12.12). For any kind of road works like internal campus roads, pathways, culverts etc. P.W.(Roads) Dept. Schedule of Rates effective from 14.11.2008 with latest Corrigendum (7th Corrigendum, dt.30.04.2012) shall be followed for analysis of rates of supplementary items instead of PWD Schedule. When such rates are determined on analysis from Schedule of Rates of PWD and or PW (Roads) Dept stated above, contractual percentage rate and discount, if there be any specified in the tender for the main work shall be applicable. Rates which are not available in the PWD schedule of rates, or P.W.(Roads), schedule of rates analysis of rate for the item has to be worked out from current market rate of materials and labour. Final rate based on current market rate of materials should be arrived with application of 10% overhead plus 10% profit on value of materials and labour (if applicable) procured from market.

In support of market rates at least three quotations from bonafied concerns have to be furnished. In the event of disagreement by the contractor the rate fixed by the Engineer in the consultation with the Employer shall be final and binding.

The value of supplementary or substituted items, analysis of which would be fixed based on current market rates of materials, labour etc., shall not be subjected to application of Price Adjustment clause no 52 of the General Condition of Contract and the rates so analysed will not be subjected to application of contractual percentage rate and discount, if there be any, in the tender for main work.

36.2 The authority of the Engineer to order and determine the rate of supplementary work is limited to 5 (five) % of the contract price. If the variation or supplementary amount of work exceeds the above aforesaid limit, prior approval of employer has to be taken by the Engineer for ordering and fixing rates of such works.

37.0 PROVISIONAL SUMS:

In the Summary Sheet of Bill of Quantities under Part C, two items designated as (i) Escalation and (j) Supplementary Works are provided as Provisional Sums for payment of Escalation due to price adjustment in terms of Clause 52 of General Conditions of Contract and for execution of any part of works or for supply of goods/materials/any kind of services etc. as supplementary works as per Clause 36 of General Conditions of Contract which sum may be used on the instruction of the Engineer.

38.0 MEASUREMENT

38.1 The quantities set out in the bill of quantities are the estimated quantities for the work and these are not to be taken as the actual and correct quantities of the works to be executed by the Contractor to fulfill his obligation under the contract.

38.2 The Engineer shall, except as otherwise stated, ascertain and determine by measurement the value of work in accordance with the contract. For the purpose, the Contractor shall send request for inspection to the Engineer or his delegated representatives to inspect and take measurements of works completed. The request for inspection should be sent well in advance in consultation with the Engineer. Before covering any item of work the contractor shall be responsible to get the measurements of the items to be covered to be jointly measured and recorded for subsequent incorporation in the bills for payment. For the purpose of measuring such permanent works as are to be measured by records and drawings the contractor shall prepare records and drawings jointly with the Engineers or his delegated representatives as the work proceeds and shall be signed jointly by both of them for incorporation in the payment bills.

All measurements for permanent works for the purpose of payment shall be recorded in printed measurement sheets to be signed jointly by the contractor's authorized representative and the Resident Engineer or Field Engineer appointed by HRBC on contract or through agency to work as delegated representatives of the Engineer. Resident Engineer shall check measurements of works valued at least 20% of work bill amount and certify compliance accordingly before forwarding the bill to the Engineer.

39.0 ARBITRATION

39.1 Except where otherwise provided in the contract all questions and disputes relating to the meaning of the specifications, designs, drawings and instructions herein before mentioned and as to the quality of workmanship or materials used on the work or as to any other questions, claim, right, matter or thing whatsoever, in any arising out of or relating to the contract, designs, drawings, specifications, estimates, instructions orders or those conditions or otherwise concerning the works, or execution, or failure to execute the same, whether arising during the progress of the work, after the completion, after termination or abandonment thereof shall be referred to the Arbitral Panel of three arbitrators. The Panel shall be composed of one arbitrator to be nominated and appointed by the Employer and one to be nominated and appointed by the Contractor. The third who will act as Chairman of the Panel, but not as Umpire, will be chosen jointly by the two nominees from a panel of three candidates, none of whom would be in regular employment of the Central and / or State Government provided by the Engineer-

in-Chief & Ex-Officio Secretary, Public Works Department, Government of West Bengal. If either of the parties fail to appoint his arbitrator, or fail to agree on the nominee for the third Arbitrator, within sixty days after receipt of notice for the appointment of such an arbitrator, the Engineer-in-Chief & Ex-Officio Secretary, Public Works Department, Government of West Bengal shall appoint upon request from either party and form such panel or otherwise such Arbitrator(s) for the matter in dispute. The appointee for Arbitration Panel may be of any nationality residing in India.

- 39.2 For referring such disputes to an Arbitral Panel the Employer or the Contractor may give notice of intention to commence arbitration as to the disputes to the other party.
- 39.3 The decision of the majority of Arbitrators shall be final binding on the parties. The award shall be a speaking one, that is, the Arbitration Panel shall recite facts and assign reasons in support of the award after discussing fully the claims and contentions of the parties. Save as aforesaid and / or otherwise provided in the Contract, the arbitration shall be conducted in accordance with the provisions of the Indian Arbitration and Conciliation Act, 1996 or any statutory modification or enactment thereof and shall be held at such a place and time in India as the Arbitration Panel may determine. The fees of the Arbitrators will be borne equally by the Employer and the Contractor or as the Arbitration Panel may determine.

40.0 DESIGN, DRAWINGS AND AS BUILT DRAWINGS

- 40.1 The Engineer shall supply drawings for all permanent works from time to time to the contractor in duplicate. The contractor shall make at his own cost any further copies required by him. The contractor shall submit a schedule of requirement of drawings for permanent work, subject to approval of the schedule by the Engineer, well in advance to enable the engineer supplying the drawings in time. For temporary and minor works, all design and drawings shall be prepared by the contractor at his own cost and obtain approval from the Engineer. Approval by the Engineer shall not relieve the contractor of any of his responsibilities under the contract.
- 40.2 Any deviation from working drawings and engineering drawings that may be required by the exigencies of construction, or otherwise, will in all cases be determined and authorized by the Engineer in writing.
- 40.3 One set of Contract document including all approved drawings furnished to the Contractor as aforesaid shall be kept by the Contractor at site and same shall be at all reasonable times be available for inspection by the Employer and / or the Engineer and by any other person authorized by the Engineer in writing.
- 40.4 Progressively as the Works are completed the Contractor shall furnish to the Engineer the "As built" drawings all clearly revised and completed and brought up-to-date showing the permanent construction as actually made, failing which a lump sum amount as decided by the Employer will be deducted from the final bill. The last lot of "As built" drawings shall be submitted within 2 months of completion of the Works. These drawings shall show apart from the number, title, date of drawing, dates of revisions and the name of the project, name of the Contractor, clear details as to the identity and location of Work as well as title and number. The drawings shall be submitted as reproducible in 2 (two) nos. soft copies in the form of CD. Also, 6(six) sets of hard copies of prints in A-3 Size of all "As built" drawings shall also be submitted in number of bound

sets arranged for each project site location wise. All these submissions shall become the property of the Employer. For complying with the above provisions the contractor shall not be entitled to any additional payment or any kind of compensation.

41.0 INSPECTION OF OPERATIONS

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

42.0 REMOVAL OF IMPROPER WORK, MATERIALS OR PLANT

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

- (a) total removal from the Site, within such time or times as may be specified in the instruction, of any materials or Plant which, in the opinion of the Engineer, are not in accordance with the Contract.,
- (b) the substitution of proper and suitable materials or Plant, and
- (c) the removal and proper re-execution, notwithstanding any previous test thereof or interim payment thereof, of any work which, in respect of
 - i) materials, plant or workmanship, or
 - ii) design by the Contractor or for which he is responsible, is not, in the opinion of the Engineer, in accordance with the Contract.

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

43.0 CONTRACTOR'S SUPERINTENDENCE

The Contractor shall provide all necessary superintendence during the execution of the Works and as long thereafter as the Engineer may consider necessary for the proper fulfilling of the Contractor's obligations under the Contract. The Contractor, or a competent and authorised representative approved of by the Engineer, which approval may at any time be withdrawn, shall give his whole time to the superintendence of the Works. Such authorised representative shall receive, on behalf of the Contractor, instructions from the Engineer or, subject to the provisions of Clause 2, the Engineer's Representative.

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

44.0 TAKING OVER CERTIFICATE:

When the whole of the Works have been completed and have satisfactorily passed any Tests on Completion prescribed by the Contract, the Contractor may give a notice to that effect to the Engineer, with a copy to the Employer, accompanied by a written undertaking to finish with due expedition any outstanding work during the Defects Liability Period. Such notice and undertaking shall be deemed to be a request by the Contractor for the Engineer to issue a Taking-Over Certificate in respect of the Works. The Engineer shall, within 21 days of the date of delivery of such notice, either issue to the Contractor, with a copy to the Employer, a Taking-over Certificate, stating the date on which, in his opinion, the works were substantially completed in accordance with the contract, or give instructions in writing to the Contractor specifying all the work which, in the Engineer's opinion, is required shall also notify the Contractor of any defects in the Works affecting substantial completion that may appear after such instructions and before completion of the Works specified therein. The Contractor shall be entitled to receive such Taking-Over Certificate within 21 days of completion, to the satisfaction of the Engineer, of the works so specified and remedying any defects so notified.

45.0 DEFECTS LIABILITY:

45.1 The defect liability period shall mean the period of 12(twelve) months calculated from the date of issue of taking over certificate for whole of the works comprised in the contract.

46.0 DEFECT LIABILITY CERTIFICATE:

The contract shall not be considered as completed until a defect liability certificate shall have been signed by the engineer and delivered to the employer with a copy to the contractor, stating the date on which the contractor shall have completed his obligations to execute and complete the works and remedy any defects therein to the engineer satisfaction.

47.0 HRBC'S RISK:

The HRBC's risks are

- a) War, Hostilities, Invasion, act of foreign enemies
- b) Rebellion, revolution, insurrection, or military or usurped, civil war.
- c) Ionizing radiation or contamination by radioactivity from any nuclear fuel, or from any nuclear waste from combustion of nuclear fuel, radioactive toxic explosive or other hazardous properties of any explosive nuclear assembly or nuclear component thereof.
- d) Riot, commotion, disorder, unless solely restricted to employees of the Contractor and arising from conduct of the work, provided that the same is not temporary or transitory and affect the work appreciably.
- e) Any other operation of the forces of nature against which an experienced Contractor could not reasonably have been expected to take precaution.

48.0 BRIBES AND COMMISSION:

Any bribes, commission, gift or advantages given, promise of bribe by or on behalf of the CONTRACTOR/s or servants or any one on their behalf to any officer, employee, representative or Contractor of the HRBC or any person on his or their behalf of showing favour or disfavour to any person in relation to the contract, in any manner whatsoever will entitle the HRBC to cancel his contract and also to claim from CONTRACTOR's payment, any loss or damage resulting from such cancellation.

49.0 TERMINATION:

49.1 If the Contractor is deemed by Law unable to pay his debts as they fall due or enters into voluntary or involuntary bankruptcy, liquidation or dissolution (other than a voluntary liquidation for the purpose of amalgamation or reconstruction), or becomes insolvent or makes an arrangement with, or assignment in favour of his creditors, or agrees to carry out the contract under a committee of inspection of his creditors or if a receiver, administrator, trustee or liquidator is appointed over any substantial part of his assets or if under any law or regulation relating to reorganization, arrangement or readjustment of debts, proceedings are commenced against the Contractor or resolutions passed in connection with dissolution or liquidation of if any steps are taken to enforce any security interest over a substantial part of the assets of the CONTRACTOR, or if act is done or event occurs with respect to the Contractor or his assets which, under any applicable law has a substantially similar effect to any of the foregoing events. The contract shall forthwith stand terminated. Further if the Engineer certifies to the Employer, with a copy to the Contractor that in his opinion, the Contractor:

- a) Has repudiated the contract
- b) Has failed to comply with the instructions issued by Hooghly River Bridge Commissioners or his authorised officer or has failed to commence the work within 10 days after receiving the "Notice to Commence with the work"
- c) Despite previous warning is otherwise persistently or flagrantly neglecting to comply with any of the obligations under the contract.
- d) Committed any breach of any of the terms of contract, or
- e) Has given false or untrue information regarding eligibility to bid, as revealed at the selection process is over or even earlier or
- f) Non courteous, rude behavior with the public
- g) Breach of any of the terms and conditions of the contract for any reason whatsoever

then the Employer may, after giving 10 days notice to the Contractor, enter upon the site and works and terminate the Employment of the Contractor without thereby releasing the Contractor from any of his obligations or liabilities under the contract or affecting the rights and authorities conferred on the Employer or the Engineer by the contract, and may himself complete the works or may employ any other contractor to complete the works.

49.2 If the CONTRACTOR/s being a natural person/s die/dies or being a natural person or a partnership firm is adjudged insolvent or commit any criminal activity or act of moral turpitude or detained under any preventive law i.e., TADA, FERA, etc or if the CONTRACTOR/s or servants of the CONTRACTOR/s are convicted of any offence under the State of West Bengal Prohibition Act. West Bengal Opium Smoking Act and/or

the Narcotic Drugs and Psychotropic substances Act, or fails to observe any of the provisions of this contract or any of the terms and conditions governing the contract, the contract shall, forthwith, stand terminated.

50.0 PAYMENT UPON TERMINATION:

Upon termination of the contract under Clause 49.1 or 49.2. the amount of performance security will be forfeited by the Employer. The Engineer will arrange joint measurement or in absence of the contractor ex-party measurement of the works already executed which are considered acceptable but not paid within a reasonable time. The contractor will be entitled to receive payment for the unpaid works as stated above. If liquidated damages has to be recovered under terms of contract, the same shall be separately recovered from the dues of the contractor and /or from the amount of retention money at hand. Retention should otherwise be refunded to the contractor as per terms of contract.

51.0 DISPUTES AND RESOLUTION ARISING OUT OF INTERPRETATION OF CONTRACT CONDITIONS:

In case of disputes or differences of opinion arising out of interpretation of contract conditions the decision of the Vice-Chairman shall be final and binding on the CONTRACTOR. The contractor shall be given reasonable opportunity to represent his case before the Vice-Chairman.

52.0 PRICE ADJUSTMENT

52.1 Contract price shall be adjusted for increase or decrease in price of Steel Component comprising Mild Steel/Tor Steel reinforcement bars and Mild Steel Structural works and Cement in accordance with the following Principles :-

52.1.1 The price adjustment shall apply for the work done from the date of commencement as mentioned in the contract up to stipulated date of completion or extensions granted but, shall not apply to the work carried out beyond the stipulated time for reasons attributable to the contractor.

52.1.2 Adjustment amount shall not exceed 10% of the Bid amount.

52.1.3 Contract price wherever appears under price adjustment clause shall mean value of executed work at contract rates.

52.2 Price Adjustment in respect of construction materials –Steel Components as defined in sub-clause 52.1 and Cement.

52.2.1 **Price Adjustment for Steel components** (as defined in sub-clause 52.1)

Price adjustment for increase or decrease in price of Steel component will be calculated in the manner as follows :

- (i) For percentage rate tender $V_S = R_1 \times (S_1 - S_0) / S_0 \times Q_S \times C$
- (ii) For item rate tender $V_S = R_1 \times (S_1 - S_0) / S_0 \times Q_S$

Where,

- $V_s =$ Adjustment to the contract price on account of increase or decrease of price of Steel components during the period under consideration.
- $R_1 =$ Basic price of Steel Components as indicated in Schedule of Rates for Building works of Public Works Dept., Govt. of West Bengal effective from 01.08.2010 with latest Corrigendum (4th Corrigendum dated 10.12.12).
- $S_1 =$ Wholesale price index (monthly average) for Iron & Steel published by the Office of the Economic Adviser, Ministry of Commerce & Industry, Government of India, during the period under consideration.
- $S_o =$ Wholesale price index (monthly average) for Iron & Steel published by the Economic Adviser, Ministry of Commerce & Industry, Government of India, in the month which contains date of calling of Notice Inviting Tender.
- $Q_s =$ Quantity of Steel components consumed on items of work (supported by related delivery orders & challans showing price details) as per Contract during the period under consideration excluding involvement of Steel components on items of work under the contract whose rates are derived on the basis of market rate of Steel components prevailing at the time of execution of work.
- $C =$ (100 \pm P) / 100 (applicable for percentage rate tender only), where
- $P =$ Contractual rate in percentage above or below Estimated amount put to tender (where (+) for above and (-) for below) in case of percentage rate tender.

52.2.2 **Price Adjustment for Cement component :-**

- (i) For percentage rate tender $V_c = R_1 \times [(C_1 - C_o) / C_o] \times Q_c \times C$
 (ii) For item rate tender $V_c = R_1 \times [(C_1 - C_o) / C_o] \times Q_c$

Where,

- $V_c =$ Adjustment to the contract price on account of increase or decrease of price of Cement.
- $R_1 =$ Basic price of Cement as indicated in Schedule of Rates for Building works of Public Works Dept., Govt. of West Bengal effective from 01.08.2010 with latest Corrigendum (4th Corrigendum dated 10.12.12).
- $C_1 =$ Wholesale price index (monthly average) for Cement published by the Office of the Economic Adviser, Ministry of Commerce & Industry, Government of India, during the period under consideration.
- $C_o =$ Wholesale price index (monthly average) for Cement published by the office of the Economic Adviser, Ministry of Commerce & Industry, Government of India, in the month which contains date of calling of Notice Inviting Tender.
- $Q_c =$ Quantity of Cement consumed on items of work (supported by related delivery orders & challans showing price details) as per Contract during the period under consideration excluding involvement of Cement on items of work under the

contract whose rates are derived on the basis of market rate of Cement prevailing at the time of execution of work.

C = (100 ± P) / 100 (applicable for percentage rate tender only), where

P = Contractual rate in percentage above or below Estimated amount put to tender (where (+) for above and (-) for below) in case of percentage rate tender.

52.3 Any rebate / or discount over Bid amount will be incorporated in the formulae applying corresponding multiplication factor.

52.4 If at any time the current indices are not available, provisional indices as determined by the Engineer will be used, subject to subsequent correction of the amounts paid to the contractor when the current indices become available.

52.5 On completion of the works and before final payment, contractor shall give a certificate that he has made full disclosure to the Engineer of every increase or decrease in price obtained by him on all times affected by this clause.

53.0 SUBSEQUENT LEGISLATION

53.1 If, after the date 28 days prior to the latest date for submission of tenders for the Contract there occur in the country in which the Works are being or are to be executed changes to any National or State Statute, Ordinance, Decree, or other Law or any regulation or bye-law of any local or other duly constituted authority, or the introduction of any such State Statute, Ordinance, Decree, law, regulation or bye-law which causes additional or reduced cost to the Contractor, in the execution of the Contract, the Contractor will bear the cost of or benefit from such additional or reduced cost.

54.0 JOINT AND SEVERAL LIABILITY :

If the Contractor is a joint venture of two or more persons, all such persons shall be jointly and severally bound to the Employer for the fulfillment of the terms of the Contract and shall designate one of such persons to act as a leader with authority to bind the joint venture. The composition or the constitution of the joint venture shall not be altered without the prior consent of the Employer.

55.0 DETAILS TO BE CONFIDENTIAL:

55.1 The Contractor shall treat the details of the Contract as private and confidential, save insofar as may be necessary for the purposes thereof, and shall not publish or disclose the same or any particulars thereof in any trade or technical paper or elsewhere without the previous consent in writing of the Employer or the Engineer, If any dispute arises as to the necessity of such publication or disclosure for the purpose of the Contract the same shall be referred to the decision of the Employer whose award shall be final.

56.0 MONTHLY PAYMENTS :

56.1 The contractor shall submit a statement in triplicate to the Engineer through the Resident Engineer at the end of each month in a tabulated form approved by the Engineer

showing the amounts to which the contractor considers himself to be entitled up to the end of the month in respect of :

- (a) Value of Permanent Works executed at the unit rates and prices quoted by him.
- (b) Actual value certified for payment for works executed upto the end of previous month at unit rates and prices quoted by him.
- (c) Estimated contract value at unit rates and prices quoted by him for the month in question obtained by deducting (b) from (a).
- (d) Complete measurements based on approved drawings or deviation as per Engineering norms along with quality certification.
- (e) The value of any variation/supplementary works executed upto the end of the month in question less the amount certified in the previous interim payment certificate.
- (f) Amounts reflecting price adjustment pursuant to clause 52
- (g) Amounts to be deducted as repayment to Advance under provision of clause 10
- (h) Any other sum to which the contractor may be entitled under the contract.

56.2 The said statement shall be scrutinized by the Resident Engineer and approved or amended by the Engineer in such a way that, in the Engineer's opinion, it reflects the amounts due to the Contractor in accordance with the Contract, after deduction, of any sums which may have become due and payable by the Contractor to the Employer. In cases where there is a difference of opinion as to the value of any item, the Engineer's view shall prevail. Within a reasonable time of receipt of the monthly statement, the Engineer shall determine the amounts due to the Contractor and shall issue to the Employer and the Contractor a certificate herein called "Interim Payment Certificate", certifying the amounts due to the Contractor.

56.3 Notwithstanding the terms of this Clause or any other Clause of the Contract, no amount will be certified by the Engineer for payment until the performance security has been provided by the Contractor and approved by the Employer. Provided that normally the Engineer shall not be bound to certify more than once in a month unless any payment under this Sub-Clause if the net amount thereof, after retentions and all deductions, would be less than 1% of the value of contract as stated in the Appendix to bid.

56.4 Only under valid circumstances more than one payment in a month even if the net value of the same falls below 1% of the value of contract may be made.

57. REGISTRATION AND COLLECTION OF CESS UNDER THE BUILDING AND OTHER CONSTRUCTION WORKERS' (RECS) ACT, 1996 AND THE BUILDING & OTHER CONSTRUCTION WORKERS' WELFARE CESS ACT, 1996.

Successful tenderer will have to produce Registration Certificate as required under the Building and Other Construction Workers' (RECS) Act, 1996 and the Buildings & Others Construction Workers' Welfare Cess Act, 1996 and the Rules made there under. Statutory deduction towards cess @1% of the cost of construction will be made from the bill of the construction in addition to I.T., S.T. etc.

58.0 THIRD PARTY QUALITY CONTROL ENGAGEMENT

58.1 METHODOLOGY OF APPOINTMENT

The Engineer in consultation with the Employer will deploy suitable third party Supervision and Quality Control professionals/sub-professionals/support personnel from one or more consulting firms by evaluating their curriculum vitae and through interactive assessment on their suitability for the required assignment who will be deemed to be delegated representatives of the Engineer and supervise execution of works, check quality of works and materials, assist in taking joint measurement of works and carry out any other jobs for execution of the project as directed by the Engineer. The deployment of personnel will be made through agencies selected by the process of tender.

59.0 TIME OF PAYMENT

- 59.1 The amount due to the Contractor under any Interim Payment Certificate issued by the Engineer pursuant to this Clause, or to any other term of the Contract, shall, be paid by the Employer to the Contractor an amount of 75% of the bill within 7 days and the remaining amount within 45 days, after the Contractor's monthly statement has been certified by the Engineer and delivered to the Employer or in the case of the Final Certificate pursuant to Clause 45.0, the full payment to be made within 56 days after the agreed Final Statement and written discharge have been submitted by the Engineer after certification to the Employer for payment.

60.0 CORRECTION OF CERTIFICATES

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

61.0 STATEMENT AT COMPLETION

- 61.1 Not later than 30 days after the issue of the Taking-Over Certificate in respect of the whole of the Works, the Contractor shall submit to the Engineer 6(six) copies of a Statement at Completion with supporting documents showing in detail, in the form approved by the Engineer,
- (a) the final value of all work done in accordance with the Contract up to the date stated in such Taking-Over Certificate;
 - (a) any further sums which the Contractor considers to be due: and
 - (b) an estimate of amounts which the Contractor considers will become due to him under the Contract.

Estimated amounts shall be shown separately in such Statement at Completion. The Engineer shall certify payment in accordance with conditions of contract.

62.0 FINAL STATEMENT

- 62.1 Not later than 30 days after the issue of the Defects Liability Certificate pursuant to Clause 46.0, the Contractor shall submit to the Engineer for consideration 6(six) copies of a draft final statement with supporting documents showing in detail, in the form approved by the Engineer,
- (a) the value of all work done in accordance with the Contract: and
 - (b) any further sums which the Contractor considers to be due to him under the Contract or otherwise.
- 62.2 If the Engineer disagrees with or cannot verify any part of the draft final statement, the Contractor shall submit such further information as the Engineer may reasonably require and shall make such changes in the draft as may be agreed between them. The Contractor shall then prepare and submit to the Engineer the final statement as agreed (for the purposes of these Conditions referred to as the "Final Statement").
- 62.3 If, following discussions between the Engineer and the Contractor and any changes to the draft final statement which may be agreed between them, it becomes evident that a dispute exists, the Engineer shall issue to the Employer an Interim Payment Certificate for those parts of the draft final statement which are not in dispute. The dispute shall then be settled in accordance with Clause 39.0. The Final Statement shall be agreed upon on settlement of the dispute.

63.0 DISCHARGE

- 63.1 Upon submission of the Final Statement, the Contractor shall give to the Employer, with a copy to the Engineer, a written discharge confirming that the total of the Final Statement represents full and final settlement of all monies due to the Contractor arising out of or in respect of the Contract. Provided that such discharge shall become effective only after payment due under the Final Payment Certificate issued pursuant to Clause 64.0 has been made and the performance security referred to in Clause 6.0 has been returned to the Contractor.

64.0 FINAL PAYMENT CERTIFICATE

Within 30 days after receipt of the Final Statement, and the written discharge, the Engineer shall issue to the Employer (with a copy to the Contractor) a Final Payment Certificate stating

- (a) the amount which, in the opinion of the Engineer, is finally due under the Contract or otherwise, and
- (b) after giving credit to the Employer for all amounts previously paid by the Employer and for all sums to which the Employer is entitled, the balance, if any, due from the Employer to the Contractor or from the Contractor to the Employer as the case may be.

65.0 CESSATION OF EMPLOYER'S LIABILITY

65.1 The Employer shall not be liable to the Contractor for any matter or thing arising out of or in connection with the Contract or execution of the Works, unless the Contractor shall have included a claim in respect thereof in his Final Statement and (except in respect of matters or things arising after the issue of the Taking-Over Certificate in respect of the whole of the Works) in the Statement at Completion referred to in Clause 61.0.

66.0 ENGINEER AT LIBERTY TO OBJECT

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

67.0 SHEDS, STORES, YARDS

The Contractor shall at his own expense provide sheds, store-houses and yards in such situations and in such numbers as in the opinion of the Engineer are necessary for carrying on the works and the Contractor shall keep at each of such sheds, store-houses and yards sufficient quantity of materials and plant in stock as not to delay the carrying out of the works with due expedition. The Engineer and the Engineer's representatives shall have free access to the said sheds, store-houses and yards at any time for the purpose of inspecting the stock of materials and plant so kept in hand. Any materials or plant which the Engineer may object to shall not be brought upon or used in the Works, but shall forthwith be removed from the sheds, store-houses or yards by the Contractor. The Contractor shall at his own expense provide and maintain any other land, space, plant or equipment necessary for execution of works.

68.0 ROADS AND WATER COURSES, ACCESS TO PREMISES AND SAFETY OF PUBLIC

- i. Existing road or water courses shall not be blocked, cut through, altered, diverted or obstructed in any way by the Contractor, except with the permission of the Engineer. All compensation claimed for any unauthorized closure, cutting through, alteration, diversion or obstruction to such roads or water courses by the Contractor or his agent or his staff shall be recoverable from the Contractor by deduction from any sums which may become payable to him in terms of the Contract, or otherwise according to law.
- ii. During progress of work in any street or thoroughfare, the Contractor shall make adequate provision for the passage of traffic, for securing safe access to all premises – approached from such street or thoroughfare and for any drainage, water supply or means of lighting which may be interrupted by reason of execution of works and shall erect and maintain at his own cost barriers, lights and other safeguards as prescribed by the Engineer for the regulation of traffic, and provide watchman necessary to prevent

accidents. The works shall in such cases be prosecuted day and night if so ordered by the Engineer and with such vigour that the traffic is impeded for as short a time as possible.

- iii. The Contractor shall be responsible for taking all precautions to ensure safety of the public, whether on public or Employer's property and shall post such look out men as may, in the opinion of the Engineer, be necessary to comply with the regulations appertaining to the work and to ensure safety.

69.0 CARE OF WORKS

The Contractor shall take full responsibility for the care of the works, materials and plats for incorporation therein from the commencement date until the date of issue of the Taking Over Certificate for the whole of the works.

70.0 FORCE MAJEURE

If, at any time during the currency of the Contract, the performance in whole or in part by either party of any obligation under this Contract shall be prevented or delayed by reason of any war, hostilities, invasion, acts of public or foreign enemies, rebellion, revolution, insurrection, civil commotion, sabotage, large scale arson, floods, earthquake, large scale epidemics, nuclear accidents, any other catastrophic unforeseeable circumstances, quarantine restrictions, any statutory rules, regulations, orders or requisitions issued by a Government department or competent authority or acts of God (hereinafter referred to as "event") then, provided notice of the happening of such an event is given by either party to the other within 21 days of the occurrence thereof.

- a. Neither party shall by reason of such event be entitled to terminate the Contract or have claim for damages against the other in respect of such non-performance or delay in performance.
- b. The obligations under the Contract shall be resumed as soon as practicable after the event has come to an end or ceased to exist.
- c. If the performance in whole or part of any obligation under the Contract is prevented or delayed by reason of the event beyond a period mutually agreed to if any, or 90 days, whichever is more, either party may at its option terminate the Contract.
- d. In case of doubt or dispute, whether a particular occurrence should be considered an "event" as defined under this clause, the decision of the Engineer shall be final and binding.
- e. Works that have already been measured shall be paid for by the Employer even if the same is subsequently destroyed or damaged as a result of the event. The cost of rebuilding or replacing any work that has been measured, shall be borne by the Employer.

- f. If the Contract is terminated under this Clause, the Contractor shall be paid fully for the work done under the Contract, but not for any defective work or work done which has been destroyed or damaged before its measurement. The Employer shall have the option to take over any plant and materials lying at site, at rates provided for in the Contract, failing that, as per rates which are determined to be fair and reasonable by the Engineer.

71.0 TEMPORARY WORKS

All temporary works necessary for the proper execution of the works shall be provided and maintained by the Contractor at his cost and subject to the consent of the Engineer shall be removed by him at his expense when they are no longer required and in such manner as the Engineer shall direct. In the event of failure on the part of the Contractor to remove the temporary works, the Engineer will cause them to be removed and cost as incurred for removal, supervision and other incidental charges, shall be recovered from the Contractor. No temporary huts or any other form of accommodation can be provided by the Contractor on the Employer's land for labour engaged by him for the execution of the works. The Contractor shall arrange for such accommodation by himself.

72.0 LABOUR CAMP

72.1 PROVISION OF LABOUR CAMP

The Contractor, shall, at his own expense, make adequate arrangements for the housing, supply of drinking water, canteen and provision of latrines and urinals, for his staff and workmen employed on the Work., directly or through petty contractors or sub-contractors and for temporary creche (Bal-mandir) where 50 or more women are employed at a time. All camp sites shall be maintained in a clean and sanitary condition, by the Contractor, at his own cost.

72.2 COMPLIANCE WITH RULES FOR EMPLOYMENT OF LABOUR

The Contractor shall comply with all laws, bye-laws, rules and regulations, for the time being in force, pertaining to the employment of local or imported labour, and shall take all necessary precautions to ensure and preserve the health and safety of all staff, employed on the Works directly or through petty contractors or sub-contractors.

72.3 SANITARY ARRANGEMENTS

The Contractor shall obey all sanitary rules, and carry out at his cost all sanitary measures that may from time to time be prescribed by the Local Medical Authority, and "permit inspection of all sanitary arrangements at all times by the Engineer, the Engineer's Representative or the Medical staff of the Employer and the staff of the local municipal or other authorities concerned. Should the Contractor fail to make adequate sanitary arrangements, these will be provided by the Employer, and the cost thereof recovered from the Contractor.

72.4 MEDICAL FACILITIES AT SITE

The Contractor shall, at his own cost, provide First Aid and medical facilities, at the Site as may be prescribed by the Engineer, on advice of Medical Authority in relation to the strength of the Contractor's staff and workmen employed on the Works, directly or through petty contractors or sub-contractors.

73.0 INDEMNITY

73.1 DAMAGE TO PERSONS AND PROPERTY

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

- (a) death of or injury to any person, or
- (b) loss of or damage to any property (other than the Works),

which may arise out of or in consequence of the execution and completion of the Works and the remedying of any defects therein, and against all claims, proceedings, damages, costs, charges and expenses whatsoever in respect thereof or in relation thereto, subject to the exceptions defined in Sub-Clause 73.2.

73.2 EXCEPTIONS

The "exceptions" referred to in Clause 73.1 are:

- (a) the permanent use or occupation of land by the Works, or any part thereof,
- (b) the right of the Employer to execute the Works, or any part thereof, on, over, under, in or through any land,
- (c) damage to property which is the unavoidable result of the execution and completion of the Works, or the remedying of any defects therein. in accordance with the Contract,
- (d) death of or injury to persons or loss of or damage to property resulting from any act or neglect of the Employer, his agents, servants or other contractors, not being employed by the Contractor, or in respect of any claims, proceedings, damages, costs, charges and expenses in respect thereof or in relation thereto or, where the injury or damage was contributed to by the Contractor, his servants or agents, such part of the said injury or damage as may be just and equitable having regard to the extent of the responsibility of the Employer, his servants or agents or other contractors for the injury or damage.

73.3 INDEMNITY BY EMPLOYER

The Employer shall indemnify the contractor against all claims, proceedings, damages, costs, charges and expenses-in respect of the matters referred to in the exceptions defined in Sub-Clause 73.2.

73.4 ACCIDENT OR INJURY TO WORKMEN

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

**CONSTRUCTION OF A PERMANENT MODERN BUS TERMINUS
AT G.T. ROAD NEAR ESI HOSPITAL WITH A
MULTI STORIED COMMERCIAL COMPLEX OF (B+G+5)
FLOORS ALONG WITH BASEMENT INCLUDING ALL CIVIL
WORKS, SANITARY & PLUMBING WORKS, ELECTRICAL
WORKS INCLUDING LIFT AND OTHER ANCILLARY WORKS
UNDER SERAMPORE MUNICIPALITY, HOOGHLY,
WEST BENGAL**

TENDER DOCUMENTS

(NIP NO. HRBC/PL. & DN./07 of 2013-2014, dt: 12.09.2013)

**BOOK -1
Volume II**

HOOGHLY RIVER BRIDGE COMMISSIONERS

(A Statutory Organisation under Government of West Bengal)

TRANSPORT DEPARTMENT

MUNSHI PREMCHAND SARANI

(ST. GEORGE'S GATE ROAD)

KOLKATA 700 021

OCTOBER 2013

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TERMINUS AT G.T. ROAD NEAR ESI HOSPITAL WITH A MULTI
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**Volume II
Technical Specification**

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(A Statutory Organisation under Government of West Bengal)
TRANSPORT DEPARTMENT
MUNSHI PREMCHAND SARANI
(ST. GEORGE'S GATE ROAD)
KOLKATA – 700 021

OCTOBER 2013

TECHNICAL SPECIFICATION

Preamble

The works of **“Construction of a permanent modern Bus Terminus at G.T. Road near ESI Hospital with a multi storied commercial complex of (B+G+5) floors along with basement including all civil works, sanitary & plumbing works, electrical works including lift and other ancillary works under Serampore Municipality, Hooghly, West Bengal.”** are to be carried out in accordance with the Technical Specifications, Vol. II of tender documents and the Specifications for PWD (WB) schedule of rates for Building and S&P Works(effective from 01.08.2010) with the latest corrigendum (3rd Corrigendum dated 01.09.12) and as per directions of the Engineer or his representative. For items in the Bill of Quantities , whose technical specification are not available in the above schedule, those shall be adopted from respective specification outlined in the relevant PWD (Roads) SOR for Road and Bridge Works (effective from 14.11.2008) or PW(Roads) NH SOR for Road and Bridge Works (effective from 01.07.2011) or CPWD specification with latest corrigendum.

All electrical works are to be carried out in accordance with the Specifications for PWD schedule of rates for Electrical Works (Volume-I August, 2008) and Enhancement order (effective from 18.07.2012) vide Memo No. 284/AM(I)/P3 dated 24.07.2012 issued by Office of SE, Electrical Resource Circle, PWD.

For items in Bill of Quantities, specification of which are neither available in this document nor in specification books mentioned above should be followed in accordance with good engineering practices.

TECHNICAL SPECIFICATION

CIVIL WORKS

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TECHNICAL SPECIFICATION

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 - 1.3 Quality of materials & General Standards of work
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 - 1.5 Scaffolding
 - 1.6 Measurements
 - 1.7 Tools and plant
 - 1.8 Setting out
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 - 1.10 Dewatering
 - 1.11 Access to site, approach roads and roads within the premises
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 - 2.2 Related Specification and Codes
 - 2.3 Methodology
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 - 7.8 Neat Cement Plaster, Skirting and Dado
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 - 14.1 Rolling Shutters
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- 16.0 Aluminium Composite Panel Cladding
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- 17.12 Safety Precautions
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 - 18.1 Joint Sealing Compounds
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 - 18.3 Expansion Joint Seal System for Floor Slab joint width upto 100mm
 - 18.3.1 Product Description
 - 18.3.2 Joint Type
 - 18.3.3 Physical Properties of 3R 100
 - 18.3.4 Joints Specification
 - 18.4 Expansion Joint Seal System for Floor Slab joint width not less than 300mm
 - 18.4.1 Technical Data Sheet
 - 18.4.2 System Configuration
 - 18.4.3 Standard Specification
 - 18.4.4 Seismic Centre Bar:
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 - 19.1.1 Application of Specification
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 - 19.1.4 Secrecy of Information
 - 19.1.5 Work Included
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 - 19.2.2 Type of Construction
 - 19.2.3 Storing Materials
 - 19.2.4 Workmanship
 - 19.3 Welding
 - 19.3.1 General
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 - 19.3.4 Welding Procedure
 - 19.3.5 Minimum leg length and Throat Thickness in Fillet Welds
 - 19.3.6 Deslagging

- 19.3.7 Quality of Welds
- 19.3.8 Weather Conditions
- 19.3.9 Qualification and Testing of Welders
- 19.4 Crane Rails
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 - 19.5.1 Measurement
- 19.6 Erection
 - 19.6.1 General
 - 19.6.2 Erection Drawings
 - 19.6.3 Storing and Handling of Materials
 - 19.6.4 Setting Out
 - 19.6.5 Assembly and Erection
 - 19.6.6 Erection Tolerance
 - 19.6.7 Field Connections
 - 19.6.8 Field Welding
 - 19.6.9 Bedding and Grouting
 - 19.6.10 Correction of misfits
- 20.0 Paved Area on Driveway and In Footpaths
 - 20.1 Sub-Grade : Preparation and Consolidation
 - 20.1.1 Preparation of Sub-Grade
 - 20.1.2 Consolidation
 - 20.1.3 Surface Regularity
 - 20.2 Granular Sub-Base
 - 20.2.1 Materials
 - 20.2.2 Physical requirements
 - 20.2.3 Preparation of Subgrade
 - 20.2.4 Surface Finish and Quality Control of Work.
 - 20.3 Bituminous filler in Expansion joint
 - 20.4 Paving on the driveway
 - 20.5 Paving on footpath
 - 20.6 Reflectorised Paint
 - 20.7 RCC Hume Pipe
- 21.0 Horticulture and Land Scaping
 - 21.1 Horticulture Work
 - 21.1.1 Trenching In Ordinary Soil
 - 21.1.2 Oil Cake
 - 21.1.3 Supply and Stacking Of Sludge
 - 21.1.4 Rough Dressing Of The Trenched Ground
 - 21.1.5 Uprooting Weeds From Trenched Areas

- 21.1.6 Fine Dressing The Ground
 - 21.1.7 Spreading Sludge/Manure
 - 21.1.8 Mixing Of Good Earth and Sludge/Manure
 - 21.1.9 Grassing with select grass no. 1
 - 21.1.10 Preparation Of Beds For Hedge And Shrubbery
 - 21.1.11 Digging Holes For Planting Trees
 - 21.1.12 M.S. Flat iron tree guard
 - 21.1.13 Filling Mixture of Earth & Sludge Over Manure
- 22.0 Miscellaneous Items
- 22.1 Polycarbonate Roofing Sheet
 - 22.2 Preformed Steel Roof / Wall
 - 22.3 UPVC Outlet Pipes / Spouts
 - 22.4 G.I. Barbed Wire
 - 22.5 Acoustical Treatment Work
 - 22.6 Manhole Covers & Frames
 - 22.6.1 Manhole Covers
 - 22.6.2 Cast Iron Manhole Covers and Frames
 - 22.7 Road Gully Grating
 - 22.8 Plinth Protection
- 23.0 Applicable Codes and Specifications
- 24.0 List of Approved Brand / Manufacturer
- 1.0 WATER REQUIREMENTS
- 1.1 Source of Water
- SPECIFICATION OF INTERNAL WATER SUPPLY & SANITARY DRAINAGE SYSTEM
- 2.0 GENERAL
- 2.1 Samples
 - 2.2 Materials, Workmanship & Samples
 - 2.3 Materials
- 3.0 Sanitary- Wares
- 4.0 Cast Iron Soil & Waste Pipe
- 4.1 Lead Caulked Joints
 - 4.2 Smoke Testing
 - 4.3 Testing of Materials and works
- 5.0 G.I Pipes and Fittings
- 6.0 (Full Way) Gate Valves
- 7.0 C.P. Toilet Fittings
- 7.1 C.P. Brass Bib Cocks, Two-way Bib Taps, Stop cocks, Angle Stop cocks, Pillar cocks, Sink cock

- 7.2 C.P. Brass Pillar Cock [for Wash Basins]
- 7.3 Health Faucets
- 7.4 Sink Cock
- 8.0 Ball Float Valve
- 9.0 Submersible Pump of Bore well
 - 9.1 Testing of Water Sample
 - 9.2 Bleaching Dosing Tank
 - 9.3 Domestic Water FEED Pump (Hydro-pneumatic) to respective Toilets, Kitchens etc. & To TERRACE TANK (To be located inside the Basement of the Building)
 - 9.4 Electronic Controller
 - 9.5 Programmable Functions
 - 9.6 Control Cabinet
 - 9.7 Variable Speed Hydropneumatic System
 - 9.8 Domestic Water FEED Pump (Hydro-pneumatic) to respective Kitchens / Canteen & LAB uses etc.
 - 9.9 Basement De-Watering Pumps
- 10.0 Gate Valve (Flanged type)
- 11.0 Pressure Reducing Valve :
(At Inlet Main to every individual toilets and Kitchen / Canteen – except the Top floor)
- 12.0 Non-Return Valve (N.R.V.)
- 13.0 Gate Valve (Bronze Body)
- 14.0 Non-Return Valve (N.R.V) : C.I. Body
- 15.0 Air-Release Valve : Bronze/Gun metal Body
- 16.0 “Blow-off” VALVE : Bronze / Gun metal Body
- 17.0 Drainage- Stone Ware Pipes
- 18.0 Sanitary Installation
 - 18.1 Fixing
 - 18.2 Flushing by PVC ‘Low Level’ Cistern : (manually)
 - 18.3 Brackets (for Wall mounted W.C.- fixing)
 - 18.4 Flush Pipe
 - 18.5 Seat & Lid
- 19.0 Urinals
 - 19.1 Waste Pipes-concealed & Traps
 - 19.2 Painting
- 20.1 Fittings
- 20.2 Waste Connection :
- 20.3 Bottle Trap for waste
- 21.0 Kitchen Sink
 - 21.1 Fittings
 - 21.2 Waste Connection

- 21.3 Fitting
 - 21.4 Waste Connection
 - 21.5 Lab Sink
 - 21.5.1 Fittings
 - 21.5.2 Waste Connection
 - 22.0 Toilet Requisites
 - 22.1 Mirror :
 - 22.2 CP Robe Hooks (with double/ single Forks)
 - 23.0 Water Closets
 - 23.1 European type water Closets (EWC) : "Floor mounted type"
 - 23.2 Fixing
 - 23.3 Flushing by PVC Flushing Cistern (manually)
 - 23.4.1 Brackets
 - 23.5 Flush Pipe
 - 23.6 Seat & Lid
 - 23.4 Fixing
 - 23.5 Flushing by Flush valve (manually)
 - 23.6 Brackets (for Wall mounted W.C.- fixing)
 - 23.7 Flush Pipe
 - 23.8 Seat & Lid
 - 24.0 Rainwater Harvesting System
 - 24.1 Roof top Rain water Harvesting
 - 24.1.1 Rain Harvested Water FEED Pump (Hydro-pneumatic) to Landscaping, Car washing etc, uses from respective Rain Harvesting Tank
 - 24.2 Natural Recharge from open areas
 - 24.3 Surface Run off from Paved plaza and parking spaces
 - 25.0 Rain Water Pipes of C.I. & CI Pipe Fittings (as per IS -3989: "Centri" cast / or as per IS-1729 - Sand cast)
 - 25.1 Lead Caulked Joints for Rain water Pipes
 - 25.2 Smoke Testing of Rain Pipes
 - 25.3 Testing of Materials and works
 - 25.4 Joints of Pipes & Fittings
 - 25.5 C.I. Roof Outlets
 - 26.0 Waste Connections
 - 27.0 Anti- Syphonage (Vent) Pipes : 75mm dia C.I (sand cast as per IS-1729)
 - 28.0 Painting
 - 29.0 Water Supply
- Specification Of Water Supply Materials
- 29.1 G.I. Pipes and Fittings
 - 29.2 Laying & Fixing

- 29.3 Internal Work
- 29.4 External Work
- 29.5 Painting
- 29.6 Testing
- 30.0 Brass Water Fittings
 - 31.0 External Sewerage And Drainage System
- 32.0 SEWERAGE AND SEWAGE DISPOSAL SYSTEM
- 33.0 Drainage : (External)
 - 33.1 Stone Ware Pipe : For External Sewerage -
 - 33.2 Trenches for S.W. Pipe Drains
- 34.0 Storm Water Drainage
- 35.0 Road Crossings :
- 36.0 Protection of Existing Services :
- 37.0 Lighting and Watch :
- 38.0 Refilling :
- 39.0 Concreting :
- 40.0 Laying and Jointing S.W. PIPES
 - 40.1 Laying
 - 40.2 Jointing
 - 40.3 Testing
- 41.0 General
 - 41.1 Under-ground Storm Water Drain Pipes
 - 41.2 Precaution
 - 41.3 Measurements
- 42.0 S.W. Gully Traps
 - 42.1 Excavation
 - 42.2 Fixing
 - 42.3 Masonry Chamber
 - 42.4 C.I. Cover
- 43.0 Manholes , Inspection Pits, Gully Chamber Etc.
 - 43.1 Manholes
 - 43.4 Bed Concrete
 - 43.5 Plaster
 - 43.6 Pointing
 - 43.7 Benching
 - 43.8 R.C.C. Work
 - 43.9 Foot Rests
 - 43.10 C.I. Manhole Covers
 - 43.11 Plain Manhole
 - 43.12 Plain Manhole : (both for Sewerage & Storm Drainage)

- 44.0 Levels of Invert of Inspection Pits and Storm water Manholes
 - 44.1 Measurements
 - 44.2 House Connections
 - 44.3 Drop Connections (Drop Manholes) – if any
- 45.0 C.I. Pipe Drainage
 - 45.1 C.I. Drainage
 - 45.2 Trenches
 - 45.3 Pipes
 - 45.4 Fittings
 - 47.5 Laying
 - 45.6 Testing
 - 45.7 Masonry Chamber
- 46.0 List Of Approved Manufacturer
- 1.0 EXTERNAL ELECTRIFICATION WORK FOR SERAMPUR BT
 - 1.1 Scope of Work
 - 1.2. Applicable Specifications
 - 1.3. Quality & Completeness of Supply and Installation
 - 1.4. Water and Power for Construction
 - 1.5. Scaffolding
 - 1.6. Measurements
 - 1.7. Tools and Plant
 - 1.8 Drawings by Contractor
 - 1.9. Testing
 - 1.10. Guarantee
 - 1.11. Approvals
 - 1.12. Workmanship
 - 1.13. Tools and Spare Parts
- 2.0 33 kV HT 4 PANEL VCB
 - 2.3. Quality & Completeness of Supply
 - 2. 4. Testing
 - 2.5. Guarantee
 - 2.6. Workmanship
 - 2.7. Technical Speciffication
- 2.8. 33kV Circuit Breaker
- 3.0 33 kV /433V TRANSFORMER
- 4.0 1000 KVA OUTDOOR TYPE DIESEL GENERATOR SETS
- 5.0 33 KV XLPE CABLE
- 6.0 LT SWITCH GEAR PANEL
- 7.0 LT CABLES
- 8.0 DISTRIBUTION PILLARS

- 9.0 EXTERNAL LIGHTING
- 10.0 PROTECTION OF BUILDINGS AGAINST LIGHTNING
- 11.0 SUBSTATION AUXILIARIES INSTALLATION
- 12.0 POWER FACTOR CAPACITOR
- 13.0 LIFT
- 14.0 INTERNAL ELECTRIFICATION WORK FOR SERAMPUR BT:
- 15.0 GENERAL INSTRUCTION
- 16.0 *BLANK*
- 17.0 CONDUIT WIRING:
- 18.0 POINT WIRING
- 19.0 EARTHING:
- 20.0 LIGHTING FITTINGS:
- 21.0 DISTRIBUTION BOARDS:
- 22.0 MOULDED CASE CIRCUIT BREAKERS:
- 23.0 MINIATURE CIRCUIT BREAKER
- 24.0 BUS DUCT & RISING MAIN (SANDWICH CONSTRUCTION)
- 25.0 CABLE TRAYS:
- 26.0 TELEPHONE SYSTEM
- 27.0 UNINTERRUPTIBLE POWER SUPPLY (UPS)
- 28.0 ELECTRICAL DRAWINGS TO BE SUBMITTED BY CONTRACTOR
- 29.0 LIST OF RECOMMENDED MAKES OF MATERIAL
- 30.0 LIST OF WORKS AND PRICES FOR INTERNAL ELECTRIFICATION
- 1.0 INTENT OF THE SPECIFICATION
- 2.0 GENERAL INFORMATION
- 3.0 SCOPE OF WORK
 - 3.1 Refrigeration Units (Air Cooled Screw Chiller Units)
 - 3.2 Pump Sets
 - 3.3 Double Skinned Air Handling Unit
 - 3.3.4 Double Skinned Casing
 - 3.3.7 Filters
 - 3.3.8 Design Data for Air-handlers
 - 3.4 Water Piping
 - (b) Flanges
 - (c) Butterfly Valves
 - (e) Y-Strainer
 - (f) Balancing/Controller Valves
 - (g) 2-way modulating valves
 - 3.4.4 Supports For Pipes
 - 3.4.5 Layout and Sizing of Pipe Lines
 - 3.4.7 Testing of Pipe System

- 3.4.8 Air-Vents
 - 3.5 SHEET METAL DUCT
 - 3.6 Insulation
 - 3.7 Painting Work
 - 3.8 Noise and Vibration Controls
 - 3.9 ELECTRICAL MOTORS & STARTERS
 - 3.10 ELECTRICALS
 - 3.11 Tube Axial Flow Fans
 - 3.12 Propeller Fans
 - 3.13 Treated Fresh Air Unit With Heat Recovery Wheel
 - 3.14 DUCTABLE SPLIT UNITS / HI WALL SPLIT UNITS
 - 3.15 PRECISION AIR CONDITIONERS
 - 3.16 CIVIL WORK
 - 3.17 CODES & STANDARDS
- 4.0 List of approved makes of materials

FIRE PROTECTION SYSTEMS :

- 1.0 Scope:
- 2.0 General:
- 3.0 Fabrication:
 - 3.1 Pipe Fabrication:
- 4.0 Pipe Joints:
- 5.0 Jointing and laying :
 - 5.1. Jointing of Flanged joints of Pipes & fitting:
 - 5.2. Jointing of pipes & pipe Fittings/ Valves, etc. with screwed ends:
- 6.0 Pipe Bends :
- 7.0 Welding :
- 8.0 Installation & Erection:
- 9.0 Flanges:
- 10.0 Valves:
- 11.0 Clearance & Cover:
- 12.0 Inspection & Testing:

FIRE FIGHTING PUMPS PANEL:

- 13.0 FIRE PUMP M.C.C.

GENERAL

- 13.1 Installation
- 13.2 Commissioning and Testing
- 13.3 Moulded Case Circuit Breaker (MCCB)
- 13.4 Starters
- 13.5 Meters and Indicators

- 14.0 RECOMMENDED MAKES OF MATERIALS
- 15.0 APPROVED MAKES OF MAJOR ITEMS DESCRIBED IN B.O.Q.
- 16.0 SPRINKLER SYSTEM :
- 17.0 SPECIFICATIONS OF FIRE PUMPS / MOTORS :-
 - 17.1 MOTOR DRIVEN MAIN FIRE PUMP –(Hydrant Service):-(2850.0 LPM & 93.0 M HEAD) :-
2.0 Nos.
 - 17.2 MOTOR DRIVEN JOCKEY FIRE PUMP –(Hydrant cum Sprinkler) :- (180.0 LPM & 93.0 M HEAD) :- 1.0 NO.
 - 17.3 DIESEL ENGINE DRIVEN MAIN FIRE HYDRANT PUMP :- (2850.0 LPM & 93.0 M HEAD) :- 2.0 nos.
- 18.0 SPECIFICATIONS OF SPRINKLER PUMPS / MOTORS :-
 - 18.1 MOTOR DRIVEN MAIN SPRINKLER PUMP –(only for Sprinkler) :- (2850.0 LPM & 93.0 M HEAD) :- 1.0 NO.
 - 18.2 DIESEL ENGINE DRIVEN INTERMEDIATE LEVEL SPRINKLER PUMP –(only for Sprinkler) :- (2850.0 LPM & 93.0 M HEAD) :- 1.0 NO.
- 19.0 Fire Extinguishing System ; (By Portable Fire Extinguishers)
 - 19.1 Operation Instructions of Portable Extinguishers :-
- 20.0 Fire Alarm System :
- 21.0 Fire Detection & Alarm System
 - 21.1 GENERAL
 - 21.2 PRODUCTS
- 22.0 ANALOGUE ADDRESSABLE FIRE ALARM CONTROL PANEL (FACP)
 - 22.1 SYSTEM COMPONENTS AND DEVICES
 - 22.2 FIELD DETECTION DEVICES
 - 22.3 HEAT DETECTORS
 - 22.4 OPTICAL SMOKE DETECTOR:
 - 22.5 DUAL ANGLE OPTICAL/HEAT DETECTOR :
 - 22.6 MANUAL CALL POINTS
- 23.0 FIELD ALARM DEVICES
 - 23.1 ADDRESSABLE SOUNDER
 - 23.2 BATTERIES :
 - 23.3 WIRING
 - 23.4 EXECUTION
- 24.0 APPROVED MANUFACTURERS
- 25.0 TRAINING & FIRE DRILL

1.0 GENERAL

1.1 Scope of Work

The work contemplated under this contract includes General Construction for the aforesaid project, all as detailed in the Bill of Quantities, Specifications and Drawings.

Such other works which are not included in the aforesaid Bill of Quantities are generally intended to be executed through a separate agency. Notwithstanding the above, HRBC (The Hooghly River Bridge Commissioners), reserve the right to order additional works under the same Contract. HRBC also reserve the right to omit any item of work included in the aforesaid Bill of Quantities and award the same to any other Contractor or not perform it at all at their discretion and the Contractor shall not have any claim because of the same.

The Contractor for this work shall be required to work in co-operation and co-ordination with other agencies on site and give them all reasonable assistance and help for the execution of the work in an efficient manner all as directed. The words "approved" or "as directed" shall be deemed to convey approval or the discretions of ENGINEER - IN - CHARGE.

1.2 Indian Standard Specifications

The particular Specifications for the work is as detailed hereinafter. These specifications shall be read in conjunction with the relevant Indian Standard Specifications, PWD specification (latest revision) and the obtainable local practice as detailed in various regional handbooks of practice and the work shall be executed accordingly. Where the specifications in any of the standards are at variance with the specifications detailed herein, the specifications herein shall govern.

In case of any ambiguity/contradiction among different specification, the decision of ENGINEER - IN – CHARGE shall be final and binding on the Contractor.

1.3 Quality of materials & General Standards of work

The Contractor under this contract commits himself to use first class materials and assumes full responsibility for the quality of all material incorporated or brought for incorporation in the work. The work shall be executed in accordance with best engineering practice and as per direction of Engineer - in - charge.

In all possible cases, sample approval shall be ensured by the Contractor from ENGINEER - IN – CHARGE before bringing in the materials in bulk at site and the approved sample shall be well preserved at site at the risk and cost of the Contractor as a ready reference.

Over and above, the submission of test certificate by the manufacturer, ENGINEER - IN – CHARGE may instruct further sample testing from Government laboratories / testing houses at the risk and cost of the Contractor for submission of test reports to become eligible for payment for those particular items used at work.

In all possible cases, where the warranty of manufacturers are sought for by Engineer - In - Charge, the Contractor shall submit the cross warranty in the form as directed by ENGINEER

- IN – CHARGE and manner including workmanship etc. along with the manufacturer's warranty certificate.

The relevant IS and PWD specification shall have to be complied for all possible cases. The relevant clauses of GCC shall also be applicable and should be read in conjunction with technical specification of this contract.

In case of any anomaly / contradiction, decision of ENGINEER - IN – CHARGE shall be final and binding on Contractor.

No extra claim shall be admissible for sample testing, sample approval, testing of sample at site etc to the Contractor and shall be considered as deemed to have been included in the rates quoted by the Contractor.

All works shall be carried out strictly according to the drawings and instructions of ENGINEER - IN – CHARGE. If, in the opinion of the Employer / Architects / Engineer – in – Charge, any portions of the work is found to be defective or unsound the same shall be pulled down and reconstructed at no extra cost to the employer. Defective materials shall not be brought to the work site by the contractor.

1.4 Acquaintance with Site Condition

The intending tenderer is deemed to have visited the work site and acquainted himself of the nature of the sub-soil to be executed. No claim or extra will be allowed as a result of any misunderstanding or incorrect assessment or misinformation or ignorance of the contractor on the prevailing site conditions or soil strata.

1.5 Scaffolding

All scaffolding and ladders required for the proper execution of the work shall be provided by the Contractor. The scaffolding should be stout and strong to prevent any collapse or displacement. Proper measure for safety of workmen working on scaffolding should be taken by the Contractor.

1.6 Measurements

The mode of measurements, wherever possible, is specifically mentioned in these documents, where it has not been mentioned, it shall be as per provision of the relevant Indian Standards IS 1200 or PWD Specification or Standard Practice as applicable. All the measuring equipments, labour, manpower and other accessories necessary, shall be provided by the Contractor at his own risk and cost.

1.7 Tools and plant

The tenderer along with his tender shall furnish a list of tools, plant and machinery which he intends to use for the works. The list should indicate the exact type of machine, its capacity and year of manufacture, kind and capacity of propelling force, and all other pertinent information. The Contractor is obliged to use all the machinery mentioned in his list mentioned or others as required and instructed if ENGINEER - IN – CHARGE considers it necessary.

1.8 Setting out

The Contractor shall set out the building or other involved works after clearing the site and get the same approved by the Engineer - in - Charge. It shall be the responsibility of the Contractor to install substantial reference marks, bench marks, etc. and maintain them as long as required by the Engineer - in - Charge. The Contractor shall assume the full

responsibility for proper setting out, alignment, elevation and dimension of each and all parts of the work.

1.9 Surveying

It is the express responsibility of the Contractor to bring to site all surveying instruments necessary for the marking out, fixation of levels, etc. and conduct these survey operations himself with utmost accuracy. The Contractor shall put-up stable bench marks etc. as necessary for the work. Representative (s) of ENGINEER - IN - CHARGE may be present when this work is being carried out and will inspect all these operations with the Contractor's assistance. The Contractor shall be entirely responsible for accurate setting out of the work and he shall at his own expense make good any defects arising from errors in line and levels.

Before commencement of excavation, spot levels on an approved grid covering the entire plot shall be taken by the Contractor in consultation with the Engineer - in - Charge and a proper record of these levels shall be kept jointly signed by the Contractor and the Engineer - in - Charge.

1.10 Dewatering

Dewatering of accumulated water in all locations on jobsite from whatever source or cause until the virtual completion of the entire work shall be done by the Contractor at his own expense and shall not be separately paid for. The rates quoted by the Contractor shall be deemed to be inclusive of this.

1.11 Access to site, approach roads and roads within the premises

The Contractor shall at his own cost provide all approach roads required for the purpose of carrying out the work in the most expeditious and efficient manner and shall remove the temporary roads on completion. He shall acquaint himself thoroughly regarding condition and suitability of public roads leading upto the limits of the premises and will provide vehicles for transportation of materials which meet the requirements of these road conditions. It shall also be responsibility of the Contractor to maintain at his own cost these roads till the construction is completed. The tenderer shall also acquaint himself with local laws and By laws and complying with all police and traffic requirements.

2.0 Bored Cast-In-Situ Piles

2.1 Scope

The Scope of work comprises of furnishing of all labour, materials, equipments, tools, plant, transportations, supervision, quality control etc. for complete and proper installation of cast in situ concrete bored piles, both vertical and battered, for foundations and pile caps and beams as shown in the Drawings or specified including all surveying and setting out arrangements necessary for fixing correct location of piles etc., furnishing everything necessary for forming working piles, test piles and anchor piles (If necessary), excavation required for pile cut off, dismantling of concrete up to cut off level of all piles to true elevation specified, load tests of single piles and/or group of piles and cleaning up of the works area. For checking the quality of the pile shaft, Contractor shall provide everything necessary for examining the piles as instructed.

The information given in the bore logs and soil investigation report, is given in good faith and the Engineer - in - Charge will not be responsible for any discrepancy or inaccuracies therein and shall not entertain any claim whatsoever for the contractor on this account.

Nothing contained in this contract document or these specifications shall relieve the contractor from the responsibility of obtaining the approval from ENGINEER - IN – CHARGE for the pile installation and testing procedure to be followed by him.

During the execution of the works should any error or ambiguity appear in any of the contract documents the contractor shall not proceed with the work before obtaining instructions / clarifications from the ENGINEER - IN - CHARGE.

2.2 Related Specification and Codes

Following related specification and codes shall be referred in conjunction with this specification.

- IS 2911 - Code of practice for design and construction of pile foundations: Part 1 Concrete piles, Section 2 Bored cast-in-situ piles
- IS 2911 - Code of practice for design and construction of pile foundations: Part 4 Load test on piles

Other relevant IS codes Technical Specification for General Civil Works of Engineer - in - Charge enclosed along with this document.

Reference to any code shall always mean reference to the latest revised edition of the code including all amendment and addendum up to date.

In the event of any variation or conflict between the requirement of this specification and those of the above referred related specifications and codes the former shall govern.

2.3 Methodology

The cast in situ bored piles shall be formed within the ground by boring a hole within it to specified depths as shown or called for in the drawings or as directed by ENGINEER - IN – CHARGE at site, with or without the use of a temporary casing (as may be required to keep the hole stabilized) and filling the same with reinforced concrete as specified therein. The full depth of the bore hole may be lined with approved Bentonite suspension of adequate specific gravity may be used for the full depth as the boring proceeds, to prevent the sides of the bore-holes from collapsing.

Report on Geo-technical Investigation carried out at the proposed site is available at the office of ENGINEER - IN - CHARGE/ Engineer - in - Charge. Tenderer / Contractor may refer the same on any working day before submitting the bids to plan his method of piling process and other technical requirements. The data contained in this report are indicative. The Contractor shall verify the same including the chemical content of subsoil water prior to taking up the actual piling work. The cost of carrying out the test is deemed to have been included in the rates quoted by the Contractor and no additional cost shall be paid for the same.

2.4 Equipment & Accessories

The equipment, plants and accessories would depend upon the type of bored cast-in-situ piles chosen for a job after giving due consideration to the subsoil strata, ground water condition, manner of operation and the required penetration therein.

Boring operations shall be done by percussion or rotary type rigs with direct mud circulation or reverse mud circulation methods to bring the cuttings out. In soft layers and loose sands, bailers and chisel method, if used, should be used with caution to avoid the effect of suction.

The size of the cutting tool should not be less than the diameter of the pile by more than 75 mm.

Drilling mud should be used for stabilizing the side of the boreholes where stabilizing is not done by casing.

Standard augur boring without proper stabilization of borehole by drilling mud or casing should not be used for bored piling work.

2.5 Diameter of the piles

In general the measurement of the diameter of the pile shall be as follows:

1. For cast in situ bored piles employing temporary casing withdrawn during the placing of the concrete, the nominal diameter shall be the outside diameter of the temporary casing.
2. For cast in situ bored piles with permanent liner, the nominal diameter shall be inside diameter of the permanent liner left in place.

For partly cased bored cast in situ piles using drilling mud of suitable consistency, the nominal diameter shall be the inside diameter of the guide casing, (temporary or permanent). The contractor may however be required to demonstrate to the ENGINEER - IN - CHARGE, if so called for by him, that the diameter of the bore hole for its full length is not less than the nominal diameter specified and this may be done by lowering a guide ring having a diameter equal to the nominal diameter of the pile into the bore hole before concreting the pile or lowering the reinforcement cage.

2.6 Control of Alignment

Piles shall be installed as accurately as possible as per the design and drawing and a deviation of 1.5% in alignment for vertical piles should not be exceeded.

Piles less than 600 mm in diameter should not deviate more than 75 mm or $D/10$, whichever is less from their designated positions at the working level. In the case of single pile under a column the positional deviation should not be more than 75 mm or $D/6$, whichever is less.

2.7 Concreting Materials

Unless otherwise stated herein all aspects of the concrete work including materials, specifications, preliminary mix designs, workmanship and inspection testing stipulated in specifications of "plain and reinforced concrete" shall apply.

Cement shall be ordinary Portland cement conforming to IS 8112, IS 12269 unless specified otherwise.

Maximum size of aggregates shall be 20 mm.

Concrete, for piles cast in situ shall have sufficient slump (125 to 175 mm) to give it a self compacting consistency. The water cement ratio including the water contained in the aggregates shall be limited to 0.55 unless otherwise stipulated. Plasticizing agents may be used by the contractor to improve the workability but the ENGINEER - IN - CHARGE shall be furnished with proof that the proposed plasticizing agent has no adverse effects on the hardened concrete or reinforcement.

One set of test cubes (6 Nos.) should be taken for each pile for testing strength of concrete. Three of the six cubes constituting one test shall be tested on the 7th day from casting the cubes and the remaining three cubes shall be tested on the 28th day after casting.

ENGINEER - IN – CHARGE reserves the right to reject any pile of deficient concrete strength. Such rejected piles shall be replaced by the contractor at his own cost who shall also bear the additional costs of widening the pile caps resulting from the grouping of the piles as a result of replacement of piles.

ENGINEER - IN – CHARGE also reserves the right to order change in the mix design and/or water cement ratio to obtain the specified strength or workability.

2.8 Reinforcement

- a) All reinforcement for use in the piles shafts shall be as per drawing, duly tested from manufacturers end successfully and be assembled and tied and / or welded together and made up into cages sufficiently rigid to withstand handling without damage and distortion.
- b) Joints in longitudinal reinforcement bars, if unavoidable shall be made by lapping and the laps shall be stitch-welded duly as per design approved by Engineer – in - Charge.

The projecting length of longitudinal bars beyond the pile cut-off level shall be equal to 40 times the diameter or such other length as shown on the drawings.

Unless otherwise specified in the drawings, the lateral reinforcement shall consist of helix made from 8 mm. dia. bars at a pitch of 150 mm throughout the length of the reinforcement cage.

Concrete cover over all reinforcement including lateral helical reinforcement shall be 50 mm, unless otherwise specified or shown on the drawings. Care shall be taken to preserve the correct cover and alignment of reinforcement free from any twist, throughout the whole operation of placing the reinforcement in the bore hole and placing the concrete, The inside diameter of the reinforcement cage shall be adequate for the operation of the Tremie pipe when used.

2.9 Drilling mud (Bentonite)

Drilling mud corresponding to basic properties given under Appendix - A under Clause – 4.3 of IS : 2911 (Part I / Sec 2) shall be used to keep the sides of the Bore holes established. Mud shall have THIXOTROPIC properties i.e. gel forming Property. The drilling mud shall have such properties as to permit the formation of Filter cake on the sides of the bore holes, the thickness of which would depend on the nature of the subsoil deposit. Sodium based Bentonite have ideal properties for use as drilling mud.

Fresh sodium based Bentonite shall have:

The liquid limit shall be more than 300 percent when tested in accordance with IS : 2720(Part V) and less than 450 percent. The PH of 5% suspension shall be between 8 & 11.5. The free water standing after 24 hours of 10% suspension of 100 cc shall be only a thin veil of water. Sand content of Bentonite powder shall not be more than 7%. The marsh viscosity of 5% suspension shall be around 30 to 35 sec..The 10 minute gel strength of fresh 5% bentonite shall be between 10 to 75 Kg / Sq.m. The specific gravity of the suspension shall not be less than 1.12.

During the boring operations the fresh suspension gets contaminated with bored spoil and gradually becomes heavy. This contaminated bentonite may be reused depending upon the manner of boring, type of strata encountered and the specific gravity of the contaminated bentonite. It is essential to check the specific gravity of the bentonite in the bore hole before concreting. The contaminated bentonite may be collected in a suitable receptacle and allow the heavier particles to settle and the slurry washed before reuse.

The drilling muds shall be suitably disposed off without causing any nuisance to the surrounding area in a manner approved by the Engineer - in - Charge.

2.10 Boring Operations

Boring may be done by direct mud circulation, reverse mud circulation or by bailer using drilling mud to stabilize the bore hole from collapsing.

A protective steel casing of suitable length both above the ground and below it shall be installed for protection of personnel and to prevent cavities and displacement of the earth and for retention of the surface water.

In direct mud circulation method entire hole should then be kept full with the fluid which should be kept in motion. The density and composition of the fluid should be such as to suit the requirements of ground conditions and to maintain the fine materials from the borings in suspension.

The bottom of the boreholes shall be cleaned of all the spoils and sediments before placing of concrete.

Consistency of the drilling mud suspension shall be controlled throughout the boring as well as concreting operation in order to keep the hole stabilized as well as to avoid concrete getting mixed up with the thicker suspension of mud.

2.11 Concreting

Concreting of boreholes shall start as quick as possible after its completion. Should a bore hole be left un-concreted for more than two hours, it shall again be cleaned thoroughly before placing of concrete. The concrete shall be freshly mixed and poured in sufficient quantities in the casing so that during the withdrawal, a sufficient head of concrete is maintained to prevent the inflow of soil and subsoil water.

The entire depth of the pile shall be concreted in one operation without stoppage.

All concreting operation for piles shall be carried out during day time only.

Exposed portions of piles shall be cured for at least 10 days from the date of casting.

When installing the piles in groups, sufficient time shall be allowed for freshly poured concrete in pile to set before installing adjacent piles. ENGINEER - IN - CHARGE in consultation with the Contractor shall determine the installation sequence and time schedule to ensure that freshly concreted piles are not damaged due to installation of adjacent piles. Consecutive piles in a group with in 0.5 m of each other shall however not be constructed before a lapse of 2 days after the installation of the previous pile.

All care shall be taken to prevent formation of voids in the piles by pockets of air trapped within. Particular attention shall be paid to this during the withdrawal of casing. The volume of concrete placed in the pile shall be checked with the theoretical volume of the pile, and any shortfall in the actual volume concreted shall be reported to the ENGINEER - IN - CHARGE.

After the boring has been flushed and approved and with the reinforcement in place, the pile shaft shall be concreted by the help of tremie pipe. It should however be ensured that concrete entering the tremie pipe shall not get mixed up with the slurry, as described above for lined bored piles. Before concreting the bore shall be flushed once again with bentonite slurry through the tremie pipe to ensure that the bottom is cleaned after placing the reinforcement. The tremie pipe shall always be maintained a minimum 2 to 2.5 m inside the concrete.

2.12 Testing of Piles

Location of Load Test on working piles will be decided by ENGINEER - IN - CHARGE.

1.5% of the total number or minimum two piles shall be subjected to non-destructive load tests to 1.50 times the design load (i.e. estimated safe load carrying capacity of pile).

In case 1.5% of the total number of piles exceeds 2 (Two), number of pile to be tested shall be rounded up to next higher whole number, if it is a fraction .

The test shall be carried out by applying a series of load on a pile unaided by any other support. The load shall preferably be applied by means of hydraulic jack, of adequate capacity and shall have pressure gauge and a remote control pump, reacting against a loaded platform, which shall be preloaded to not less than 2 1/2 times the estimated safe load-bearing capacity of the pile. ENGINEER - IN – CHARGE shall demand to get the test certificate regarding the calibration of the gauge at the cost of the Contractor.

Before any load test to be performed the proposed set up and the load frame shall be got approved from ENGINEER - IN - CHARGE.

Settlement shall be recorded with minimum 2 (two) Dial Gauges for single pile and 4 (four) dial gauges of 0.01 mm sensitivity for groups each positioned at equal distance around the piles and normally held by datum bars resting on immovable supports at a distance of 3D (subject to minimum of 1.5 m) from the edge of the pile.

The test load shall be applied in equal increments of one-fifth of the estimated safe load or as directed by ENGINEER - IN - CHARGE. Alternate loading and unloading at each load increment shall be performed and the elastic and plastic settlements recorded.

Each stage of loading or unloading shall be maintained till the rate of movement of the pile top is not more than 0.02 mm. per hour.

The Contractor shall supply to ENGINEER - IN - CHARGE with a record in writing of all observations made during the load test together with the graphically representative curves as mentioned in clause 9.1 & 9.2 of IS : 2911 (Part – IV).

2.12.1 Acceptance criteria

Piles shall satisfy the following requirements:-

- i) The total settlement for the test load shall not exceed 12 mm.
- ii) The net (residual) settlement after the test load is removed shall not exceed 6 mm.
- iii) The general behavior of the pile during the test shall be proper.

The pile which fails to satisfy the above requirements shall be rejected and another pile tested in lieu. The rejected pile shall be replaced or rectified with prior approval of ENGINEER - IN – CHARGE at the Contractor's risk and cost.

If the second pile tested also fails, the rejection of part or the entire lot and rectification measures to be done at Contractor's risk and cost, shall be at the discretion of ENGINEER - IN - CHARGE.

Any pile/piles to be installed in replacement of the rejected piles as directed by ENGINEER - IN – CHARGE shall be done by the Piling Contractor at his own cost. The Contractor shall also not be paid for expenses incurred by him in extracting the rejected piles/casings provisions of extra piles, enlargement of pile caps necessitated as a result of defective or/workmanship of the Contractor.

2.12.3 Replacement of Rejected Piles

Piles/boring/casing that are defective or exceed the tolerances specified above shall be left in place or pulled out as directed by ENGINEER - IN – CHARGE without adversely affecting the performance of the adjacent piles. In case the piles/casing cannot be removed they shall be cut out as directed by the ENGINEER - IN - CHARGE.

Voids resulting from rejected borings or extraction of the piles or casings shall be filled with gravel or sand unless other piles are installed in such voids at the cost of contractor.

2.13 General

Pumping and bailing out of water, shoring, strutting, etc., if found necessary for successful and speedy operation of work, shall be carried out by the contractor and cost of such works shall be included in his rates. No extra claims whatsoever on all subsidiary works pertaining to piling work will be entertained.

All the excavated materials including debris, loose earth, muck as advised by ENGINEER - IN - CHARGE, shall be carted away and disposed off by the contractor out of the premises to any suitable place of his choice and responsibility.

The Contractor shall provide all the equipments, tools and plants required for the work and rates shall include the cost of bringing the equipment etc, to site, proper maintenance and removal of the same after completion of work.

Control of Piling Installation shall be as per the relevant IS Code (IS 2911 (part 1 section2)).

Piles that are defective shall be left in places as judged by ENGINEER - IN – CHARGE and additional piles shall be driven to replace them at no extra cost.

Adequate length of bars to be left over the cut-off level of the pile to develop anchorage in the pile caps and also dowels to be kept of adequate lengths.

Sample of the hard strata shall be taken appropriately marked and preserved by the contractor and finally handed over to ENGINEER - IN - CHARGE. The level on the container should specify the date of piling , pile marked and depth of strata from which the sample has been obtained .

Rig register and weekly report as per the format, approved by ENGINEER - IN – CHARGE shall be submitted to Engineer -in-charge of the project.

During the period of establishing mix-design at site, nominal mix 1:1:2 for piling work only can be followed but the cement consumption for entire volume of piling work under reference will be reconciled based on approved design mix. For the purpose of measurements and payments, the length of pile shall be measured from the tip of the pile to the bottom of the pile cap. The length of the pile projecting into the cap shall not be measured for the payment and also shall not be deducted from the quantity of Pile cap concrete.

Reinforcement placed in the pile shall be paid for separately for the actual quantity of reinforcement placed in the pile exclusive of couplings, welded joints, spacer bars and binding wire as stipulated in the relevant specifications for reinforcements.

All piles shall be concreted to a level 150 mm to 450 mm above the specified pile cut off elevation which shall be 7.5 cm. above the bottom of the Pile cap. For piles cast by tremie method, in bentonite established bore holes, this level of concreting above pile cut of level shall not less than 600mm.

Before casting the pile cap, this excess concrete shall be cut off up to pile cut off elevation. In case sound concrete is not met with at such elevation the piles shall be cut to such elevation where sound concrete is met.

Piles shall be cut off at level and true to elevation shown or specified on the Drawings. Care shall be taken not to damage the reinforcement or the concrete below cut off elevation during such stripping operations. Where stripping to be done to a level lower than the specified cut off elevation to obtain dense and sound concrete, the Piling Contractor shall built up the pile up to cut off elevation at his own cost.

Upon completion of the piling work, all casing equipments, construction tools, protective covering and debris resulting from the piling operations shall be removed from the works site with the permission of ENGINEER - IN - CHARGE

A minimum length of 2 metres of temporary casing shall be provided for each bored piles unless otherwise specifically desired. Additional length of temporary casing shall be used depending on the condition of the strata, ground water level etc.

2.13.1 Recording of Data

Daily site records shall be maintained by the Contractor for the installation of piles against each Rig and shall contain the number and dimension of the pile, depth bored (including depth in soft / hard rock), time taken for boring, concreting and empty boring (cut-off level), chiseling and where the pile is wet or dry.

Sample bore log in the initial stage or when major variation occur should be shown. When drilling mud is used, amount of bentonite needed for stabilization of bore, specific gravity of the fresh supply and contaminated mud in the bore hole before concreting shall be checked and recorded regularly. Concrete volume actually cast per pile against required volume and actual cement consumption. Detail of any obstruction encountered, its nature , depth and obstruction time. Any deviation from the designated location alignment or load capacity of any pile shall be noted.

Typical data sheet in triplicate for facility of recording piling data to be prepared by the Contractor in consultation with ENGINEER - IN - CHARGE before starting of actual piling operation at site and information to be recorded against each pile in the data sheet shall be signed by the contractor and countersigned by ENGINEER - IN - CHARGE. One copy of the data sheet shall be retained by the Contractor and the other two copies to be submitted to ENGINEER - IN – CHARGE for records & future reference.

At least six photographs are to be taken by the party depicting progress of the job in every week and a set of same to be separately submitted for review and record to ENGINEER - IN - CHARGE.

3.0 Earthwork

3.1 Excavation

Excavation for trenches over areas and for pits, etc. shall be done to widths, lines and levels as shown in drawings or to such lesser or greater widths lines and levels as directed. The bottom and side of excavation shall be trimmed to required levels, profile, etc. watered and thoroughly rammed. Where the Contractor excavated below required level in good ground inadvertently or carelessly they shall make up the void in concrete (1:5:10) at his own expense. During excavation the Contractor shall take necessary precaution to retain earth (viz sal ballah piling, shoring etc) so that the earth will not slide or fall down to avoid any accident and hamper the progress of work at his own risk , responsibilities and cost . They will take necessary step to prevent the damage the adjacent structure or existing services. They shall repair and make good any such damage at their

own expense to the satisfaction of the Engineer - in - Charge. A suitable path for men and materials around the excavated pit should be maintained throughout the work.

3.2 Shoring

The sides of excavation should be supported in such a way as is necessary to secure these from falling in and the shoring shall be maintained in position as long as necessary. The Contractor shall be responsible for the proper design of the shoring to be approved by the Engineer - in - Charge to hold the sides of the excavation in position and ensure safety of persons and properties. The shoring shall be removed as directed after the items for which it is required are completed. Unless otherwise mentioned in the schedule of quantities, no extra payment will be made for shoring.

3.3 Dewatering

All water which may get accumulated in excavations during the progress of work from whatever cause or source, shall be bailed or pumped out as necessary. The rates for excavation shall be deemed to include for the same.

3.4 Silver sand filling

Filling sand may be silver sand having silt content less than 5% by weight and 300mm compacted thick layers will be spread, wetted & saturated to achieve the compaction . However for any special case, ENGINEER - IN – CHARGE may instruct filling by sand other than silver sand which the Contractor shall comply .The specification etc shall be guided by relevant IS code

3.5 Filling

Filling under floors or other places indicated shall be done by fine sand or silver sand brought from outside by the Contractor. The material should generally be good quality. Filling shall be done in layers not exceeding 15 cms. thick and each layer shall be fully inundated and consolidated properly by using 8 to 10 T Roller or otherwise. For filling under floors Consolidation shall be done by hand rollers and pneumatic / plate vibrator followed by hand rammer. The surface of the filling shall be finished true to lines and levels as required. The compaction shall be such that minimum compacted density obtained on testing is 95% of the maximum dry density. In general test shall be performed for every 1000 M2 of compacted area. The filling of final level after compaction and ready to take up soling work under the floor item, shall be checked by ENGINEER - IN - CHARGE. .

3.6 Disposal of excavated materials

All materials excavated shall be removed from the site of excavation and disposed off during excavation with prior written permission of ENGINEER - IN – CHARGE from the site in an approved manner with the approval of local authority. No extra claim on any account will be entertained. The Contractor must also secure the approval of the Engineer - in - Charge regarding the quantity of surplus materials to be removed prior to commencement of this item of work.

3.7 Back filling

All shoring and form work shall be removed after their necessity ceases and trash of any sorts shall be cleaned out from the excavation. All space between foundation masonry or concrete and sides of excavation shall be refilled to the original surface with approved excavated materials in layers of 15 cm in thickness, watered and rammed. The filling shall be done after concrete or masonry is fully set and done in such a way as not to cause undue thrust on any part of the structure. Where suitable excavated materials is to be used for refilling, it shall be brought from the place where it is temporarily stacked and used in refilling.

No excavation of foundation shall be filled up or covered until all measurements of excavation, masonry, concrete and other works below ground level has been jointly recorded . Black cotton soil shall not be used for back filling or in plinth filling under any circumstances.

3.8 Measurements

Measurements for all excavation, filling, carting away and earthwork shall be in solid measure. The rates quoted by the tenderers are thus for solid measure units. The following factors shall be applied to obtain quantities of solid measure.

Excavation : No reduction in volume (as per drawing area).

Filling : Volume shall be determined and consolidated by levels taken before and in layers after compacted filling and by measuring the length and breadth as required.

The mode of measurement for various types of excavations shall be as under:-

- a) In case of trenches, pits and areas, measurements shall be on the basis of size of foundation & the depth of bottom of foundation (bottom of bed concrete if provided) formation. Surface dressing shall be measured in plan projection only.
- b) In case of pipe trenches and drains, measurement of width of trench shall be diameter of the pipe plus an allowance of 50 cms. to allow for collars, flanges etc.

4.0 Controlled Cement Concrete – Plain & Reinforced

4.1 General

Concrete and reinforced concrete work shall be carried out generally in conformity with the latest Indian Standards IS : 456 except for provisions indicated herein below. All work is to be carried out with utmost precision and upto date scientific know-how and the Contractor shall employ thoroughly competent staff to achieve the highest standards.

4.2 Cement

Cement for the work shall be either of ordinary Portland Cement conforming to the latest Indian Standards IS:8112 – 1989 for 43 grade and IS 12269 -- 1987 for 53 grade or Portland Pozzolana Cement conforming to IS 1489 (Part 1) 1991- specification (fly ash based) IS 1489 (Part 2) 1991, - specification (Calcined clay based) and of the best normal setting quality unless a quick setting quality is expressly instructed in the specifications or otherwise during the course of the work by ENGINEER - IN - CHARGE. If directed the Contractor shall purchase Portland cement as fresh as possible after manufacture and where there is reason to believe the cement has been long stored, ENGINEER - IN - CHARGE may demand a Laboratory Test Certificate regarding the character of cement and the Contractor shall furnish the same at no extra cost. ENGINEER - IN – CHARGE shall reject any cement which in its opinion does not meet the required standards.

The list of manufactures for cement as per the list of BOQ or as instructed in writing by ENGINEER - IN - CHARGE.

Any field or laboratory test for cement, if asked for by ENGINEER - IN – CHARGE shall be carried out at the risk and cost of the Contractor as per provision of relevant IS codes.

All bags and containers in which cement is packed shall be stored in a dry, weather-tight, properly ventilated structure with adequate provision against prevention and absorption of moisture. The Contractor shall at all times maintain for the inspection of ENGINEER - IN - CHARGE, a log book indicating the receipt of cement ,brand and agent from whom

obtained and the age of cement. Cement which has caked or perished by being wet or otherwise, shall on no account be used on the work. Cement shall be consumed on the works in the same sequence as that of their receipt at site. Cement reclaimed from cleaning of bags or from spillage from containers or otherwise shall on no account be used. The cement is to be stacked in an orderly and accessible way to permit ENGINEER - IN – CHARGE physical verification of existing stock at all points of time. The Contractor has to ensure furnishing a copy of manufacturer batch test certificate along with every lot of supply .

If so felt , ENGINEER - IN – CHARGE may instruct the Contractor for further testing of cement in Govt. laboratories/testing houses has been detailed in the relevant clause of GCC,. over and above the / as submission of test certificates at the risk and cost of the Contractor .

4.3 Fine Aggregate

Fine aggregate shall generally conform to latest Indian Standards (IS:383). Sand shall be natural sand, crushed gravel sand or crushed stone sand at the discretion of ENGINEER - IN - CHARGE. Use of sea sand is prohibited. It shall be composed of hard siliceous material and shall be clean and of sharp angular grit type. Sand shall be properly graded minimising all voids.

Its grading shall fall within the limit of grading zone I , II for non-plastering work and Zone III for plastering work, of Table 1 (Ref clause no 3.1.4.3 of PWD specifications 1996 , revised to 2000 vide page no 33).

Allowance for bulking of sand shall be made. Silt content shall not be more than 5%. Laboratory equipment such as measuring jars etc. are to be kept at site for time to time checking of bulkage and silt content.

For sand testing periodicity may be given at the rate of every 150 cum of concrete work of all kinds (apart from RMC) and part thereof. For plastering work however, a separate periodicity of testing in term of every 500 SQM of plastering of any thickness irrespective of number of coats and part thereof is to be adopted. For brick masonry one test for 100 cum or part thereof for masonry may be adopted. The tests so mentioned shall have to be carried out through reputed Central/State Government registered testing house/ laboratory and not from site testing facilities.

All tests , to carry out field as well as laboratory tests shall be borne by the Contractor .

4.4 Coarse Aggregate

Coarse aggregate shall be approved hard aggregate generally conforming to latest Indian Standards : IS - 383. The following tests should be carried out for every new lot of supply :---

- Crushing value
- Impact value
- Sieve analysis
- Deleterious material
- Flakiness index

For every 150 CUM of concrete work of all kinds (apart from RMC) and part thereof one test shall be carried out.

All costs to carry out field as well as laboratory tests shall be borne by the Contractor .

4.5 Water

Water conforming to IS 456 - 2000 for all concrete work shall be clean, free from deleterious matter such as oils, acids, alkalies, sugar and vegetable matter. Every attempt shall be made to use water which is fit for drinking purposes. Water storages facilities provided by the Contractor shall be maintained properly to preclude contamination of water by any of the harmful substances. ENGINEER - IN – CHARGE may instruct the Contractor to carry out test of water sample as per provision of relevant IS code in Govt. laboratories and the Contractor

shall comply the same at his risk and cost. The quantity of water to be added to concrete for mixing shall be such as to afford workability consistent with strength. Water/cement ratio shall be recorded in every batch of concrete. Arrangement for slump cone test shall be kept at site to arrive workability whenever ENGINEER - IN – CHARGE wants to check at site. The periodicity of testing may be conducted as once in every batch of concrete and part thereof.

4.6 Types of concrete, strengths etc.

The strength requirement of both controlled and ordinary concrete where ordinary Portland cement or Portland blast furnace slag cement is used shall be conforming to IS: 456.

Where ordinary Portland cement or Portland blast furnace slag cement is used, the compressive strength requirements for various grades shall be as given in Table II. It shall be the contractor's responsibility to obtain specified strength for the various grades of concrete.. Where rapid hardening Portland cement is used, 28 days compressive strength requirement specified in Table II shall be met at 7 days.

Strength requirements of concrete specified in volumetric proportions like 1:2:4 etc. will be corresponding to the following grades of concrete.

Concrete Mix	Corresponding Grade of Concrete
1: 2:4	M-15
1: 1.5 : 3	M-20
1: 1:2	M-25

MINIMUM CEMENT CONTENT SPECIFIED FOR DIFFERENT GRADES OF CONCRETE

Maximum free water Cement ratio	Grade of Concrete	Minimum Cement content (Kg/Cum)
0.55	M-20	300
0.50	M-25	300
0.45	M-30	320
0.45	M-35	340
0.40	M-40	360

STRENGTH REQUIREMENTS OF CONCRETE

Comprehensive strength of 15 cm x 15 cm cubes at 7 days and 28 days curing, (works test only) conducted in accordance with IS:516-1959 with all value in kg/sq.cm.

Grade	Preliminary Test (7 Days) (Minimum)	Mark Test (28 Days) (Minimum)
M-10	70	100
M-15	100	150
M-20	135	200
M-25	170	250
M-30	200	300

In case, the test results obtained from testing of sample cubes fail to attain specified strength of concrete, it will be considered as a result of negligence on the part of the contractor and in such cases the acceptance of work shall be in following manner.

REDUCTION IN STRENGTH	PART RATE TO BE PAID
Upto 5%	6/7 th of contract rate
5% to 10%	5/7 th of contract rate
Above 10%	To be rejected

Sufficient number of cube mould should be kept ready at site.

The type of concrete for any particular situation or work shall be as per instructions given to the Contractor by ENGINEER - IN - CHARGE notwithstanding anything contained in the foregoing clauses.

4.7 Tests for determination of strength of Reinforced concrete

As will be apparent from the Bill of Quantities, the strength of concrete specified is the criterion and the Contractor shall make every effort to obtain the specified strengths by good quality control. In case of concrete which does not obtain the specified strength at 28 days, such work shall be demolished and reconstructed to obtain the requisite strengths all as directed by ENGINEER - IN - CHARGE. To determine whether concrete in any particular part of the work is of the requisite strength or not, test cubes (works test cubes) shall be made from samples collected from the concrete being poured for the particular part and determined as per acceptance criteria detailed hereinafter. The salient features for the collection of samples is as indicated below :

The size of cubes to be prepared and tested shall be 15 x 15 x 15 cm.

All costs for sampling and field as well as laboratory testing shall be borne by the Contractor.

4.7.1 Number of tests

The number of cube tests in a work shall be entirely at the discretion and as directed by the Controlling Officer of the work. Cubes shall generally be collected for various structural members and also for works at various levels. It shall also be collected whenever the usual quality for a particular strength is in suspect. The number of cubes may at most be twelve or even more as instructed by ENGINEER - IN - CHARGE and as per provisions of relevant IS code on any given day in a particular work. However, in case other important casting works are running in parallel with a major concreting work, additional cubes in the range of six or twelve shall be taken for each of them as well.

4.7.2 Preparation and Testing of Cubes

Casting of cubes, preparation of moulds for the same, processing and curing the cubes and pressure testing the same shall be as per detailed instructions which will be issued to the Contractor from ENGINEER - IN - CHARGE from time to time or as per relevant Indian Standard as amended upto date as directed. All costs to be borne by the Contractor .

4.7.3 Equipment modules, testing etc.

It is the entire responsibility of the Contractor to prepare and get the cubes tested and provide for all material, labour, modules, equipment, facility and charges for sampling ,

testing etc. The Contractor's rate for concrete work shall be deemed to include for these and no extra whatsoever is admissible on this account.

4.7.4 Criteria for acceptance of work

The test and acceptance criteria shall comply to relevant IS codes including IS :456 Part or element of concrete work shall be deemed to be acceptable, provided the three cubes tested for 28 days strength conform to the following:

Average of the three cubes strengths shall not be less than the specified strength.

No individual cube strength shall be less than 90% of the specified strength.

If any individual cube strength exhibits more than 133% of the specified strength, such cube shall be classified as freak and criteria above, shall be applied for the remaining two cubes only and the acceptability determined. Reference is drawn to Clause 2.3.5 in this connection incases of failure.

4.7.5 Quantum of cubes and testing

The decision of ENGINEER - IN - CHARGE in this regard shall be final and binding. Cube testing shall be done at site regularly and at least 20% of this testing shall be carried out in the reputed laboratory.

Testing machine with valid calibration certificate to be kept at site for crushing of cubes. The testing shall be duly witnessed and approved by ENGINEER - IN - CHARGE.

All costs to carry out tests at field as well laboratory shall be borne by the Contractor.

4.8 Batch Mixed Concrete

Concrete shall always be mixed in a mechanical mixer unless specially approved by Engineer. Hoppers for weighing cement, mineral admixtures, aggregates and water and chemical admixture (if measured by mass) shall consist of suitable container freely suspended from a scale or other suitable load-measuring device and equipped with a suitable discharging Mechanism. The method of control of the loading mechanism shall be such that, as the quantity required in the weighing hopper is approached the material may be added at controllable rate and shut off precisely within the weighing tolerances as specified. The weighing hoppers for cement, mineral admixtures aggregate shall be capable of receiving their rated load, without the weighed material coming into contact with the loading mechanism. Where the rated capacity of a batching plant, mixing cycle is less than 2.0 m³, additional precautions shall be taken to ensure that the correct number of batches are loaded into the truck mixer. The weighing hoppers shall be constructed so as to discharge efficiently and prevent the buildup of materials. A tare adjustment, up to 10 percent of the nominal capacity of the weigh scale, shall be provided on the weighing mechanism so that the scale can be adjusted to zero at least once each day. Dust seals shall be provided on cement hoppers between the loading mechanism and the weigh hopper, and shall be fitted so as to prevent the emission of cement dust and not affect weighing accuracy. The hopper shall be vented to permit escape of air without emission of cement dust. Before loading concrete materials or mixed concrete into either a stationary mixer or truck mixer any water retained in the mixing drum for washing out purposes shall be completely discharged. The mixing time shall be measured from the time all the materials required for the batch, including water, are in the drum of the mixer. The mixing time shall not be less than that recommended by the manufacturer. Where a continuous mixing plant is used, the complete mixing time shall be sufficient to ensure that the concrete is of the required uniformity.

Concrete shall be handled from the place of mixing to the place of final deposit as quickly as practicable, by method which will prevent the segregation or loss of any of the ingredients. If segregation occurs during transport, the concrete shall be remixed before use. The concrete

shall be placed in position and compacted before the initial set of cement has commenced and shall not be subsequently disturbed. Concrete shall not be dropped into position from a height greater than 1.50 metre.

4.9 Slump

If in the opinion of ENGINEER - IN - CHARGE, slump cone tests are required to be performed to establish workability the same shall be carried out at free of cost. Slump tests are however, to serve as guide only.

4.10 Ready Mixed Concrete

The Contractor shall buy the RMC from approved manufacturer only. The Contractor in association with the manufacturer will make a suggested trial mix with correct water cement ratio, slump and workability. The tests results will determine the cement content and water cement ratio that produces the required strength. The design mix as per stipulated strength of concrete mentioned in this technical specification shall be approved by the Consultant or any other designated authority as directed by ENGINEER - IN - CHARGE.

The Contractor should arrange a material hoist to carry the wheelbarrow to the floors under construction for transferring of concrete and a smooth runways is to be provided for their travel to avoid any segregation or concrete mix may be carried by head load for placing of concrete as directed by ENGINEER - IN – CHARGE from the point of transfer of concrete at upper floors. During transferring of concrete to walls or deep beams baffle board, downspout or chute to be used for prevention of segregation. It is essential to closely supervise the discharging of concrete to prevent segregation at all points. The alternative approach can be to pump out the ready mixed concrete to the location. The method of pumping/placing, the W/C ratio and the plasticizer used need to be approved before commencing the operation as defined herein above in this clause.

Regular mandatory tests on the consistency and workability of the concrete after transferring from transit mix trucks at job site shall be done to achieve the specified compressive strength of concrete. The frequency of testing and the acceptability criteria will be according to I.S : 456 and I.S:516. A register of work test of concrete shall be maintained at site by the Contractor. Cube testing register in standard CTE format is to be kept at site. ENGINEER - IN – CHARGE shall decide whether a particular set of cubes would be tested at site or at a reputed central/state government registered testing house/laboratory. In any case, at least 20% of the testing would be carried out at such laboratories. The Contractor shall undertake the entire cost of transporting of cubes to such testing facilities outside the site and testing charge therein.

In general payment for RMC shall be made on the basis of actual measurement or as per drawing, whichever is less, for different reinforced concrete elements at site. If any deviation from the original drawing is required as per decision of the Controlling Officer, the Contractor shall comply to the same during execution. In such case, the payment will be made based on the actual measurement of different reinforced concrete elements or as per revised drawing issued subsequently whichever is less. No extra payment will be made for wastage during transfer of RMC at site or extra concreting done by the Contractor at his own. The rate includes the cost of materials and labour for carrying of RMC to upper floors, placing, consolidating, finishing, curing & testing etc.

The Contractor shall submit the design mix report and its further corroboration through trial cube tests (both 7 days and 28 days) from a reputed institute for approval by ENGINEER - IN – CHARGE and adoption at site. All related cost would be borne by the Contractor.

No RCC work shall be taken up till such time final test report of trial design mix is not available with ENGINEER - IN - CHARGE.

In case any admixture is used in RMC it shall conform to IS : 9103 latest edition and after obtaining necessary approval from ENGINEER - IN - CHARGE.

For RMC concreting, regular cube tests in the multiple of six (three for 7 days and three for 28 days respectively) are to be carried out as per IS :456 (latest revision) and the works to be carried out as per stipulations laid down in IS codes and clearance by ENGINEER - IN - CHARGE. The decision of ENGINEER - IN – CHARGE shall be deemed as final in this regard.

4.11 Transporting, Placing and Compaction of Concrete

No mixing of concrete shall be started unless the situation where they are to be poured are prepared and kept ready. Concrete shall be poured immediately on preparation. Transporting of concrete shall be done as speedily as possible and also in a manner to prevent segregation of aggregates. No retempered concrete shall be allowed to be used on the works. No concrete shall be allowed to fall through a height more than 1.20 M. where the concrete to be placed from more height it should be done through chute as per specification and relevant IS as directed by ENGINEER - IN - CHARGE.

Before fresh concrete is placed against an already cast and hardened section, such surfaces shall be roughened, swept clean, moistened with water and treated with cement slurry. Fresh concrete shall then be poured as required. Under no circumstances, concrete mixed more than stipulated initial setting time as per IS code shall be used. Dewatering of excavations for concreting where necessary shall be carried out by the Contractor as directed and the rates quoted by the Contractor are deemed to be inclusive of such dewatering. No concreting shall be done in adverse weather condition, except exigencies with proper precautions or prior approval from ENGINEER - IN - CHARGE.

4.11.1 Transportation by Mixer Trucks

These are essentially revolving drums mounted on truck chasis. Truck mixers used in the job shall be labeled permanently to indicate the manufacture specifications for mixing like:

- Capacity of drum.
- Total number of drum revolutions required for complete mixing.
- Mixing speed
- Maximum time limit before completion of discharge and after cement has entered the drum.
- Reduction in time period of discharge.
- Due to warm weather or other variables.
- All above information shall only form guidelines for the manufacture/producer of concrete.

Fulfillment of the stipulated number of revolutions or elapsed time shall not be acceptable criterion. As long as the mixing water limit is not exceeded and the concrete has satisfactory plastic physical properties and is of satisfactory consistency and homogeneity for satisfactory placement and consolidation and is without initial set, the concrete shall be acceptable.

When the concrete is totally mixed in transporting trucks or in case of .shrink-mix concrete, volume of concrete being transported shall not exceed 63% of the rated capacity of the drum. In case the concrete is totally mixed in the central batching plant, the transporting truck may be loaded upto 80% of the rated capacity of the drum. In this case the drum shall be rotated at charging speed during loading and reduced to agitating speed after loading is complete.

When transporting concrete by truck mixers, delivery time shall be restricted to 1.50 hours from the time cement has entered the mixer to completion of discharge.

4.11.2 Transportation by Agitating/non-agitating Trucks

Transporting ready mix concrete by this method shall consist of truck chassis mounted with open top bodies. The metal body shall be smooth and streamlined for easy discharge. Discharge may be from the rear when the body is mechanically tilted. Body of the truck shall have a provision of discharge gate. Mechanical vibrators shall be installed at the discharge gate for control of discharge flow.

Agitators, if mounted, also aid in the discharging of concrete from the truck in addition to keeping the concrete alive.

Water shall not be added to concrete in transport in this system.

Bodies of truck shall be provided with protective covers during period of inclement weather.

Delivery period, when adopting this system of transporting, concrete shall be restricted to 30 minutes from the moment all ingredients including cement and water enters in mixer to completion of discharge.

4.11.3 Transportation by Buckets

This method of transportation is very common for transportation of centrally mixed concrete. Buckets of suitable capacities may be fitted with concrete which is totally mixed in central plant and hauled to the job site. Buckets then may be conveyed to the actual point of placement either with the help of crane/ hoist or they may be carted.

As in the case of open truck transportation, water shall not be added to concrete transported in buckets. Concrete shall be protected from inclement weather by necessary covering arrangements. Also, maximum delivery period for this system of transportation from the time cement is introduced into the mixer to completion of discharge shall not exceed 30 minutes.

Before loading concrete in either truck mixer, open bodied trucks or buckets, the containers shall be thoroughly cleaned, washed and dried, so that there is no water or moisture in the container which may effect the designed water content of the concrete.

4.11.4 Transportation by Pumping

Concrete conveyed by pressure through either rigid pipes or flexible hoses and discharged directly into the desired area is termed as pumped concrete. The method of conveying the concrete through pipe lines is dealt with in these specifications.

Method of applying pressure to concrete is by pumps. Pumps to be used shall be either of the two types as mentioned below: -

- a) Piston type pumps
- b) Squeeze pressure type pumps.

Piston pump to be used in the works shall consist of a receiving hopper for mixed concrete, an inlet valve, an outlet valve, and the pump shall be a twin - piston pump. The two pistons shall be so arranged that one piston retracts when the other is moving forward and pushing concrete into the pipe line to maintain a reasonably steady flow of concrete. Single piston pumps shall not be acceptable.

Inlet and outlet valves shall be any one of the following types.-

Rotating plug type Sliding plate type Guided plunger type Swing type Flapper type or any combination of the above.

The pistons shall be mechanically driven using a crank or chain or hydraulically driven using oil or water.

The receiving hopper shall have a minimum capacity of 1.0 cum and the hopper shall be fitted with remixing rotating blades capable of maintaining consistency and uniformity of concrete. The primary power for pumps may be supplied by gasoline, diesel, or electric motors. The primary power unit and the pump unit may be truck, trailer or skid mounted.

Squeeze pressure pumps shall consist of a receiving hopper fitted with re-mixing blades. Re-mixing blades shall be such that these can push the concrete into the flexible hose connected at the bottom of the hopper.

The flexible hose shall pass through a metal drum around the inside periphery of the drum and come out through the top part of the drum.

The drum shall be maintained under a very high degree of a vacuum during operation. The drum shall be so fitted with hydraulically operation metal rollers, which when rotating, create a squeeze pressure on the flexible hose carrying concrete and forces the concrete out into the pipe line.

Effective range of pumps to be used in the work shall be decided by the contractors after studying the site conditions. However, the minimum horizontal range shall not be less than 150 metres and minimum vertical range shall not be less than 50 metres.

Selection of pumps based on discharge capacity shall be decided by the contractors after studying the requirements for the project. Discharge capacity shall be worked out by the contractors and approval obtained from the Engineer. As a guide line figure the contractors may assume a discharge capacity of 15 cubic metre / hour / pump.

4.12 Consolidation and processing of concrete

Concrete for all works shall be compacted by means of suitable vibrating equipment. One or more spare vibrators which are in complete working condition shall always be kept ready at sites to be put into commission in case of failure of the vibrators under use. The vibrators shall be operated by skilled personnel, thoroughly instructed as regards the mode, frequency, duration etc. regarding vibration. Concrete of low volume/ quantum for a particular work may however, be permitted by ENGINEER - IN – CHARGE at their sole discretion to be consolidated by hand only after prior permission.

4.13 Finish to concrete surfaces

Finish to concrete surfaces at various situations shall be as per directions of ENGINEER - IN - CHARGE. Where form finish is specified, the final surface shall be smooth and even and no-undulations, ridges, spots etc. shall be permitted. They shall be laid to pattern as directed. In case surfaces intended and directed for form finish, exhibit any of the defects above mentioned, the surfaces shall be rubbed with carborundum or plastered and finished all as directed at the risk and cost of the Contractor. The decision as to the acceptability or otherwise of a surface will be notified by ENGINEER - IN – CHARGE and the Contractor will implement the instructions accordingly.

4.14 Cover for reinforcement

Where not specifically indicated in the drawings, concrete cover for reinforcement shall be as per the latest Indian Standards IS 456 - 2000 and as per directions at site from time to time.

Proper concrete cover blocks adequately cured to suit various covers as required shall be provided in adequate numbers sufficiently ahead of the work.

4.15 Construction joints

Construction joints in concrete work shall be generally avoided to the maximum extent possible and may only be provided only at predetermined places as per direction and in consultation with ENGINEER - IN - CHARGE. Joints shall be provided as specified in latest Indian Standards or as directed by ENGINEER - IN - CHARGE.

4.16 Curing

It is very important that all cement concrete work shall be cured properly. All concrete work shall be kept continuously in a damp or wet condition by pouring or by covering with a layer of moist sack, canvas, hessian or similar material for a period as stipulated in the relevant IS codes and specifications from the date of concreting. Water used for curing shall also be free from any deleterious substances and shall generally be fit for drinking. The work shall be adequately protected from drying, winds and direct sun rays. The Contractor should arrange at his own cost a temporary water supply line with provision of centrifugal pump, valves etc. for curing and constructional purpose at higher level. A sample sketch is enclosed for the reference purpose.

4.17 Damp Proof Course

The damp proof course shall consist of a layer of 40mm thick PCC (1:2:4) type B0 and shall be mixed with water proofing compound conforming to IS: 2645 liquid grade as per manufacturer specification and laid as specified in para 5.42 on page 101 of MES Schedule (Part I). Water proofing compound shall conform to IS2645. It shall be mixed with concrete in the proportion and in the manner as given in manufacturers instructions. Deviations if any shall be priced on the basis of water proofing compound actually incorporated in the work.

Damp proof course shall be provided on all brick walls, PCC walls and brick pillars for their full length and width at the ground floor. Damp proof course shall also be provided under openings/door opening at depressed level including vertical faces of depressed level and including vertical faces of depressed portion of opening as per requirement of clause 5.8.1.3 of IS - 2212. However, damp proof course shall not be provided over dwarf walls/RCC columns.

5.0 Formwork

5.1 Materials and Design

The method and design of form work to be adopted by the Contractors is to be produced for approval of the same by ENGINEER - IN – CHARGE before any form work is taken up.

The form work shall be of approved 12 mm. thick water proof ply surface to be in contact with concrete, to be planed smooth. In every case joints of the shuttering are to be such as to prevent the loss of liquid / water from concrete. In ply shuttering the joints shall be perfectly close and lined.

Steel shuttering using hydraulic jacks shall preferably be used in all possible cases and as directed by ENGINEER - IN - CHARGE.

If any particular materials, or materials be specified in the schedule of quantities for form work such particularly specified material or materials shall be used in work. The form work shall be so constructed as to remain sufficiently rigid during placing of the concrete. All shuttering and forming must be adequately stayed and braced to the satisfaction of ENGINEER - IN – CHARGE for properly supporting the concrete during the period of

hardening. The forms shall have sufficient strength and rigidity to hold concrete and withstand the pressure of remaining and vibration without excessive deflection from the prescribed lines and more so when the concrete is vibrated. The surface of all forms in contact with concrete shall be clean, rigid, watertight and smooth. Suitable devices shall be used to hold corners, adjacent ends and edges of panels of other forms together in accurate alignment.

The form work shall conform to the shape, lines and dimensions to suit the R.C.C. members as shown on drawings and be so constructed. Form work shall be adequately designed to support the full weight of workers, fresh placed concrete without yielding settlement or deflection, and to ensure good and truly aligned concrete finished in accordance with the construction drawings. A camber in all directions of 6mm for every 5 M span in all slab and beam centering shall be given to allow for unavoidable sagging due to compression or other causes , unless otherwise specifically instructed in writing by ENGINEER - IN - CHARGE.

The form work shall be as designed that the sides of the beams retain its position and does not get bulged these however should be so designed that the sides of the beams can be first struck leaving the soffit of beams and the supporting props in position. Props shall be designed to allow accurate adjustment and to permit of their being struck without jarring the concrete. No bamboo propping shall be used . Bulged section shall not be accepted and need to be rectified or rebuilt as per instruction of ENGINEER - IN - CHARGE. No extra claim , in any case shall be entertained by ENGINEER - IN - CHARGE.

Temporary openings shall be provided at the base of columns forms and at other points where necessary to facilitate cleaning and observation immediately before concrete is deposited.

5.1.1 Vertical Shuttering

The vertical shuttering shall be carried down to such solid surface and is sufficiently strong to afford adequate support and shall remain in position until the newly constructed work is able to support itself. Props shall be securely braced against lateral deflection. Where timber props are used like bullies, they shall be a minimum diameter of 10cm. and shall be straight and adequately strong. The spacing of such struts shall be designed to carry to carry loads imposed on it without undue deflection of the members supported by the props. The spacing of props shall be approved by ENGINEER - IN - CHARGE and any alterations suggested by him shall be carried out at Contractor's expense. Bracing shall be provided as directed without extra cost. Contractor shall allow in his rates for providing props and struts for any height shown in the working drawings issued to Contractor from time to time.

5.1.2 Curve & Circular shuttering

Unused and new waterproof ply of 6 mm thick supported by good quality wooden batten shall be used. Repetition of the material will be same as stated above for the other shuttering.

5.2 Water Tightness

It is the Contractor's responsibility to ensure that the forms are checked for water tightness just before concreting operation starts and to make good any deficiencies.

5.3 Cleaning and Treatment of Forms

All rubbish, particularly chippings, shavings and saw dust, shall be removed from the interior of the forms before the concrete is placed and the form work in contact with the concrete shall be cleaned and thoroughly wetted or treated with an approved composition. Care shall be taken that such approval composition is kept out of contact with the reinforcements. Interior of all moulds and boxes must be thoroughly washed out with a hose pipe or otherwise

so as to be perfectly clean and free from all extraneous matter previous to the deposition of concrete.

Prior approval of the form work should be taken from ENGINEER - IN – CHARGE before placing reinforcements on form work. No concrete shall be commenced until ENGINEER - IN – CHARGE has inspected the form work and until his approval is obtained. A notice of at least 24 hours shall be given to the opinion of ENGINEER - IN – CHARGE any materials is not accordance with the specification or the form work, is wrongly done or otherwise defective the Contractor shall immediately remove such materials from site and replace the same and rectify any other defects in accordance with the instruction of ENGINEER - IN – CHARGE and to his entire satisfaction.

The lines , levels, form work, reinforcement etc shall be checked by the Contractor with subsequent approval / checking by ENGINEER - IN – CHARGE prior to allowing of concreting , by ENGINEER - IN - CHARGE. However, the cost, labour etc for such checking shall be borne by the Contractor and this will not relieve any of the obligations under this contract.

5.4 Stripping

Forms shall be left in place and removal shall be done as per norms laid down in IS codes and is authorized by ENGINEER - IN – CHARGE and shall then be removed with care so as to avoid injury to concrete. In no circumstances shall forms be struck until the concrete reaches a strength of at least twice the strength as to which the concrete may be subjected at the time of striking. The strength referred to shall be that of concrete using the same cement and aggregates, with the same proportions, and cured under conditions of temperature and moisture similar to these existing on the work. Where possible, the form work should be left longer as it would assist the curing. Exposed surfaces of concrete which are indicated/ required to be plastered shall be roughened with wire brushes and hacked out closely immediately after removal of formwork by free of cost.

Any honeycomb , appeared after removal of form work shall be mended as per procedures laid down in IS codes including pressure grouting required , if any, as instructed by ENGINEER - IN - CHARGE.

5.4.1 Stripping Time

In normal circumstances (generally where temperature are above 20°C) and where ordinary cement is used, forms shall be struck after expiry of the following periods and as per relevant IS code unless otherwise directed at site by ENGINEER - IN - CHARGE.

5.5 Form Work in Lift for Continuous Surfaces

Where forms for continuous surface are placed in successive units, (as for example in columns or walls) the forms shall fit tightly over the completed surface so as to prevent leakage of slurry from the concrete and to maintain accurate alignment of the surface.

5.6 Procedure While Removing the Form Work

All form work shall be removed without such shock or vibration as would damage the reinforced concrete. Before the soffit and strata are removed the concrete surface shall be exposed where necessary in order to ascertain that the concrete has sufficiently hardened. Proper precautions shall be taken to allow for the decrease in the rate of hardening that occur with all cements in the cold-weather.

5.7 Tolerances

The following shall be the maximum permissible tolerance :-

- a) On general setting out dimensions upto 4 M. in length a tolerance upto 3mm will be allowed.
- b) On lengths of more than 4 M. tolerance of not more than 5mm will be allowed.
- c) On the cross sectional dimensions of columns, beams, slabs, faces, chajjas, mullions, grills, fins, louvers, and such other members tolerance more than 2mm will not be allowed.
- d) The top surface of concrete floor slab will be within plus/minus 3mm of the level and line shown on the drawings.
- e) Columns and walls and other vertical members shall not be more than 3mm out of plumb in their storey height and not more than 6 mm out of plumb in their full height.
- f) If work is not carried out within the tolerance set out above (a) to (d) the cost of all rectification measures of dismantling and reconstructing as decided by ENGINEER - IN – CHARGE shall be borne by the Contractor. In case of work dismantled, the same shall not be measured and no payment even for cement and reinforcement shall be allowed .

5.8 Openings and inserts

All openings and inserts which are designated in due time or as required for services, will be exactly provided by the Contractor. The Contractor should also fix the anchors or such items which may be supplied by the Proprietor in exact position and in perfect lines and levels. Inserts apply to such items as timber, dowels, bolts, loop, brackets, suspension irons, hooks, screws, plates, pipe of various types and diameter etc. etc. Openings in concrete or masonry must be provided in exact location to correct shape, size and depth or slightly bigger, if directed so, as shown in drawings or as instructed. It must be clearly understood that the provisions of inserts and openings as contemplated in this contract are to be carried out with "utmost precision" and any deviation of the same from that as shown in drawing or instructed, have to be rectified by the Contractor at his own cost and responsibility. The Contractor should make provision of openings to deep beams and their members at bottom or at lower level as necessary for cleaning purpose prior to concreting.

6.0 Reinforcement

High strength deformed steel bars produced by Thermo Mechanical Treatment process (TMT steel bars of grade Fe 500) shall be used for reinforcement work unless otherwise mentioned.

This shall conform to the standard and quality in accordance with IS:1786 (Latest edition) and other relevant IS Codes. Bending and cutting of reinforcing steel bars shall conform to IS: 2502. Lapping of bars where necessary shall be done as per IS specifications.

6.1 Storage

The reinforcement shall not be kept in direct contact with the ground but stack on top of an arrangement of timber sleepers or the like. Reinforcement shall be coated with cement wash before stacking to prevent scale and rust. Fabricated reinforcement shall be carefully stored to prevent damage, distortion corrosion and deterioration.

6.2 Quality

All steel shall be of Grade I quality unless specifically permitted by the Engineer. Re-rolled material is generally not permitted. However, only approved / authorized re-rolling manufacturer can be allowed to supply only at the discretion of Engineer. With each lot,

contractor shall submit the manufacturer's test certificate for steel. Random tests on steel supplied by Contractor may be performed by owner as per relevant Indian Standards. All cost incidental to such tests shall be at "Contractor's Expense". Steel not conforming to specification shall be rejected.

All reinforcement shall be clean, free from grease, oil, paint, dirt, loose mill scale, loose rust, dust, bituminous material or any other substances that will destroy or reduce the bond. All bars shall be thoroughly cleaned before being fabricated. Pitted and defective bars shall not be used. All bars shall be rigidly held in position before concreting. No welding of rods to obtain continuity shall be allowed unless approved by the Engineer. If welding is approved, the work shall be carried out as per IS-2751 and according to best modern practices and as directed by the Engineer. In all cases of important connections, strength of bars welded Special precautions, as specified by the Engineer shall be taken in the welding of cold worked reinforcing bars and bars other than mild steel.

6.3 Laps

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

6.4 Bending

All bars shall be accurately bent according to the sizes and shapes shown on the approved detailed working drawings / bar bending schedules. They shall be bent gradually by machine or other approved means. Reinforcing bars shall not be straightened and rebend in a manner that will injure the material, crack or split. Bar of over 25 mm in diameter shall be bent cold, except bar specifically approved by the Engineer. Bars, which depend for their strength on cold working, shall not be bent hot. Bars bent hot shall not be heated beyond red colour (not exceeding 645°C) and after bending shall be allowed to cool slowly without quenching. Straightening and rebending be such as shall not in the opinion of Engineer injure the material_ No reinforcement shall be bent when in position in the work without approval, whether or not it is partially, embedded in hardened concrete. Bars having kinks or bends other than those required by design shall not be used.

6.5 Fixing

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

6.6 Inspection

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

6.7 Sampling & Testing

Sampling & testing for following physical test of steel shall be carried out as per relevant IS Codes.

- i. Tensile strength / Proof Stress.
- ii. Nominal Mass
- iii. Bend / Rebend Test

iv. Elongation Test

The frequency of testing shall be as per relevant code or as directed by Engineer depending on the source of materials, previous test results etc.

7.0 Masonry & Plastering Work

7.1 Brick Masonry

7.1.1 Bricks

All bricks shall be table moulded, burnt bricks of crushing strength not less than 75 kg/Sq cm. They shall be hard sound and well burnt with sharp edges and of uniform sizes and shapes. Bricks shall be neither under burnt nor over burnt and shall be free from cracks, stone floats, or other such defects as defined in relevant IS code and PWD specifications. When immersed in water for 24 hours, bricks shall not absorb more water than 20% of its dry weight. All bricks shall be identical / equal to samples submitted and approved by ENGINEER - IN - CHARGE before the commencement of the work. Metallic sound of brick is also a criteria .

7.1.2 Cement and Sand

Cement and sand used for masonry and under the heading plastering work shall conform to the specifications laid down under the heading "Plain and Reinforced Concrete" as per clause of 1.3 above and relevant IS code and PWD specifications .

7.1.3 Additives

Additives, like integral waterproofing compounds, shall be of the approved type from reputed manufacturers and as per instruction in writing by ENGINEER - IN - CHARGE. These shall be used strictly in accordance with the manufacturer's instructions/specification. The additives shall conform to IS : 9103.

7.1.4 Samples

When demanded by ENGINEER - IN - CHARGE, the Contractor shall produce samples of materials or carry out samples of work for ENGINEER - IN – CHARGE approval. All materials used as also works carried out shall conform to the quality of approved samples. Production of these samples shall be at Contractor's cost. However, approval of samples by ENGINEER - IN – CHARGE shall not relieve the Contractor's obligation of the cost for this .

Testing of bricks shall be carried out in respect of dimension, crushing strength, water absorption and efflorescence in a standard sample size of six bricks. The periodicity of testing may be taken as once for every 50 CUM of brick masonry of nominal thickness not less than 250 mm and part thereof and for half brick masonry, once for every 500 SQM and part thereof. These tests shall be guided as per relevant IS code and PWD specification at the risk and cost of the Contractor.

7.2 Laying

Brick shall be soaked in clear water for at least six hours in a vat before use. Bricks shall be laid in English bond unless specified otherwise. No half or quarter brick shall be used except as closers. Brick shall be accurately raised to plumb.

Brick work shall be raised uniformly all round and no part shall be raised more than 1 metre above another at any time, and the work shall be properly toothed and racked back. In case of 125 mm. thick brick walls, wire mesh shall be provided in every third course as per relevant specification and as instructed by ENGINEER - IN - CHARGE. The wire mesh shall be properly bedded in mortar, as directed.

Joints in brick work shall not be more than 10 mm. thick. Brick work shall not be raised more than 10 courses a day. The work shall be kept watered thrice a day for 10 days and afterwards twice a day for 3 weeks. All joints shall be thoroughly flushed with mortar at every course. Care shall be taken to see that bricks are properly bedded and all vertical joints completely filled to the full depth. The jointed of brick work shall be raised out to a depth not less than 10mm. as the work proceeds. The surface of brick work shall be cleaned down and watered properly before the mortar sets.

7.3 Deleted

7.4 Half Brick Masonry

Specification of half brickwork is same as that mentioned above except that all the bricks shall be laid stretch wise breaking joints with those in the upper and lower course. Mix for mortar shall be as specified in the schedule of quantities and / or shown On drawings.

7.4.1 Reinforcement Bars

The mild steel reinforcing bars shall conform to specification as laid down herein. Two bars of 6 mm diameter shall be used longitudinally at every third course of the brickwork. The first reinforcement shall be placed on the top of the bottom most courses.

The bars shall be fully embedded in the mortar and the ends shall be properly anchored to the mortar of main brickwork of the main wall to which half brickwork is joined. Laps shall be provided with a minimum length of 45 d. For unsupported length of half brickwork exceeding 3.5 m, 115 x 200 mm wide RCC mullion (M-15, nominal mix) shall be provided @ 3.5 m and Horizontal RCC band of 115 x 150 mm at lintel level for heights of half brick work more than lintel level to be provided for which payment will be made separately under relevant item.

7.5 Curing

All brick works shall be kept continuously wet for at least 7 days from the date of laying.

7.6 Brick Soling

Where brick soling is required to be provided, it shall conform to the following specifications:-

It shall be flat of the bricks touching each other as per item. Soling shall be closely packed leaving no interstices or gaps. The interstices to be filled with fine sand and shall be sprayed with water. If crevices appeared between two bricks after spraying with water it shall be mended again by spreading fine sand.

7.7 Plastering

Plastering work in general shall proceed from top to bottom. An entire unobstructed area shall be plastered in one operation. The surface to be plastered shall be thoroughly cleaned, watered and roughened to provide key. Joints in brick work shall be raked out and cleaned. The surface shall be watered and well wetted for at least 24 hours before the commencement

of work. The entire plastered work shall be truly vertical and to proper lines and levels. All exposed angles shall be carefully flushed to provide neat and even surface. Any work that does not conform to approved samples or is not to the satisfaction of ENGINEER - IN - CHARGE shall be rejected and the Contractor shall be liable to redo the work at his own cost. Cement sand plaster will be used. Sand will be coarse or fine (Zone-III). Where waterproofing compound is specified to be provided in mortar for plaster, approved integral waterproofing compounds shall be used. These shall be used and plastering work shall be carried out strictly as per manufacturer's recommendations.

7.8 Neat Cement Plaster, Skirting and Dado

7.8.1 General

The skirting shall be flushed with wall plaster or projecting out uniformly by 6 mm from the wall plaster, as specified. The work shall be preferably carried out simultaneously with the laying of floor.

7.8.2 Preparation of wall surface

The joints in masonry shall be raked out to a depth of at least 12 mm, while the masonry is being laid. In case of concrete walls, the surfaces shall be roughened by hacking. The surface shall be cleaned thoroughly, washed with water and kept wet before skirting is commenced. The wall rendering shall be neatly cut in a straight line parallel to the floor at the height of the top of the skirting and dado before fixing the skirting.

7.8.3 Application

Skirting with specified mortar and of specified thickness of not less than 18 mm shall be laid immediately after the surface is prepared. It shall be laid along with the border or adjacent panels of floor. The joints in skirting shall be kept true, and straight in continuation of the line of joints in borders or adjacent panels and the skirting shall be finished smooth and true with top truly horizontal and vertical joints truly vertical except where otherwise indicated.

7.8.4 Finishing

The finishing of surface shall be done simultaneously with the borders of the adjacent panels of floor. A floating coat of neat cement slurry shall be applied uniformly over the area for smooth finishing at the rate of 2 kg. of cement per litre of water applied over an area of 1 sq.m

7.8.5 Curing

Curing shall be commenced on the next day of finishing when the plaster has hardened sufficiently and shall be continued for a minimum period of 7 days.

7.9 Measurements

7.9.1 General

All the rates quoted by the Contractor shall be for a fully finished item of work and shall include for all material, labour, miscellaneous works like storage, loading / unloading, scaffolding, hoisting gear etc. as also all taxes, duties, overheads, profits, etc. complete. The measurement of all items shall be guided by PWD specification, in general.

7.9.2 Masonry

Accounts on masonry shall be settled on the basis of cubic metres or square metres as indicated in the Bill of Quantities. Quantities will be decided on the basis of pertinent plans. Openings and recesses, which exceed 0.10 sqm. will be deducted from quantities.

Openings left initially on specific instructions or as required shall be closed at a later date, if so instructed by ENGINEER - IN - CHARGE, at no extra cost. Similarly, all openings, recesses, grooves etc. shall be provided at no extra cost. All materials supplied by ENGINEER - IN – CHARGE shall be fixed in masonry free of charge.

7.9.3 Plastering

Accounts on plastering shall be settled on the basis of square metre, as arrived at from pertinent plans and for a particular type of plaster. Accounts shall be settled on the basis of dimensions of raw structure. Grooves, notches, drip notches etc. shall be provided in plaster free of cost, wherever indicated by ENGINEER - IN – CHARGE or shown in drawings. Similarly, no special compensation shall be paid for plastering in recesses, grooves, etc. shall be accounted for under relevant item of work. However, providing cleavage or similar miscellaneous works shall be deemed to have been include in the rates quoted by the Contractor and shall not be separately paid for.

8.0 Flooring

8.1 Kotah Stone Flooring , Dado & Skirting

Kotah Stone shall be of selected quality, hard, sound, dense and homogenous in texture free from cracks, decay, weathering and flaws. They shall be hand or machine cut and shall be of approved colour of even shade as far as permissible. The stones having yellowish strips, dent, black patch and broken edges shall not be used. The slabs shall conform to the sizes of 600 mm. x 600 mm. or as required and shall be laid to pattern as directed. The edges will be perfect vertical and in right angled to each other. Minimum thickness of slabs shall be 20 mm. and the minimum thickness of floor finish including bedding mortar shall be 40 mm or specified in the relevant items of BOQ and PWD and IS specification. The floor surface to be tiled shall be closely picked or hacked and throughly watered and cleaned. Mortar for bedding shall be 1 part of cement, 4 parts of sand with a layer of neat cement slurry. The stone slabs shall be laid on this bedding immediately and as each stone is laid it shall be taped with a wooden mallet and set. Flush joints shall not exceed 1 mm thick and shall be as per pattern indicated by ENGINEER - IN - CHARGE. The joint shall be set close with white cement, stone dust, adhesive and admixture of pigment matching the shade of kota stone. After the work has set, the surface shall be machine polished to the satisfaction of ENGINEER - IN - CHARGE. The final polished surface shall then be washed of all dirt, mortar, etc. by using Oxalic Acid and handed over in a neat condition. Measurement will be taken on finished dimensions. Before the start of kotah laying work, approval should be taken from ENGINEER - IN – CHARGE on the sample work and the approved sample(s) shall be kept at site for ready reference. For dado, 1200mm high, 300mm wide and 20mm thick Kotah shall be fixed in wall, raised from the plastered surface matched with floor joints or as directed by ENGINEER - IN - CHARGE.

Rates to include

- a] All labour , materials and equipments , cleaning the sub-base laying mortar bed and cement grout and fixing marble slabs and making the joints and polishing.
- b) Any cutting and waste if required.
- c) Curing
- d) Cleaning the floor and wall from all stains etc complete .

8.2 Ceramic Tile Flooring and Dado/Skirting

General

This item relates to the furnishing of materials and installations of ceramic tiles in flooring, dado, etc. Tiles shall conform to IS : 15622 and workmanship shall be per IS : 1443.

Materials

The ceramic tiles shall be of high quality of approved manufacturers as specified by ENGINEER - IN - CHARGE. The size of tiles shall be as specified or as directed in the drawing and shall be of appropriate minimum thickness as mentioned in the item of ceramic tile flooring & dado in BOQ. No chipped, cracked, crazed or warped tiles shall be used. Glazed rounded corners and cups (convex or concave) shall be provided at corner of walls, edge, junctions of floor and dado etc., if so specified. The mortar shall be in the proportion 1:4. (Cement : Sand)

Laying

The fixing shall generally conform to IS : 1443.

Workmanship

The surface to be covered shall be plastered rough to a thickness of 12 mm. Fix 12 mm size stone chips (5 nos. one in each corner and one in the middle of each tile with Adhesive viz., Areldite of equivalent for keying action) or with approved chemical of reputed brand and the tiles shall be soaked in water for at least 2 (two) hours prior to fixing at site. A thin layer of cement paste shall be buttered on the back of the tile and on the side after which the tile shall be pressed and tapped home taking care that the corner tiles are perfectly matching. After the backing coat has set the tile joints shall be grouted with neat, white cement slurry with necessary pigment. All surplus slurry that remains on the surface shall be carefully wiped off before it sets. Care shall be taken to ensure that the finished surface is absolutely plumb and to proper levels without any profusions , waviness or zig- zag. Joints between tiles shall be uniform in straight level lines. After completion of the entire work or part of it , the surface shall be cleared of all stains , cement etc., by washing with oxalic acid (1:10) or any other approved compound.

Fixing tiles

The dado work, shall be done only after fixing the tiles / slabs on the floor. The approved glazed tiles before laying shall be soaked in water for at least 2 hours. Tiles shall be fixed when the cushioning mortar is still plastic and before it gets very stiff.

The back of the tile shall be covered with this layer of cement mortar 1:3 using fine sand (table III, zone IV, IS383-1963), and the edge of the tile smeared with neat white cement slurry. The tile shall then be pressed in the mortar and gently tapped against the wall with a wooden mallet. The fixing shall be done from bottom of wall upwards without any hollows in the bed of joints. Each tile shall be as close as possible to one adjoining. The tiles shall be jointed with white cement slurry. Any thickness difference in the thickness of the tiles shall be arranged out in cushioning mortar so that all tiles faces are in one vertical plane. The joints between the tiles shall not exceed 1.00 mm in width and they shall be uniform.

While fixing tiles in dado work, care shall be taken to break the joints vertically. The top of the dado shall be touched up neatly with the rest of the plaster above.

After fixing the dado / skirting etc. they shall be kept continuously wet for 7 days.

If doors, windows or other openings are located within the dado area, the corners, sills, jambs etc. shall be provided with true right angles without any specials. The Contractor will not be entitled to any extra claims on this account for cutting of tiles if required.

Cleaning

After the tiles have been laid in a room or the day fixing work is completed, the surplus cement grout that may have come out of the joints shall be cleaned off before it sets. After the complete curing, the dado or skirting over shall be washed thoroughly clean. In the case of flooring, once the floor has set, the floor shall be carefully washed clean and dried. When dry, the floor shall be covered with oil free dry sawdust. It shall be removed only after completion of the construction work and just before the floor is used.

Pointing and Finishing

The joints shall be cleaned off with wire brush to a depth of 3 mm and all dust and loose mortar removed. Joints shall then be flush pointed with white cement and floor kept wet for 7 days and then cleaned. Finished floor shall not sound hollow when tapped with a wooden mallet.

Testing of the tiles

The tiles used for dado including border tiles are to be tested as per IS 13630 from Part I to Part 13 whichever is applicable. In the periodicity of the testing shall be one set of tiles for every 300 Sqm of dado area and part thereof. The tiles used for the flooring are to be tested as per IS 13630 from Part I to Part 13 whichever is applicable and in case of its periodicity of testing may be done as one set of tiles for every 100 sqm and part thereof. The Contractor shall submit the test certificates of the manufacturer (s). Over and above , sample testing shall have to be done as directed by ENGINEER - IN – CHARGE at the risk and cost of the Contractor from Govt. laboratories / testing houses .

8.3 Deleted

8.4 Vitrified Tiles

8.4.1 Vitrified Tiles in Flooring

The Vitrified tiles wherever shown on drgs / schedule of finishes shall be polished / satin matt finished of sizes 595 x 595 mm not less than 10 mm thick, jointed in neat white cement and pointed in white cement with pigment to Match. The colour / shade of the same shall be as approved by PM nearly matching with colour / shade if specified in drawings. Tiles shall be of first quality of Group B1 a confirming to IS: 13006/EN 176 Group B1a. The tiles shall be laid on 10 mm thick cement mortar (1:3) over 20mm thick PCC (1:2:4 type BO over neat cement slurry @3 kg / sq.m over RCC slab in first and subsequent floors. In the ground floor, the tiles shall be laid on 10 mm thick cement mortar (1:3) over 20mm thick PCC: (1:2:4) type BO over 75 mm thick PCC (1:4:8) type D-2 over rammed earth. Tiles shall be laid as per pattern shown on drawing or as directed by PM.

8.4.2 Vitrified Tiles in Skirting

Where shown on drawings/Schedule of finishes provide skirting of glazed vitrified tiles of specified size (or nearest available size) & specified thickness and height with shade matching with floor or as approved by PM. The tiles shall be laid over 10mm thick screed of cement mortar (1:3) set and jointed in neat cement slurry and pointed in white cement with pigment to match. Tiles shall be of first quality. The workmanship and lying of tiles shall be all as specified in clause 13.41 of MES Sch 2009 Part-I on page 306.

8.5 Granite Floor and Cladding

Sampling

Granite need for floor & cladding work shall be sampled and criteria for selection shall conform to IS 3376-1974 and IS 14223 (Part-I):1995 and as per PWD specification .

Variation efface dimensions on any granite shall not exceed 1 mm in 900 mm

Total variation of thickness on any granite shall not exceed ± 3 mm

Any bow or twist on finished faces of any stone shall not vary from the plane by a dimension exceeding 1 mm in 1200 mm.

All granite, unless otherwise designed, shall stand up square at all face corners so that any deviation in length or heights dimensions is reasonably uniform.

Water absorption shall be maximum 0.5 with a dry density of 2.60 to 2.68 .

Cutting, Drilling and Fitting

Provide holes required for anchors, cramps, dowels and other devices requires to support stone and to accommodate other items that connect to or penetrate the stone.

Include all cutting, drilling and fitting of stonework required to accommodate the work of other trades. In cutting and fitting, carefully cut and grind edges to a neat tight fit. Execute cutting in such a manner so as not to impair strength or appearance of stone. Use physical templates from the proper trade for all cutting and drilling of work.

Treatment of Granite

Mortar mixes, setting beds, leveling screed and joint sealant shall be as specified and to approval.

Where required granite joints shall be sealed with joint sealant.

Where required shall be grouted with Elastiment Grout.

Fabric mesh reinforcement shall be incorporated in the leveling screed exceeding 75 mm thick.

Leveling screed shall be laid to the required thickness as indicated in the Contract Drawings or as required by the Architect.

Setting Generally

When ready for setting, all stone units shall be clean and free from stains , dirt or dust. If necessary scrub face with mild soap and clean water applied with stiff fibre brushes. Rinse well with clean water.

Keep exposed faces of stone units free of mortar or joint sealant. And mortar or joint sealant that gets on exposed faces shall be immediately removed. To prevent marking of stone masking tape shall be applied to either side of the joint. The materials, labours etc deemed to have been included in the rate quoted by the Contractor and no claim in this regard shall be entertained by ENGINEER - IN – CHARGE.

8.6 Marble in Floor, Tread & Counter Top

8.6.1 General

Marble / Granite shall be hard, sound, dense and homogeneous in texture in accordance to the sample & of the required size and thickness approved by the Engineer. It shall be reasonably uniform in colour, texture, pattern & shape and free from stains, cracks, decay and weathering and of specified quality, size and thickness. The slabs shall be pre-polished or as specified. Before placing order a samples of the flooring shall be installed at the site and got approved. The granite slabs shall be mirror polished or as specified.

8.6.2 Dressing of Slabs

Every stone shall be prepolished and accurately machine cut to the required size and shape so that a straight edge laid along the side of the stone is fully in contact with it. For patterned flooring actual dimensions shall be taken at the site and shop drawings in suitable scale prepared to identify correctly the sizes and shapes of all stones. Each stone shall be marked with a suitable identification number. All angles and edges of the granite slabs shall be true, square or angular as required and free from chippings and . the surface shall be true and plane.

The thickness of the slabs shall be shown in the drawing with allowable tolerance of ± 2 mm. In respect of length and breadth of slabs a tolerance of ± 5 mm will be allowed.

8.6.3 Laying / Finishing

Sub-grade concrete or the R.C.C. slab on which the slabs are to be laid shall be cleaned, wetted and mopped. For patterned work the stone shall first be laid in position loose to ensure achievement of the required pattern and any adjustments required shall be made and

all stone shall be wetted and washed just before placing and the bedding for the slabs shall be with mortar as described in the item.

The average thickness of the bedding mortar under the slab shall be to suite the overall thickness of flooring specified and the thickness at any place under the slab shall not be less than 12 mm.

Mortar of the specified mix shall be spread under the area of each slab, roughly to the average thickness specified in the item. The prepolished slabs shall first be laid on top of the mortar in accordance with the approved drawing and pressed tapped with wooden mallet and brought to proper level in continuity with the adjoining slabs. It shall be lifted and laid aside. The top surface of the mortar shall then be corrected by adding fresh mortar at hollows. The mortar shall be allowed to stiffen slightly & uniformly and cement slurry of honey like consistency shall be spread over the same at the rate of 4.4 kg of cement per sq.m. The edges of the slab already paved shall be buttered with grey or white cement with or without admixture of pigment to match the shade of the slabs as given in the description of the item. The slab to be paved shall then be lowered gently back in position and tapped with wooden mallet till it is properly bedded in level and line with as fine a joint as possible. Subsequent slabs shall be laid in the same manner. After each slab has been laid, surplus cement on the surface of the slabs shall be cleaned off. The flooring shall be cured for a minimum period of seven days.

The surface of the flooring as laid shall be true to falls and, slopes as required The slabs shall be matched as shown in drawing or as instructed by the Engineer.

Slabs which are fixed in the floor adjoining the wall shall enter not less than 12 mm under the plaster skirting or dado. The junction between wall plaster and floor shall be finished neatly and without waviness. Wherever required the flooring shall be laid in patterns and / or with brass divider strips as required.

The day after the slabs are laid all joints shall be cleaned of the cement grout with a ,wire brush or trowel to a depth of 5 mm and all dust and loose mortar removed and cleaned. Joints shall then be grouted with white cement mixed with or without pigment to match the shade of the topping of the wearing layer of the slabs. The Plaster of Paris slurry shall be applied to the entire surface of the slabs in a thin coat to protect the surface from abrasive damage.

Before handing over the protective cover shall be removed carefully and the surfaces cleaned and carefully rubbed with a "namdah" block to leave a clean & shining floor without any defects to the satisfaction of the Engineer. If any slab is disturbed or damaged, it shall be refitted or replaced and properly jointed. The finished floor shall not sound hollow when tapped with a wooden mallet.

8.6.4 Marble in Skirting, Dado and Risers

Material shall be of approved quality and shade in matching with the floor stone and shall have correct sizes and thickness as mentioned in items or drawings. Preparation of base surfaces, laying etc. shall be same as per Kotah stone in dada and skirting as stated here-in-before. Pointing of stone shall be with matching pigmented white / grey cement slurry as directed.

8.7 Deleted

8.8 Cement Concrete Flooring (Indian Patent Stone)

Materials

The specifications for materials, grading, mixing and the quantity of water to be added shall generally conform to their relevant specifications described under plain and reinforced concrete. The maximum size of coarse aggregate shall be 10 mm. The fine aggregate shall

consist of properly graded sand. Concrete shall be mixed preferably by machine, and hand)mixing shall be avoided as far as practicable.

Preparation of Base

The base concrete surface shall be thoroughly chipped to remove laitance, caked mortar, loose sand, dirt etc. cleaned with wire brush and washed clean and watered until no more water is absorbed. Where the base concrete has hardened so much that roughening the surface by wire brushes is not possible, the same shall be roughened by chipping or hacking at close intervals. The surface shall be soaked with water for at least 12 hours and surface water removed and dried before laying the topping. Before laying the concrete, cement slurry at 2.75 kg/sqm. of surface shall be applied for better bond. Concrete flooring shall then be laid in alternate bays in pattern and joints, wide / flush as per drawing. The edge of each panel into which the floor is divided shall be, supported by wooden or metal strips duly oiled to prevent sticking. Exact size of panel shall be decided by the Engineer to suit the size of the room. Where PVC / aluminium / Glass dividing strips are proposed to be provided, the same shall be fixed in cement mortar 1:2 @ 600 mm. centres or as specified in the schedule for full depth of the finished floor.

The depth of dividing strips shall be the thickness as proposed for the finished floor in the item. The dividing strips or bars should be removed before fining in the adjoining panel in case of flush joints. Alternate panels only may be cast on same day. At least 48 hours shall elapse before the concreting of adjacent bay is commenced.

Mixing

The topping concrete shall be of mix of one part of cement, two parts of sand and 4 parts of well graded stone chips of 10 mm maximum size. The ingredients shall be thoroughly mixed with just sufficient water to the required plasticity, having water cement ratio not more than 0.45.

Laying

The free water on the surface of the base shall be removed and a coat of cement slurry to the consistency of thick cream shall be brushed on the surface. On this fresh grouted base, the prepared cement concrete shall be laid immediately after mixing. The concrete shall be spread evenly and laid immediately after mixing. The concrete shall be spread and leveled carefully. The concrete shall be completed and brought to the specified levels by means of a heavy straight edge resting on the side forms and down ahead with a sawing motion in combination with a series of lifts and drops alternatively with small lateral shifts, either mechanically or manually as directed by the Engineer.

While concreting the adjacent bays, care shall be taken to ensure that the edges of the previously laid bays are not broken by carelessness or hand tamping. Immediately after laying the concrete, the surface shall be inspected for high or low spots and any needed correction made up by adding or removing the concrete and whole surface is again leveled. When the layer is made even, the surface shall be completed by ramming or beating and then screed to a uniform line and level. Before the initial set commences, the surface shall be trowelled to smooth and even surface free from defects and blemishes and tested with straight edges. No dry cement or mixture of dry cement and sand shall be sprinkled directly or empty gunny bags spread over the surface of the concrete to absorb excess water coming on top due to floating.

Finishing the Surface

After the concrete has been fully compacted, it shall be finished by trowelling or floating. Finishing operations shall start shortly after the compaction of concrete and shall be spread over a period of one to six hours depending upon the temperature and atmospheric conditions.

The surface shall be trowelled intermittently at intervals for several limes so as to produce a uniform and hard surface. The satisfactory resistance of floor to wear depends largely upon

the care with which trowelling is carried out. The object of trowelling is to produce as hard and close knit a surface as possible. The lime interval allowed between successive trowelling is very important. Immediately after laying only just sufficient trowelling shall be done to give a level surface. Excessive trowelling in the earlier stages shall be avoided as this lends to work a layer rich in cement to the surface, some lime. After the first trowelling, the duration depending upon the .temperature, atmospheric conditions and the rate of setting of cement used, the surface shall be retrowelled many limes at intervals to close any pores in the surface, and to bring to surface and scrap off any excess water in concrete or laitance (it shall not be trowelled back into the topping). The final trowelling shall be done well before the concrete has become too hard but at such a time that considerable pressure is required to make any impression on the surface. Trowelling of rich mix of dry cement and fine aggregate on to the surface shall not be permitted. Trowel marks should not be seen on the finished surface.

Where broom finish is specified, after the concrete has been thoroughly compacted, and when most of the surface water has disappeared, the surface shall be given broom finish with an approved type of brass or M.S. fibre. The broom shall be pulled gently over the surface from edge to edge in such a manner that corrugation shall be uniform in width and depth, the depth shall be not more than 1.5 mm. Brooming shall be done when the concrete is in such a condition that the surface will not be torn or unduly roughened by the operation. Coarse or long bristles which cause irregularities or deep corrugation shall be trimmed out. Brooms which are worn or otherwise unsatisfactory shall be discarded.

After the concrete in the bays has set, the joints of the panels should be filled with cement cream and neatly floated smooth or jointed. Care should be taken that just the minimum quantity of cream for joint is used and excess spilling over the already finished surface shall be removed when the cream is still green.

In case of wide joints the same shall be filled with pigmented cement concrete (1:2:4) using approved pigment and the joint shall be finished in perfectly straight line.

Curing

The completed flooring shall be protected from sun, wind and rain for the first two days and movement of persons over the floor is prohibited during this period. The finished surface shall be covered and cured continuously form the next day after finishing, at least for a period of 7 days. Bonding with murrum for curing is prohibited as it will leave permanent stain on the finished floor.

Curing, shall be done by spreading sand and kept damp throughout the curing period of seven days minimum. The surface shall be protected from any damage to it whatsoever. The surface shall then be allowed to dry slowly. All corners, junctions of floor with plastered wall surface shall be rounded off when required at no extra cost.

8.9 Deleted

8.10 Deleted

8.11 Interlocking Pre-cast tiles flooring.

Providing and laying 50mm thick factory made cement concrete interlocking paver block of M-25 grade made by block making machine over 50mm thick fine sand over 75mm thick PCC 1:5:10 type Pin the location as shown on drawing. The interlocking paver block surfaces to be compacted with brator. The approve size and design/ shape laid in required colour and pattern as directed by PM. the same will be measured and paid under schedule A Section IV (Road and Path). The colour of interlocking paver block to be approved by PM.

8.12 Mode of Measurement

The rate for flooring and skirting shall be in square metre of the area covered.

The length and width of the flooring shall be measured net between the faces of skirting or dado or plastered faces of walls, which is the proudest.

All openings in flooring exceeding 0.1 sqm. in area where flooring is not done shall be deducted and net areas only shall be measured and paid for. Flooring under dado, skirting or plaster shall not be measured for payment.

Nothing extra shall be paid for laying the floor at different levels in the same room. The dimensions shall be measured upto two places of decimals of a metre and area worked out upto two places of decimal of a square meter.

9.0 Painting

9.1 Scope of work

The scope of work as enumerated under this tender includes painting of external plastered and concrete surface, steel work, timber surfaces, pipes, as detailed in the Bill of Quantities. The work shall be carried out as per IS and PWD specification and also as directed by ENGINEER - IN - CHARGE.

9.2 Materials

The paints to be used for this work shall be of first class quality paint of reputed manufacturers and of approved type by ENGINEER - IN - CHARGE.

9.3 Preparation prior to painting

The surfaces to be painted shall be thoroughly cleaned of all dirt, cement slurry with coir or wire brush. The slight surface cracks shall be made good with hard stopping or filled with approved compound. Special care shall be taken in case of exposed concrete or shutter finish work. Besides whatever is been mention about, preparation shall be strictly in accordance with manufacturers instructions.

9.4 Finishing Coats

All earlier coats of paints shall be thoroughly dry before subsequent coats are applied and shall be rubbed down with fine sand paper. The finishing coats are intended generally as follows: (The exact type of finish shall be as described in Bill of Quantities).

External wall surface Cement based waterproofing paint/Textured paint or as directed by ENGINEER - IN – CHARGE.

9.5 Samples

The Contractor shall be required to prepare the sample of painting at least three different samples or combinations(each sample not exceeding approx. 4 M2 in area) at the site for approval as per the painting scheme prepared by ENGINEER - IN – CHARGE at his own risk and cost.

9.6 Mode of Measurement

All measurement unless otherwise specified in these documents shall be as per latest Indian Standard and PWD specifications for mode of measurement.

9.7 General

The rates shall include for all materials like putty, fillets, rubbing compound primer, paint etc. as also labour for repertory works and painting all for a completed item of work..

The work shall be done as per best engineering practice. Samples and shades of paint should be approved by ENGINEER - IN – CHARGE prior to execution of work. Consumption of materials and the special precautions etc. shall be as per manufacturer's specifications. Necessary equipment for spray painting shall be supplied by the Contractor. Guaranty /warranty for paint should be given by the manufacturer along with cross warranty for entire work by the Contractor.

9.8 Primer

All surface for painting, if they are new, should have a coat of priming before application of the paint. The primer should be of approved quality as directed by ENGINEER - IN – CHARGE quality of ready mix primer.

9.8.1 Wood Primer

Wood primer of approved brand (by ENGINEER - IN - CHARGE) and as per manufacturer's specification is to be applied on the wooden surface which would be free from moisture and loose particles.

9.8.2 Steel Primer

For steel surface red oxide primer , zinc chromate primer of approved brand by ENGINEER - IN – CHARGE and is to be applied on the surface as per manufacturer's specification and as approved by ENGINEER - IN - CHARGE. The surface should be made free of grease, rust, moisture and loose particles. All blistered surface should be made free by hammering, filling or otherwise so as to have smooth surface before priming.

9.8.3 Cement Primer Coat (Alkali Resisting Primer)

Cement primer coat is to be used as base coat on wall finish of cement, lime or lime cement plaster or on asbestos cement surface before application of any wall coating e.g. oil bound distemper oil based paints, synthetic enamel, plastic emulsion etc. on them. The cement primer is composed of a medium and pigment which are resistant to the alkalis present in the cement, lime or lime cement in wall finish and provides a barrier for the protection of subsequent coats of oil bound distemper or paints. Priming coat shall be preferably applied by brushing and not by spraying. Hurried priming shall be avoided particularly on absorbent surface. New plaster patches in old work before applying oil bound distemper paints etc. should also be treated with cement primer. The surface shall be thoroughly cleaned of dust, all white or colour wash by washing and scrubbing. The surface shall then be allowed to dry for at least 48 hours. It shall then be sand papered to give a smooth and even surface. Any unevenness shall be made good by applying putty, made of plaster of Paris with water on the entire surface including filling up the undulation and then sand papering the same after it is dry. The cement primer shall be applied with a brush on the clean dry and smooth surface. Horizontal stroke shall be given first. Vertical strokes are to be applied after horizontal stroke is absorbed on wall/ ceiling surface immediately afterwards. This entire operation will constitute one coat. The surface shall be finished as uniformly as possible leaving no brush mark. It shall be allowed to dry for at least 48 hours before oil bound distemper or paint is applied. The entire process of application shall conform to manufacturer specification and as per IS and PWD specification, as per decision / directive of ENGINEER - IN - CHARGE.

9.9 Waterproofing Cement base paint

Waterproof cement based paint of approved manufacturer, and IS code 5410:1992 Part 2 : 1972 of desired shade/shads shall be applied over the Cement primer coat. Ensure that the surface is thoroughly dry before painting to avoid premature paint failure. When preparing the

surface for painting ensure that all loose and flaking paint or foreign matter is removed and get an absolute smooth surface dried at ambient temperature outside. Wherever textured paint is applied it is to be ensured that the textured matt finish of smooth granular feeling is obtained after application of 2 coats of "Weather shield" or equivalent compound of reputed manufacturer as approved by ENGINEER - IN - CHARGE acrylic exterior textured paint. The entire process of application shall conform to manufacturer specification and as per IS and PWD specification.

9.10 Acrylic Emulsion Paint

Finishing of the external wall surfaces will be provided with 2(two) coats of premiere exterior acrylic emulsion paint of approved make as specified including one coat of acrylic based water thinable exterior primer as an under coat. The surface area coverage and preparation shall be strictly in accordance with manufacturer's instructions.

9.11 Precaution

Brushes should be quickly washed in water, immediately after use and kept immersed in water during break periods to prevent the paint from hardening on the brush.

In the preparation of walls for plastic emulsion painting, an oil base putty shall be used in filling cracks, holes etc.

Splashes in floors etc. shall be cleaned out without delay as they will be difficult to remove after hardening.

Washing of surface treated with emulsion paints shall not be done within 3 to 4 weeks of application or the time specified by manufacturer.

9.12 Painting Synthetic / Plastic Emulsion

Ready mixed oil paint, plastic emulsion paint, ready mixed synthetic enamel paint, Aluminium paint, etc., shall be brought in original containers and in sealed tins. If for any reason thinner is necessary the brand and quantity of thinner recommended by the manufacturer or as instructed by the HPCL I Architects shall be used.

The surface shall be prepared as recommended by the manufacturers and as instructed by the HPCL I Architects and cost of approved primer shall be applied. After 24 hours drying, approved of specified quality paint shall be applied evenly and smoothly. If required filler putty coating may be given to give smooth finish. Each coat shall be allowed to dry out thoroughly and then lightly rubbed down with sand paper and cleaned of dust before, the next coat is applied. Number of coats shall be as specified in the item and if however the finish of the surface is not uniform additional coats as required shall be applied to get good and uniform finish at no extra cost. After completion no hair marks from the brush or clogging of paint puddles in the corners of panel angles of mouldings shall be left on the work. The glass panes floor etc. shall be cleaned of stains.

10.0 Waterproofing

10.1 Waterproofing for underground reservoir

10.1.1 Proposed system

- ✓ **SikaTop Seal 107**, acrylic, cementitious waterproof coating
- ✓ **Intraplast EP**, Expanding grout admixture
- ✓ A food grade epoxy coating **Sikagard 67** on concrete

10.1.2 Surface Preparation

- ✓ Clean the PCC surface from dust, oil, grease, loosely adhering particles etc. Apply 12mm plaster (C:S::1:3) on the surface.

10.1.3 Application Methodology

Slab

- ✓ Apply two coats of acrylic cementitious waterproof coating of Sika® Top Seal 107 on the prepared substrate.
- ✓ A 12mm thick plaster (C:S::1:4) should be given on the waterproof coating before fixing of the reinforcements. The plaster should be prepared by mixing an integral waterproofing compound, Plastocrete Plus @ 100gms per bag of cement.
- ✓ Drill hole up to half of the depth of the concrete and fix nozzles min. 15mm dia, 100mm long GI nozzle 1.5 m C/C in a grid pattern in the interior surface of retaining wall with the help of quick setting compound Sika 2.
- ✓ Extra nozzle should be provided on the construction joint.
- ✓ Inject Cement slurry enriched with Intraplast EP- Non shrink grouting compound through the fixed nozzle in a pressure of 2.8 kg /cm² with the help of hand operated grouting pump. Injection operation should be executed after 28 days of concreting.

Wall

- ✓ After the release of shuttering, repair all bug or pin hole with polymer modified mortar on the exterior surface of underground retaining wall.
- ✓ Make a 20X20 groove along with the construction joint and seal the same with polymer modified mortar, specially the starter joint of the retaining wall.
- ✓ Prior to apply SikaTop Seal 107, the surface should be made SSD.
- ✓ Apply first coat of SikaTop Seal 107 over prepared surface. Coating should be continued over the projected portion of the raft and also 300mm above from the G.L. Allow the coated surface air cure for 4 hrs.
- ✓ Before application of 2nd coat, surface should be wet again with the help of sprinkling water. Apply second coat of SikaTop Seal 107 over the executed first coat.
- ✓ The coating shall be covered with 12 mm thick plaster added with waterproofing admixture Plastocrete Plus 0.2% by weight of cement with a cement - sand mortar (1:4).
- ✓ Drill hole up to half of the depth of the concrete and fix nozzles min. 15mm dia, 100mm long GI nozzle 1.5 m C/C in a grid pattern in the interior surface of retaining wall with the help of quick setting compound Sika 2.
- ✓ Extra nozzle should be provided on the construction joint.
- ✓ Injection grouting shall be executed as mentioned above.

After necessary surface preparation, apply two coats of water based, food grade epoxy coating **Sikagard 67** on the RCC surface from inside. This is two component system, comp.A : comp.B:: 1:1 by weight and density is 1.2 kg/l.

10.2 Waterproofing for Roof

10.2.1 Proposed system

- ✓ **SikaTop 77**
- ✓ Screed with panels

10.2.2 Surface Preparation

- ✓ The substrate shall be rendered sound, free from contaminants such as fungus, algae, dust, etc., by removing all weak layers and cleaning with up to 5% solution of Sodium Hypochloride and using water jet.
- ✓ The drainpipe openings shall be just above the prepared substrate and if they are not, either the substrate shall be repaired or the drain pipe relocated suitably.
- ✓ Should any defect be present in the substrates, the contractor or applicator shall carryout all the necessary rectification works and preparatory works before the installation of the specified waterproofing system.
- ✓ Cracks running through the sections shall be repaired using low viscosity, solvent free epoxy injection resin system, Sikadur 53 UF.
- ✓ Any surface cracks shall be chased open into a 'V' groove, and filled with Sika Latex modified cementitious mortar. In case the cracks are " Live " , it is recommended to seal the same with a flexible single component polyurethane sealant Sikaflex Construction after opening up the joint in a V groove.
- ✓ Special attention shall be given on substrate preparation on the internal surfaces of drain pipe openings to ensure it is carried out to properly.
- ✓ The detailing at the penetrations of any pipes, cables, air-con mountings, etc., shall be carefully carried out as specified by the architect.

10.2.3 Application Methodology

- ✓ The prepared substrate shall be treated with SikaTop Seal 107, a two component acrylic polymer modified, cementitious, ready to use waterproofing slurry in two coats at right angles to each other and taking the coatings over the vertical parapet up to at least 300mm on the exterior surface of the parapet.
- ✓ Special care shall be taken to ensure proper coating of the inner surfaces of the drain openings in the parapet wall
- ✓ When the cementitious membrane is dried, an acrylic bond coat of SikaTop 77 shall be applied. When the bond coat becomes tacky, the treated roof area shall be laid with avg. 75mm thick concrete screed admixed with the waterproofing admixture, Plastocrete Plus,

ensuring that the screed gently slopes towards the drain pipes. The concrete screed should be cast in panels of 2mx2m maintaining 10mmx10mm groove using solvent free polyurethane pavement sealant, Igas Ih.

All corners and joints such as those between the parapet wall and the roof slab, chimney and roof slab, etc shall be chamfered with 150mm X 150 mm fillet of mortar (Cement: sand – 1:4) admixed with **SikaTop 77**. Before chamfering a prime coat shall be given with the slurry of **SikaTop 77**.

10.3 Waterproofing for Toilet

10.3.1 Proposed system

- ✓ SikaTop Seal 107, acrylic cementitious waterproof coating
- ✓ Coving with acrylic emulsion and waterproof additive SikaTop 77
- ✓ Sealing of pipe mouth with Sikagard 694 F (I), moisture insensitive epoxy putty
- ✓

10.3.2 Surface Preparation

- ✓ Clean the RCC surface from dust, oil, grease, loosely adhering particles etc. and it should be rendered smooth with cement sand mortar.

10.3.3 Application Methodology

- ✓ A 1:3 cement — sand mortar, mixed with SikaTop 77 — the polymer modified high quality emulsion, shall be installed as a coving at the corners of floor and the vertical surface in the sunken area, and between floor and walls in the remaining area.
- ✓ SikaTop Seal 107 — the cementitious, flexible waterproof coating shall be applied onto the prepared surface in a continuous film on the floor of the sunken area, taking the coating over the vertical surfaces on to the floor and over the coving on to the wall (before tiling) to at least 300mm above the final finished floor level. The coating shall also be continued on to the inner surfaces of the pipe penetration holes. Two coats shall be applied. The coating shall be protected with 15mm plaster admixed with Plastocrete Plus, an integral waterproofing compound @ 100gms per bag of cement.
- ✓ Tiles are to be fixed with ready to use tile adhesive for vitrified tiles, Sika Ceram (Grey).

Pipe penetrations

Where the pipes are already installed:.

Sikagard 694F(I), a Moisture insensitive epoxy putty shall be installed in a continuous, 10mm thick gasket around the pipes to a width of approximately 15mm.

10.4 Water Proofing of Basement Raft and Wall

10.4.1 Scope

This specification covers the waterproofing system for concrete underground structure & basements.

10.4.2 General

Quality assurance: All products in the system shall meet the key performance properties listed in Section A against each and shall be sourced from a manufacturer with a certified QA system such as, ISO 9001 or an established and proven QA system that has ensured consistent products.

Approved sources: All products in the specified system shall be sourced from a single manufacturer, from amongst the list of approved products and sources for each in Section D.

Installation: All the products/systems specified in this document shall be installed by a Specialist Applicator approved by the manufacturer strictly in accordance to the written application guide by the manufacturer.

Multiple sources and compatibility: Should the Specialist Applicator or the Contractor want products from different sources, they shall submit proof of compatibility between the products of different sources.

Alternate equivalents: Should the Specialist Applicator or Contractor prefer to use alternative equivalent product(s) to the approved list in Section B, it can only be after obtaining a written approval by the Specifier for use of the preferred alternative; such approvals can only issued by the Specifier after establishing conformity to the specified key performance properties.

10.4.3 Substrate preparation

Before starting to install the specified waterproofing system, the substrate shall jointly be inspected by the Contractor and the Specialist Applicator for soundness; any defects shall first be repaired utilising products and systems compatible with the specified waterproofing system.

10.4.4 The Waterproofing System

The specified waterproofing system for the underground structure / basement comprises of the following systems for vertical & horizontal surface and different parts of the basement viz. Raft Slab, Retaining Wall, Pile head Treatment or rock anchor pipe sleeve or pressure release pipe sleeve; each generic product specified shall meet the key performance properties in Section A.

Low permeability concrete slab

Smart Dynamic Concrete shall be used to cast the basement floor raft and retaining walls, using approved admixtures; the concrete should exhibit tensile strength of minimum 1.5 MPa.

10.4.5 Waterproofing system for basement Raft slab

Providing and installing geotextile of 500gsm as correction/ slippage layer horizontally and (Masterpren BG/FR) 2.0mm thick single ply PVC loosely laid membrane waterproof system. The system to be installed over the hardened well levelled surface of the PCC or Blinding levelling course. The (Masterpren BG/FR) 2.0mm thick, single ply twin coloured plasticised PVC membrane system shall be compartmentalised & injection pipettas using PVC surface waterstop & pitpettas at required locations, based on the site requirements. To be done before the raft concreting

(For System Layer Built-up and Installation details please refer to the Submittal and Method Statement of the system by the manufacturer)

10.4.6 Waterproofing membrane for retaining wall

Providing and installing geotextile of 300gsm as correction/ slippage layer and (Masterpren BG/FR) 2.0mm thick single ply, twin coloured, and plasticised PVC membrane waterproof system. The system to be installed over the hardened well levelled surface. The (Masterpren BG/FR) 2.0mm thick, PVC membrane system shall be compartmentalised using PVC surface waterstop at required locations, based on the site requirements.

(For System Layer Built-up and Installation details please refer to the submittal and Method Statement of the system by the manufacturer)

10.4.7 System for watertight construction joints

Hydroswellling Gasket

All construction joints shall be installed with Masterflex 610, 20mm x 10mm cross-sectional sized hydro-swelling water bar based on advance vinyl acrylate polymers. The water bar shall be formulated to exhibit low pre-mature swelling (less than 50% within 12 hours) and shall not be based on super absorbents. The water bar shall have low swelling pressure; not exceeding 0.25 MPa at full swelling capacity. The water bar shall be installed with special adhesive, Masterflex 610 glue and not to be fixed using nails.

All below grade construction joints shall incorporate the Masterflex 610 swelling gasket which shall be capable of performance in the following manner:

- ✓ Must Swell in contact with water by up to 150%, effectively seal the joint.
- ✓ Must be effective even in saline water.
- ✓ Elastomeric: Keeps swelling and reverting to original volume throughout the life of structure.

The product system shall be installed by an experienced specialist applicator, certified by BASF with experience of more than three years with Masterpren membrane waterproofing system only

Pipes/penetrations – joints:

The joint between the pipes / penetrations and the substrate shall be made watertight using hydro swelling gasket system and Non-shrink cementitious grout. Swelling gasket paste and hydro swelling water bar shall be applied as gaskets on the inner surface of the holes and on the pipes / penetrations respectively, before insertion.

Non shrink cementitious grout shall be filled in the annulus space between the pipes / penetrations and concrete.

Encapsulation of interface between Metal Installation / upstands / pile head & the installed PVC membrane system.

The PVC membrane is dressed up to the outer surface of the installation or up stand. This membrane is then encapsulated in with an epoxy grout. The grout has a minimum thickness of 10mm below the membrane and mini 20mm on top of it. The grout is extended to the edge of outer surface of the interface.

10.4.7 Key performance properties of the specified products

SECTION A

PVC Membrane Waterproof System

The synthetic PVC twin colour membrane with signal layer, it shall have light green upper surface and lower surface in black colour for visual quality check, (Masterpren BG / FR), manufactured by co-extrusion in a UNI EN ISO 9001:2000 and UNI ENI 14001:2004 certified plant, shall be thickness 2mm, roll width of 2.10 meters, with the physical-chemical properties as mentioned below:

Properties	Values	Test Method
Thickness (mm)	2.00	UNI EN 1849-2
Specific Weight (Kg/m ²)	2.860	UNI EN 1849-2
Ultimate Tensile Strength (N/mm ²)		
Transverse	≥ 16.7	UNI EN ISO 527-3
Machine Direction	≥ 16.7	
Elongation at break (%)		

Transverse	310 (-30)	UNI EN ISO 527-3
Machine Direction	310 (-30)	
Puncture resistance (mm)	≥ 1100	DIN 16726-5.12
Hydrostatic Pressure resistance (6 hours at 5 bar)	Waterproof	UNI EN 1928 Method B
Root Resistance (N/mm)	No penetration	DIN 4062
Tear Resistance (N/mm)	≥ 45	ISO spec fig 2
Resistance to static puncture (N)	≥ 2300	(CBR) UNI EN ISO 12236
Fire Behaviour	Class E	EN ISO 11925-2

The membrane shall be of a twin colour co extrusion to give a visual indication when damage occurs, it shall act as a signal layer. The membrane shall be double seam welded which shall be subject to a pneumatic test at 2 bar pressure. The material shall be capable of being welded to the surface PVC water stop with welding fins, to compartmentalize the structure at the construction joints. The slip membrane under the membrane shall be a geotextile manufactured from virgin polypropylene and shall be with a specific weight of minimum 300gsm up to 500 gsm.

The vertical protection shall be with a specific weight of maximum 500 gsm

The horizontal protection over the membrane shall be geotextile layer followed by minimum 50 mm thick screed, to facilitate the installation and tying of reinforcement bars for casting of raft.

The encapsulation of interface junction of membrane with up stands or pile head, shall be treated as shown in the section details along with epoxy grout material by encapsulation method with the following properties:

PROPERTIES	VALUES
Mix Density :	2400 kg/m ³
Volume solids :	100 %
Pot life :	50 Minutes at 25°C 25 Minutes at 40°C
Compressive strength (BS 6319, part 2) :	80 MPa at 1 Day 90 MPa at 3 Days 100 MPa at 7 Days
Flexural Strength (BS 6319, part 3) :	25 MPa at 7 Days
Tensile Strength (BS 6319, part 7) :	11 MPa at 7 Days

Approved products

The following products from their respective manufacturer for each type of product meet the specified key properties in Section D and are approved for use in this job..

Type of product	Approved products	Manufacturer
Admixtures for Self Compacting Concrete	Glenium xxx	BASF
Single Ply PVC membrane system	Masterpren BG/FR	BASF
Hydro-swelling waterbar	Masterflex 610	BASF
Swelling gasket paste	Masterseal 612	BASF
High modulus polyurethane joint sealant	Masterflex 474	BASF

Re-injectable hose system	Masterflex 900	BASF
Water swellable injection grout	Masterflex 801	BASF
Low to medium modulus polyurethane joint sealant	Masterflex 472	BASF
Epoxy Grout / Mortar	Masterflow 410 PCT	BASF

10.4.8 Testing

The performance of applied system shall be tested as below:
After completion of installation of the PVC membrane system each joint shall be tested as per the test procedure defined by the manufacturer and recorded.

10.6 Guarantee

All the specialist water proofing agency/s shall provide performance guarantee of the water-proofing system on non-judicial stamp paper of appropriate value in approved format to the Owner through the Main Contractor for a period of ten years after completion of the relevant treatment.

In the event of unsatisfactory performance of waterproofing treatment work, the specialist agency shall undertake to the owner, to carry out necessary remedial / rectification work to render the structure free from leakage/seepage of waterproofing including all associated works that may be necessary in the opinion of the owner at no extra cost.

The specialist agency shall also give a bank guarantee for an amount equal to 10% of the gross amount of water proofing item valid for a period of 10 years from the date of final completion. 50% of this bank guarantee shall be released on satisfactory performance of waterproofing job for a period of 5 years and remaining amount of the bank guarantee shall be released on satisfactory performance for 10 years.

The Main Contractor as well as the specialist agency shall be jointly and severally bound by this agreement.

PERFORMANCE GUARANTEE (ON NON-JUDICIAL STAMP PAPER OF APPROPRIATE VALUE) TO BE EXECUTED BY CONTRACTORS FOR REMOVAL OF DEFECTS AFTER COMPLETION IN RESPECT OF WATERPROOFING TREATMENT

ARTICLES OF AGREEMENT made at Kolkata, this.....day of..... two thousand between State Bank of India, having its registered office at.....hereinafter referred to as the "Owner" (which expression shall include its successors and assigns in law) of one part and Messrs (Main Contractor) & Messrs(Specialist Agency), firms registered under the Companies Apt of 1956 and having their registered office at respectively, hereinafter referred to as the "Guarantor/s" (which expression shall mean and include the partners or partner for the time being of the firm and their or his respective heirs, executors and administrations/its successors and assigns in law) in the other part.

WHEREAS THIS AGREEMENT is supplementary to the Contract (hereinafter called the 'said contract') between the owner and Messrs.....(hereinafter called the 'Contractor'), whereby the contractor inter-alia, undertook to render the building and structures, in the said contract, safe from waterproofing and completely waterproof.

AND WHEREAS THE GUARANTOR/S agreed to give a guarantee to the effect that the said structures will remain waterproof for ten years from the date of providing of waterproofing treatment.

NOW THE GUARANTOR/S hereby guarantees that waterproofing treatment provided by him will render the structures completely waterproof and the minimum life of such waterproofing treatment shall be ten years to be reckoned from the expiry date of maintenance period.

Provided that the guarantor/s will not be responsible for any defects caused by earthquake or misuse or alteration of the structure.

The decision of the Owner with regard to cause of damage/defect shall be final.

During this period of guarantee the guarantor/s shall make good all defects and in case of any defect being found, render the building waterproof to the satisfaction of the owner at his own cost and shall commence the work for such rectification within seven days from the date of issue of the notice from the Owner calling upon him to rectify the defects falling which the work shall be go t down by the Owner by some other contractor at the Guarantor/s cost and risk. The decision of the owner as to the cost, payable by the Guarantor/s shall be final and binding.

That if the guarantor/s fails to make good defects or commits breach thereunder then the guarantor/s will indemnify the Owner and his successors against all loss, damage, cost, expense or otherwise which may be incurred by him by reason of any default on the part of the GUARANTOR/S in performance and observance of this supplementary agreement. As to the amount of loss and/or damage and/or cost incurred by the Owner the decision of the owner will be final and binding on the parties.

Signature of Guarantor
(with office seal)

Signature of Owner
(with office seal)

Witness 1.
Witness 2.

Witness 1.
Witness 2.

11.0 Doors

11.1 Wood Work

The work consists of supply of materials, fabrication, joinery, carpentry, delivery and erection at site on wooden door and window, flush doors as specified in Bill of Quantities. The measurements, materials etc shall be guided by relevant IS code and PWD specification.

11.1.1 Materials

Timber shall be best quality teak locally available or well seasoned Sal wood (as per BOQ) uniform in texture, free from large, loose dead or cluster knots, waves injurious open shakes, discolouration, soft or spongy spots. It shall have uniform colour, reasonably straight grains and shall be free from all defects.

All samples of wood work shall be got approved by ENGINEER - IN – CHARGE before bringing in bulk quantity at site and the samples shall be kept at site for future reference . Samples of wood may be sent for testing in Govt. laboratories / testing houses , if instructed by ENGINEER - IN – CHARGE at the risk and cost of the Contractor. The tests shall be governed by relevant IS codes and PWD specifications . Necessary test certificates shall have to be submitted , if asked for by ENGINEER - IN – CHARGE irrespective of further testing of samples as detailed above .

Wood work abutting against or embedded in masonry or concrete shall be painted with a coat of solignum paint before being placed in position. No wood work shall be painted prior to checking and subsequent approval by ENGINEER - IN - CHARGE.

11.1.2 Fixing/erection in position of door frames

Before the frames are fixed in position, these shall be inspected and passed by ENGINEER - IN - CHARGE. The frames shall be placed in proper position and fixed to the walls with suitable holdfasts/clamps as per PWD and IS specification as shown in drawing.

In case the door frames without sills the vertical members shall be buried in floor 50 mm. deep at least. Sills shall be provided where so directed. The door frames without sills while being placed in position shall be provided with temporary wooden bracings well wedged between the styles at the sill level. The sills shall be retained to keep the frames from warping during construction. These frames shall also be protected from damages during construction.

11.1.3 Shutters (Block Board)

Flush doors shall be solid core type with commercial or decorative faces. All flush door shall be obtained from approved manufacturer. This should be solid core with 1 mm thk. decorative laminates on both sides of approved shade & quality as desired by ENGINEER - IN - CHARGE and as mentioned in the approved list of materials with teak wood lipping all around and bonded with phenol formaldehyde synthetic resin as per IS specification. The specification generally should conform to I.S.2202/1966. Necessary test certificates shall have to be submitted by the Contractor, if asked for by ENGINEER - IN - CHARGE. Samples shall be approved well in advance prior to bringing in bulk quantities at site. Rejected materials shall be removed from site within 48 hours.

11.1.4 Tolerance

Tolerance on width and height shall be + 2mm and on thickness it will be + 1.2mm. The thickness of shutter shall be uniform throughout with a variation not exceeding 0.8 mm. when measured at any two points.

11.1.5 Adhesives

Only synthetic resin adhesives conforming to IS No.IS-851/1964 or latest amendment shall be used for bonding core members to one another including core frame and other exposed parts. The adhesive used for bounding cross band to core and face veneers to cross band shall conform to IS:848/1957 (Phenolic and Aminoplastic), or equivalent IS standards with latest amendment.

11.1.6 Fittings

Fitting shall be of Stainless Steel made of approved manufacturer. These shall be of the following types according to the material used.

The sample of fittings to be actually provided in a particular work shall however be approved by ENGINEER - IN - CHARGE prior to bringing in bulk quantities at site. Approved samples shall be kept at site for any reference.

Screws used for fittings shall be of the same metal.

The rate quoted for doors shall include all necessary hardware and screws as generally required to complete the job, as specified in the relevant items of BOQ and as per PWD and IS specifications.

11.1.7 Measurement

The rates quoted by the Contractor under each item in the Bill of Quantities for a complete finished item of and no claims by the Contractor in this regard shall be admissible. Supplying and fixing of all the fittings and iron mongery shall be deemed to have been included in Contractor's rates and consequently shall not be paid for separately.

11.2 Deleted

11.3 Aluminium

11.3.1 General

Aluminium doors, windows etc. shall be fabricated from approved extruded sections and the manufacture & installation shall be carried out by an approved specialised agency. Unless otherwise specified the fabrication shall be done with heavy gauge extruded box sections. The sections free of scratches shall be of the sizes & details as shown on drawings. The details shown on the drawings indicate generally the sizes of the component parts and the general standards. These may be varied to some extent to suit the standards adopted by the manufacturers of the aluminium work.

All materials and details especially the weather-strip, gaskets and sealants shall be of approved high quality material capable of resisting the local climatical & environmental requirements.

11.3.2 Shop Drawings and Samples

The contractor shall submit complete shop drawings and samples of each type of door, window, ventilators and other aluminium work, to the Architect / Engineer for his approval. The shop drawings shall show full size sections of doors, windows, etc. thickness of metal, details of construction, details of glazing, anchoring details, hardware as well as connection of curtain wall windows, doors and other metal work to adjacent work. Samples of all joints and methods of fastening and joining etc. also shall be submitted to the Architect / Engineer for approval well in advance of commencing the work. Samples of the actual work shall be installed at the site and got approved before proceeding with the work.

11.3.3 Sections

The aluminium extrusions shall be of approved make. The sections shall be extruded from aluminium alloy of commercial quality and free from all defects impairing appearance, strength and durability. Hollow Box sections shall be extruded from Aluminium alloy as per IS:1285. The permissible dimensional tolerances of the extruded sections shall be such as not to impair the proper and smooth function/operation and appearance of doors and windows. For any excess weight of section used nothing extra shall be paid.

The sections shall also conform to the following parameters:

- a) Minimum tensile strength - 19 kg./mm²
- b) Maximum allowable deviation in length from a straight line of 0.5mm/metre.
- c) Maximum allowable deviation from straight of 1 degree.
- d) Maximum permissible twist of 0.5mm metre.
- e) Maximum variation in flatness of not more than 0.125 x width/25.

11.4 Anodizing / Powder Coating

All aluminium materials used shall be colour anodized for protection against corrosion in marine environment in approved shade. The anodic coating shall conform to IS 1868-1968

and shall be of AC20 grade with minimum thickness of 20. Microns when measured as per IS:660/2-1970 and density shall be atleast 32 MG/sqm. The anodic coating shall be tested in an approved laboratory by Eddy current method as per IS.6012 for thickness. Sulphuric acid shall be used as the electrolyte for the anodic process. Prior to anodizing all aluminium shall be rendered uniform in appearance free from disfiguring scratches, stains or other blemishes and etched in a caustic soda solution. Requisite tests shall also be carried out at the site as required by the Engineer and the contractor shall arrange all assistance and equipments required for the purpose.

11.5 Protection and Handling

All aluminium members shall be wrapped with approved self adhesive non-staining PVC tapes and crated in a suitable manner to protect the material against any damage during transportation. The loading, unloading, storing shall be carried out in an approved manner with utmost care.

11.6 EPDM Gasket

EPDM gaskets of approved make, size and profile shall be provided and installed at all locations as shown and as called for to render the installation absolutely air and weather tight.

11.7 Sealant

The gaps between the Aluminium member and the perimeter and also any gaps in the door and window sections themselves shall be raked out as directed and filled with silicon sealant or any other sealant as specified of approved make and colour and make to ensure complete water-tightness.

The silicon sealant shall be of such colour, and composition that it would not stain the masonry/concrete work, shall receive paint without bleeding, will not sag or run and shall not set hard or dry out under any condition of weather. Silicon sealant shall be applied with a special gun as per manufacturers recommendation.

11.8 Aluminium Doors and Windows

11.8.1 Doors

The kick panel shall be of 2.00 mm aluminium alloy sheet conforming to IS Designation NS 3-1/2H of IS 737-1965. Specification for Wrought Aluminium and Aluminium Alloys Sheet and strip (for general engineering purposes) and shall be screwed to the frame and the glazing bar. The hinges shall be stainless steel frictional hinges of same type as in window's but of larger size. The hinges shall normally be of 50mm projecting type. Non projecting type hinges may also be used if approved. The handles for door shall be of specified design and of same specifications as the windows. A suitable lock for door openable either from outside or inside shall be provided. In double shutter doors, the first closing shutter shall have a concealed aluminium alloy bolt at top and bottom shall be so constructed as not to work loose or drop by its own weight.

Single and double shutter doors may be provided with a three way bolting device. Where this is provided in the case of double door, concealed aluminium bolts may not be provided.

11.8.2 Side-Hung Windows & Ventilators

For fixing stainless steel hinges, slots shall be cut in the fixed frame and the hinges inserted inside and may be riveted to the frame. The hinges shall normally be of the projecting type not less than 65 mm and not more than 75 mm wide. The pins for hinges in case of non-oxidised work shall be of stainless steel of non-magnetic type or of suitable

aluminium alloy. However, in the case of anodised work only suitable aluminium alloy for pins shall be used. Friction hinges shall be provided for side-hung shutter windows - in which case peg stay will not be required. In case of non-friction type hinges, peg stay which shall be either of cast aluminium conforming to IS Designation A.5.M of IS:617-1959 or folded from IS Designation NS4 aluminium alloy sheet conforming to IS:737-1955. It shall be 300 mm long complete with peg and locking bracket and shall have holes for keeping the shutter open in three different positions. The peg and locking bracket shall be rivetted or welded to the fixed frame.

The handle for side-hung shutters, shall be of cast aluminium conforming to IS Designation A.5.M of IS:617-1975 and mounted on a handle plate or welded or rivetted to the opening frame in such a way that it could be fixed before the shutter is glazed to match the window. The handle shall be anodised. The handle shall have a two-point nose which shall engage with an aluminium striking plate on the fixed frame in a slightly open as well as in a closed position.

11.8.3 Fabrication

All jointing shall be of mechanical type. The aluminium sections joints shall be designed to withstand a minimum wind load pertaining to the relevant IS code. The contractor should ensure design of the relevant sections and approved the same from the Engineer-in-charge. The designed shall also ensure that the maximum deflection of any framing shall not exceed 1/175 of the span of the member. All members shall be accurately machined and fitted to form hairline joints prior to assembly. The jointing accessories such as cleats, brackets, etc. shall be of such material as not to cause any bimetallic action. The design of the joint and accessories shall be such that the accessories are fully concealed. The fabrication shall be done in suitable sections to facilitate easy transportation, handling and installation. Adequate provision shall be made in the door and window members for anchoring to supports and fixing of hardware and other fixtures as approved by the Engineer. The fabricated frames shall be square and flat with corners in a true right angle.

11.8.4 Installation

Just prior to installation, the doors, windows, etc. shall be stacked on edge on level bearers and supported evenly.

Unless otherwise shown window/door frames shall be fixed to openings with 20mm thick aluminium sub-frames. Width of sub-frame shall be exactly the same width as the frames. The sub-frames shall be pre-fixed to the masonry surrounds with approved fasteners. The face of sub-frame shall be in true line, level and plumb.

When the sub-frame is properly secured and all major internal and external finishing works are completed, the assembled doors/windows shall be placed in correct final position in the opening and fixed to the sub-frame by cadmium plated machine screws of required size and spacing suited to the purpose.

Sizes, details, spacing, etc. given above are approximate and indicative only. They can be varied at the option of Engineer to suit particular sizes and situations and the contractor shall carry out the instructions of the Engineer in this regard at no extra cost to the owner. The contractor may suggest alternative methods of fixing and anchoring for consideration of the Engineer while the decision of the Engineer in this regard shall be final and binding.

In the case of composite windows and doors, the different units are to be assembled first. The assembled composite units shall be checked for line, level and plumb before final fixing is done. Units may have to be assembled in their final location if the situation so warrants.

Where aluminium comes into contact with masonry, concrete, plaster or some dissimilar metal, it shall be coated with an approved insulation lacquer or plastic tape to ensure that

electro-chemical corrosion is avoided. Insulation material shall be trimmed off to a clean flush line on completion.

The contractor shall be responsible for assembling composite units, bedding and pointing with mastic inside and outside, at the transoms and mullions, placing the doors, windows, etc. in their respective openings. After the doors/windows have been fixed in their correct assigned position, the open hollow sections abutting masonry/concrete shall be filled with cement grout (1 cement: 3 coarse sand) densely packed and finished neat. Packing grout shall be of the expanding type made by approved additive.

11.8.5 Protection & Final Cleaning

11.8.6 Deleted

11.9 M.S. Hollow Rectangular Door Frames (I-Type Section)

11.9.1 Materials

Steel door frames shall be manufactured from commercial mild steel sheet of 1.60 mm thickness, conforming to IS 2062 and 4351.

Steel door frames shall be made in the profiles as per drawings and/or as directed by the Engineer-in-charge.

11.9.2 Construction

Each door frame shall consist of hinge jamb, lock jamb, head and if required angle threshold. These shall be welded or rigidly fixed together by mechanical means. Where no angle threshold is required, temporary base tie shall be screwed to the feet of frames in order to form a rigid unit. Where so specified base ties shall be pressed mild steel 1.60 mm thick adjustable to suit floor thickness of 35 or 40 mm and removable, or alternatively, threshold of mild steel angle of section 50 x 25 mm, minimum shall be provided for external doors frames.

11.9.3 Fabrication

The M.S hollow rectangular steel door frames shall be got fabricated in an approved workshop as approved by the Chief Engineer.

11.9.3.1 Fixing Lugs:

There shall be three adjustable lugs with split end tail to each jamb.

The head of the fixing lug shall be 120 mm long and made up flat steel strip 25 mm wide and 1.60 mm thick.

Hinges 100 mm mild steel butt hinges shall be used. Floor door frames 80 cm wide and under, three hinges shall be rigidly fixed to one jamb and for frames of door above 80 cm wide, four hinges shall be rigidly fixed to one jamb, if it is single shutter. Where the height of door shutter exceeds 2.15 metres, one additional hinge shall be provided for every 0.5 m or part thereof of the additional height.

In all cases the hinges shall be so fixed that the distance from the inside of the head rebate to the top of the upper hinge is 20 cm and the distance from the bottom of the door frame to the bottom of the bottom hinge is also kept about 200 mm. The middle hinges shall be at equal distance from lower and upper hinges or as agreed to between the purchaser and the supplier. Hinges shall be made of steel 2.5 mm thick with zinc coated removable pin of 6 m'm diameter. The space between the two leaves of the hinge when closed shall be 3 mm and the

leaf that is not welded to the frame shall have four counter sunk holes to take Number-10 cross recessed head wood screws.

11.9.3.2 Aldrops, Sliding Bolts and Tower Bolts :

Provisions shall be made for aldrops, sliding bolts and tower bolts in the frames as per the positions given by the purchaser. Necessary mortar guards/metallic or nylon bushes shall be provided inside the frames for aldrops, sliding bolts and tower bolts.

11.9.3.3 Lock Strike Plate :

Provision shall be made to fix lock strike plates of mortise locks or latches, complying with the relevant Indian Standards. A slot suitable for lock strike plate shall be pierced into the rebate of the frame and necessary fixing arrangement and mortar guard from the inside of the frame shall be provided.

11.9.3.4 Shock Absorbers:

For side-hung door there shall be not less than three buffers of rubber or other suitable material inserted in holes in the rebate and one shall be located at the centre of the lock jamb of frame and other two shall be 300 mm from top and bottom of the frame. For double leaf doors two buffers shall be provided.

11.9.4 Finishing

The surface of door frame shall be thoroughly cleaned, free of rust, mill — scale dirt, oil etc. either by mechanical means, for example sand or shot blasting or by chemical means such as pickling. After pretreatment of the surface one coat of approved primer i.e. red oxide zinc chrome primer conforming to IS 2074. Two coats of paints as directed by the Engineer-in-Charge shall be applied to the exposed surface.

11.9.5 Fixing

Frames shall be fixed up right in plumb and plane. To avoid sag or bow in width during fixing or during construction phase, temporary struts across the width preventing sides bulging inwards may be provided. Wall shall be built solid on each side and grouted at each course to ensure solid contact with frame leaving no voids behind the frame.

Three lugs shall be provided on each jamb with spacing not more than 75 cm the temporary struts should not be removed till the masonry behind the frame is set. In case screwed base tie is provided, this should be left in position till the flooring is laid when it can be removed.

After pretreatment of the surface one coat of steel primer and two coats, of paint, as directed by Engineer-in-charge shall be applied to the exposed surface.

11.9.6 Measurements

The length shall be measured in running metre correct to a cm. along the centre line of the frames.

11.9.7 Rate

The rate shall include the cost of labour and material involved in all the operation described above including one coat of approved steel primer but excluding two coats of paints.

11.9 Steel Fire Proof Door

The fire proof (steel) door should be designed in such a manner that it will neither collapse nor will allow the passage of flame/smoke during the entire rated period of fire under specified conditions. Fire proof doors should satisfy three important criterions of stability, integrity and insulation as stipulated in BS 476 Part-22 and IS.: 3614 Part. -

The mean temperature on non fire side shall not exceed 140°C above ambient temperature to ensure quick escape of *personnel and* to avoid combustion hazards to flammable goods lying on the non-fire side.

The temperature on non-fire side during live test after 120 minutes of severe fire averaged only 93°C as against 140°C plus ambient temperature permitted vide BS: 476 part 22 and 1.S. 3614 Part - II.

The glazing/vision panel should be provided particularly in corridor. As per National Building code part - IV which permits vision panel/glazing upto 0.5 Sqm. per door set. However, permission should be taken from local fire authorities for incorporating the same

12.0 Structural Glazing

12.1 Scope of Works

The scope of works under this contract includes design, supply installation, protection guarantees, testing and maintenance upto the defects liability period of Structural glazing, openable panels, glass doors and fixed glazing.

The work under the section includes all labour, materials, equipment and services as required for the engineering, preparation of shop drawings, testing, fabrication, assembly, delivery anchorage, installation, installation, protection and waterproofing of the structural glazing openable panels, glass doors and fixed glazing system and all in accordance with the true intent and meaning of the specifications and drawings taken together, regardless of whether the same may or may not be particularly shown on the drawings or described in the specification provided that the same can be reasonably inferred there from. Anchorage includes all primary and secondary anchor assemblies and supportive structural framing as required to secure Structural glazing system glass doors and fixed glazing. The materials, work etc shall be as per relevant IS codes and PWD specification and overall direction of ENGINEER - IN - CHARGE.

The detailed scope of work is as outlined hereunder -

The Structural glazing system and openable panels described hereafter shall include but will not necessarily be limited to the following:

12.2 Frames

Openable panels where indicated, inclusive of all accessories, fittings, etc.

All caulking, sealing and flashing including sealing at junctions with roof waterproofing and exterior wall, raised kerbs and in window surrounds. Sealant within and around the perimeter of all work under this section. Separators, neoprene / EPDM and silicon gaskets, trims, etc. Inserts in concrete, anchor fasteners etc. for the anchorage of all work under this section is subject to the approval of ENGINEER - IN - CHARGE. Isolation of all dissimilar metal surfaces as well as moving surfaces similar or dissimilar. Fire-stops, flashing, sealing of all interfaces with buildings etc. Protection during storage and construction unit handing over Engineering proposals, drawings and data . Shop drawings, engineering data and structural calculations of all systems including framing, fasteners. Scheduling and monitoring of the work All samples, mock-ups and test units Coordination with work of Main Civil Contractor and other agencies / Contractors employed on site. All final exterior and interior cleaning of the Structural glazing system, doors etc. Hoisting, staging, scaffolding and temporary

services Specified tests, inclusive of necessary reports, Maintenance manuals, Performance guarantees . Periodic inspection, supervision and advice by tenderer's Principal as well as a back-up guarantee in an acceptance format by the Principal for the quality and performance of works. Construction monitoring for regular quality control and technical inspection to ensure the work conforms to the shop drawing details (including any modification made during testing) and acceptable standards of quality.

12.3 Reference and Standards

Materials and workmanship shall comply with the latest edition of the following standards as follows (but not limited to this list of standards) :

ANSI Z97.1.84.	Safety Glazing Materials used in Buildings
ASTM C1036-90	Specification for Float Glass
ASTM C1048-90	Specification for Heat Treated Float Glass
ASTM C864-90	Specification for Compression Seal Gaskets
ASTM C1115-89	Specification for Silicon Rubber Gaskets
ASTM C920-87	Specification for Sealants
ASTM C509-90	Specification for Sealing Material
GTA Specification No. 89-1-6	Specification for environment durability for heat strengthened Spandrel Glass with Applied O pacifiers
BSCP 118	Structural use of Aluminium

In general the Contractor may follow any international Standards subject to his satisfying ENGINEER - IN – CHARGE that these specifications are equivalent to latest specifications issued by ASTM, ISO, AAMA, BSS & SSIR or equivalent Indian standard as approved by ENGINEER - IN - CHARGE.

Copies of all codes proposed to be followed for design, materials, installation and testing shall be submitted to ENGINEER - IN – CHARGE within 2 weeks of issue of Works Order.

Building Regulations

Design of the Structural glazing system shall comply with all IS codes and regulations for wind design. All calculations shall comply with the requirements of the relevant National Building Code and Indian Standard Code, unless specified otherwise.

12.4 Guarantee

The Contractor shall be fully responsible for and shall guarantee proper design safety and performance of this installed system for such a period as per manufacturer by providing guarantee/ warranty provided by the manufacturer along with the cross warranty by the Contractor as directed by ENGINEER - IN – CHARGE as per terms of the contract from the date of handing over of works by the Contractor.

In addition specific, guarantees in approved formats shall be given for performance of glass, double-glazed units, anodizing and sealants. All the Guarantees shall be submitted before payment from the date of actual completion of work, and shall not in any way limit any other rights to correction which ENGINEER - IN – CHARGE may have under the Contract.

12.5 Contractor's Responsibilities

The Contractor's responsibilities include but are not necessarily limited to the following items :

The Contractor shall provide and install all supplementary parts necessary to complete all items generally implied in the drawings and in the specifications though not specifically shown or mentioned.

This shall include providing, assembly & erection of all sections and anchor assemblies to meet the performance and furnishing and installation of all inserts, fasteners, clips bracing and framework as required for the proper anchorage of the structural glazing system elements to the structure, unless otherwise noted or specified to be furnish / installed by another agency. Alternate anchorage proposals will be considered, if in the opinion of ENGINEER - IN - CHARGE the general design and intent of the drawings and specifications are maintained.

The Contractor's system therefore must perform satisfactorily as a whole.

Drawings and specifications indicate the required basic dimensions, profiles and performance criteria. The Contractor shall have the option of modification and addition of details provided the visual concept and performance requirements are fulfilled. Proposed modification shall be clearly shown on shop drawings as "Design Modifications" and acceptance of the same will not relieve the Contractor from sole responsibility for performance of the structural glazing and other system. The Contractor shall be solely and fully responsible for due performance of his installation based on his own design and details. This should be done after approval of ENGINEER - IN - CHARGE, in writing, subject to the modified design and drawings with all necessary calculations etc and approved by ENGINEER - IN - CHARGE.

In-plant and job site inspection : The Contractor shall afford for ENGINEER - IN - CHARGE and / or their authorised agent full access to plants, shops and assembly points to view and inspect the processes and methods employed in the fabrication, assembly and finishing of the Structural glazing and other system for this project at their own expense, whatsoever. This should be guided by the relevant clause of GCC of this contract .

ENGINEER - IN - CHARGE will have the right to reject any Structural glazing and other system, components, assemblies during assembly and erection if the workmanship and intent are not in strict conformity with the approved shop drawings, documentation, certifications, samples and mock-up and shall be binding on the Contractor. Replacement , modification , removal of rejected materials shall be done at the risk and cost of the Contractor .

Glass, sealants and other items or materials procured by purchase shall be back to back guaranteed by the manufacturer and cross guarantee/ warranty by the Contractor .

12.6 Shop Drawings

Within 15 days upon award of contract, the Contractor shall prepare shop drawings by necessary modifications, if any to the preliminary drawings and two (2) copies of all shop drawings along with the plan and method to execute the job mentioning the brand of materials, other accessories to be used for the work shall be submitted to ENGINEER - IN - CHARGE for review and approval. ENGINEER - IN - CHARGE's review of all shop drawings will be limited to their conformity to the concept & specifications. ENGINEER - IN - CHARGE's approval of the shop drawings will not relieve the Contractor from any of the responsibilities and requirements as stated in Contract documents. No work shall be fabricated until the shop drawings and all other relates submission, documentation, certifications, samples and the mock-up for that work have been reviewed and approved by ENGINEER - IN - CHARGE. On approval the Contractor shall submit 4 copies of drawings to ENGINEER - IN - CHARGE for release to site.

Shop drawings shall incorporate scaled and dimensioned plans, elevations, sections and full size details for all work in this section.

Shop drawings shall indicate the desired dimensional profiles and modules function, performance standards and, in general, delineate the scope of work. The Contractor shall verify and co-ordinate these items with all applicable and / or related trades, contract drawings and specifications. Since the dimensions and modular references shown on the drawings are for specific and / or typical detail, the shop drawings shall include a full complete layout of all modular and referenced dimensions for all the Structural glazing ,openable panels, glass doors and fixed glazing and their related elements. All dimensions / modules, etc. shall be fixed and checked as required.

The full size details shall show and specify all metal sections, types of finishes; areas to be sealed and sealant materials, gaskets; direction and magnitude of thermal expansion, direction and magnitude of all applicable construction including fasteners and welds, all anchorage assemblies and components; the fabrication and erection tolerances for the work and applicable related works adjoining, attached to or in some way related to the work covered by these specifications. The location of all static and dynamic anchor assemblies, the direction of thermal and other applicable building movements, coordination with concrete works and the sequence of installation shall be designated on the applicable plans, elevations and / or sections. All details shall be subject to ENGINEER - IN - CHARGE's approval.

Shop drawings shall indicate the desired profiles, dimensions, details of metal finish and in general delineate the scope of the work. Profile adjustments in the interest of economy, fabrication, erection, weather-ability to satisfy the performance requirements may be made only with the written approval of ENGINEER - IN - CHARGE, provided that the general design and intent of the drawings and specifications are maintained.

Six (6) copies plus two reproducible sepia print and one soft copy each of all final approved shop drawings shall be submitted to ENGINEER - IN - CHARGE.

12.7 Samples and Manuals

Within 2 weeks of issue of Work Order, the following samples of actual job site materials together with detailed technical data / catalogues shall be submitted in duplicate, unless otherwise noted, and in the sizes noted, for ENGINEER - IN – CHARGE review alike for approval of all other samples to be used for the work at site and approval. Any omission of an item, or items which require the Contractor's compliance with these documents does not relieve him from such responsibility.

Aluminium Extrusions – one of each section, 300 mm long of specified thickness.

Glass; Each type and kind, 300 X 250 mm of specified thickness and including frame

Glazing gaskets, tapes, separators, glass setting blocks, etc. Each section of unit 300 mm long or unit.

Fasteners and connecting devices, each type and size

Finish samples: after approval of the final finish coating ENGINEER - IN – CHARGE is to be provided with six (6) approved samples.

Patch fitting door mongery and all accessories, as applicable.

Flashings and finish samples

Samples submitted should also include assembly of various components forming a typical fixing detail complete with glazing, extrusion, fastener, sealant, etc.

12.7.1 Maintenance Manual

Submit six (6) copies each along with one soft copy , if applicable of detailed procedures for the periodic inspection maintenance and cleaning of all the Structural glazing, openable panels, glass doors, windows and fixed glazing, finishes, etc.

12.8 Structural Properties

The design of structural glazing system / other fixing systems and all related components shall comply in general with the requirements of National Building Code IS-875 and Indian Standard Code IS-456 along with all relevant IS and PWD specification. No structural glazing / other glazing system including sealants and sealed joint shall sustain permanent deformation or failure under loading equivalent to 1.5 times the design wind pressure herein specified.

Deflections: The specified deflections must be reduced if they are in any way detrimental to the Structural glazing and sealants.

The maximum deflection shall not exceed 1/300 of span of transom / sill/ head members.

Under 1.5 times design wind pressure there should be no permanent deflection of framing member exceeding 1/1000 of span length.

Maximum deflection of glass under design wind pressure at centre of any panel shall not exceed 15 mm or as recommended by the manufacturer whichever is less.

12.8.1 General

All braces, supports and connections for the structural glazing shall be designed, provided and installed complete as required.

Anchors for curtain wall sections shall be located with a maximum distance of 500 mm above or below the RCC floor slab unless specifically approved otherwise by the ENGINEER - IN - CHARGE.

Variations from Schematic layouts indicated on the drawings may be permitted at the risk, cost and responsibility of the Contractor but only if a proposed revision does not, in ENGINEER - IN - CHARGE's opinion, deviate from the design intent, cause excessive stress in the structure, cause excessive deflection, inhibit thermal and building movement or conflict with other requirements.

Member shapes and / or profiles if schematically shown on ENGINEER - IN - CHARGE's drawings are not necessarily the exact shapes required or best suited for the particular condition. Final shapes and locations shall be as designed by the Contractor and are subject to ENGINEER - IN - CHARGE's review and approval.

The horizontal or lateral load on such transom / railing (where not backed by an RCC concrete) shall be designed in accordance with the following criteria i.e. a horizontal UDL at 0.74 KN/m run, UDL supplied to the infill of 1.0 KN/m² and a part load applied to part of the infill at 0.5 KN.

No holes shall be burned, filed or drilled in any structural steel members unless expressly approved by ENGINEER - IN - CHARGE in writing.

The Contractor shall provide detailed layouts, alignments jigs etc. for the proper and exact placement of all welded anchor studs, anchorage components without any harmful effect to the structural glazing.

No field forming, cutting and / or alterations of primary wall elements will be allowed. All framing members shall be shop fabricated and finish coated. No furnished surfaces will be permitted on exposed surfaces.

12.8 Concrete Tolerances

The Contractor shall take into account tolerance in concrete and masonry surfaces to which the structural and glazing framework is fixed.

Fire stop and Interface with Building

Joints in the structural glazing system between successive floors shall have the required fire resistance of at least 2 hours and shall comply with requirements of CFO.

A fire-stop-cum-smoke seal shall be provided at each window head level. In addition the Contractor shall provide an aluminum flashing to approved design at the window sill level and on 2 sides of vision panels.

All interfaces with building structure and other elements shall be sealed / flashed provided with expandable gaskets to ENGINEER - IN - CHARGE's approval.

12.9 Sound Control

Provisions shall be made (e.g. capping of all ends of mullions) to prevent sound transmission through the system. Provisions shall also be made to prevent metal to metal rubbing noise due to thermal changes and wind pressure.

12.10 System Description

The front seal structural glazing system is semi unitized system. In this specially designed extruded aluminium mullions are fixed to the building structure by means of SS brackets of angles 100 X 100 X 12 mm of minimum 300 mm long with necessary aluminium packing for true alignment, suitable chinch anchor bolts of minimum 150 X 10 mm shall be provided for fixing the brackets. On to this mullions, the transoms are fixed by means of pre-positioned angle cleats. After installing the grid work of mullion and transom, the entire frame work is aligned in perfect line, level and plumb. Drainage chamber, pressure equalisation system and openable panel shall be provided.

Bonding of glass is not to be done on site. Panels are glazed in the factory under controlled conditions as per silicone manufacturer's recommendation to achieve required bonding result. These pre-glazed panels are brought to the site and fixed on to the preinstalled aluminium grid work. The gap between the adjacent glass panels is thereafter filled with silicone sealant to have complete homogenous surface of glass without any grooves and cavities and this shall depend upon the systems offered. The tenderer will indicate the details of systems offered along with the tender.

12.11 Frame Work

Frame work consists of specially designed mullion of minimum size of 101.6 mm X 57 mm X 3 mm (Alloy 6063-T-5/T-6 temper) B.S. 1474. Selection of mullion will depend upon the floor to floor height, distance between two. Mullions wind pressure and other required structural stabilities. Transoms of minimum 83 X 57 X 2.25 mm (E 91 WP(IS) 1285) are attached to this mullion by means of aluminium angle cleats. The material shall be of reputed manufacturer as approved by ENGINEER - IN - CHARGE. Extruded section sample before anodisation shall be produced to ENGINEER - IN - CHARGE for approval.

All aluminium sections shall be blackmatt anodised to 15 microns minimum. Bolts for connections of frame work shall be high tensile steel minimum 100 mm length and pop rivets shall be used and two samples shall be submitted for approval. Test shall include, DFT, film hardness, dry, cross batch adhesion, boiling water adhesion, test & glass measurements & general appearance and shall meet the following performance requirements. Sample testing shall be done at Govt. laboratories / testing houses at the risk and cost of the Contractor , as directed by ENGINEER - IN - CHARGE.

Salt spray resistance 3000 hrs exposed to 5% salt solution at 95% RH, 37.5°C > 125 mm creepage or loss of adhesion from scribed lines or cut edges.

Humidity resistance
Abrasion resistance
Mortar resistance
Detergent resistance
Color retention

Guarantee for peeling, cracking, checking, blistering, fading, chalking, color change.

Cleats & spigots : 6351 alloy T6 temper and SS screws shall be used for fixing the panels.

12.12 Fasteners

The type, size, alloy and quantity and spacing of all fasteners and anchoring devices shall be as required for the specified performance standards. The material shall be of reputed manufacturer , as approved by ENGINEER - IN - CHARGE.

Bolts, anchors and fastening devices shall be self locking, suitable for conditions encountered and shall be torque tightened when required to achieve maximum Torque Tension relationship in fasteners, washers, nuts all ancillary items shall be same material as fasteners.

Fastening devices between aluminium and aluminium shall be AISC type 302 (18-8) stainless steel unless otherwise approved.

Fastening devices between aluminium and dissimilar material shall be 300 series non-magnetic stainless steel unless otherwise approved.

Exposed fasteners shall be of stainless steel.

Self locking fasteners shall be stainless steel with nylon inserts or patches.

Proper care shall be taken in anodizing process to proper adhesion of the structural silicone to the anodized aluminium substrate. The anodizer shall be apprised that the extrusion to be finished will be used for structural glazing application. Sample of fasteners shall be submitted to ENGINEER - IN – CHARGE before anodisation for approval.

After a long period of time, anodised surface may develop an aluminium hydroxide surface film. This film shall be removed by detergent free boiling hot water rinse. Random production samples of anodised extrusions must be tested by silicone sealant manufacturers and certified by them. The sample testing shall be done at Govt. laboratories / testing houses at the risk and cost of the Contractor , as directed by ENGINEER - IN - CHARGE.

12.13 Glazed Panels

These are factory made glazed panels of approved make (as of ENGINEER - IN – CHARGE) which are brought to site of work and are bolted on the pre-fixed gird work of mullions and transoms. The entire safety and principle of structural glazing depends on these panels, in which the glass is bonded to the aluminium frames by means of structural silicone sealant. This has to be done in perfectly controlled conditions and as per the procedure recommended by sealant manufacturer. The sealant manufacturer shall visit the place of application for on-site testing of bonding by deglazing few panels. Necessary certification by the sealant manufacturer shall be furnished indicating that the glazing has been carried out as per their recommended procedure , based on which the Contractor shall submit the warranty along with the certification of the manufacturer .

12.14 Sealants

All sealant applications must be clearly designated on the applicable shop drawing details and reference to a master sealant schedule specifying materials special instructions and application procedures.

The compatibility and sequence of installation for all sealants must be carefully considered in all proposals in order to ensure the required cure and optimum performance. Sealants must not degrade and / or fail under all design conditions including, but not limited to thermal movement, water, ultraviolet exposure and / or other adverse environmental conditions. The following sealant materials are specified for performance standards only. All proposals must be equal to or better than the materials herein specified. The designation of sealant types noted on the drawings is intended for general design guidance. Final selection by the Contractor for the sealant types shall be based on their conformity with the Performance Requirements herein specified and meet with ENGINEER - IN - CHARGE's approval. Maximum precautions shall be taken to prevent failure of sealant. Necessary warranty certificate by the manufacturer along with cross warranty by the Contractor shall have to be submitted .

12.14.1 Front Sealing

After glass panels are installed, leveled and aligned, the groove between two glasses on all the sides which depends upon the systems adopted shall be as minimum as possible. This groove is then filled with weather grade 789/79B black silicone sealant from outside to give one smooth surface. This silicone filled grooves shall allow for thermal movements in the glass. Sleek grooves are to be provided for esthetical requirement.

12.14.2 Structural Sealant

Dow Corning silicone sealant 995/GE ultra-glaze 4000. All exposed and concealed metal to metal (including tight or butt type metal to metal assembly prior to assembly), perimeter metal to concrete joints shall be silicone base sealant, preferably two component, in approved colour, conforming to the manufacturer's recommendations for the specific uses and performance criteria. The manufacturer shall conduct laboratory test for adhesion for each lot of aluminium sections and glass. Laboratory reports shall be submitted to ENGINEER - IN - CHARGE. Submission of warranty by the manufacturer and cross warranty by the Contractor is required .

12.14.3 Weather Sealant

Grade of sealants for concealed metal to metal and metal to concrete joints are to be installed or embedded in a full bed sealant and shall be of Dow Corning / GE. Joint fillers and back up materials shall be of neoprene and as per the written recommendation from sealant manufacturer. Shape, size hardness, compatibility and bond breaking requirements are to be considered. All sealants shall be non-staining.

All sealants shall be given Guarantee for materials by the manufacturer along with cross warranty including , workmanship and performance from the date of completion of Contract.

12.14.4 Caulking compound

Dow Corning 790, one part gun grade consistency, colour to match adjacent material or approved by ENGINEER - IN - CHARGE for use around frame or between frame and floor slab.

12.14.5 Installation

The GI bracket having three way adjustments are first fixed to the building structure as per approved detailed drawings. On to these brackets, the mullions are bolted. The mullion to

mullion joint on each floor is achieved by special aluminium sliding sleeve. There is an expansion gap between two mullion to allow thermal movements.

12.14.6 Smoke Seal

The gap between the building structure and the structural glazing frame is closed with perforated aluminium tubes. These smoke seals will stop the smoke, travelling from one floor to other floor as well as will stop the noise, travelling from one floor to other floor and shall be two hour fire resistant. Necessary tests shall be conducted at the risk and cost of the Contractor to check the functioning of smoke seal as directed by ENGINEER - IN - CHARGE complying to IS and PWD specifications.

12.15 Glass

For structural glazing, minimum 6 mm thick grey, tinted heat strengthened glass shall be used for spandrel areas and 24 mm thick insulated glass with 6 mm thick reflective toughened glass +12 mm air gap +6 mm thick clear toughened glass for other areas. 6 mm thick clear toughened glass may also be used depending on the Architectural design and drawing in such cases relevant U value of the glass should be finalized with the Engineer-in-charge before procurement. The colour of the glass shall be as per the design of the ENGINEER - IN - CHARGE. Prior to bringing the materials in bulk, sample approval shall be done by ENGINEER - IN - CHARGE. Material shall be of reputed manufacturer and approved by ENGINEER - IN - CHARGE. All glass and glazing materials shall be verified and coordinated with the applicable performance requirements.

Furnish and install glass and glazing work as indicated on the drawings and as specified herein. All glass shall be cut to required sizes and ready for glazing. Any pane which does not fit any section of the glazing and shop front will be rejected and a replacement made at the Contractor's expense. All glass shall be of accurate sizes with clear undamaged edges and surfaces which are not disfigured. Sample testing shall be done at the risk and cost of the Contractor as directed by ENGINEER - IN - CHARGE, over and above, the submission of test certificate from the manufacturer .

Heat strengthened glass shall not deviate in surface flatness by more than 0.23 mm within 260 mm of leading or trailing edge, or 0.076 mm in centre. Direction of ripples shall be consistent. Distortion of glass shall be controlled as much as possible during heat strengthening. Sag distortion shall be uni-directional as per ENGINEER - IN - CHARGE's option. Surface compression stress of heat strengthened glass shall be within 320-450 kg/cm².

Permanent identification marking on glass shall be accomplished by a technique selected by the manufacturer. The location of the marking shall be proposed by the Manufacturer and approved by ENGINEER - IN - CHARGE. All glass shall be delivered to site with the manufacturer's label of identification attached along with the test certificate of the manufacturer.

Submit for ENGINEER - IN - CHARGE's approval a complete list of materials to be used, including the sealants proposed and such samples as ENGINEER - IN - CHARGE may require. All glass and glazing methods and materials including the design and profile dimensions of glazing pockets shall be as approved and recommended in writing by the applicable glass and sealant manufacturers. A sealant substrate test report shall be submitted for each type of sealant for adhesion and compatibility. If required, ENGINEER - IN - CHARGE may ask the Contractor for further sample testing of sealants in Government laboratories /testing houses at the risk and cost of the Contractor. Warranty of the material by the manufacturer along with cross warranty including workmanship etc. shall be submitted by the Contractor.

Sealants in factory-glazed panels shall be fully cured prior to shipment to project site and installation.

All glass breakage caused by the Contractor or his sub-Contractor because of negligence or caused by the installation of faulty work by him shall be replaced by the Contractor at his own expense without delay to the project completion.

The Contractor shall be responsible to deliver to ENGINEER - IN – CHARGE without charge replacement for any unit of glass and glazing that fails within the Guarantee period of stipulated period by the manufacturer, from date of completion of contract.

The glass glazed panels / structural glazing frames for the structural glazing system shall be designed to withstand lateral imposed loads and comply with requirements of local building codes.

Glass thickness should be selected in accordance with IS 875:1987(Part III) to satisfy design performance requirements and local design codes.

Glass shall be free from defects or impurities detrimental to its performance. Defects such as bubbles, waves, spots, scratches, spalls, discoloration, visibly imperfect coating, chipping and bubbles or delamination of opacifier film shall be limited in accordance with the Manufacturer's / trader's guidelines. The glass is to be produced in such a way that the rollers will be parallel to what will be the horizontal position of the glass. Glass shall be consistent in colour. Manufacturers' glazing instructions regarding installation, clearance, dimensional tolerance, bite edge clearance etc. shall be followed and shall also be guided by relevant IS codes and PWD specifications.

All solar control glass panels shall be stored with particular care and protected against abrasion, sun and moisture prior to installation.

Precautions specified by glass manufacturers to minimise thermal stress must be followed. A thermal stress analysis shall be obtained from glass manufacturer prior to fabrication and their recommendations shall be followed. Allowances shall be made for thermal movements due to an air temperature range of 60⁰C and a material temperature range of 100⁰ C.

Glass panels shall be selected / rejected on the basis of product quality standards specified by the manufacturer concerning scratches, pinholes, clusters, distortion, colour variations, flaws in coating and other defects. Decision of ENGINEER - IN – CHARGE in this regard shall be final and binding to the Contractor.

Each type of glass shall be obtained from only one manufacturer and in one lot. Adequate spare quantity shall be ordered to cover for breakage and for replacement during maintenance period. Setting blocks for glass shall be extruded neoprene with minimum 80 durometer hardness.

12.16 Gaskets

Gaskets and seals shall be extruded EPDM of approved quality, compatible with substrates, finishes and other components they are in contact with. All gaskets exposed directly on the exterior face shall be silicon gaskets.

Extruded EPDM sections shall have the following properties :

Shore Hardness : 70 ±5A
Tensile strength : Min. 70 kg / cm²
Elongation : 300%
Ozone Resistance : No crack at 50± 5pphm, test temp of 40±2⁰C, test duration of 96 hours and 20% strain

Extruded neoprene sections if specifically permitted shall have the following properties :

Physical Property	Test Method	Performance
Hardness, Durometer A	ASTM D 2240	601.5 points

Tensile strength	ASTM D 412	1800 psi, minimum
Elongation at break	ASTM D 412	25% min
Brittleness temperature	ASTM D 746	40 ⁰ F
Resistance to heat	ASTM D 573	
Change in original properties after 70 hrs. at 100 ⁰ C		
Hardness	-	+ 10 points, max.
Elongation	-	40%, max.
Tensile strength	-	15% max.
Resistance to permanent set compression set after 70 hrs. at 100 ⁰ C	ASTM D 395	25% max.

12.18 Surface Preparation

Solvent cleaning

Dirty glass edges shall be cleaned with a solvent such as isopropyl alcohol (IPA), Oily metal surfaces shall be cleaned with degreasing solvent such as toluene, or xylene. Glass and metal finish manufacturers shall ensure compatibility of the solvent used for cleaning.

Primer shall be applied as per the manufacturer's recommendations. Silicon sealant shall be applied as soon as possible to prevent built up of dirt, moisture and other contaminants from affecting adhesion of silicone to substrates. Silicone used shall be natural curing type. Acetoxy curing sealant which release acetic acid during the cure process are not recommended for use.

All adjacent surfaces shall be masked prior to sealant application. Backer rods shall be carefully positioned.

Sealant shall be applied in a continuous operation from a caulking gun or pump. Positive pressure, adequate to fill the entire joint cavity shall be applied by pushing the sealant bead ahead of application nozzle. The sealant must fill the entire joint and firmly contact with the glass and metal surfaces. Water, soaps or alcohol solutions shall not be used as tooling aids. After tooling, the masking shall be removed.

12.19 Separators

Separators between steel and aluminium members shall be of rigid type, high impact smooth both side Teflon with minimum thickness of 0.8 mm.

12.20 Quality & Certificates

All required certificates shall be furnished against each concerned supply. Certificate of conformance for anodized finishes and thickness along with the test result.

Test certificates from sealant manufacturers issued at regular intervals during building process, conforming compatibility of materials and adhesion properties and workmanship of the system, testing of adhesion and chemical compatibility of all elements and design review in accordance with sealant manufacturer. Physical and chemical properties of aluminum sections used.

Over and above the submission of test certificate from the manufacturer, ENGINEER - IN - CHARGE may instruct the Contractor for sample testing at Govt. laboratories / testing houses at risk and cost of the Contractor.

12.21 Leakage Test

The leakage test shall be conducted through hose pipes with water supplied at a pressure of 5 kg / sq.cm. at his own cost.

12.22 Accessories

All accessories shall conform to the relevant IS standard and shall meet all required functional aspects.

12.23 Guarantee

The tenderer shall provide full guarantee for structural glazing and other works carried out by them in this contract which shall include:

- Against non-falling of glasses
- Sturdiness of the system
- Against water penetration
- Against air infiltration
- Smooth operation of the doors.

The structural glazing, door & fixed glazing systems shall be guaranteed for a period of 10 years and all repairs to the structural, sealant and other items if required shall be carried out without any additional cost. The guarantee shall be furnished in stamped paper in the form to be provided after the award of work.

If breakage of glass / structural defects occurs due to faculty design and execution within the guarantee period of 10 years, the same shall be replaced without any additional cost and the same shall be replaced within 2 weeks. The decision of ENGINEER - IN – CHARGE shall be final. Complete drainage system in the structural glazing panes. Water leakage and condensation shall be drained or discharged to exterior face of wall and shall be sealed off at every floor and water shall not be retained.

12.24 Drawings

On receipt of the order, the tenderer within 15 days shall submit detailed fabrication and erection drawings indicating all fixing details and panel arrangement, door details etc. for approval and fabrication to be taken up after approval of these drawings.

12.25 Packing

Packing shall be made with PVC adhesive tape for anti-scratch requirements. Transport of glazed units shall be done only after the sealant is cured fully.

12.26 Payment

The opening area of structural glazing / door opening shall be measured for payment. The measurement shall be guided by the PWD specification. In case of any dispute, decision of ENGINEER - IN – CHARGE shall be final and binding on the Contractor. The rate shall include cost of all materials viz. Aluminium, sections, making frames, erection, glazing sealants, weather strips, fittings and fixtures, all fixing arrangements testing, fabrication at plants and erection at site including labour, machinery, scaffolding, staging, chipping of wall, beams, columns, tests , pre commissioning test, commissioning test , rectification of plaster, painting if required, for the complete job.

13.0 DELETED

14.0 DELETED

15.0 Aluminium Curtain Wall Glazing / Windows & Ventilators

15.1 Material

All sections shall be obtained from approved , reputed , manufacturers such as Hindalco, Jindal, Domal or as approved by ENGINEER - IN – CHARGE and shall be extruded from aluminum alloy conforming generally to IS : 733 - 1983 and IS : 1285 - 1975.

Sections shall, conform to IS : 1948-1961 and the relevant wind load criteria before any procurement and installation.

All sections shall be coloured anodised. Anodising shall be done from reputed agencies as approved by ENGINEER - IN – CHARGE with the warranty by the anodizing agency. The thickness of anodising shall be a minimum of 15 microns and the Contractor shall furnish necessary evidence in proof of this to the satisfaction of the ENGINEER - IN - CHARGE. Samples of extruded aluminium section shall be approved by ENGINEER - IN – CHARGE and kept at site by the Contractor for ready reference .

The engineer at his discretion may send samples to an independent laboratory for testing at the cost of the Contractor and if the test report from the laboratory indicates any deficiency the materials shall be rejected. Warranty certificate from the manufacturer shall be submitted by the Contractor .

15.2 Workmanship

All frames for windows, ventilators etc., shall be flat , with all corners at right angles and shall not be warped.

Frames shall be fabricated from sections machine cut to length, mitred and riveted with clips at corners. Sub- dividing bars shall be tenoned and riveted into the frame.

Hinged door shall be provided with approved quality floor springs , and aluminium push plates. Push plates shall extend the full width of the shutter , and shall be provided with tower bolts and approved quality lock.

All the members of all shutters have built -in grooves to take on snap on aluminum beading. Neoprene gaskets shall be provided to prevent direct contact between glass and aluminum and make the shutter completely weather seal.

The Contractor shall measure each opening before fabrication. The employer shall not be responsible for any variation in the widths and heights of openings.

Frames shall be fabricated so that during fixing 6 mm clearance is obtained all round.

The Contractor before fabrication shall submit shop drawings to ENGINEER - IN – CHARGE for prior approval.

Before erecting, frames coming in contact with masonry , plaster , concrete care should be taken that a distinct gap as directed by ENGINEER - IN – CHARGE should be kept and the same to be sealed with colourless polysulphide sealant all round the frame on both sides . The Contractor shall provide necessary treated wooden spacer blocks or frame before erecting and finalizing the alignment of the aluminium frame with respect to the masonry opening.

Plain or tinted glass glazing, as specified shall be fixed.

15.3 Mode of Measurement and Payment

Measurement shall be in Sq.m. and as per PWD specification.

The rate for window and Glass partitions shall include for all materials including glazing, fabrication, transport to site, erection, cost of scaffolding, maintaining in position till completion of job and including all tools, tackle, plant and equipment, testing etc. and all other necessary works incidental to the completion of the work as per these specifications. For partitions with Bison panel in Aluminium frame the rate should also be inclusive all materials labour and tools and plants.

Windows shall be measured from outside edge to outside edge of the frame .

16.0 Aluminium Composite Panel Cladding

Cladding shall be non-toxic composite aluminium panels of adequate strength with approved aluminium details. The panels shall be 4mm thick composite units finished with PVDF (Polyvinylidene difluoride) coating overall 35 micron thick of approved metallic colour. The resin content of the PVDF (Polyvinylidene difluoride) coating shall be 75% to 80%. The back of the panel shall be chromatised 3-4 micron thick, compatible with adhesives for stiffeners if any or given a polymer coating.

The fabrication and installation of the cladding systems shall be carried out as per manufacturer's instructions with invisible/concealed fastenings, aluminium sub-structure, silicon sealants properly tooled etc.

All cladding panels of one kind shall be obtained in one lot from the manufactures.

Each panel shall be guaranteed for a flatness of ± 1 mm from the true face after installation under no-wind conditions. Deviations from the true alignment of adjoining panels shall not be cumulative. Full load deflections shall be kept to the minimum possible. Each panel shall be capable of withstanding 300 Kg/Sq.m wind pressure without any permanent deformation.

The cladding system shall be adequately ventilated. The air-gap between the cladding panels and the concrete /block –wall shall be at least 50 mm to allow proper ventilation of the rain screen system. The cavity shall be closed by a perforated bird/vermin-proof closer at bottom and by a flashing at top or any other method as mentioned in the drawing. The wall behind should be treated with approved water proof paint applied over plastered surface as directed by the ENGINEER - IN - CHARGE.

The fabrication processes including cutting, grooving, benching, folding, root-in as well as installation shall be performed as per manufacturer's instructions. The panels shall be backed by approved aluminium support framework, fixed to wall with aluminium/galvanized steel brackets. Cross warranty attaching the warranty of the manufacturer shall be submitted by the Contractor to ENGINEER - IN – CHARGE in approved form and manual .

The composite Aluminium panels shall satisfy the following fire codes requirements:

BS476	part6	Class	0
ASTM E-84	Flame Spread Index		0
Smoke developed	Index		<15

UBC 26-9 & NFPA for 30 minute Intermediate scale Multi-story Apparatus. Test to prove no flame spread beyond the area directly exposed to fire source.

Sample approval from ENGINEER - IN – CHARGE shall have to be got done by the Contractor prior to bringing the material in bulk at site. Necessary test certificate with warranty from the manufacturer shall have to be submitted by the Contractor. Over and above the

submission of test certificate, ENGINEER - IN – CHARGE its discretion may ask for sample testing further in Govt. laboratories / test house at the risk and cost of the Contractor.

17.0 Anti-Termite Treatment

17.1 General

Anti-termite treatment shall be as per ISI-6313(Part II) with a guarantee period of 10 years and shall be carried out by an approved specialist agency.

17.2 Materials concentration

Chloropyriphos (emulsifiable concentrates as per IS: 8944-1978) of 20% E.C. shall be brought to site of work in sealed original containers. The material shall be brought in at a time in adequate quantity to suffice for the whole or at least a fortnight's work. The empties shall not be removed from the site of work, till the relevant item of work has been completed and permission obtained from the Engineer.

17.3 Pre-Construction Chemical Treatment

Hand operated pressure pump shall be used for uniform spraying of the chemical. To have proper check for uniform spraying of chemical, graduated containers shall be used. Proper check shall be kept so that the specified quantity of chemical is used for the required area during the operation.

17.4 Time of Application

Soil treatment shall start when foundation trenches and pits are ready to take mass concrete in foundations. Laying of mass concrete shall start only after the chemical emulsion has been absorbed by the soil and the surface is quite dry. Treatment shall not ilie-carried out when it is raining or the soil is wet with rain or subsoil water. The foregoing applies also in the case of treatment to the filled earth surface within the plinth before laying the subgrade for the floor.

17.5 Disturbance

The treated soil barriers shall not be disturbed after they are formed. If by chance, treated soil barriers are disturbed, immediate steps shall be taken to restore the continuity and completeness of the barrier system.

17.6 Treatment of Column-Pits, Wall-Trenches and Basement Excavations

In the case of RCC framed structures with columns, plinth beams and RCC basements the treatment shall start at the depth of 500 mm below ground level. When ground level is raised or covered by filling, or cutting, the new soil level resulting from the filling or cutting shall be considered as ground level. The vertical surfaces of RCC basement walls shall be treated at the rate of 7.5 ltrs/sqm. of the vertical surface. If water is used for ramming the earth fill, the chemical treatment shall be carried out after the ramming operation is done by redoing the earth at 150 mm centres close to the wall surface and spraying the chemical with the above dose. The earth is usually returned in layers and the treatment shall be carried out in similar stages. The chemical emulsion shall be directed towards the concrete or masonry surfaces of the columns and walls so that the earth in contact with these surfaces is well treated with the chemical.

17.7 Treatment of 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 the sand/subgrade is laid. Holes upto 50 to 75 mm deep at 150 mm centres both ways shall be made with crow bars 12 mm diameter on the surface to facilitate saturation of the soil with chemical emulsion.

17.8 Treatment of Junction of Wall & Floor

To achieve continuity of the vertical chemical barrier on inner wall surfaces from the ground level as explained earlier small channel 30 x 30 mm shall be made at all the junctions of wall and columns with the floor (before laying the sub-grade) and rod holes made in the channel upto ground level 150 mm apart and the chemical emulsion poured along the channel @ 7.5 litres/sqm. of the vertical wall or column surface so as to soak the soil right to bottom. The soil shall be tamped back into place after this operation.

17.9 Treatment of Soil along External Perimeter of Building

After the building is complete, holes shall be provided with iron rods along the external perimeter of the building in the soil at intervals of about 150 mm and depth 300 mm and these holes shall be filled with chemical emulsion at the rate of 7.5 litres per sqm. of vertical surface. In the event of filling being more than 300 mm thick, external perimeter treatment shall extend to the full depth of the filling.

17.10 Treatment of Expansion Joints

Anti-termite treatment shall be supplemented by treatment through the expansion joint after the subgrade has been laid at the rate of 2 litres per linear metre of expansion joint.

17.11 Treatment of Soil Surrounding Pipes, Wastes and Conduits

When pipes, wastes and conduits enter the soil inside the area of the foundations, the soil surrounding the points of entry shall be loosened around each such pipe, waste or conduit for a distance of 150 mm and to a depth of 75 mm before treatment is commenced. When they enter the soil external to the foundations, they shall be similarly treated for a distance of over 300 mm unless they clear of the walls of the building by about 75 mm.

17.12 Safety Precautions

All chemicals used for anti-termite treatment are poisonous and hazardous to health. These chemicals can have an adverse effect upon health when absorbed through the skin, inhaled as vapours or spray mists or swallowed. Person using or handling the chemicals shall be warned of the dangers and safety precautions.

The containers shall be clearly labeled and shall be stored carefully so that children and pets cannot get at them. They shall be kept securely closed. Particular care shall be taken to prevent skin contact with concentrates. Prolonged exposure to dilute emulsions shall also be avoided.) Workers shall wear suitable clothing and shall wash thoroughly with soap and water, especially before eating and smoking. In the event of severe contamination, clothing shall be removed at once and the skin washed with soap and water. If chemicals splash into the eyes they shall be flushed with plenty of soap and water and immediate medical attention shall be given. The concentrates are oil solutions and present a fire hazard owing to the use of petroleum solvents. All fire hazard precautions shall be taken while mixing. Care shall be taken in the application of chemicals to see that they are not allowed to contaminate wells or springs which serve as sources of drinking water. In case of poisoning, suitable measures shall be taken for protection in accordance with IS:4015 (Part-I) and IS : 4015 (Part-II).

17.13 Guarantee

It shall be guaranteed that the building is safe from termite infestation for a period of 10 years from the date of completion of anti-termite treatment as certified by the Engineer. Such performance guarantee on a non-judicial stamp paper of appropriate value shall be directly given by the specialist agency to the owner in a form as enclosed & approved by the Engineer. In the event of reinfestation at any time during guarantee period, the specialist agency shall undertake to the Owner to carry out such treatment as may be necessary to render the structure free from termite infestation including breaking and reinstalling any other works that may be necessary for the treatment at no extra cost.

PERFORMANCE GUARANTEE (ON NON-JUDICIAL STAMP PAPER OF APPROPRIATE VALUE) TO BE EXECUTED BY CONTRACTORS FOR REMOVAL OF DEFECTS AFTER COMPLETION IN RESPECT OF RECONSTRUCTIONAL ANTI-TERMITE TREATMENT

ARTICLES OF AGREEMENT made at Calcutta, this..... day of Two thousand & between having its registered office at hereinafter referred to as the "Owner" (which expression shall include its successors and assigns in law) of the part and Messrs....., a firm registered under the Companies Act of 1956 and having their registered office at hereinafter referred to as the "Guarantor" (which expression shall mean and include the partners or partner for the time being of the firm and their or his respective heirs, executors and administrations/its successors and assigns in law) in the other part.

WHEREAS THIS AGREEMENT is supplementary to the Contract (hereinafter called the 'said contract') between the owner and Messrs..... hereinafter called the 'Contractor), whereby the contractor inter-alia, undertook to render the building and structures, in the said contract, safe from termite proof and completely termite proof.

AND WHEREAS THE GUARANTOR agreed to give a guarantee to the effect that the said structures will remain termite proof for ten years from the date of completion of anti-termite treatment as certified by the Engineer.

NOW THE GUARANTOR hereby guarantees that termite proofing treatment given by him will render the structures completely termite proof and the minimum life of such termite proofing treatment shall be ten years.

Provided that the guarantor will not be responsible for termite infestation caused by earthquake or structural defects or misuse or alteration:

The decision of the Owner with regard to cause of termite infestation shall be final.

During this period, of guarantee the guarantor shall make good all defects and in case of any defect being found, render the building termite proof to the satisfaction of the owner at his own cost and shall commence the work for such rectification within seven days from the date of issue be got down by the Owner by some other contractor at the Guarantor's cost and risk. The decision of the owner as to the cost, payable by the Guarantor shall be final and binding.

That if the guarantor fails to make good defects or commits breach thereunder then the guarantor will indemnify the Owner and his successors against all loss, damage, cost, expense or otherwise which may be incurred by him by reason of any default on the part of the GUARANTOR in performance and observance of this supplementary agreement. As to the amount of loss and/or damage and/or cost incurred by the Owner the decision of the owner will be final and binding on the parties.

Signature of Guarantor

Signature of Owner

Witness 1

Witness 1.

Witness 2

Witness 2

18.0 Expansion Joint

Expansion joints shall be provided as shown on the drawings. The joints shall be provided with approved joint filler board, sealing compound etc. as stated in items or shown in drawings. The surfaces where expansion joints are to be formed shall be properly cleaned of all dirt, mortar / concrete sticking, dust, etc. Care shall be taken that the filler boards do not get damaged or warped during all operations.

Expansion joints shall be provided with approved joints filler, a joint sealing compound and in waterproof concrete a water bar as specified in drawing.

- (i) Open joint fillers:
Where shown on the drawings, open joints in the structure shall be filled with following expansion joint filler: -
 - (a) Material conforming to IS:1838 containing bitumen emulsion fibres or cork granules bound together with natural resin;
- (ii) The joints filler shall be easily & uniformly compressible to its original thickness, tappable, easily cut or sawn, robust, durable, resistant to decay due to termite or weathering, unaffected by water and free of any constituent, which will bleed into or stain the concrete.
- (iii) The joint filler shall be of same thickness of the joint width, it shall extend through the full thickness of the concrete unless otherwise specified and shall be sufficiently rigid during handling and placing to permit the formation of straight joints.

18.1 Joint Sealing Compounds

- (i) Joint sealing compounds shall be in accordance with the IS 3037-1986 and approved by the Engineer and shall seal joints in concrete against the passage of water, prevent the ingress of grit or other foreign material and protect the joint filler. The compound shall have good extensibility and adhesion to concrete surfaces and shall be resistant to flow and weathering.
- (ii) Where so specified joints shall be sealed with approved polyurethane liquid polymer, stored, mixed, handled, applied and cured strictly in accordance with the manufacturer's printed instructions. Such joints shall be formed to the correct dimensions, thoroughly cleaned & treated with recommended primer. The Contractor shall use only competent personnel experienced in the application of polyurethane sealant for such work.
- (iii) Where specified in the drawings, rubber / bituminous based sealants shall be of an approved manufacturer. The treatment of the joint and the use of sealing compound shall be strictly in accordance with the manufacturer's printed instructions.

18.2 Bison Panel / Aluminium Strip

Wherever specified and shown bison panel / aluminium strip cover to vertical expansion joint is to be provided with and including all screws and plugs as required and to be finished with approved shade of paint.

18.3 Expansion Joint Seal System for Floor Slab joint width upto 100mm

18.3.1 Product Description

The 3R 100 series of joints are manufactured from impermeable, closed cell, ethylene vinyl acetate, and low-density polyethylene co polymer.

3R 100 joints have groove along the bond surfaces at 6mm to 12mm centres and these are typically 3mm wide c 3mm deep and run the entire length of the joint to improve the surface contact area for better adhesion to the surface. Table below show the width of the uncompressed joint, associated gap width and +/- movement capacity from this gap width.

3R 100 joints supplied are black in colour and can be made available in standard colours.

18.3.2 Joint Type

3R 100 is suitable for installation in exterior applications in floors, decks and walls forming a watertight impenetrable seal that is unaffected by road salts and petroleum products. Its capacity will reject stones and debris and will sustain pedestrian traffic and repeated loading from wheeled vehicles.

3R 100 will resist hydrostatic pressure based upon the following depths of seal being used:

Seal Depth mm	Head of Water meters
50	7.00
65	10.50
75	12.50
90	22.00

3R 100 has excellent resistance to a wide range of chemicals including dilute acids and alkalis. For specific application, please contact our technical department for further assistance.

18.3.3 Physical Properties of 3R 100

General	Meets ASTM 1056. Type 2, Class B, Grade 2
Compression set	50% compression for 22 hours at 73 C:-
Extrusion	When a test specimen in compressed to 66% of its original width with three side restrained the amount of extrusion on the free side dose not exceed 6mm
Elongation	>= 250%
Density	47 Kg/m ³
Water Absorption	Typically 0.3 kg/m
Weather Test	Tested to HH-F341a, Type 1, Class A-no degradation
Tensile Strength	800 Kpa >= 500 pa
Recovery	97% recovery tested to ASTM D545
Teat Resistance	0.34 N/cm ²
Environment	3R 100 is safe for use in potable water
Tolerance	3R 100 joints are supplied to the following dimensional tolerance : Depth +10%- 5%: Width + /- 2%
Compressive Strength	72 N/nm ² >= 60 N/nm ²

Cell Structure	Closed cell
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18.3.4 Joints Specification

Product code	Material Width mm	Dimension Depth mm	Structural Width mm	Gap	Joint Movement +/- mm
3R 75	95	75	75		37

18.4 Expansion Joint Seal System for Floor Slab joint width not less than 300mm

Metal floor Covers

18.4.1 Technical Data Sheet

Product Description	: 3R Metal floor Cover
Expansion Gap Width	: 50 mm to 500 mm
Movement	: Multi Directional
Load	: Medium to high / Heavy Duty
Load Capacity	: 25-30 tones (250 KN – 300 KN)
Area of Application	: Internal & External, floor to floor, floor to wall, All type of civil engineering structure
Floor finish	: Granite, Marble, Tiles, Ceramic, Kota Stone, Vitrified tiles, carpet.

18.4.2 System Configuration

- Aluminium frame
- Plate
- Center Bar
- EPDM/PVC seal
- Water barrier – PVC /EPDM

18.4.3 Standard Specification

Aluminium:

All aluminum frame & plate are extruded from ASTM 6063 grade, T4, T5, T6 & 1200 H2 joints are designed to accommodate varying types of vehicles loads, based on load applied & wheel contact area as per DIN 1055: part 2 loading of fork loft trucks & standard vehicles & DIN 1072: standard moving lands.

18.4.4 Seismic Centre Bar:

Structural centering bar solid aluminum ball ends, impact damper & adjustable single or dual tension springs.

18.4.5 EPDM Profiles

UHF cured EPDM profiles & compression seals are manufactured as per BS 4255 standard under stringent quality control with following tested properties.

- Visual Examination : free from porosity, surface defects
- Dimension : as per drawing
- Hardness : 67-68A
- Rubber contents : 26%
- Resistance to heat : 100 +/- 2⁰C for 70 hours
- Change in hardness : +6
- Specific Gravity : 1.239
- Ozone resistance 100 hours : No visible cracks at 10x magnification at 40⁰C

18.4.6 PVC Profile

PVC profile is manufactured with following tested properties:

- Visual Examination : free from porosity, surface defects
- Dimension : as per drawing
- Hardness : 71-72A
- Specific Gravity : 1.42
- Resistance to heat : 100 +/- 2⁰C for 70 hours
- Change in hardness : +6
- Ozone resistance 100 hours : No visible cracks at 10x magnification at 40⁰C

19.0 Structural Steel Work

19.1 General

19.1.1 Application of Specification

For this purpose, the contractor has to complete the erection work in certain sections on priority basis and take-up other sections as per the requirements of areas planned and approved for execution by the Owner/Consultants. This aspect is to be kept in mind by the Contractor and fully ascertain the working conditions.

19.1.2 Keeping Works free from Water

The Contractor shall provide and maintain at his own cost labour, and all equipment to keep the site free from water to do so until the completion of the work.

19.1.3 Bench Marks and Ground Water Ganges

The Contractor shall protect surveyor's bench marks and ground water ganges, zero line marks and base line marks from damage or movement during work.

19.1.4 Secrecy of Information

The Contractor shall not divulge any information that he may obtain regarding the project to any other party.

19.1.5 Work Included

The Contractor shall furnish labour, materials, equipment and tools so as to complete the work as specified herein and/or as shown in drawings and/or bill of quantities. The work shall include :-

- a. Preparation of shop drawings
- b. Supplying structural steel and all other materials unless otherwise provided in the contract.
- c. Fabrication of structural steelwork and painting as prescribed and delivery of the fabricated steelwork at site of erection.
- iv) Loading/handling of steel to fabrication site.
- v) Erecting the structural steelwork, including aligning, leveling and grouting.
- vii) Providing painting as specified on all structural steel work after erection.

19.2 Fabrication

19.2.1 Standards

All fabrication of structural steelwork shall be in accordance with Indian Standards unless otherwise stated herein. The tolerances of fabrication of steel structures shall be in accordance with IS:7215 unless specified otherwise.

19.2.2 Type of Construction

All structural steel work will be generally of welded construction unless otherwise shown in the design drawings. All shop connections will be of welded construction. Site connection shall be generally bolted or welded with erection bolts. The above connections are applicable in general unless other shown in the design drawings. Where erection bolts are used, the holes for erection bolts are to be plug welded after welding at site.

19.2.3 Storing Materials

All materials shall be stored properly on skids, above the ground. It shall be kept clean and properly drained. Structural steel shall be stored and handled so that members are not subjected to excessive stresses and damage. Girders and beams shall be placed upright and stored. Long members such as columns shall be supported on closely spaced skids to prevent injury from deflection

19.2.4 Workmanship

19.2.4.1 General

All workmanship shall be equal to the best practice in modern structural shops. Greatest accuracy shall be observed in the manufacture of every part of the work and all similar parts shall be strictly interchangeable. Rolled material before being laid off or worked must be straight. If straightening or flattening is necessary it shall be done by methods that will not injure the material.

19.2.4.2 Templates

Templates used throughout the work shall be of steel or steel bushed in such cases as may be considered necessary by the Engineer. In cases where actual materials have been used as templates for drilling similar pieces the Engineer will decide whether they are fit to be used as parts of the finished structures.

19.2.4.3 Straightening

All materials shall be straight and if necessary before being worked shall be straightened and/or flattened by pressure unless required to be of curvilinear form and shall be free from twists. Decoiling and straightening in case of thinner sheets/plates, if supplied in coil is also included.

19.2.4.4 Clearance

The erection clearance for cleared ends of members connecting steel to steel should be not greater than 2mm at each end. The erection clearance at ends of beams without web cleats should not be more than 3, at each end, but where for practical reasons greater clearance is necessary, suitably designed seatings shall be provided.

19.2.4.5 Shearing, Flame cutting and Planning

Shearing and flame cutting may be used at the Contractor's option provided that a mechanically controlled cutting torch shall be used for the flame cutting and that the resulting edge shall be reasonably clean and straight. Care shall be taken to ensure a full bearing of the stiffeners at the supports and at other points where concentrated load is applied.

1.15.7.4.6 Making holes :

Holes for bolts shall not be more than 1.5mm or 2.0mm (as the case may be depending on whether the diameter of the bolts is less than or more than 25mm), in diameter larger than the nominal diameter of the bolts, unless otherwise specified. All holes, except as stated hereunder shall be drilled to the required size or sub punched 3mm less in diameter and reamed thereafter to the required size. Thickness of the material for sub punching shall not be greater than 16mm. All matching holes for bolts shall register with each other so that a guage of 1.5mm or 2.0mm as the case may be, less in diameter than the hole can pass freely through the members assembled for bolting in the direction at right angle to such members

19.2.4.6 Assembly

All parts assembled for bolting shall be in close contact over the whole surface and all bearing stiffeners shall bear tightly at both top and bottom without being drawn or caulked. The component parts shall be so assembled that they are neither twisted nor otherwise damaged.

19.2.4.7 Bolting

All site connections shall be with site weld or black bolts and all the holes shall be 1.5mm larger in diameter. All such bolts shall be provided with washers having a hole of 1.5mm

larger in diameter than the barrel of the bolt and thickness not less than 6mm so that the nut, when tightened, shall not bear on the unthreaded body of the bolt.

Additional joints, wherever required, in case the length of the member is short of length, is to be done by the Contractor at no additional cost to the Employer. However, prior permission of the Engineer has to be taken for such cases.

19.3 Welding

19.3.1 General

The welding and the welded work shall conform to IS:816 and IS:823 unless otherwise specified. As much work as possible shall be welded in shops and the layout and sequence of the operations shall be so arranged as to eliminate distortion and shrinkage stresses.

19.3.2 Plant and Equipment

The equipment shall be of sufficient capacity to suit the welding procedure laid down and be capable of depositing the particular type or types of electrodes to be used under the conditions of current and voltage specified by the electrode manufacturer. All equipment, accessories and connections shall be maintained in proper working order.

19.3.3 Preparation of Joints

The edges shall be prepared with automatically controlled flame cutting torch correctly to the shape, size and dimensions of the groove, prescribed in the design and shop drawings. In case of U-groove joint, the edges shall be prepared with an automatic flame cutting torch in two phases following a bevel cut with a gauging pass or by machining. The welding surface shall be smooth uniform and free from fins, tears, notches or any other defect which may adversely affect welding and shall be free of loose scale, slag, rust, grease, paint, moisture, or any other foreign material.

19.3.4 Welding Procedure

The welding procedure shall be arranged by the Contractor to suit the details of the joints as indicated on the drawings and the position at which welding has to be carried out. Welding procedure shall cover the following :-

- i) Type and size of electrodes;
- ii) Current and (for automatic welding) arc voltage;
- iii) Length of run per electrode; or (for automatic welding) speed of travel;
- iv) Number and arrangement of runs in multirun welds
- v) Position of welding;
- vi) Preparation and set up of parts;
- vii) Welding sequence;
- viii) Pre or post heating;

19.3.5 Minimum leg length and Throat Thickness in Fillet Welds

The minimum leg length of a fillet welds as deposited shall be not less than the specified size. In no case shall a concave weld be deposited unless specifically permitted, where permitted, the leg length be increased above that specified, so that the resultant throat, thickness is as great as would have been obtained by the deposition of flat faced weld of the specified leg length.

19.3.6 Deslagging

After making each run of welding all slag shall be thoroughly removed and the surface cleaned.

19.3.7 Quality of Welds

The weld metal as deposited (including tack welds if to be incorporated) shall be free from cracks, slag inclusions, porosity, cavities and other deposition faults. The weld metal shall be properly fused with the parent metal without undercutting or overlapping at the toes of the weld. The surface of the weld shall have a uniform consistent contour and regular appearance.

19.3.8 Weather Conditions

Welding shall not be done under such weather conditions which might adversely affect the efficiency of the welding.

19.3.9 Qualification and Testing of Welders

The Contractor shall satisfy the Engineer-in-charge that the Welders are suitable for the work upon which they will be employed and shall produce evidence to the effect that welders have satisfactorily completed appropriate tests as described in IS:817. The Engineer-in-charge may at his own discretion order periodic tests of the welders and/or of the welds produced by them. Such tests shall not be at the expense of the Contractor.

The Contractor shall employ competent welding supervisor to ensure that the standard of workmanship and the quality of the materials comply with the requirements laid down in this specification.

19.4 Crane Rails

The rail shall be reasonably free from twist and the camber shall not exceed 0.2 percent of the length. The rails shall be straight and deviation from straightness shall not exceed + 1.5mm.

Rail joints shall overlap the joints of the gantry girder by a minimum distance of 300mm. Joint in one crane rail shall be staggered to the joint in the opposite crane rail.

19.5 Inspection and Testing

The Engineer-in-charge shall have free access at all reasonable times to the Contractor's works where the fabrication of steel work is carried out and shall be afforded all reasonable facilities by the Contractor for satisfying himself that the fabrication is being undertaken in accordance with the provisions of the specification and drawings.

The Contractor shall continually inform the Engineer-in-charge of the progress in fabrication and as to when individual pieces will be ready for inspection.

Unless directed otherwise, inspection shall be made at the place of manufacture prior to despatch. Should any structure or part of a structure be found incomplete any of the provisions of this specification, it shall be liable for rejection. No structure or part of the

structure, once rejected shall be resubmitted for inspection/test, except in cases where the Engineer considers the defect as rectifiable.

Defects which may appear during fabrication shall be made good with the consent of and according to the procedure laid down by the Engineer. All gauges and templates necessary to satisfy the Engineer shall be supplied by the Contractor. The Engineer may, at his discretion, check the test results obtained at the Contractor's works by independent tests at the Government Test House or elsewhere and should the material so tested be found to be unsatisfactory the costs of such tests shall be borne by the Contractor.

19.5.1 Measurement

Measurement of structural steel work shall be made on the calculated weights of steel work as determined from the dimensions given on the approved drawings or any approved amendment thereto. In the case of mild steel plates the calculated weights shall be based on 78.50 Kg. per sq.m. of metal 1 cm thick and in the case of mild steel standard sections the weight shall be calculated on the basis of weight per metre run specified in IS Hand No.1 .

The weights of all plates and sections shall be calculated using the overall square dimensions, no deduction being made for skewcut and holes.

No additional weight for weld metal deposited shall be allowed in the measurements. No deduction shall be made for bolt holes. No measurements shall however be made for bolts and nuts used in fabrication and erection.

19.6 Erection

19.6.1 General

Erection of structural steelwork shall be carried out in accordance with IS:800 and in an expeditious manner in conformity with the drawings and specifications.

The suitability and capacity of all plant, equipment etc. used for erection shall be to the satisfaction of the Consultant.

19.6.2 Erection Drawings

The approved erection drawings and any approved arrangement drawings, specifications or instructions accompanying them shall be followed in erecting structural steelwork. Erection drawings for structural steelwork shall be prepared by Contractor and shall consist of line diagrams showing every member in position with the respective erection mark.

Erection marks shall appear on the structural steel members as in detail drawing and all steelwork shall be erected with marks in the same relative position as shown on the plan or elevation.

19.6.3 Storing and Handling of Materials

The fabricated materials on receipt at site shall be carefully unloaded, examined for defects, checked, sorted out and stocked securely on skids above level ground. The ground shall be kept clean and properly drained. Girders and beams shall be placed upright and stored. Long members such as columns and chords shall be supported on skids placed near enough to prevent injury from deflection.

The fabricated materials shall be verified with respect to markings on the marking plan or erection drawing supplied by the Contractor. Any material found damaged or defective shall be stacked separately and the damaged or defective portions shall be identified by painting in distinct colour. Such materials shall be dealt with as ordered by the Engineer.

The handling and storing of the component parts of a structure shall involve the use of method and appliances not likely to produce injury by twisting, bending or otherwise deforming the metal. No member slightly bent or twisted shall be put in place until the defects are corrected and members seriously damaged in handling shall be rejected.

All small bends or twist received by members shall be rectified before such members are put in place, any serious bends or damage shall be reported at once to the Engineer-in-charge by the Contractor for instructions. The straightening of bend edges of plates, angles and other shapes shall be done by methods not likely to produce fracture or other injury. Following the completion of the straightening of a bend or buckle, the surface of the metal shall be carefully inspected by the Contractor for evidence of incipient or other fractures. The Contractor shall immediately report to the Engineer, presence of any such evidence and act according to his instructions.

19.6.4 Setting Out

The Contractor shall be responsible for checking the alignment and levels of foundations and correctness of foundation bolt centres, well in advance of starting erection work and shall be responsible for any consequences for noncompliance thereof. Discrepancies, if any shall immediately be brought to the notice of the Engineer-in-charge for his advice.

The Contractor shall assume full responsibility for the correct setting out of all steel work and erecting it correctly as per alignment and levels shown on the Drawings. Notwithstanding any assistance rendered to the Contractor by the Engineer-in-charge, if at any time during the progress of the work any error should appear or arise therein, on being required to do so, the Contractor at his own cost shall remove and amend the work to the satisfaction of the Engineer-in-charge.

19.6.5 Assembly and Erection

Before starting erection the Contractor shall submit to the Engineer-in-charge for his approval the method he proposed to follow and the number and type of equipment and temporary work he proposes to use for the erection. The approval of the Engineer-in-charge shall not be considered as relieving the Contractor from responsibility for the loads which the erection equipment and temporary work will be called upon to carry or support. Adequate allowance and provision shall be made for lateral forces and wind loads. Drawings for such temporary work shall be submitted to the Engineer-in-charge for prior approval, if so desired by him.

The Contractor shall plumb and level all steel work and shall thoroughly brace the structures during erection to keep them plumb and rigid till completion. Erected parts of the structure shall be stable during all stages of erection and the structural elements to be erected shall be strong enough to bear erection loads. The stability of structures subject to the action of winds, dead weight and erection forces shall be obtained by observing specified sequence of erection of vertical and horizontal structural members by installing permanent and temporary bracing. As the work progresses, the steel members shall be securely bolted up to take care of all dead loads, wind and erection stress, including those due to erection equipment or its operation. No permanent bolting, welding or grouting shall be done until proper alignment has been obtained and approved by Engineer-in-charge.

19.6.6 Erection Tolerance

19.6.6.1 Erection Tolerance for Buildings without Cranes

The maximum tolerance for line and level of steel work shall be + 3.0 mm on any part of the structure, the structure shall not be out of plumb more than 3.5mm on each 10 m. section of height but not more than 7.0 mm per 30 m section height. These tolerances shall apply to all parts of the structures unless otherwise stated on the drawings.

19.6.6.2 Erection tolerances for buildings containing cranes :

Component	Description	Variation allowed
3. Crane Girder & Track.	a) Difference in levels of crane rail measured between the adjacent columns.	6.0 mm
	b) Deviation to crane rail gauge.	+ 6.0mm
	c) Relative shifting or ends of adjacent crane rails in plan and elevation after jointing.	2.0 mm
	d) Deviation of crane rail axis from centre line of web.	+3.0mm

19.6.7 Field Connections

Field connection in the trusses, portals, columns, roof girders, floor girders, crane girders, surge girders, auxiliary girders, column bracings, etc. shall be welded with erection bolts or shall be bolted. Connection of purlins, girts, roof bracings, wind girders, catwalkways, staircases, ladders, hand rails and all other secondary members may be bolted with black bolts, except where welded connections are required. The above connections shall be applicable in general unless otherwise shown in detail drawings. All nuts for securing run-ways and gantries shall be locked against turning after tightening by provision of suitable spring washer.

Holes of erection joints to be bolted (with machine bolts), shall be filled with temporary bolts and plugs, after mounting the structures. The number of temporary bolts and plugs shall not be less than 50% of the total number of holes. In joints where the number of holes is equal to or less than 5, then 3 holes shall be filled.

The number of washers on permanent bolts shall not be more than two (and not less than one) for the nut and one for the bolt head.

19.6.8 Field Welding

All field assembly and welding shall be executed in accordance with the requirements for shop fabrication excepting such as manifestly apply to shop conditions only. Where the steel has been delivered painted, the paint shall be removed before field welding, for a distance of at least 50mm on either side of the joints.

19.6.9 Bedding and Grouting

Bedding and grouting shall be carried out with mortar grout or cement concrete grout. The Contractor shall provide screed bars or mild steel plates and fix them in mortar. The bedding and grouting shall not be carried out by Civil Contractor until as sufficient portion of steel work including columns, girders, beams, trusses, bracings etc. has been properly aligned, leveled and plumbed and approval of the Engineer-in-charge has been obtained.

Immediately before grouting, the space under the base plate and around bolts shall be thoroughly cleaned and made free from foreign materials. The grout shall be prepared with correct quantity of water to get derived consistency and shall be vibrated and compacted so that the entire grouting space and holes are filled up with dense grout.

Wherever the site connection has to be made, concrete encasing structural member should be cleaned and after erection of new structurals re-encasing at the cut portion has to be made.

19.6.10 Correction of misfits

Correction of minor misfits, a reasonable amount of reaming and cutting of excess will be considered a legitimate part of the erection.

Any error in shop work which prevent the proper assembling and fitting up of parts by the moderate use of reaming and slight chipping, cutting shall immediately be reported to the Engineer-in-charge and his approval for the method of correction is to be obtained.

20.0 Paved Area on Driveway and In Footpaths

20.1 Sub-Grade : Preparation and Consolidation

In sub-grade composed of clay, fine sand or other soils that may be forced up into the coarse aggregate during rolling operation, an insulation layer of suitable thickness of granular materials or over size brick aggregate not less than 10 cm thick shall be provided for blanketing the sub-grade, which shall be paid for separately, unless otherwise specified. In slushy soils or in areas that are water logged, special arrangements shall be made to improve the sub-grade and the total pavement thickness shall be designed after testing the properties of the subgrade soil. Necessary provision for the special treatment required shall be made in the project and paid for separately.

20.1.1 Preparation of Sub-Grade

The surface of the formation for a width of sub-base, which shall be 15 cm more on either side of base course, shall first be cut to a depth equal to the combined depth of sub-base and surface courses below the proposed finished level (due allowance being made for consolidation). It shall then be cleaned of all foreign substances. Any ruts or soft yielding patches that appear due to improper drainage conditions, traffic hauling or from any other cause, shall be corrected and the sub-grade dressed off parallel to the finished profile.

20.1.2 Consolidation

The sub-grade shall be consolidated with a power road roller of 8 to 12 tonnes. The roller shall run over the sub grade till the soil is evenly and densely consolidated and behaves as an elastic mass (the roller shall pass a minimum of 5 runs on the sub grade). All undulations in the surface that develop due to rolling shall be made good with material or quarry spoils as the cases may be and the sub-grade is rerolled.

20.1.3 Surface Regularity

The finished surface shall be uniform and conform to the lines, grades and typical cross section shown in the drawings, when tested with the template and straight edge, the variation shall be within the tolerances specified in Table 16.11.

TABLE 16.11
Permissible Tolerances of Surface Evenness of Sub Grade

<i>Longitudinal profile maximum permissible undulation when measured with a 3 metre straight edge</i>	<i>Cross profile maximum permissible variation from specified profile when measured with a camber template</i>
24 mm	15 mm

Where the surface irregularity of the sub grade falls outside the specified tolerances, the contractor shall be liable to rectify these with fresh material or quarry spoils as the case may be, and the sub-grade rerolled to the satisfaction of Engineer-in-Charge.

20.2 Granular Sub-Base

20.2.1 Materials

The material to be used for the work shall be natural sand, moorum, gravel, crushed stone, crushed slag, crushed concrete, brick metal, laterite, Kankar etc. or combinations thereof depending upon the grading required. The mixed material shall be free from organic or other deleterious constituents and conform to one of the three grading given in PWD (Roads) Specification..

20.2.2 Physical requirements

The fraction of material passing 20mm sieve shall give a CBR value as specified in Table 400-1 or more as specified in the Contract, when tested in accordance with IS: 2720 (Part XVI) after preparing the samples at maximum dry density and optimum moisture content corresponding to IS: 2720 (Part VII) and soaking the same in water for 4 days.

20.2.3 Preparation of Subgrade

Immediately prior to the laying of subgrade already finished to Section 301 or 305 as applicable, shall be prepared by removing all vegetation and other extraneous matter, lightly sprinkled with water if necessary and rolled with one pass of 8-10 tonne smooth wheeled roller.

Moisture content of the loose material shall be checked in accordance with IS: 2720 (Part II) and suitably adjusted by sprinkling additional water from a house line, truck mounted water tank or other approved means 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 VII). While adding water, due allowance shall be made for evaporation losses. After water has been added, the material shall be processed by mechanical or other approved means if so directed by the Engineer-in- Charge until the layer is uniformly wet.

Immediately thereafter, rolling shall be started with 8 to 10 tonne smooth wheeled rollers or other approved plant. Rolling shall commence at the edges and progress towards the centre longitudinally except that on superelevated portions it shall progress from the lower to the upper edge parallel to the centre line of the pavement. 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 camber shall be checked and any high spots or depressions which become apparent corrected by removing or adding fresh material.

Rolling shall be continued till the density achieved is at least 100% of the maximum dry density for the material determined as per IS: 2720 (Part VII). The surface of any layer material on compaction shall be well closed, free from movement under compaction planes, ridges, cracks or loose material. All loose, segregated or otherwise defective areas shall be made good to the full thickness of layers and re-compacted.

20.2.4 Surface Finish and Quality Control of Work.

The Surface finish of construction shall conform to the requirements of Clause 901 of specified for Road and Bridge works issued by Ministry of surface Transport.

Control on the quality of materials and works shall be exercised by Engineer-in-Charge in accordance with Clause 902 of specified for Road and Bridge works issued by Ministry of surface Transport.

20.3 Bituminous filler in Expansion joint

After the curing period is over the joint portion above the filler board shall be cleaned thoroughly as directed by the Engineer-in-Charge. The joints shall be filled with hot applied sealing compound. Grade A (Normal) for concrete constructions other than those which are subjected to spillage of kerosene or other heavy petroleum oils and Grade B (Jet fuel resistant) for concrete constructions of runways for jet air crafts, conforming to IS 1834.

20.4 Paving on the driveway

The work shall be carried out in the following sequence of work.

- Box cutting on existing ground as per level gradient and camber.
- Roll the box cut formation surface with 8 to 10 ton power roller.
- Lying of a sand base of 200mm. thick duly compacted with watering and rolling.
- Laying of PCC M20 grade as specified in BOQ as in road pavement
- Laying 100mm. thick pre-cast concrete of M 40 grade interlocking blocks as per manufacturer's specification. Over a sand cushion of 200mm. thick on the concrete pavement in level, gradient as directed, joint shall be sealed with cement mortar 1 4
- Chiseled stone block should be laid as edging simultaneously while laying block

20.5 Paving on footpath

The work shall be carried out in places where vehicular traffic is not likely to use, only pedestrian traffic to use the surface.

The interlocking precise concrete tiles should be of at least M40 grade manufactured by approved manufacturer of approved cour / pattern as approved by Engineer laid over 50mm thick sand cushion over rammed earth.

20.6 Reflectorised Paint

Refectorised paint shall be laid in compliance with this Specification and with the manufacturers recommendations with a minimum marking thickness of 0.5 millimeter. Reflectorised glass beads for use in conjunction with reflectorised paint shall conform to the requirements of Clause — 803.4.4 of IRC.

The reflectorised paint (thermoplastic paint) shall readily get scruled / exhuded at temperature specified by manufacturer for respective method of application to produce a line of specified thickness which shall be continuous and uniform in slhape having linear and sharp edges. The material upon heating to application temperature shall not exude fumes which are toxic, obnoxious and injurious to persons and property. All precautionary measures should be taken by the Contractor.

20.7 RCC Hume Pipe

RCC hume pipes shall conformed to specification as per IS : 458 — 1988 as amended.

21.0 Horticulture and Land Scaping

21.1 Horticulture Work

Horticultural operations shall be started on ground previously levelled and dressed to required formation levels and slopes. In case where unsuitable soil is met with, it shall be either removed or, replaced or it shall be covered over to a thickness decided by the Engineer-in-charge with good earth. In the course of excavation or trenching during horticultural operations, any walls, foundations, etc. met with shall not be dismantled without pre-measurement and prior to the written permission of the Engineer-in-charge.

21.1.1 Trenching In Ordinary Soil

Trenching is done in order to loosen the soil, turn over the top layer containing weeds etc. and to bring up the lower layer of good earth to form a proper medium for grassing, regrassing, hedging and shrubbery. Trenching shall be done to the depth ordered by the Engineer-in-charge. The depth is generally 30 cm for grassing and 60 cm for regrassing in good soil. The trenched ground shall, after rough dress, be flooded with water by making small kiaries to enable the soil to settle down. Any local depression unevenness etc. shall be made good by dressing and/or filling with good soil. Weeds or other vegetation which appear on the ground are then uprooted and removed and disposed off and paid.

Trenching shall consist of the following operations:

1. The whole plot shall be divided into narrow rectangular strips of about 1.5 m width or as directed by the Engineer-in-Charge.
2. These strips shall be sub-divided lengthwise into about 1 m long sections. Such sections shall be excavated serially and excavated soil deposited in the adjacent section preceding it.
3. In excavating and depositing care shall be taken that the top soil with all previous plant growth including roots, get buried in the bottom layer of trenched area, the dead plants so buried incidentally being formed into humus.
4. The excavated soil shall be straight away dumped into the adjoining sections so that double handling otherwise involved in dumping the excavated stuff outside and in back filling in the trenches with leads is practically eliminated.

Measurements

Length and breadth of the plot shall be taken correct to 0.1 m and depths correct to cm. Cubical contents shall be calculated in cubic meters, correct to two places of decimal. No deduction shall be made nor extra paid for removing stones, brick bats and other foreign matter met with during excavation upto initial lead of 50 m and stacking the same.

Rate

The rate shall include the cost of all labour and material involved in the operations described above, including cost of all precautionary measures to be taken for protections and supporting all services etc. met with during trenching. It does not include the cost of mixing of earth, sludge/manure.

21.1.2 Oil Cake

Neem/Castor: The cake shall be free from grit and any other foreign matter. It should be undecorticated and pulverized. The material shall be packed in old serviceable gunny bags of 50 kgs capacity approximately. The weight of

gunny bag shall be deducted @1 kg per bag and payment shall be made for net quantity. The quality of cake should be got approved by the Engineer-in-charge before supply.

Measurements

The arrangement for weighing shall be made at site of work by the department. The gunny bags shall be the property of the government.

Rate

The rate shall include the cost of labour and material involved in all operations described above, including carriage up to site of work with all lead and lifts, weighing etc.

21.1.3 Supply and Stacking Of Sludge

It shall be transported to the site in lorries with efficient arrangement to prevent spilling enroute. It shall be stacked at site. Each stack shall not be less than 50 cm height and volume not less than 3 cum.

Measurements

Length, breadth and depth of stacks shall be measured correct to a cm. The volume of the stack shall be reduced by 8% for looseness in stacking and to arrive at the net quantity for payment.

Rate

The rate shall include the cost of labour and material involved in all operations described above, including carriage up to one km. The rate shall also include royalty if payable.

21.1.4 Rough Dressing Of The Trenched Ground

Rough dressing of the area shall include making kiaries for flooding.

The trenched ground shall be levelled and rough dressed and if there are any hollows and depressions resulting from subsidence which cannot be so levelled, these shall be filled properly with earth brought from outside to bring the depressed surface to the level of the adjoining land and to remove discontinuity of slope and then rough dressed again. The supply and spreading of soil in such depressions is payable separately. In rough dressing, the soil at the surface and for 75 mm depth below shall be broken down to particle size not more than 10 mm in any direction.

Measurements

Length, breadth of superficial area shall be measured correct to 0.1 metre. The area shall be calculated in sqm. correct to two places of decimal.

Rate

The rate shall include the cost of all the labour and material involved in all the operations described above.

21.1.5 Uprooting Weeds From Trenched Areas

After 10 days and within 15 days of flooding the rough dressed trenched ground with water, the weeds appearing on the ground shall be rooted out carefully and the rubbish disposed off as directed by the Engineer-in-charge.

Measurements

Length, breadth of superficial area shall be measured correct to 0.1 meters. Superficial area of the weeded ground shall be measured for purpose of payments.

Rate

The rate shall include the cost of all the labour and material involved in all the operations described above.

21.1.6 Fine Dressing The Ground

Slight unevenness, ups, and downs and shallow depressions resulting from the settlement of the flooded ground, in drying and from the subsequent weeding operations, shall be removed by fine dressing the surface to the formation levels of the adjoining land as directed by the Engineer-in-charge, and by adding suitable quantities of good earth brought from outside, if necessary.

Measurements

Length, breadth and depth of stacks shall be measured correct to a cm. The area shall be calculated in sqm. correct to two places of decimal.

Rate

The rate shall include the cost of all the labour and material involved in all the operations described above.

21.1.7 Spreading Sludge/Manure

Good earth shall be thoroughly mixed with sludge or manure in specified proportion as described in the item or as directed by the Engineer-in-Charge. The mixing shall be spread to the thickness ordered by the Engineer-in-Charge.

Measurements

The quantity of good earth and sludge or manure mixed shall be determined by the difference in the volume of good earth and sludge or manure in stack, before and after spreading duly accounted for voids and looseness in stack.

Rate

The rate shall include of all the labour and material involved in all the operations described above, but does not include the cost of good earth sludge or manure which shall be paid for separately, unless otherwise described in the item.

21.1.8 Mixing Of Good Earth and Sludge/Manure

The stacked earth shall, before mixing be broken down top particle of sizes not exceeding 6 mm in any direction. Good earth shall be thoroughly mixed with sludge or manure in specified proportion as described in the item or as directed by the Engineer-in-charge.

Measurements

The quantity of good earth and sludge or manure mixed shall be determined by the difference in the volume of good earth, sludge or manure in stack, before and after spreading duly accounted for voids and looseness in stack.

Rate

The rate shall include the cost of all labour and materials involved in all the operations described above, but does not include the cost of good earth sludge or manure which shall be paid for separately, unless otherwise described in the item.

21.1.9 Grassing with select grass no. 1

The area from where the grass roots are to be obtained shall be specified by the Engineer-in-Charge at the time of execution of the work and no royalty shall be charged on this account from the contractor. Grass is to be arranged by contractor (cost of grass to be paid separately).

The soil shall be suitably moistened and then the operation of planting grass shall be commenced. The grass shall be dibbled at 10 cm, 7.5 cm, 5 cm apart in any direction or other spacing as described in the item. Dead grass and weeded shall not be planted. The contractor shall be responsible for watering and maintenance of levels and the lawn for 30 days or till the grass forms a thick lawn free from weeded and fit for moving whichever is later. Generally planting in other direction at 15 cm, 10 cm, spacing is done in the case of large open spaces, at 7.5 cm spacing in residential lawn and at 5cm spacing for Tennis Court and sports ground lawn. Rates are including cost of labour and material (grass shall be paid separately.)

Measurements

Length, breadth of the lawn grassed shall be measured correct to 0.1 meter and the area shall be calculated in sqm. correct to two places of decimal.

Rate

The rate shall include of all the labour and material involved in all the operations described above, excluding supply of the requisite quantity of good earth and grass so needed for properly maintaining the levels of the lawns. (payment of grass to be paid separately).

21.1.10 Preparation Of Beds For Hedge And Shrubbery

Beds for hedges and shrubbery are generally prepared to width of 60 cm. to 125 cm. and 2 to 4 meters respectively. The beds shall first be excavated to a depth of 60 cm. and the excavated soil shall be stacked on the sides of the beds. The surface of the excavated bed shall then be trenched to a further depth of 30 cm, in order to loosen the soil, in the manner described in 23.1. No flooding will be done at this stage but the top surface shall be rough dressed and levelled. The excavated soil from the top 60 cm depth of the bed stacked at the site shall then be thoroughly mixed with sludge over manner in the proportion 8:1 by ratio or other proportion described in the item. The mixed earth and manure shall be refilled over the trenched bed, leveled neatly and profusely flooded so that the water reaches even the bottom most layers of the trenched depth of the bed. The surface after full subsidence shall again be refilled with the earth and manure mixture, watered and allowed to settle and finally fine dressed to the level of 50 mm to 75 mm below the adjoining ground or as directed by the Engineer-in-Charge. Surplus earth if any, shall be disposed off as directed by the Engineer-in-charge. Any surplus earth if removed beyond initially lead shall be paid separately. Stones, bricks bats and other foreign matter if met with during excavation or trenching shall be removed and stacked within initially lead & lift, such material as is declared unserviceable by the Engineer-in-charge shall be disposed by spreading and levelling at places ordered by him. If disposed outside the initial lead & lift, then the transport for the extra leads will be paid for separately. If a large proportion of material unsuitable for the hedging and shrubbery operations is met with and earth from outsides is required to be brought in for mixing with manure and filling, the supply and stacking of such earth will be paid for separately.

Measurements : Length, breadth and depth of the pit excavated and trenched shall be measured correct to a cm. The cubical contents shall be calculated in cubic meter correct to two places of decimal.

Rate : The rate shall include the cost of all the labour and material involved in all the operations described above. The rate shall not include the cost of supply & stacking of the manure unless the same is specifically included in the description of the item.

21.1.11 Digging Holes For Planting Trees

In ordinary soil, including refilling earth after mixing with oil cake, manure and watering. Holes of circular shape in ordinary soil shall be excavated to the dimensions described in the items and excavate soil broken to clods of size not exceeding 75 mm in any direction, shall be stacked outside the hole, stones, brick bats, unsuitable earth and other rubbish, all roots and

other undesirable growth met with during excavation shall be separated out and unserviceable material removed from the size as directed. Useful material, if any, shall be stacked properly and separately. Good earth in quantities as required to replace such discarded stuff shall be brought and stacked at site by the contractor which shall be paid for separately. The tree holes shall be manured with powdered Neam/castor oil cake at the specified rate along with farm yard manure over sludge shall be uniformly mixed with the excavated soil after the manure has been broken down to powder, (size of particle not be exceeded 6 mm in any direction) in the specified proportion, the mixture shall be filled in to the hole up to the level of adjoining ground and then profusely watered and enable the soil to subside the refilled soil shall then be dressed evenly with its surface about 50 to 75 mm below the adjoining ground level or as directed by the Engineer-in-charge.

Measurements : Holes shall be enumerated.

Rate : The rate shall include the cost of all the labour and material involved in all the operations described above, excluding the cost of supply and stacking the requisite quantity of manure/sludge and oil cake.

21.1.12 M.S. Flat iron tree guard

M.S. Iron Riveted Tree Guard

The tree guard shall be 600 mm in diameter and 2 meter high above ground level and 25 cm in below ground level. The tree guard shall be framed of 4 nos. 25 x 6 mm M.S. flat 2 meter long excluding displayed outward at lower and upto an extent 10 cm and 8 nos. 25 x 3 mm vertical M.S. Flat Rivetted to 3 Nos. 25 x 6 mm Flat iron rings in two halves, bolted together 8 mm dia and 30 mm long M.S. bolts and nuts. The entire tree guard shall be given two coats of synthetic enamel paint of approved brand and manufacturer of required shade over a priming coat of ready mixed steel primer of approved brand and manufacturer. The design of tree guards shall be shown in the drawing.

M.S. Flat Iron Welded Tree Guard

The tree guard shall be 600 mm in diameter and 2 meter high above ground level and 25 cm in below ground level. The tree guard shall be framed of 4 nos. 25 x 6 mm MS. Flat 2 metres long excluding displayed outward at lower and upto an extent 10 cm and 8 Nos. 25 x 3 mm vertical M.S. Flat Rivetted to 3 nos. 25 x 6 mm flat iron rings in two halves, bolted together 8 mm dia and 30 mm long M.S. Bolts & nuts. The entire tree guard shall be given two coats of synthetic enamel paint of approved brand and manufacturer of required shade brand and manufacturer of required shade over a priming coat of ready mixed steel primer of approved brand and manufacturer. The design of tree guards shall be shown in the drawing.

Measurement: The tree guard shall be enumerated.

Rate : The rate shall include the cost of all the labour and material involved in all the operations described above.

21.1.13 Filling Mixture of Earth & Sludge Over Manure

The separately specified earth and sludge shall be broken down to particles of size not exceeding 6 mm in any directions before mixing. Good earth shall be thoroughly mixed with sludge over manure in specified proportions as directed by Officer-in-Charge. During the process of preparing the mixture as above, trenches shall be flooded with water and levelled.

Measurements : Measurement shall be made in (Length, breadth and height of stacks) cubic meter. The cubical contents shall be worked out to the nearest two places of decimal in cubic meter.

Rate : The rate shall include the cost of all the labour and material involved in all the operations described above, but do not include the good earth, sludge or manure which will be paid separately.

22.0 Miscellaneous Items

22.1 Polycarbonate Roofing Sheet

Polycarbonate Panel System should be 12mm thick (minimum) with 3 cells — 4 walls structure conforming to technical specifications mentioned below.

- Panel shall be 12 mm thick (min.) single panel.
- Panel Width shall be 900mm to ensure best performance for wind uplift, vibration, oil canning and visual appearance. The panel below 900 mm will not be acceptable.
- The panels shall be uniform in color with an integral Multi-Cell core. In a cross section, the core shall be constructed of Multicell of 4mm x 4mm.
- Panels shall be manufactured with Vertical Standing Seam at both sides of the panel. Welding or gluing of up stands or standing seam is not acceptable.
- Snap-on connector to interlock the panels shall have a grip-lock double tooth locking Mechanism to ensure maximum uplift capability. Panel without double tooth will not be acceptable.
- Panels shall be co-extruded UV protected and Softlight type to prevent glare.
- Panels are secured with snap-on connectors with/ without continuous double wall Aluminum spacer along the standing seam.
- Polycarbonate End-cap / Aluminum U-Profile (mill finish) for ends.

22.2 Preformed Steel Roof / Wall

Steels supports shall be Zinc or paint coated. Sheets shall have approved side laps with the top sheet laps facing away from the prevailing weather.

Flashings are to be manufactured from like or compatible materials as designated and shall cover the sheets a minimum of 100 mm.

Attachments and joints are to be made with mechanical fasteners and sealants approved by the cladding manufactures.

Packs of sheet shall be kept dry in transit and on site to prevent water and/or condensation being trapped between adjacent surfaces. Packs of sheet standing on site shall be stored clear off the ground. Sheets shall be handled using clean dry gloves.

The roof and gutters shall be swept clean of all debris (nuts, screws, cuttings, fillings etc.) by using a soft broom at least at the end of the each day's work and particularly on the completion of fixing. The job shall be left clean and in the weather tight condition. All sheets shall be fixed in a workmanlike manner and in accordance with the manufacturers' recommendations.

Base steel shall be cold rolled Galvalume[®] Steel as per AS 1397 (150 gm/m² zinc/aluminium alloy coating mass) or cold rolled galvanized steel as per IS: 277 with 175 gm/m² zinc coating mass.

Substrate shall be pre-painted with polyester paint system/silicon polyester/fluoropolymer paint system.

Foam fillers for ridge cappings and transverse flashings shall have to be used for roof slopes below 3 deg.

Handling and Storage

To preserve the surface, handling should only be carried out using clean, dry gloves. Do not slide sheets over rough surfaces or each other. Packs of TRACDEK[®] steel cladding in all finishes must be kept dry in transit, and stored clear of the ground under cover to prevent water and/or condensation being trapped between adjacent surfaces. If packs become wet, sheets should be separated, wiped with a clean cloth without delay and placed so that air circulation completes the drying process. These procedures are recommended to avoid possible

deterioration of the coating which could lead to a reduced life expectancy or poor appearance.

Cutting Sheets

It is good practice to place the finish paint side down when cutting coloured pre-finished steel cladding with a power saw. This lessens the amount of hot filing likely to adhere to the paint surface and cause early corrosion problems. Do not cut over the top of other painted products. Likewise, if power cutting or drilling is to be carried out on an organic coated steel product already fixed in position, the area around the holes or cuts should be masked or at least covered with tape, rags, etc. to shield the paint surface from hot filings.

Ensure that metallic articles are swept off sheet surfaces immediately following any cutting, drilling, etc..

22.3 UPVC Outlet Pipes / Spouts

Outlet Pipes / Sprouts shown in drawings shall be of uPVC type conforming to the latest IS specifications. Length of outlet pipes / spouts shall be as indicated on drawings but not less than 300 mm where length is not shown, it shall be taken as 300 mm overall.

22.4 Deleted

22.5 Deleted

22.6 Manhole Covers & Frames

22.6.1 Manhole Covers

The covers and frames shall conform to IS 1726 for cast Iron and IS 12592 for pre-cast concrete covers and shall be of the following grades and types.

Grades	Grade Designation	Type/shape of cover
Light Duty	LD - 2.5	Rectangular, Square, Circular
Medium Duty	MD - 10	Rectangular, Circular and Square (for pre-cast concrete manhole covers)
Heavy Duty	HD - 20	Circular-Square, Rectangular, (Scrapper Manhole)
Extra Heavy Duty	EHD - 35	Circular, Square, Rectangular, (Scrapper Manhole)

22.6.2 Cast Iron Manhole Covers and Frames

- (i) Manhole covers and frame shall be manufactured from appropriate grade of grey cast iron not inferior than FG150 grade of IS 210.
- (ii) They shall be cleanly cast and shall be free from air and sand holes, cold shuts and warping.
- (iii) Covers shall have on its operative top a raised chequered design to provide for an adequate no-slip grip. The rise of chequers shall be not less than 4mm.
- (iv) Key holes, keys and lifting devices shall be provided in the manhole covered to facilitate their placement in the frames and their operative maintenance.
- (v) Manhole covers and frames shall be coated with materials having base with a black bituminous composition. The coating shall be smooth and tenacious. It shall not flow when exposed to temperature of 63°C and shall not be so brittle as to chip off at temperature of 0°C.
- (vi) Size and shape and performance requirement of manhole covers and frames shall conform to IS 1726.
- (vii) Each manhole covers and frame shall have cast on them the following information:
 - (a) Manufacturer's name or trade-mark
 - (b) Grade designation

- (c) Date of manufacturer
- (d) The words SWD or 'Sewer' to denote 'storm water drain' or 'sewer' respectively
- (e) Identification marks as required by Engineer-in-Charge.
- (viii) The cover shall be gas tight and water tight.
- (ix) The sizes of covers specified shall be taken as the clear internal dimensions of the frame.
- (x) The approximate weight of the various type of manhole covers and frames shall be as per IS 1726.
- (xi) The cover shall be capable of easy opening and closing and it shall be fitted in the frame in workmanship like manner.

22.7 Road Gully Grating

Horizontal Gully Grating: The casting of the grating and frames shall be the same as that of manhole covers described in 19.2.2.1. The gully grating cover shall be hinged to the frame to facilitate its opening for cleaning and repairs. A typical grating is shown in Fig. 19.13 & 19.14. The weight of grating shown in Figure shall be minimum 75 Kg. In case of R.C.C. horizontal gully grating it shall be in cement concrete 1:1:2 (1 cement: 1 coarse sand: 2 graded stone aggregate 20 mm nominal size)

Vertical Gully Grating: The chamber shall be of brick masonry, 12 mm dia, round bar shall be fixed in cement concrete block at the bottom. The bars at the top shall be welded or riveted to M.S. flat 40x6 mm

Horizontal and Vertical Gully Grating: The details of typical road gully chamber of brick masonry with horizontal and vertical grating

22.8 Plinth Protection

Plinth protection shall be 75mm thick in cement concrete (1 :3:6) type C-2 over 75mm thick hard core of 40mm graded stone aggregate and well compacted over rammed earth and shall be finished even and fair with steel trowel without using extra cement. Plinth protection shall be laid to a slope of 1 in 24 in alternate bays system., Each bay shall not exceed 3 metre in length. 12mm wide and 7.5 cms deep joint shall be formed between the bays which shall be filled with mastic filling to full depth, comprising a mixture of one part of heated hot blown bitumen 85/25 Penetration and two parts of heated coarse sand (by volume). The width of plinth protection irrespective of what is shown on drawings shall be 1500 mm. The toe of plinth protection of size 75mm deep and 75mm wide shall also be of PCC 1: 3:6 type C-2 and shall be provided in buildings irrespective of whether shown on drawings or not. Plinth protection shall be provided to all buildings irrespective of whether shown on drawings or not.

23.0 Applicable Codes and Specifications

The following specifications, standards and codes are made a part of this specification. All standards, tentative specifications, codes of practice referred to herein shall be the latest editions including all applicable official amendments and revisions.

Some of the IS codes that are applicable to the work are listed below :

IS 269	Specification for ordinary, rapid hardening and low heat Portland cement.
IS-10262	Recommended guidelines for concrete mix design.
IS 8112	Specification for high strength ordinary, Portland cement.
IS 1489	Specification for Portland - pozzolona cement.
IS 383	Specification for coarse and fine aggregates from natural source for concrete.
IS 2386: Part 3	Methods of test for aggregates for concrete. (Part I to VIII)
IS 516	Method of test for strength of concrete.
IS 1199	Method of sampling and analysis of concrete.

IS 3025	Methods of sampling and test (Physical and chemical) water and waste water used in industry.
Part 17	Non-filterable residue (total suspended solids)
Part 18	Volatile and fixed residue (total filterable and non-filterable)
Part 22	Acidity
Part 23	Alkalinity
Part 24	Sulphates
Part 32	Chloride
IS: 1786	TMT Bars
IS 2645	Specification for integral cement waterproofing compound.
IS 456	Code of practice for plain and reinforced concrete.
IS 3370	Code of practice for concrete structures for storage of liquids (Part I to IV)
IS 2502	Code of practice for bending and fixing of bars for concrete reinforcement.
IS 2571	Code of practice for laying in situ cement concrete flooring.
IS 3596	Safety code for scaffolds and ladders. (Part I & II)
IS 1200	Method of measurement of building works.

In addition to the above IS codes, all other IS codes that are applicable to the work should also be followed and provided to ENGINEER - IN - CHARGE, if asked for at the risk and cost of the Contractor. Moreover, PWD specification with names of codes and detail specifications shall also be applicable. In case of any dispute , ambiguity etc the decision of ENGINEER - IN – CHARGE shall be final and binding to the Contractor .

24.0 List of Approved Brand / Manufacturer

Sl. No.	Description of Approved Material	Approved Brand / Manufacturer
1	Cement	ULTRATECH(L&T) / AMBUJA /ACC /LAFARZE
2	Reinforcement Steel	SAIL/TATA/RINL
3	Structural Steel	SAIL/TATA/RINL
4.	Glazed Tile	NITCO /KAJARIA /
5.	Ceramic Floor Tile	NITCO /JOHNSON/ KAJARIA /
6.	Vitrified Floor Tile	NITCO / RESTILES / MARBONITE
7.	Cement Bonded Particle Board Conforming to IS 14276 – 1995	“BISON PANEL” – INDIA – NCL INDUSTRIES LTD. (Boards Division) / EVEREST INDUSTRIES LTD .
8.	Ply Wood, Shuttering Ply Conforming to IS 303-1989 / IS 4990-1993	M/s. Century Plyboards (I) Ltd. / M/s. Green Ply Industries Ltd./ SARDA Industries
9.	Wooden Frame	Siliguri Sal / Malayasian Sal
10.	Fire Door	Shakti Met-Dor
11	Rolling Shutter	Bengal Rolling Shutter
12.	Stainless Steel Section	SAIL/ TATA
13.	Stainless steel hardware for doors	Dorma /Haffelle
14	Glazing	Saint Gobain / Asahi Float Glass Ltd / Hindustan Safety Glass Works Ltd. / Modi.

15.	Injection water proofing, waterproofing coating, water repellents Conc. Admixtures. Plasticized PVC membrane of waterproofing	Sika Qualcrete Ltd./ Structural Waterproofing Co. / Pidilite Industries Ltd. / 'Fosroc / BASF
16.	Synthetic Enamel Paints, Distemper, Acrylic Emulsion Paints, Melamine Coating , Aliphatic Acrylate	I.C.I (I) Ltd. / Berger Paints (I) Ltd. / Jenson & Nicholson (I) Ltd. / Asian Paints (I) Ltd. / FOSROC Chemicals(I) Pvt Ltd .
17.	Flush door (Factory made)	M/s. Century Plyboards (I) Ltd. / Green ply / Merino Industries
18.	Aluminium Sections and Extrusion shall conform IS:733-1983 and IS:1285-1975	HINDALCO / JINDAL /DOMAL
19.	General Hardware	
	a) Latches, hinges etc.	GODREJ / DORMA / HAFELLE
	b) Locks , Flush bolt	GODREJ / DORMA / HAFELLE
	c) Handles	GODREJ / DORMA/ HAFELLE
	d) Screw	Nettlefold / GKW / ND
	e) Door Closure	GODREJ / DORMA/HAFELLE
	f) Floor Spring	GODREJ / M/s. EVERITE Agencies Pvt. Ltd. / M/s. Garnish
	g) Aldrop	ISI Marked
	h) Tower bolt	ISI Marked
	I) PVC Buffer block	ISI Marked
	J) Door Stopper	ISI Marked
	k) Patch fittings for toughened glass	Dorma Systems
20.	Laminates	"DECOLAM" (Bakelite Hylam Ltd.) / "MERINO" (Century Laminating Co. Ltd.)/ GREENLAM (GREEN PLY)
21	Marble	
	a) White Variety (Indian)	Abu White Super
	b) Green Variety (Indian)	Udaipur
	c) Italian Marble	As per approved shade
	Granite :	
	a) Red	Ruby Red
	b) Black/Grey	Premium
22	Kotah stone (Bluish grey)	Premium
23	Waterproof Adhesive for Tile / Slab fixing to wall or floor	Terraco India (P) Ltd. / M/s. Pidilite Industries Ltd. / M/s. Roffe Construction Chemicals Pvt. Ltd.

24	Sealant	Rhodorsil-33, Pidiseal A-11 & B-11 : M/s. Pidilite Industries Ltd. Techseal RDL-600, Techseal RDL-940, Techseal RDL-1000 : M/s. Choksey Chemical (P) Ltd. Roffseal : M/s. Roffe Construction Chemicals Pvt. Ltd. or Fosroc .
25	Tile Jointing Materials	"Rainbow Tile Mate – HD" (M/s. Roffe construction Chemicals Pvt. Ltd.). "Terragrout" (M/s. Terraco India (P) Ltd.). or Fosroc
26	Decorative Ply (Teak / Cedar / Mahogany / Walnut Veneer)	M/s. Century Plyboards (I) Ltd. / Jacsons/Truwoods (P) Ltd /GREEN PLY
27.	Cement Based Exterior Textured Paint	ICI (I) Ltd / Asian Paints / Berger Paint (I) Ltd .
28	Glass Mosaic tiles	Shon, Kent , Bisazza
29	Glass for structural glazing & canopy (Coloured Reflective toughened glass)	Saint Gobain / Hindustan Pilkington/ Ashai float glass .
30	Silicone Sealant	GE/Dow Corning
31.	Aluminium composite panel	Aluco bond ,Aludecor , Alstrong
32.	MS Conduit pipe	BEC /SUPREME/ AKG
33.	PVC Conduit pipe	AKG /PLAZA/ PADAM
34.	Pre-constructional Anti-termite (Chloropyriphos)	Pest Control India or approved by Engineer-in-charge
35.	Cement Primer	ICI / BERGER / ASIAN
36.	Textured Paint	ICI / BERGER / ASIAN PAINTS ,
37.	Waterproofing acrylic emulsion exterior grade paint	ICI / BERGER / ASIAN PAINTS
38.	Acrylic Polymer waterproofing coat	SIKA / FOSROC / PIDILITE / ROFFE/ BASF
39.	Expanding grout admixture	SIKA / FOSROC / PIDILITE / ROFFE/ BASF
40.	Integral waterproofing compound	SIKA / FOSROC / PIDILITE / ROFFE
41.	Waterproofing admixture	SIKA / FOSROC / PIDILITE / ROFFE
42.	Plasticizer	SIKA / FOSROC / PIDILITE / ROFFE
43	APP Modified Bituminous membrane	SIKA / FOSROC / PIDILITE / ROFFE
44	PVC door	SINTEX OR AS APPROVED BY ENGINEER-IN-CHARGE
45	Aluminium anodized louver	HUNTER DOUGLAS
46	Structural glazing	JINDAL/HINDALCO .
47	Stainless steel handrail with balluster	GODREJ / DLINE
48	False ceiling	GYPSUM/EVEREST/ARMSTRONG

Note : If the approved brands mentioned above are not available, equivalent make as may be approved by Engineer-in-charge only to be used for the work. The items for which brand name or name of the manufacturer have not been mentioned in the above list , shall be given by Engineer-in-charge to the contractor during the execution of work . The above list is not comprehensive and Engineer-in-charge reserve the right to ask the contractor for use of any alternate brand / manufacturer during execution of work of equivalent quality.

TECHNICAL SPECIFICATION

WATER SUPPLY, SANITARY & PLUMBING

1.0 WATER REQUIREMENTS

1.1 Source of Water

The Domestic Water demand for the daily activities will be met up by the Municipal Authority , which is in charge of supply of potable water and treatment and disposal of spent water in the Municipal Area. However, the Authority is not going to supply any water for Construction purposes, which is also quite significant for such a huge project. It is therefore proposed to sink one temporary Tubewell of depth 152 m and size 250mm-150 mm with an assessed yield of 10,000 gph to meet up the construction water needs.

SPECIFICATION OF INTERNAL WATER SUPPLY & SANITARY DRAINAGE SYSTEM

2.0 GENERAL

The Contractor shall arrange with local Municipal Authorities for getting the water and sewerage connections. The actual connection charges to be paid to the local bodies shall be borne by the Contractors.

No payment will be made to the Contractor for submission of plans to the statutory authorities / Local bodies etc. and obtaining sanction of the same. The rates quoted by the Contractor shall be considered and deemed to have been included of all these charges that might have been incurred by the Contractor.

The rates are of complete items as fixed in position and over all costs- e.g. cutting of holes ,chases, etc., and also for provision of fixing arrangement viz., clamps ,brackets, wooden blocks priming, painting etc. the rates shall also include restoration to original condition of all damages to walls, floors etc., during the process of fixing sanitary installations , water supply and drainage . All debris of plumbers excavation, etc., shall be removed without any extra charge. The plumbing work/or the building work effected by the plumber work shall be left thoroughly cleaned to the satisfaction of ENGINEER-IN-CHARGE.

Unless specified to the contrary, all material should conform to ISI specification and be of best quality and make as approved by the ENGINEER-IN-CHARGE. Testing shall be undertaken for various materials samples, pipe lines etc. and as may be directed by the ENGINEER-IN-CHARGE at the risk & cost of the Contractor.

All G.I pipes (except concealed pipes and underground pipes) and brackets and fixtures and manhole covers shall be painted with 2 coats of synthetic enamel paints of approved brand over a coat of Red-oxide Primer/ Red lead primer, as directed.

All concealed and underground G.I pipes and specials shall be painted with 2 coats of Bituminous paint of approved brand as directed by ENGINEER-IN-CHARGE.

All priming and painting work shall be carried out to the satisfaction of the ENGINEER-IN-CHARGE and cost thereof shall be covered in the rates of all the respective items.

The Plumbers shall obtain the drainage completion certificate and the certificate of adequate water supply from the Local statutory body / Panchayat / Municipality and shall abide by the rules and regulations prescribed by them or other authorities concerned, wherever necessary.

In case of concealed G.I pipe work, the chases in floors and walls shall be made as approved by ENGINEER-IN-CHARGE. The pipes shall be secured tightly to the walls with clamps. The chases shall be filled with cement concrete 1:2:4 (1 cement: 2 coarse sand : 4 graded stone aggregate of 20mm nominal size). Payment shall be made for cutting chases and filling in

the cement concrete and making them good as per relative item in the Bill of quantity for renewal items as per CPWD specifications.

The cast iron pipes shall be laid exposed on wall with M.S. holder bat clamps made from 32mm thick. M.S. flats of approved design and required size. A clear minimum gap of 25mm between the wall and the pipe shall be left. All the clamps shall be embedded in cement concrete blocks sized 20cm x 20 x 10 cms. in 1:2: 4 mix (1 cement :2 coarse sand : 4 graded stone aggregate - 20mm. nominal size) . The holes in walls and RCC work shall be made at point approved by ENGINEER-IN-CHARGE, and shall be made by the Contractors. Payment shall be made as per relative item in the Bill of Quantity complying with CPWD specifications.

All plumbing and sanitary fixtures, pipes and pipe fittings, traps etc., which are to be embedded into the concrete or masonry work or other building work shall be placed in position and embedded for concealed at the time of casting of concrete and during the work shall be placed in position and embedded for concealed at the time of casting of concrete and during the work of construction. In case where chasing or cutting of concrete, masonry, or other structural or constructional work is unavoidable, the location of such fittings, pipe lines and traps etc., shall be chalked out at the various places and the cutting, chasing or disturbing of the construction work shall be proceeded only after the due approval of ENGINEER-IN-CHARGE.

All cuttings, chasing and fixing work shall be completed before commencement of any plastering, tiling or finishing work. Any rectification required shall be done at the risk & cost of the Contractor to the entire satisfaction of ENGINEER-IN-CHARGE.

Galvanised iron pipes of "TATA" or equivalent make, of "**Medium**" quality, E.R.W. as per IS – 1239, P-I; and Pipe Fittings shall be of "Heavy" quality, as per IS – 1239, P-II, of Galvanised Malleable Cast Iron, with Material code conforming to IS-1879 of "HB", or "NB" , "Zoloto", Leader, "JSI" or equivalent Brand.

Test certificates from the manufacturer shall be submitted by the Contractors. Over & above the submission of test certificates; ENGINEER-IN-CHARGE may also ask to the Contractor's for further testing of samples in Govt. laboratories/test houses at the risk & cost of the Contractor.

2.1 Samples

In all cases samples of the materials proposed to be used shall be submitted for approval of the ENGINEER-IN-CHARGE, before taking up the work in hand and the samples shall be well preserved at site by Contractor at his own risk & cost.

2.2 Materials, Workmanship & Samples

All the materials and workmanship are to be of the best possible description and to the entire satisfaction of ENGINEER-IN-CHARGE and the Contractors shall immediately remove from the site any materials and /or workmanship which, in the opinion of ENGINEER-IN-CHARGE, is defective or unsuitable and shall substitute proper materials and /or workmanship forthwith at Contractor's risk& cost.

The Contractors shall ,if required by ENGINEER-IN-CHARGE, arrange to test material and / or portions of the works at his own cost in order to prove their soundness and efficiency, physical & chemical properties from Govt. laboratories / test houses. If after any such test, the work or portion of works is found in the opinion of the ENGINEER-IN-CHARGE, to be defective or unsound , the Contractor shall pull down and re-execute the same at his own cost. DEFECTIVE materials shall be removed from the site within 7 days from receipt of such order at his risk & cost. No extra claim whatsoever shall be entertained by ENGINEER-IN-CHARGE.

Wherever reference has been made to Indian Standard or CPWD specifications or any other specifications, the same shall mean to refer to the latest specifications irrespective of any particular edition of such specifications being mentioned in the specifications or schedule of quantities. In case of any dispute, the decision of ENGINEER-IN-CHARGE shall be final & binding on the Contractor.

The rates quoted shall be for all heights and depths.

Bidders should note that the quantities in the Bill of quantities are approximate and are subject to variation to any extent.

This Technical specification shall be read in conjunction with other part / specification of the contract, viz. GCC etc.

ENGINEER-IN-CHARGE shall have the right to modify / change the working drawing even after issue to the Contractor.

2.3 Materials

- General :**
- a) All materials shall be of best of their kind and shall conform to the latest Indian Standard specifications .
 - b) A set of specification samples of all approved materials shall be kept well preserved at site, cost of which is to be borne by the Contractor.

3.0 Sanitary- Wares

All sanitary wares and fittings shall be of first class quality white vitreous China as manufactured by **Hindware**, or Parryware or Cera and sample brand approved by ENGINEER-IN-CHARGE prior to the procurement in bulk by the Contractor.

Stainless steel sinks and draining board shall be of best quality stainless steel of "**Hafele**" / "**Nirali**" / "**Imagine**" **SS Sink from "Saraswati steel"** / "Parryware" / with sample and brand approved by ENGINEER-IN-CHARGE prior to the procurement in bulk by the Contractor.

4.0 Cast Iron Soil & Waste Pipe

All cast iron soil pipes shall be of Sand cast with Socket & Spigot ends of standard make. The thickness and specification shall conform to Indian Standard specifications **IS: 3989- "Centri" cast.**

Pipes and fittings shall be true to shape smooth cylindrical, their inner and outer surfaces being as nearly as practicable concentric.

Pipe when tested for soundness by striking with a light hand- hammer shall emit a clear ringing sound. The pipes shall be free from cracks, laps, pinholes or other imperfection and shall be neatly dressed and carefully felted.

The fittings shall be of easy clean type. The access door fittings shall be designed so as to avoid dead spaces in which filth may accumulate. Door shall be provided with(3mm) rubber insertion packing and when closed and bolted ,these shall be water tight. These Pipe Fittings (ie., Bend with or without door, Equal or unequal junction with or without door, Inspection pipe piece with door, Heel rest bend, Angle Bend 135⁰ / 92.5⁰ Bend with or without door, Expander, Collar etc.) shall be "Centri" Cast iron pipes (class 'SWR') conforming to Indian Standard specification **IS: 3989- "Centri" cast.**

CI (“Centri” cast as per IS-3989) **Vent Cowls** of approved make and of required size of the Vertical Stack shall be fitted at the top of every Sewer, Waste & Vent Stacks as statutory. Every Vent Cowl shall preferably remain projected atleast 1.2 metres above the Roof Level.

Pipes and fittings shall be supplied without ears. Each pipe fittings shall have the trade mark of the Manufacturer and nominal size suitably marked on it.

M.S. stays and clamps shall be made from minimum 1.6mm thick M.S. flat of minimum 30mm width bent to the required shape and size to fit tightly on the socket, when tightened with screw bolts. Lead to be used for the jointing of the pipes shall be refined lead of best quality.

Floor traps shall be of approved make, ‘P’ type with minimum of 2” (50mm) water seal. At the top of each of these Floor Traps there shall be provided with **5” dia.(125mm) CP brass circular Grating of approved make.**

These shall be Sand Cast iron pipes (class ‘SWR’) conforming to Indian Standard specification **IS: 3989- “Centri” cast.**

Sample and brand / make approval shall be done by ENGINEER-IN-CHARGE prior to procurement in bulk quantities by the Contractor. ENGINEER-IN-CHARGE at its discretion may ask the Contractor for sample testing through Govt. test house / laboratories at the risk and cost of the Contractor.

4.1 Lead Caulked Joints

The annular space between the socket and spigot will be first well packed in with spun yarn leaving 25 mm.(1”) from the lip of the socket for lead . the joint may be leaded by using proper leading rings or if they are not available , by wrapping a ring of hemp rope covered with clay round the pipe. The lead shall be rendered thoroughly fluid and each joint filled in one pouring. Before caulking , the projecting lead shall be removed by flat chiesel and the joint caulked round with proper caulking tools and a hammer of 1 to 1.1/2 kg (2 to 3 pounds) in weight in such a manner as to make the joint quite sound. After being well set, the joint is to be flush , neat and even the sockets. The specifications etc, shall comply to the relevant IS & CPWD specifications.

The approximate depth and weight of pig lead for various diameters of C.I pipes and specials shall be as given below (as a guide-line) :

LEAD FOR DIFFERENT SIZES OF PIPES

Nominal Size of Pipe (mm)	Lead/Joint (Kg.)	Depth of lead Joint (mm)
80	1.8	45
100	2.2	45
125	2.6	45
150	3.4	50
200	5.0	50
250	6.1	50
300	7.2	55
350	8.4	55
400	9.5	55
450	14.0	55
500	15.0	60
600	19.0	60
700	22.0	60
750	25.0	60

Note: The quantity of lead given in the table are provisional and a variation of 20 percent is permissible, at the discretion of ENGINEER-IN-CHARGE.

The approximate depth and weight of pig lead for various diameters of C.I pipes and specials shall be as per relevant IS & CPWD specifications.

4.2 Smoke Testing

All CI Sewer & Waste pipes and fittings including joints will be tested by a smoke test and left in working order after completion. The smoke test shall be carried out as stated under. No extra payment will be made for the tests. Smoke shall be pumped into the brains at the lowest end from a smoke machine which consists of a blow and burner. The materials usually burnt are greasy cotton waste which form clear pungent smoke which is easily detectable by sight as well as smell if leaking at any point of drain. the Contractor will have to rectify all defects traced in such tests at his own expense to the complete satisfaction of the ENGINEER-IN-CHARGE. The test shall be carried out at the risk & cost of the Contractor at Site, in presence of ENGINEER-IN-CHARGE complying to the relevant IS & CPWD specifications.

4.3 Testing of Materials and works

As and when required by the ENGINEER-IN-CHARGE, the Contractor shall arrange to test materials and /or portions of works at his own cost to prove their soundness and efficiency. if after tests, any materials ,work or any portions of work are considered defective or unsound by the ENGINEER-IN-CHARGE, the Contractor shall remove the same from the site forthwith at his own risk & cost. No extra claim for this or for any rectification / modification shall be entertained by ENGINEER-IN-CHARGE. All testing shall be guided by relevant IS & CPWD specifications at the risk & cost of the Contractor.

5.0 G.I Pipes and Fittings

All pipes shall be of galvanised iron “**Medium**” quality (as per IS-1239, P-I) of “TATA” make unless otherwise specified or separately / specifically approved / allowed by ENGINEER-IN-CHARGE. All fittings shall be of ‘HB’, or ‘NB’, ‘Zoloto’, ‘Leader’, ‘JSI’ brand or other equivalent make bearing ISI certification mark. The pipes shall be seamless screwed or socketted conforming to the requirement of IS : 1239-1985. These shall be of the diameter (nominal bore) specified. The pipes and sockets shall be cleanly finished, well galvanised in and other defects. All screw threads shall be clean and well cut. the ends shall be cut cleanly and square with the axis of the tube. Sample tests for physical & chemical properties may be asked for by ENGINEER-IN-CHARGE at the risk & cost of the Contractor from Govt. laboratories / Test houses over & above submission of Manufacturer’s Test certificates.

6.0 (Full Way) Gate Valves

These shall be of Bronze / Gun metal (PN-10) or (PN-16) quality of “ZOLOTO” “SANT” or ‘SBM’, ‘Leader’ conforming to the relevant IS specifications and tested to 21 kg. per sq. cm. for 2 minutes. Necessary Test certificates shall be submitted by the Contractor with warranty from the manufacturer as asked for by ENGINEER-IN-CHARGE.

7.0 C.P. Toilet Fittings

7.1 C.P. Brass Bib Cocks, Two-way Bib Taps, Stop cocks, Angle Stop cocks, Pillar cocks, Sink cock

These shall be of Chromium plated Brass ‘heavy’ quality, threaded to BSPT (F) of ‘**Marc**’ / ‘**Jaquar**’, /‘**Hindware**’ /‘**Essco**’ makes (as per the B.O.Q) conforming to IS specification as per IS- 8931. Sample approval shall be taken by the Contractor from ENGINEER-IN-CHARGE prior to procurement in bulk quantities with samples well preserved at Site at the risk & cost of the Contractor.

7.2 C.P. Brass Pillar Cock [for Wash Basins]

This shall be of 'Marc' / 'Jaquar', /'Hindware' /'Essco' model with wall mounted Control Box below the Wash Basins, threaded to BSPT (F) and conforming to IS-8931. Sample approval shall be taken by the Contractor from ENGINEER-IN-CHARGE prior to procurement in bulk quantities with samples well preserved at Site at the risk & cost of the Contractor.

7.3 Health Faucets

This shall be of 'Marc' / 'Jaquar', "Allied" model, /"Hindware" to be fitted with the Two-way Bib Taps inside each W.C.s (except Driver's Toilet), threaded to BSPT (F) and conforming to IS-8931. Sample approval shall be taken by the Contractor from ENGINEER-IN-CHARGE prior to procurement in bulk quantities with samples well preserved at Site at the risk & cost of the Contractor.

7.4 Sink Cock

This shall be of CP body (Table mounted) Model Sink Mixer with extended Spout.

8.0 Ball Float Valve

The Ball Float valves shall be of Brass body of high pressure or of Pressure as specified. The Ball valve shall be of brass and the float of PVC of high pressure withstanding capacity. The minimum gauge of PVC Ball Float, the body of the ball valve shall be capable of withstanding a pressure of 200 lbs. per sqm. (14 kg. per sqm.) . the ball valve shall conform to IS specification No. 1708-1962. Necessary test certificates with warranty shall be submitted from manufacturers by the Contractor to ENGINEER-IN-CHARGE when asked for.

9.0 Submersible Pump of Bore well

(To supply underground water from subsoil aquifer to the R.C.C underground tank.)

The daily needs of water by the different categories of users of the University during its operation will be met up from the distribution sources of Public health Engg. Dte., NKDA. But the PHED will not supply water required for construction. Hence, it is proposed to sink and install one Tubewell temporarily, during the construction phase to meet up the demand of different construction activities. The technical details of the proposed temporary source is as per following:

Size : 250-150 mm

Total Depth : 150 M (250 -36m & 150 -114 m)

Material : UPVC

Strainer length : 30 M provided at a depth of 96 m

Expected Yield : 45,000 LPH

Method of Sinking : Direct Circulation Drilling by mechanical rig

Siting : location of the temporary source has been marked in the services layout plan.

Development of the well : By means of air Compressor and pumping out water for 5 consecutive days

Packing of Well : Pea gravel packing with top 10 m packed with puddle clay balls.

Storage : Water for construction and other purposes will be stored at a height of 5 M for a temporary capacity of 25 Cu.M.

Cost of Installation : Rs. 8.0 lakhs.

Supply, installation in Borewell, testing and commissioning of Submersible multistage pump motor set Capacity- 15.0 cum/Hr. max (i.e., 250 LPM) at 50 M head with 'Submersible' type suitable HP Rated Motor (min. 3.7 kw , 5HP) at 2900 / or 1450 RPM; including supplying of 35 Mtr. long suitably rated & suitable cross-sectioned 3 1/2 -core "Submersible" type PVC insulated Sheathed Armoured Cable with Cable Clamps (Cable size as per Manufacturer's

standard) as required, and including 415 Volt, 3-phase, 50 Hz Star-delta Starter Panel suitable to withstand +/- 10% voltage variation and +/- 3% frequency variations with Switch Fuse units and Isolators etc, of approved Make/Brand, including all other necessary accessories complete as required.

(Make :- "CALAMA", / " KSB" / "TEXMO")

Necessary test certificates with "warranty" from manufacturers as asked for by ENGINEER-IN-CHARGE shall have to be submitted by the Contractor with functional testing at site at the risk & cost of the Contractor in presence of ENGINEER-IN-CHARGE's representative.

9.1 Testing of Water Sample

Necessary chemical and bacteriological tests as per IS specifications for potable water shall have to be done by the Contractor at his risk & cost from Govt. laboratories / test houses as directed by ENGINEER-IN-CHARGE prior to commissioning of the Project.

9.2 Bleaching Dosing Tank

The bleaching dosing tank as shown in the drawing should be constructed and the dosing shall comply the specification & requirements of relevant IS code & specifications.

9.3 Domestic Water FEED Pump (Hydro-pneumatic) to respective Toilets, Kitchens etc. & To TERRACE TANK (To be located inside the Basement of the Building)

It shall be of Hydro-pneumatic type 2-stage pumps in a single Skid with (2-working + 1-standby) for transfer of water from U/G Domestic Water Reservoir to directly to individual Toilets Kitchen etc, with an extra provision to connect with the terrace Domestic tank to store the water suitable to suit the drinkable water quality (as per IS-10500).

(Pumps should be with C.I. Impeller, integrally coupled with 3 – phase 2900 R.P.M., 415 Volts, A.C. Motor, capable to withstand a voltage variation of (+/-) 10% and frequency variation of (+/-) 3%, including Pump Control Panel with "Auto" Start / Stop 3nos. "Indfoss' make Pressure switch with each sets of Pump .

Pump of Capacity – 3000.0 LPM @ 108.0 M head – with 90 KW Motor input under peak load condition, 3-phase integrally coupled Motor with 1 motor VFD drive out of 3 motors.

Working Principal- How the Systems Operate

Variable Speed System – With Variable frequency drive & Pressure transmitter

General Description

The unit consists of 4nos. (3-working + 1-standby) pumps mounted on a common base frame provided with all necessary fittings and a control cabinet. Upon delivery the booster set is ready for operation.

A control cabinet holds an Electronic Pump Controller as per the details given below

9.4 Electronic Controller

An electronic dedicated pump logic controller shall be a (Multi Pump Controller). The controller shall operate the pumps to maintain the required system pressure while using minimum energy and alternating between pumps to maintain relatively equal pump operating hours.

As flow demand begins, one of the pumps will start at low speed. As demand increases, the pump will speed up until it reaches full RPM. At this point the second pump will start in full speed. The speed of the first pumps will vary until it builds up required system pressure. This

sequence will continue for additional working pumps, if demand is not met. Pumps shall changeover automatically to maintain the system pressure depending on demand, time, and fault.

Electronic controller will perform a flow estimation every 2 minutes so as to minimize or utilize the number of duty pumps and stop all pumps in an event of no demand, thereby the performance and energy consumption of the system is optimized.

If the system includes an optional standby pump, the controller shall exercise the standby pump as a part of the system and equally run the pump as other pumps in the system. The controller shall accept a low-suction pressure or other suction fault input to shut down the system.

The controller shall have a keypad and a graphical user interface display with Installation wizard for easy commissioning of the system.

9.5 Programmable Functions

System functions shall be programmable through the keypad. These programmable functions and information shall include, but not be limited to:

- Closed loop control.
- Automatic pump alternations.
- Automatic cascade control of pumps.
- Set point adjustment and control.
- Clock Program.
- Flow estimation function.
- Programmable pump testing.
- Programming of No of starts/stops per hour .

- Remote controlling of the entire Hydro Pneumatic System through Ethernet. (User has to provide Static IP address to HPS system which can be accessed by BMS computer for remote control).
- Standby pump designation.
- Friction Loss Compensation (set point).
- Pump status.
- Elapsed running hours for each pump.
- System pressure set point.
- Actual system pressure.
- Pump speed (percentage).
- Fault memory up to recent 24 faults with time stamping.
- To display calculated system flow.
- Pressure transducer design settings.
- Redundant primary sensor for pressure monitoring.
- High and low discharge pressure shut-down limit.
- Analog input for remote set-point control.
- Digital input for remote stop/start.

9.6 Control Cabinet

The controller will be mounted in a control cabinet with an IP 41 enclosure of suitable rating with the keypad and display screen mounted through the outer door. In addition to the

electronic pump controller, the control cabinet shall include circuit breakers for each pump and the control circuit and control relays for alarm functions.

Control cabinet shall include the following, but not be limited to:

- 1) Motor protection.
- 2) Dry run protection – Float switch / Inlet pressure monitoring device for suction lift condition.
- 3) Ethernet connectivity (Web based control).
- 4) 320 X 240 pixels VGA display with adjustable backlight.
- 5) Pump Fault Lights – A Red light for fault indications.
- 6) Visual Alarm.
- 7) Pump Elapsed Time Meters.
- 8) Manual Operation.

9.7 Variable Speed Hydropneumatic System

It shall be Approved make **Variable speed** Hydro pneumatic pumpset model Hydro MPC F 4 CR 64-5-1 suitable to Discharge 60m³/hr at 108 mts head, with 1 pump working, 120m³/hr at 108mts head with 2 pump working & 180m³/hr at 108mts head with 3 pumps working.

The Pumpset comprises of 4 nos (3 no working & 1 no standby) The Pumpset model CR 64-5-1 mounted in parallel on a common base frame. The pumps are vertical multistage centrifugal type and are fitted with maintenance free mechanical shaft seal duly coupled with 30 KW motor each with 90KW. The material of construction of the pumps are as follows:

Pump Head	: Cast Iron	Intermediate	
Shaft	: Stainless Steel	Chamber	: Stainless Steel
Impeller	: Stainless Steel	Coupling Guard	: Stainless Steel

The pumps are automatic operated according to system demand by means of pressure transmitter.

A float switch is also provided on the suction side to protect the pump from Dry Running.

To ensure stable operation the booster set will be supplied with 1 nos diaphragm tank of size 200 ltr tank with valves, fittings and pressure gauges etc.

Necessary test certificates with “warranty” from manufacturers as asked for by ENGINEER-IN-CHARGE shall have to be submitted by the Contractor with functional testing at site at the risk & cost of the Contractor in presence of ENGINEER-IN-CHARGE’s representative.

Necessary test certificates with “warranty” from manufacturers as asked for by ENGINEER-IN-CHARGE shall have to be submitted by the Contractor with functional testing at site at the risk & cost of the Contractor in presence of ENGINEER-IN-CHARGE’s representative.

9.8 Domestic Water FEED Pump (Hydro-pneumatic) to respective Kitchens / Canteen & LAB uses etc.

It shall be of Hydro-pneumatic type 2-stage pumps in a single Skid with (2-working + 1-standby) for transfer of water from U/G Domestic Water Reservoir to the respective Kitchen/Canteen, & LAB uses to make the water available, suitable to suit the drinkable water quality (as per IS-10500). The Water from this Pump shall be directly fed to the respective areas through Wet Riser system for respective individual uses.

(Pumps should be with C.I. Impeller, integrally coupled with 3 – phase 2900 R.P.M., 415 Volts, A.C. Motor, capable to withstand a voltage variation of (+/-) 10% and frequency variation of (+/-) 3%, including Pump Control Panel with "Auto" Start / Stop 3nos. "Indfoss" make Pressure switch with each sets of Pump .

Pump of Capacity – 900.0 LPM @ 35.0 M head – with 8 KW Motor input, 2900 r.p.m, 3-phase integrally coupled Motor with 1 motor VFD drive out of 3 motors.

9.9 Basement De-Watering Pumps

Basement "De-watering Pump" shall be of Vertical Pump integrally coupled with motor, with matching Motor Control Panel of Mono-set fully submersible Vertical mounting type reservoir pumps for transfer of logged water from Basement to the adjacent outside building Yard Gully Chamber / Storm water Manhole.
Pump should be with CI 'Mixed Flow' / 'Radial Flow' type Impellers, integrally coupled with submersible type 3 – phase 2900 RPM 415volts, AC motor capable to withstand a voltage variation of (+/-) 10% and frequency variation of (+/-) 3%, but excluding pump control panel.
Pump of capacity – approximate - 200.0 LPM @ 8.0 M to 10.0 M head with KW (HP) Motor input, 3 phase integrally coupled "Submersible" type Motor.
(To be located inside the BASEMENT)
[1-working + 1-Standby]
Make = "CRI" / 'MBH' / "DARLING" / "JALRANI").

10.0 Gate Valve (Flanged type)

C.I. body Gate valve , Flanged type, 'IS 14846, PN 1.0 class, bolted bonnet, inside screw non rising stem, hand wheel operated with CI bonner, brass/SS stem, rubber/hemp gland packing, CI wedge, CI stuffing box, Bronzed seat ring, body tested to 15 BAR, Seat tested to 1 MPA Hydrostatically.
(Make :- Zoloto, / "Sant" / "Leader" / "Amco" / "Hawa")

All the Valves mentioned above shall be of approved quality (screwed end- female threaded / or Flanged ends).

Necessary test certificates with warranty from manufacturers as asked for by ENGINEER-IN-CHARGE shall be submitted by the Contractor with functional testing at site at the risk & cost of the Contractor in presence of ENGINEER-IN-CHARGE's representative.

11.0 Pressure Reducing Valve :

(At Inlet Main to every individual toilets and Kitchen / Canteen – except the Top floor)

It shall be of 50mm and 32mm nominal diameter of **Rubber Diaphragm type Pressure Reducing Valve** of Bronze Body / Bottom Cover & Lock-nut (as per IS- 318 LTB 2), Spring loaded, screwed (female) end as per B.S.-21 class **with reduced Set pressure range (Up-stream - to - Down-stream) of 3.5 Kg. / sq. cm. - to - 1.0 Kg. / sq. cm.**, with C.I. Camber & Bonnet, Seat Ring & Stem of S.S. (AISI 410), Bolt/nut & Tommy Bar of M.S., C.I. Spring Disc & Carbon Steel Spring, & EPDM Diaphragm, C.A.F. Gaskets (IS- 2712, Gr.-C), and the Valve with a Test Pressure (Hydraulic) of 35 Kg. / sq. cm. & with S.S. Screw / bolts / washers etc., and also with Teflon Thread Seal etc., all complete.

(Make - ZOLOTO- Product Catalogue no.-1040)

Necessary test certificates with warranty from manufacturers shall be submitted by the Contractor, as asked for by ENGINEER-IN-CHARGE. The functionality shall be tested at site in presence of ENGINEER-IN-CHARGE's representative at the risk & cost of the Contractor.

12.0 Non-Return Valve (N.R.V.)

Bronze body "VERTICAL -LIFT" type Non-Return ("Check") valve with S.S. (AISI-410) body Seat Ring, two-piece design, S.S.(AISI-410) Disc, Screwed to BSPT-female (BS-21), with necessary 'Teflon' Thread Seal, including accessories.

(Make - ZOLOTO- Product Catalogue no.-1045 / Leader)

(At Submersible Raw water Supply Pump Discharge pipe at the U/G Reservoir).

Necessary test certificates with warranty from manufacturers shall be submitted by the Contractor, as asked for by ENGINEER-IN-CHARGE. The functionality shall be tested at site in presence of ENGINEER-IN-CHARGE's representative at the risk & cost of the Contractor.

13.0 Gate Valve (Bronze Body)

It shall be of 40mm nominal diameter of **Gate Valve** of Bronze Body, hand wheel operated, screwed (female) end as per B.S.-21 class with Non-Rising Spindle, Screwed in Bonnet, and Lubricated Gland packing, & with a provision of re-packing, Valve conforming to IS- 778, Class -I, outer body with Bronze conforming to IS-318 LTB 2, Bonnet, Stuffing Box & Gland of Bronze/ forged Brass conforming to IS-318 LTB 2 / or IS-6912 FLB, Brass Stem, Bronze or Brass Gland nut, with C.I. Hand wheel conforming to IS-210 Gr.- FG 200, & with S.S. Screw / bolts / washers etc., and Valve Test pressure of 1.0 M Pa, and also with Teflon Thread Seal etc., all complete.

(Make - ZOLOTO- Product Catalogue no.-1035 / Leader)

(At Submersible Pump Discharge pipe).

Necessary test certificates with warranty from manufacturers shall be submitted by the Contractor, as asked for by ENGINEER-IN-CHARGE. The functionality shall be tested at site in presence of ENGINEER-IN-CHARGE's representative at the risk & cost of the Contractor.

14.0 Non-Return Valve (N.R.V) : C.I. Body (At Hydro-pneumatic Pump Discharge pipe)

These should be of C.I. Body, Check valve, Horizontal "Lift" – type with PN – 10 rating, with M.S. "Slip-on" type matching Flanges, along with CAF gaskets and appropriate M.S. Bolts, nuts, plain round Washers etc, all complete
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(Make:- "Zoloto", code- 1067/ "Sant" / "CRI" / "Hawa" / "Amco")
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Necessary test certificates with warranty from manufacturers shall be submitted by the Contractor, as asked for by ENGINEER-IN-CHARGE. The functionality shall be tested at site in presence of ENGINEER-IN-CHARGE's representative at the risk & cost of the Contractor.

15.0 Air-Release Valve : Bronze/Gun metal Body (At Water Supply Lie top to different Blocks & to Kitchen pipe Riser top)

It shall be of Bronze / Gun metal body "Parallel Slide" – "Blow-off"valve with BS-10 Table-H / E Flanged ends, sliding action Discs, spring loaded, rack-pinion arragt., S.S Discs, Body Seat Ring of S.S., Graphite Asbestos packing, M.S. Key, with Hyd. Test pressure of 500 p.s.i.g, with adjustable 'OPEN' / 'SHUT' arragt. of approved quality (Flanged end)
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(Make:- "Zoloto", code- 1052)

Necessary test certificates with warranty from manufacturers shall be submitted by the Contractor, as asked for by ENGINEER-IN-CHARGE. The functionality shall be tested at site in presence of ENGINEER-IN-CHARGE's representative at the risk & cost of the Contractor

16.0 “Blow-off” VALVE : Bronze / Gun metal Body
(At Water Supply delivery Main Line Hydro-pneumatic system for blow-off due Extra pressure in Main back to the U/G treated tank)

It shall be of Bronze / Gun metal body “Parallel Slide” – “Blow-off” valve with BS-10 Table-H / E Flanged ends, sliding action Discs, spring loaded, rack-pinion arrangt., S.S Discs, Body Seat Ring of S.S., Graphite Asbestos packing, M.S. Key, with Hyd. Test pressure of 500 p.s.i.g, with adjustable ‘OPEN’ / ‘SHUT’ arrangt. of approved quality (Flanged end)
(Make:- “Zoloto”, code- 1052)

Necessary test certificates with warranty from manufacturers shall be submitted by the Contractor, as asked for by ENGINEER-IN-CHARGE. The functionality shall be tested at site in presence of ENGINEER-IN-CHARGE’s representative at the risk & cost of the Contractor.

17.0 Drainage- Stone Ware Pipes

All pipes shall be of best salt glazed variety conforming to IS specification. The pipes shall be free from visible defects such as fire cracks or hair cracks. The glaze of the pipe shall be free from blisters. The pipes shall conform to **IS : 651-1965**.

18.0 Sanitary Installation

Sample approved shall be done prior to bringing in bulk quantities at site by the Contractor.

The W.C. Pans shall be of white Viterous China Wall mounted Pattern with C.I. Chair Bracket of fitted with ‘P’ or ‘S’ trap (with a conversion bend) of viterous China with effective 2” seal and 2” vent as per IS : 771-1963 & IS:2556 (Part II & VII) , 1967.

18.1 Fixing

The W.C. Pan shall be laid in floor sloped towards the pan in a workman like manner, care being taken not to damage the pan in the process of fixing. It shall be fixed on a base of cement concrete 1: 3: 6 mix. (1 cement: 3 coarse sand: 6 stone ballast 40 mm and down gauge) taking care that the cushion is uniform and even without having any hollows between the concrete and pan. The joint between the W.C. pan and the trap shall be made with cement mixed with water proofing compound and made leakproof.

18.2 Flushing by PVC ‘Low Level’ Cistern : (manually)

The flushing of W.C. pan shall be done by “Hindware” / Parryware / Cera make, PVC ‘Low Level’ Cistern- manually operated. with push lever.

18.3 Brackets (for Wall mounted W.C.- fixing)

The fixing bracket of Wall mounted W.C.’s should be of C.I. ‘Chair’ Bracets to remain fully concealed & embedded in wall and partialy in floor finish. The W.C. shall be fixed to the chair Bracket with proper galvanised fixing Bolts, Nuts, and Wahers etc, to the satisfaction of the Engineer- in charge.

18.4 Flush Pipe

The outlet of flush pipe from the cistern shall be of 32 mm (1.1/2”) rigid P.V.C. (as per ASTM D 1785), schdl.-40 pipe to remain concealed inside the wall & finish upto the mouth of the

Inlet port of the 'Wall hung' W.C.'s, and that shall be connected with the W.C. pan by means of an approved type of joint.

18.5 Seat & Lid

These shall be of black plastic or any approved matching colour hygienic seat and lid or as specified with rubber buffers, CP brass hinges and screws of standard 'Hindware' or 'Parryware' makes relative to the or equivalent approved Models & makes as in the schedule of Quantities.

19.0 Urinals

The urinal basin shall be flat back of white vitreous China of specified size. It shall be fixed in position by using wooden plugs and screws at a height such that the outside bottom of Urinal Basin remains at 600 mm. from the finished floor level. The Urinal Basin shall be of "Flat-back-Large" type. Standard height of the Urinal Basins shall be as per the respective Manufacturer's standard. Each urinal shall have CP Flush Pipe (for range of one or two Urinals as a set), 32 mm. dia. CP Bottle Trap with connected CP Waste Pipes, CP Waste Couplings etc, (as per the drawings).

19.1 Waste Pipes-concealed & Traps

Each concealed Waste pipes (in proper slope) from the Urinals shall have 32 mm. dia. Rigid PVC (ASTM D 1785), schdl.-40) and this shall be further connected to 40 mm. lead of PVC waste pipe conforming to ASTM D 1785, complete with G.I. unions, elbows, tees (equal or unequal) (as per IS-1879) of approved make as specified in the schedule of quantities, including wiped plumber joint complete with unions shall be terminated upto the mouth of respective extension pieces of the 100mm dia C.I. 'P' traps (below floor finish).

The main and distribution pipes fittings and clamps shall be of C.P brass unless otherwise specified in the schedule of quantities, distribution pipes shall feed the urinals with C.P. brass spreaders of approved make.

19.2 Painting

In case of cast iron flushing cisterns ,painting shall be done as specified in the Bill of quantity.

20.0 Wash Basin

Wash Basin

These shall be of white vitreous China with single or two three holes as specified in the schedule of quantities and as per manufacturers specification. These shall be supported on a pair of C.I brackets of approved design. These shall be supported on a pair of C.I brackets of approved design. The Wash Basins should conform to the provisions of relevant IS: code. The Wash Basin shall be White Vitreous chinaware of flat-back and size of atleast of 550 x 400mm of approved Brand/Make.

20.1 Fittings

Each Wash Basin / Sink shall have single of approved make Pillar Tap/special Taps for the type of the sink specified and other fittings as specified , and of approved make 32 mm

(1.1/2") C.P. brass waste (CP). C.P. brass angle valve with inlet connection of C.P. brass chain and rubber plug.

20.2 Waste Connection :

Waste pipe shall be of 1.1/2" dia. (32 mm.) P.V.C. of approved make of threaded type as per ASTM D 1785, schdl.-40; complete with unions. This shall discharge into a floor trap.

20.3 Bottle Trap for waste

Each Wash Basin shall have 32 mm. dia. Approved make CP Bottle Trap with or without CP wall flange, with 250mm long wall connection pipes and also connected with CP Waste Pipes, CP Waste Couplings etc, (as per the drawings).

21.0 Kitchen Sink

The above item shall be of **Salem Stainless Steel Kitchen Sink - (AISI-304, conforming to IS-13983), Single Bowl**, built with superior steel, with **Bowl size not less than- 560 x 410mm** and with **Bowl depth of 205mm to 215mm; and total overall size - 1145 x 510mm, with a provision of a Drain-board**, also including with 40mm Salem Stainless Steel Unique Waste Coupler and Coupler knob with C.I. / MS fixing Brackets, and C.P. screws/washers etc.

(Make - 'Hindware' - / Parryware / Hefele / Nirali)

21.1 Fittings

Each Sink shall have single pillar tap (Sink Cock with swinging lever of "Jaquar", model-Clarion). It's a special tap for the type of the sink specified and other fittings as specified, of 'Jaquar'/'Essco' make 40 mm (1.1/2") C.P. brass waste (CP). C.P. brass angle valve with inlet connection of C.P. brass chain and rubber plug.

21.2 Waste Connection

Waste pipe shall be of 1.1/2" dia. (32 mm.) rigid P.V.C. (concealed) pipe of approved make (as per ASTM D 1785), complete with unions. This shall discharge into a Floor trap.

21.3 Fitting

Sinks shall be provided with 1/2"(15 mm C.P. brass valve) mixing fitting of 'Jaquar', or 'ESSCO' make complete with swinging spout.

21.4 Waste Connection

The waste pipe shall be of PVC 1.1/2" (32 mm.) dia. As per ASTM D 1785, discharging upto the Floor trap. The rates shall include the cost of all materials and labour involved in all the operations described above.

21.5 Lab Sink

These shall be of white vitreous China with single or two holes as specified in the schedule of quantities and as per manufacturer's specification. These shall be supported on a pair of C.I brackets of approved design. These shall be supported on a pair of C.I brackets of approved

design. The LAB Sink should conform to the provisions of relevant IS: code. The LAB Sink shall be White Vitreous chinaware of approved make and size of atleast of 550 x 400mm of approved Brand/Make.

21.5.1 Fittings

Each Sink shall have single pillar tap (Sink Cock with swinging lever of “Jaquar”, model-Clarion). It's a special tap for the type of the sink specified and other fittings as specified , of ‘Jaquar’/ ‘Essco’ make 40 mm (1.1/2”) C.P. brass waste (CP) . C.P. brass angle valve with inlet connection of C.P. brass chain and rubber plug.

21.5.2 Waste Connection

Waste pipe shall be of 1.1/2” dia. (32 mm.) rigid P.V.C. (concealed) pipe of approved make (as per ASTM D 1785), complete with unions. This shall discharge into a Floor trap.

22.0 Toilet Requisites

Sample approved shall be done prior to bringing in bulk quantities at site by the Contractor.

22.1 Mirror :

Mirrors shall be of 6.0 mm. thick plate glass ‘Saint Gobain’ or ‘Modi-guard’ or “Ashai” make or approved equivalent make. The glass shall be uniformly silver plated at the back. Silvering shall have a uniform protective coating of red lead paint. The mirror shall have Plastic moulded frame of approved quality and colour. The mirror and its 6mm thick hard backing shall be fixed on the wall face to wooden cleats with C.P. brass screws and washers.

Toilet paper holder shall be of Chromium plated as specified in the schedule of quantities of “Jaquar” –Stealth or “Jaquar”- Continental.

22.2 CP Robe Hooks (with double/ single Forks)

Theses should be of **CP Robe Hooks with double / or single forks**, of “Hindware” / “Jaquar”- Continental supported on anodised chromium plated Base, fixed with 40mm long screws, rawl plugs etc., all complete.

22.3 CP Towel Rail

The Towel Rail shall be of CP on brass with two nos. CP on brass brackets, or as specified. The size of the Rail shall be as specified in the Drawing. The brackets shall be fixed by means of CP brass screws to rawl plug firmly embedded in wall. This should be projected 75mm from the wall.

23.0 Water Closets

Samples shall have to be got approval from ENGINEER-IN-CHARGE prior to bringing in bulk quantities at site by the Contractor.

23.1 European type water Closets (EWC) : “Floor mounted type” (Hindware / Parryware)

The W.C. Pans shall be of white Viterous China Wall mounted Pattern with C.I. Chair Bracket of fitted with ‘P’ or ‘S’ trap (with a conversion bend) of viterous China with effective 2” seal and 2” vent as per IS : 771-1963 & IS:2556 (Part II & VII) , 1967.

23.2 Fixing

The W.C. Pan shall be laid in floor sloped towards the pan in a workman like manner, care being taken not to damage the pan in the process of fixing. It shall be fixed on a base of cement concrete 1: 3: 6 mix. (1 cement: 3 coarse sand: 6 stone ballast 40 mm and down gauge) taking care that the cushion is uniform and even without having any hollows between the concrete and pan. The joint between the W.C. pan and the trap shall be made with cement mixed with water proofing compound and made leakproof.

23.3 Flushing by PVC Flushing Cistern (manually)

Every WC shall be equipped with PVC body IS approved "Low Level" Flushing Cistern with 'Auto' Flushing device under syphonage action flushing when full, with manual Flushing Lever/ button (Dual Flush also can be considered) including with fixing brackets.

23.4.1 Brackets

(for Wall mounted W.C.- fixing)

The fixing bracket of Wall mounted W.C.'s should be of C.I. 'Chair' Brackets to remain fully concealed & embedded in wall and partially in floor finish. The W.C. shall be fixed to the chair Bracket with proper galvanised fixing Bolts, Nuts, and Washers etc, to the satisfaction of ENGINEER-IN-CHARGE.

23.5 Flush Pipe

The outlet of flush pipe from the cistern shall be of 32 mm (1.1/2") rigid P.V.C. (as per ASTM D 1785), schdl.-40 pipe to remain concealed inside the wall & finish upto the mouth of the Inlet port of the 'Wall hung' W.C.'s, and that shall be connected with the W.C. pan by means of an approved type of joint.

23.6 Seat & Lid

These shall be of black plastic or any approved matching colour hygienic seat and lid or as specified with rubber buffers, CP brass hinges and screws of standard 'Hindware' or 'Parryware' makes relative to the or equivalent approved Models & makes as in the schedule of Quantities.

The W.C. Pans shall be of white Viterous China Wall mounted Pattern with C.I. Chair Bracket of fitted with 'P' or 'S' trap (with a conversion bend) of viterous China with effective 2" seal and 2" vent as per IS : 771-1963 & IS:2556.

23.4 Fixing

The W.C. Pan shall be laid in floor sloped towards the pan in a workman like manner, care being taken not to damage the pan in the process of fixing. It shall be fixed on a base of cement concrete 1: 3: 6 mix. (1 cement: 3 coarse sand: 6 stone ballast 40 mm and down gauge) taking care that the cushion is uniform and even without having any hollows between the concrete and pan. The joint between the W.C. pan and the trap shall be made with cement mixed with water proofing compound and made leak-proof.

23.5 Flushing by Flush valve (manually)

The flushing of W.C. pan shall be done by "Jaquar" make, CP Flush valve with 32mm dia CP Control cock (Wall mounted), with push lever.

23.6 Brackets (for Wall mounted W.C.- fixing)

The fixing bracket of Wall mounted W.C.'s should be of C.I. 'Chair' Brackets to remain fully concealed & embedded in wall and partially in floor finish. The W.C. shall be fixed to the chair Bracket with proper galvanised fixing Bolts, Nuts, and Washers etc, to the satisfaction of ENGINEER-IN-CHARGE.

23.7 Flush Pipe

The outlet of flush pipe from the cistern shall be of 32 mm (1.1/2") rigid P.V.C. (as per ASTM D 1785), schdl.-40 pipe to remain concealed inside the wall & finish upto the mouth of the Inlet port of the 'Wall hung' W.C.'s, and that shall be connected with the W.C. pan by means of an approved type of joint.

23.8 Seat & Lid

These shall be of black plastic or any approved matching colour hygienic seat and lid or as specified with rubber buffers, CP brass hinges and screws of standard 'Hindware' or 'Parryware' makes relative to the or equivalent approved Models & makes as in the schedule of Quantities.

24.0 Rainwater Harvesting System

The main principle of RWH in the campus will be

1. To store the rooftop rainwater run off and reuse the same during the period of shortage/crisis
2. Natural recharge through the top soil by limiting the area of impervious surface in the open spaces to the bare minimum.
3. Collection of surface run off from open areas in an RW pond and reuse the same for gardening and landscaping.

24.1 Roof top Rain water Harvesting

Storm water from the roof surfaces will be collected by 150 mm dia RW Pipes at the preferred locations and will lead to the Rain water collection tank provided at ground level. Tank overflow will lead to Yard Gully chambers of the surface drainage system.

Total area of Roof = 11,800 Sq.M.

Annual Rainfall of Kolkata region = 1640 mm

Considering Run Off coefficient as 0.90 and efficiency of collection in consideration of evaporation and spillage losses and first flush wastage as 80%,

Quantity of available Rain water = $11800 \times 1.64 \times 0.9 \times 0.8 = 13933$ Cu. M.per year

Considering, Rainfall duration of 120 days in a year,

Average volume of Rain water available per day= $13933/120 = 116$ Cu. M.

Considering a peak rainfall intensity of 25 mm for 15 mins,

Peak Run off quantity for 15 mins = $11800 \times 0.025 \times 0.8 \times 0.8 = 189$ Cu.m.

To provide 2 nos. ground level storage tanks of size 7.0 m x 7.0 m x 2.0 m

The quantum of Rain water stored will be reused for renewal of Fire Fighting reserve and other non domestic purposes like floor cleaning, car washing, etc.

24.1.1 Rain Harvested Water FEED Pump (Hydro-pneumatic) to Landscaping, Car washing etc, uses from respective Rain Harvesting Tank

It shall be of Hydro-pneumatic type 2-stage pumps in a single Skid with (2-working + 1-standby normally) for transfer of Harvested Rain water from U/G covered Rain Water Harvesting Tank to the Terrace Tanks of both to cater to the Landscaping uses, also to the Car washing water for the Car Parking Zone & Lab Floor washing. The Water from the U/G Tank shall be directly distributed directly from Hydro-pneumatic Pump.

(Pumps should be with C.I. Impeller, integrally coupled with 3 – phase 2900 R.P.M., 415 Volts, A.C. Motor, capable to withstand a voltage variation of (+/-) 10% and frequency variation of (+/-) 3%, including Pump Control Panel with "Auto" Start / Stop 3nos. "Indfoss' make Pressure switch with each sets of Pump .

Pump of Capacity – 900.0 LPM @ 35.0 M head – with 8 KW Motor input, 2900 r.p.m, 3-phase integrally coupled Motor with 1 motor VFD drive out of 3 motors.

(To be located inside the Basement; Suction Pipe connected to the Rain Harvesting Tank)

24.2 Natural Recharge from open areas

Total area of unpaved surface = 17000 Sq.m.

Total area of Road ways & paved surface = 7,250 Sq.m.

Considering, a percolation co-efficient of 80% and efficiency of collection in consideration of evaporation losses as 90%,

Water endowment of the area = $17000 \times 1.64 \times 0.8 \times 0.9 = 20,000$ Cu.M. annually

Average daily endowment = $20000/120 = 167$ Cu. M.

Surface run- off to be carried by drainage system for peak rainfall intensity of 25mm/15 min

Run-off from the paved roadways and pathways = $7250 \times 0.025 \times 0.8 \times 1.0 = 145$ Cu.M

Surplus run off from the open area = $17000 \times 0.025 \times 0.2 \times 0.9 = 76.5$ Cu.M

Hence, Total flow through the drainage system = 221.5 CUM/15min = 0.25 Cumec = 8.7 Cusec

24.3 Surface Run off from Paved plaza and parking spaces

Total area of paved surface = 3,644 Sq.m.

Considering, a run off co-efficient of 80% and efficiency of collection in consideration of evaporation losses as 80%,

Quantity of available Rain water = $3644 \times 1.64 \times 0.8 \times 0.8 = 3825$ Cu.M. per year

Considering, Rainfall duration of 120 days in a year,

Average volume of Rain water available per day = $10622/120 = 32$ Cu. M.

Considering a peak rainfall intensity of 25 mm for 15 mins,

Peak Run off quantity for 15 mins = $3644 \times 0.025 \times 0.8 \times 0.8 = 58.3$ Cu.m.

Hence, Volume of Settlement Tank required = 58.3 Cu.M.

Provided. Rainwater pond of capacity : 800 M^3 , which will be sufficient enough to hold the runoff from paved areas during average as well as the peak rainfall intensity.

25.0 Rain Water Pipes of C.I. & CI Pipe Fittings (as per IS -3989: "Centri" cast / or as per IS-1729 - Sand cast)

All Rain water pipes shall be of cast iron "SWR" pipes shall be of Sand cast with Socket & Spigot ends of standard make. The thickness and specification shall conform to Indian Standard specifications **IS:3989- 'Centri' cast or IS: 1729- "Sand cast"**.

Pipes and pipe Fittings shall be as per IS-1729 and shall be of true to shape smooth cylindrical, their inner and outer surfaces being as nearly as practicable concentric.

Pipe when tested for soundness by striking with a light hand-hammer shall emit a clear ringing sound. The pipes shall be free from cracks, laps, pinholes or other imperfection and shall be neatly dressed and carefully felted.

The Fittings shall be of easy clean type. The access door fittings shall be designed so as to avoid dead spaces in which filth may accumulate. Door shall be provided with(3mm) rubber insertion packing and when closed and bolted ,these shall be water tight.

Pipes and fittings shall be supplied without ears. Each pipe fittings shall have the trade mark of the Manufacturer and nominal size suitably marked on it.

M.S. stays and clamps shall be made from minimum 1.6mm thick M.S. flat of minimum 30mm width bent to the required shape and size to fit tightly on the socket, when tightened with screw bolts. Lead to be used for the jointing of the pipes shall be refined lead of best quality.

Pipe Fittings shall be of CI “Sand” cast of approved make, ‘SWR’ class conforming to IS-3989 or IS-1729, Socket & Spigot **of approved make.**

These shall be Sand Cast iron pipes (class ‘SWR’) conforming to Indian Standard specification **IS: 3989-‘Centri’ cast** / or **IS: 1729 - “sand” cast.**

Sample and brand / make approval shall be done by ENGINEER-IN-CHARGE prior to procurement in bulk quantities by the Contractor. ENGINEER-IN-CHARGE at its discretion may ask the Contractor for sample testing through Govt. test house / laboratories at the risk and cost of the Contractor.

25.1 Lead Caulked Joints for Rain water Pipes

The annular space between the socket and spigot will be first well packed in with spun yarn leaving 25 mm.(1”) from the lip of the socket for lead . the joint may be leaded by using proper leading rings or if they are not available, by wrapping a ring of hemp rope covered with clay round the pipe. The lead shall be rendered thoroughly fluid and each joint filled in one pouring. Before caulking , the projecting lead shall be removed by flat chiesel and the joint caulked round with proper caulking tools and a hammer of 1 to 1.1/2 kg (2 to 3 pounds) in weight in such a manner as to make the joint quite sound. After being well set, the joint is to be flush, neat and even the sockets. The specifications etc, shall comply to the relevant IS & CPWD specifications.

The approximate depth and weight of pig lead for various diameters of C.I pipes and specials shall be as given below (as a guide-line) :

LEAD FOR DIFFERENT SIZES OF PIPES

Nominal Size of Pipe (mm)	Lead/Joint (Kg.)	Depth of lead Joint (mm)
80	1.8	45
100	2.2	45
125	2.6	45
150	3.4	50
200	5.0	50
250	6.1	50
300	7.2	55
350	8.4	55
400	9.5	55
450	14.0	55
500	15.0	60
600	19.0	60
700	22.0	60
750	25.0	60

Note : The quantity of lead given in the table are provisional and a variation of 20 percent is permissible, at the discretion of ENGINEER-IN-CHARGE.

The approximate depth and weight of pig lead for various diameters of C.I pipes and specials shall be as per relevant IS & CPWD specifications.

25.2 Smoke Testing of Rain Pipes

All CI Sewer & Waste pipes and fittings including joints will be tested by a smoke test and left in working order after completion. The smoke test shall be carried out as stated under. No extra payment will be made for the tests. Smoke shall be pumped into the brains at the lowest end from a smoke machine which consists of a blow and burner. The materials usually burnt are greasy cotton waste which form clear pungent smoke which is easily detectable by sight as well as smell if leaking at any point of drain. the Contractor will have to rectify all defects traced in such tests at his own expense to the complete satisfaction of the ENGINEER-IN-CHARGE. The test shall be carried out at the risk & cost of the Contractor at Site, in presence of ENGINEER-IN-CHARGE complying to the relevant IS & CPWD specifications.

25.3 Testing of Materials and works

As and when required by the ENGINEER-IN-CHARGE, the Contractor shall arrange to test materials and /or portions of works at his own cost to prove their soundness and efficiency. if after tests, any materials, work or any portions of work are considered defective or unsound by the ENGINEER-IN-CHARGE, the Contractor shall remove the same from the site forthwith at his own risk & cost. No extra claim for this or for any rectification / modification shall be entertained by ENGINEER-IN-CHARGE. All testing shall be guided by relevant IS & CPWD specifications at the risk & cost of the Contractor.

All Rain Water pipes and fittings shall be of CI 'Sand cast', conforming to the latest Indian standard specifications for Rain pipes. The pipes shall have spigot and socket ends, with bead on spigot and shall be with ears. Instead MS Holder Bat Clamps may be used for proper clamping on the wall.

These shall be free from cracks and other flaws. The interior of pipes and fittings shall be clean and smooth and the Pipes & Fittings are to be painted outside with Paints matching with the colour of the building outside wall paints.

The access door fittings shall be of proper locations and in no circumstances less than as shown in the drawings. Doors shall be provided with 3 mm. (1/8") rubber insertion packing and when closed and bolted they shall be fully water tight.

25.4 Joints of Pipes & Fittings

The annular space between the socket and spigot will be **Lead jointed by caulking tools** between the pipes & Pipe Fittings. This shall be done with 100% Leak-proof under Hydrostatic Pressure **Test under 4.0 Kg-f / cm² (g)** pressure with a minimum Holding time of 1.0 hour and those joints after found tested OK shall be preserved and care is to be taken in such a manner so that there should be no undue load / impact / hammerrage on those tested joints so as to make the joint quite sound. After being well set, the joint is to be flushed, neat and even the sockets.

The Pipes shall be of "SWR" class.

25.5 C.I. Roof Outlets

The traps shall be of self cleaning design provided with a minimum 50 mm (2") Water seal at the Trap to arrest Foul smell there stopping it to enter into the building inside from the

respective Stacks. Further more every Floor Trap will associated with a S.S. "Chilly" make cockroach arrestor trap with SS Circular Grating.

26.0 Waste Connections

Waste from Wash Basins, floor traps , Sinks, Ablution Traps inside wc's etc, shall separately discharged into the Waste Stacks that terminated & fed to the Gully Traps on the building outside ground level / Plinth protection level and shall be separately connected to (IP) Inspection Pits that leads to the Septic tank.

27.0 Anti- Syphonage (Vent) Pipes : 75mm dia C.I (sand cast as per IS-1729)

Anti-syphonage Vent pipe shall be HCI pipes of sand cast (as per IS-1729) with lead caulked joints and tob remained connected at a point with the Sewer Stack above every Junction Branches (keeping a gap of at least 450mm above the top-most Junction Branches per floor from the Stack and finally that 50mm dia Vent Stack after running parallely with Sewer Stack joined again with the Sewer Stack by 150 x 150x 75 mm dia Inverted unequal junction (IS-1729) above the top most finish floor level at a point above all the other horizontal junction points.

In every floor with the main anti-syphonage pipe junction Tees shall be 75 mm. (3") internal diameter or as specified.

28.0 Painting

All the exposed CI Stacks / Pipes and fittings shall be painted with two coats of synthetic enamel paint over one coat of primer of approved quality, manufacture, colour and shade to match the surroundings. The cost of such painting should be included in the Contractor's rates for pipe work.

The surface of pipes and fittings to be painted shall be cleaned thoroughly , Red lead or other primer shall be painted as specified and allowed to dry. the finishing shall be done by painting 2 or more coats with paint in an approved colour and shade.

29.0 Water Supply

Sample and brand / make shall be got approved by ENGINEER-IN-CHARGE prior to bringing in bulk quantities at site by the Contractor. Necessary test certificates shall have to be submitted from the manufacturer. Over & above the submission of test certificates, ENGINEER-IN-CHARGE may ask the Contractor for further test from Govt. test house / laboratories at the risk & cost of the Contractor.

Specification Of Water Supply Materials

(As per Specifications Pages attached Annexure as a guideline to the Contractor)

General

- a) All materials shall be of best of their kind and shall conform to the latest Indian Standard specification.
- b) A set of specification samples of all approved materials shall be kept & well preserved at site by the Contractor for ready reference, cost of which is to be borne by the Contractor.
- c) Over & above the list of specifications, ENGINEER-IN-CHARGE reserves the right to ask the Contractor for fixing of materials / fittings of equivalent quality other than mentioned in the list.

29.1 G.I. Pipes and Fittings

The pipes shall be of galvanised steel, ERW, (IS-1239, P-I) '**Medium**', screwed and socketed and shall conform to latest Indian Standard specifications for medium quality.

The pipes shall be tested to a pressure of 50 kg/sqm. (700 lbs. per sq. inch). these shall have threads and the sockets, paralleled threads complying to the relevant IS & CPWD specifications.

29.2 Laying & Fixing

Where pipes have to be cut or re-threaded ,ends shall be care-fully filled out so that no obstruction to bore is offered.

In jointing the pipes , the inside of the sockets and the screwed end of the pipe shall rubbed over with white lead and few turns of hemp yarn wrapped round the screwed end of the pipe which shall then be screwed home in the socket with a pipe wrench. Care must be taken that all pipes and fittings are kept at all times free from dust and dirt during fixing.

29.3 Internal Work

For internal work, G.I pipes and fittings inside and outside the walls shall be fixed either visible (not in chase) by means of standard pattern holder bat clamps keeping the pipe 12 mm (1/2") clear of the wall every-where or concealed as specified in Bill of Quantity . When it is imperative to fix the pipe in front of house or in any conspicuous position where it looks unsightly chasing may be adopted.

All pipes and fittings shall be fixed truly vertical and horizontals or as directed by the ENGINEER-IN-CHARGE.

29.4 External Work

For external work G.I pipes and fittings shall be laid in trenches. the width of the trench shall be the minimum width required for working the pipes laid underground level . they shall not be less than 60 CMS (2 feet) from the ground level, and wrapped with gunny cloth dipped in hot bitumen. The work of excavation and refilling shall be done in accordance with the instruction of the ENGINEER-IN-CHARGE.

29.5 Painting

All internal G.I pipes and fittings shall be painted with two coats of synthetic enamel paint over one coat of red lead primer of approved quality manufacture, colour and shade as directed by ENGINEER-IN-CHARGE. The cost of such painting shall be included in the Contractor's rates.

29.6 Testing

All G.I pipes and fittings shall be tested to a pressure of 16 kg. per sqm.(225 lbs. per sq. inch), by "Hydrostatic pressure Holding Test", for Holding time atleast of 1 hour, or as specified in the relevant IS & CPWD specifications; to ensure that pipes have "Leak-proof" joints with proper threads and that proper materials (i.e., white lead with hemp / or Teflon etc, thread Seal) have been used in jointing. All leaky joints must be made leak-proof by tightening at Contractor's expense. ENGINEER-IN-CHARGE may ask the Contractor to submit the necessary test certificates in this regard.

29.7 PVC CONNECTOR – (to Cisterns & Basin Pillar Taps)

These Connectors shall be of PVC body (LDPE) with Symet nuts at both ends of "Prayag" or approved make to be connected with the CP Angle cocks to the respective Sanitary Fixture CP Taps. These connectors shall be of flexible type at least 45 cm long and IS approved.

30.0 Brass Water Fittings

All water fittings shall be of standard manufacture as approved by ENGINEER-IN-CHARGE and shall be in all respects comply with the latest Indian Standard Specifications. the brass fittings shall be fixed in the pipe line in a workmanship like manner. Care shall betaken to see that joints between fittings and pipes are made leakproof . The fittings and joints shall be tested to pressure of 21 kg per sqm. (300lbs. per sq. inch) unless otherwise specified. The defective fittings and the joints shall be repaired or replaced.

31.0 DELETED

32.0 SEWERAGE AND SEWAGE DISPOSAL SYSTEM

- The System for vertical transmission of sewage is proposed to be a “TWO STACK SEPARATE DISPOSAL SYSTEM”. One Stack being the **C.I. Sewer Stack (“Centri” cast as per IS-3989)** conveying the Human Sewage from WC’s & Urinals directly to the Inspection Pits and finally disposed to the nearest **MANHOLE** of the existing NKDA **SEWERAGE system** through **Master Trap chamber**. The other Stack being the **Waste Stack (“Centri” cast as per IS-3989)** disposing the Waste water from Wash basins & Ablution Floor Traps of the WC’s / Floor washing Floor Traps (FT) etc., to the Inspection Pits via (GC) – Gully Trap Chamber and final disposal to the Master Trap Chamber .connected to the NKDA **SEWERAGE system** .
- The Salient features of the Sewerage and Sewage Disposal systems are :
 - ✚ That the Inspection Pits of the sewer lines, to be located inside the ‘greenery Plantation’ / or Paved area as far as possible, such that they can be camouflaged properly by the Plantations beside the Drive-way. There are a few Inspection Pits to be arranged at the centre of the Drive-way to avoid direct Vehicle Wheel pressure.
 - ✚ Gully Trap Chambers through its water seal will arrest the “Foul odour” from entering the Building Waste pipe Network.
 - ✚ All Inspection Pits (IP) and (GC) Gully Trap Chambers should be at least one full brick thick masonry walled construction with RCC cover Slab of proper strength.
 - ✚ All Inspection Pits (IP) should be covered with fully “Air tight” with ‘Double water Seal’ Ream C.I. – **Medium / Heavy** duty covers (**as per IS-1726**)-**ISI approved**, for preventing any Rain water seepage and leakage of foul odour.
 - ✚ All IPs and manholes are to be constructed as per specifications laid down in the CPHEEO Manual.
 - ✚ Under-ground Sewerage Lines should be of Salt-glazed Stoneware (SGSW) pipes with all-round concrete encasing with 150mm thick concrete bedding to be connecting consecutive IPs.
 - ✚ C.I. pipes from the building Stacks. will terminate at the 1st ‘Summit’ Pit (1st Inspection Pits)

- ✚ All Sewerage 'Soil' Stacks to be connected with a **Sand Cast (IS-1729) 50mm dia Vent Stack** from the gr. Floor up to the top floor portion of the Sewer Stack and finally air vented through a CI Vent Cowl fixed at the top of each Stack.
- ✚ Every preferred Bends and Junctions of the Stacks / or Fittings to be provided with the inspection door provisions to facilitate probing/cleaning / rodding etc.operations as and when required., Pipes / Stacks to be fixed to the external walls with the help of MS Holder Bat Clamps.
- ✚ Except the Vent Stack all the Sewer & Waste pipes and Pipe Fittings and Specials should be of Centrifugally Cast (Spun) C.I. pipes in conformity with IS-3989.

33.0 Drainage : (External)

33.1 Stone Ware Pipe : For External Sewerage -

Pipes : All pipes must be new and perfectly sound, free from fire cracks and imperfection of glazing, cylindrical straight and of standard nominal diameter, length and depth of socket. They shall be hard burnt stoneware of dark grey colour and thoroughly salt glazed inside and outside. They should conform **IS: 651-1965**.

33.2 Trenches for S.W. Pipe Drains

Excavation : The trenches for the pipes shall be excavated to lines and levels as directed. The bed of the trench shall be truly and evenly dressed throughout from one change of grade to the next.

The gradient is to be set out by means of bending rods and should the required depth be exceeded at any point the trench shall be refilled by means of cement concrete of the specification of the bed concrete, at the Contractor's own expense. the bed of the trench if in soft or made up earth shall be well watered and rammed and depressions thus formed filled with sand or other suitable materials as directed by ENGINEER-IN-CHARGE before laying the bed concrete.

If rock is met with, it shall be removed to 15 cms. (6") below the level of the pipe and the trench will be refilled with concrete, sand or other suitable material as directed by ENGINEER-IN-CHARGE to bring it to required bed level. the excavated materials shall be kept away from the edge of the trench at a distance equal to 1 Metre (3 ft.) or equal to half the depth of the trench which -ever is greater.

The trench shall be kept free from water. Shoring and timbering shall be provided wherever required.

The trench width shall be the nominal diameter of the pipe plus 36 cms. (15") but it shall not be less than 52 cms. (21") in case of all kinds of soils excluding rock and not less than 92 cms.(3 feet) in case of rock.

Wherever the drain runs deeper , the width of the trench in the upper reaches may be increased as per the directions of the ENGINEER-IN-CHARGE.

34.0 Storm Water Drainage

The entire campus has been provided with underground RC pipe drainage system for carrying the run-off from the open areas as well as the spillage from the storage provisions through yard gully chambers. The drainage lines have been provided along all the internal

roads and pathways for ultimate disposal into the Storm water Manholes of the Township drainage system

Drainage of basement:

The basement in case of water stagnation , will be drained out by means of two nos. separate dewatering pumps located at the end of saucer drains inside the basement with a sump

35.0 Road Crossings :

All road crossings shall be excavated half at a time , the second half being commenced ,after the pipes have been laid in the first half and the trench refilled. The trench at the existing road crossings shall be filled in with mud concrete for the full depth except for the 15 cms (6") layer ,which shall be filled with cement concrete 1:2: 4 or as directed.

36.0 Protection of Existing Services :

All pipes , water mains , cables etc., met within the course of excavation shall be carefully protected and supported. Such mains will be hung from timbers placed across the trench. Care shall be taken not to disturb the electrical and communication cables, removal of which if necessary may be arranged by ENGINEER-IN-CHARGE.

37.0 Lighting and Watch :

The open trenches shall be provided with requisite fencing and watchman to guard against accidents. Red flags during day and red light during night shall be provided at the ends and at intervals along the sides of the trenches.

Sign boards with necessary wording such as "SLOW, ROAD CLOSED" etc. shall be provided at least 30 metres ahead of road crossing where the work is in progress. The precautions will be continued till the surface is restored.

Temporary bridges or planks shall be provided over the trenches for keeping open the access to private or public property.

38.0 Refilling :

Refilling in trenches for pipes shall be commenced as soon as the joints and concrete have been passed. The refilling on the top and around the drain shall be done with great care and in such a manner as will obtain the greatest amount of compactness and solidity possible . For this purpose the earth shall be laid in regular layers of 15 cms (6") watered and rammed at each layers. All surplus earth shall be disposed off as directed by ENGINEER-IN-CHARGE.

39.0 Concreting :

All S.W. pipes shall be laid on a bed of 15 cms. (6") thick cement concrete as specified with projection on each side of the pipe to the full width of the trench and surrounding the pipes all-round with 1:4:8 concrete mix.

All NP-2 RCC pipes below Road crossing / Car Parking areas shall be laid on a bed of 15 cms. (6 ") thick cement concrete as specified with projection on each side of the pipe to the full width of the trench with 1:4:8 concrete mix.

The pipes with their crown level at 1.22 Metre (4 ft.) depth and less from ground shall be covered with 15 Cms. (6") thick concrete above the crown of the pipe and slipped off to give a minimum thickness of 15 Cms. (6") around the pipe or as per construction drawing.

Pipes deeper than these shall be concreted upto haunches level with the top of the pipe.

40.0 Laying and Jointing S.W. PIPES

40.1 Laying

The pipes shall be carefully laid to the levels and gradients shown on the plans and sections. Great care shall be taken to prevent sand etc., from entering the pipes. The pipes between two manholes shall be laid in straight line without vertical or horizontal undulations.

The pipes will be laid "socket up" the gradient. The body of the pipe shall for its entire length rest on an even bed.

40.2 Jointing

The cement mortar joints shall be cured at least for seven days.

40.3 Testing

All joints shall be tested to a head of 61 Cms. (2') of water above the top of the highest pipe between two manholes.

The lowest end of the pipe shall be plugged watertight. Water shall then be filled in manhole at the upper end of the line. The depth of water in the manhole shall be 61 cms. (2) plus the diameter of the pipe. The joints shall then be examined. Any joint found leaking or sweating shall be remade or embedded into 15 Cms. (6") layer of cement concrete (1:2:4) in length and section re-tested, at the Contractor's expense until satisfactory results are obtained.

41.0 General

41.1 Under-ground Storm Water Drain Pipes

NP-2 R.C.C. pipes are used for storm water drainage, on a concreting at pipe bed with 1:4:8 mix. The cement mortar for jointing with the Pipes and Collars will be 1:2 or that as specified in the Schedule of Quantities. Testing of joints also. will be required under a Hydro-static Pressure Test under 1.5 Kg-f / cm² (g) pressure with a minimum Holding time of 1.0 hour and those joints after found tested OK shall be tagged "Tested OK" for those portion of the tested pipe and shall be preserved and care is to be taken during back-filling in such a manner so that there should be no undue load | impact | hammerrage on those tested joints so as to make the joint quite sound.

41.2 Precaution

To avoid logging of drains, both ends shall be kept plugged until the construction of manholes is completed in every respect. On completion, care shall be taken that each plug is removed and the face of the drain made smooth.

41.3 Measurements

The measurements for providing, laying and jointing R.C.C. pipes shall be recorded for the finished length of the pipe line i.e., from inside of one manhole to the inside of other manhole.

42.0 S.W. Gully Traps

This must be new, perfectly sound free from fire cracks and other imperfections of glazing of standard nominal diameter and other dimensions . It shall be made of hard burnt stoneware of dark grey colour and thoroughly salt glazed inside and outside.

Each Gully Traps shall be of Stone-ware body Square mouth with 15cm dia outlet housed in Brick masonry Chamber of 30cmx30cm internal. The masonry Chamber shall have one water tight C.I. cover with frame 30 x 30 Cms. (12" x 12") (inside dimensions) with machine seating faces or as specified. The masonry Chamber shall also have atleast 15cm thick bed concrete and PCC coping at top - as specified in the drawing.

42.1 Excavation

The excavation for gully traps shall be done true to dimensions and levels as indicated on plans or as directed by the Engineer-in- Charge.

42.2 Fixing

The gully trap shall be fixed on cement concrete foundation 70 Cms. (2'3") square and not less than 10 Cms. (4") thick.

The mix for the concrete will be 1 :3 : 6 (1 Cement : 3 Sand : 6 Stone ballast) 40 mm (1.1/2" gauge) or as specified. The jointing of gully outlet to the branch drain shall be done similar to jointing of S.W. pipes.

42.3 Masonry Chamber

After fixing and testing the gully and branch drain , a brick masonry Chamber 30 x 23 Cms (12" x 9") (inside in first class brick in cement mortar 1:5 shall be built with 11 Cms. (4.1/2") thick around the gully trap from the top of the bed concrete upto ground level . The space between the Chamber walls and the trap being filled in with cement concrete of the specifications of bed concrete. The upper portion of the Chamber i.e. above the top level of the trap shall be plastered inside with cement mortar 1:3 (1 cement : 3 sand) finished with floating coat of neat cement. The corners and bottom of the Chamber shall be rounded off so as to slope towards the grating.

42.4 C.I. Cover

C.I. cover with frame 30 x 23 Cms. (12" x9") or as specified with mechanical seating faces shall then be fixed on the top of the brick masonry with cement concrete 1 : 2 : 4 and rendered smooth. The finished top of cover shall be left 15 Cms. (6") above the adjoining ground level so as to exclude the surface water from entering the gully trap.

43.0 Manholes , Inspection Pits, Gully Chamber Etc.

43.1 Manholes

(The size of Manholes) : The size specified as in the Tender Drawing, shall be in the internal size of the manhole. The work shall be done strictly as per drawings and specifications. The following specifications shall be adopted.

43.2 Excavation

The manhole shall be excavated true to dimensions and levels, shown on the plan or as directed by ENGINEER-IN-CHARGE.

43.3 Brick Work

The brick work shall be with best quality brick in cement mortar 1:4 , brick work in arches shall be with 1st class brick in cement mortar 1:4 , brick masonry round the pipes shall also be with 1st class brick in cement mortar 1:4 , the joints shall be made thoroughly leakproof.

43.4 Bed Concrete

The manhole shall be built on a bed of 15 Cms. (6") thick cement concrete (1 : 3 : 6) over a layer of brick flat soling.

43.5 Plaster

Inside of the walls be plastered with 12 mm. (1/2") thick cement plaster 1:3 (1 cement : 3 coarse sand) finished with a floating coat of neat cement.

In wet ground , 12 mm. (1/2") thick cement plaster of the above specifications shall be done on the outside surface of the walls also. This plaster shall be done with waterproofing admixture as approved by ENGINEER-IN-CHARGE. The plastering shall be done upto 30 cms.(1 foot) above the wet soil line. Extra shall be paid for plastering the outside surface wherever directed.

43.6 Pointing

Pointing shall be done with cement mortar 1:2.

43.7 Benching

The channels is and benching shall be done in cement concrete 1:2:4 and rendered smooth with neat cement.

The following sizes of the channels shall be adopted for the benching :-

Size of the Drain	Depth at the Centre	Depth at sides i.e. , at walls
100 mm. (4")	15 Cms (6")	20 Cms
150 mm. (6")	20Cms (8")	25 Cms
250 mm. (9")	28 Cms(11")	38 Cms
300 mm. (12")	35 Cms(14")	45 Cms

43.8 R.C.C. Work

R.C.C. work for slabs or lintels shall be in cement concrete 1:11/2:3 with steel reinforcement as per details. Plain concrete, if used for fixing manhole covers, shall be of (1:2:4) proportion, unless otherwise mentioned specifically in the BOQ / drawings etc.

43.9 Foot Rests

These shall be of C.I. standard / or by M. S square rod 22 mm. (7/8") or as specified and shall be galvanised or painted with coal tar. These shall be embedded in masonry in cement mortar at least 23 Cms. (9") while the brick work is in progress. These shall be fixed 30 Cms. (1foot) apart vertically and staggered laterally and shall not project more than 11 Cms., (4.1?2") from the wall.

43.10 C.I. Manhole Covers

The C.I covers shall be of tough homogeneous cast iron of 'heavy' or 'Medium' type as specified in the Bill of quantities, are the clear internal dimensions. The approximate weights of the various types of manhole covers with frames and their internal size will be as per specification in schedule of quantities & conform to IS : 1726-1966. Variations in weight to the extent of 6 percent on either sides shall be permissible. the covers used in manhole on sewer lines shall invariably bear the work 'SEWER' on the top and those used for storm water drains shall bear the word 'S.W.D.' .These markings shall be done during casting of the covers.

The frame of manhole cover shall be embedded firmly in the R.C.C slab or plain concrete as the case may be on the top of the masonry.

After the completion of the work , manhole covers shall be sealed by means of thick mortar greased. All exposed surfaces of the frames and covers shall be painted with coal tar. The cost of such paintings should be included in the Contractor's rates for the manhole cover.

43.11 Plain Manhole

As per drawing or 60 cms. x 60 cms. (2' x 2') when not mentioned / shown specifically. This type of manhole is minimum generally constructed within compounds for house drainage only. Due to shallowness and narrowness the manhole is provided with cover with bigger opening to facilitate cleaning and repairs. Top Cover shall be of RCC of size 560mm dia circular shall be used.

43.12 Plain Manhole : (both for Sewerage & Storm Drainage)

As per drawing or 1.2 X 0.9 M (4" x 3") when not mentioned / shown specifically. This type of manhole is constructed for main drainage work for depth less than 2.4 Meters (8') but more than 0.9 M – as per N.B.C..

When the manhole is built on the footpath ,this shall be provided with 45 Cms. (18") internal diameter light type C.I cover , when it is built within the width of the road under traffic, it shall be provided with 53 Cms. (21") internal diameter heavy type C.I cover.

43.13 Circular Manhole 1.52 M internal Dia : (both for Sewerage & Storm Drainage) :

As per drawing 1.52 M (5' dia) internal dia Circular manhole when mentioned / shown specifically. This type of manhole is constructed for main External Sewerage work for depth less than 2.3 Meters (8') but more than 1.5 Metres.

When the manhole is built on the footpath ,this shall be provided with 45 Cms. (18") internal diameter light type C.I cover , when it is built within the width of the road under traffic, it shall be provided with 53 Cms. (21") internal diameter heavy type C.I cover.

44.0 Levels of Invert of Inspection Pits and Storm water Manholes

All Invert levels as specified in the drawing to be maintained strictly as minimum requirement. All Invert levels (I.L.) given in the drawings are with respect to the **(+/-) 0.00 level as specified in the drawings.**

Unless some acute problem as per the Site conditions the Invert levels as mentioned in the drawing shall have to be maintained.

For any alterations in Invert levels as per the Site conditions (if any) shall have to be approved by ENGINEER-IN-CHARGE before executing the job.

The invert of the smaller sewer at its junction with main shall be at least 2/3rd dia. of the main above the invert of the main . The branch sewer should deliver sewage in the manhole in the direction of main flow and the junction must be made with ease so that flow in the main is not impeded.

44.1 Measurements

The depth of the manhole wall be reckoned from the invert level of the channel to the top level as to the C.I cover . The depth shall be measured correct to nearest 25 mm.

44.2 House Connections

No drain from house fittings e.g. gully trap or soil pipe etc., to manhole shall exceed a length of 6 Meters (20 feet) unless it is unavoidable.

44.3 Drop Connections (Drop Manholes) – if any

In case where branch pipe sewer enters the manholes on main pipe sewer at a higher level than the main sewer, a drop connection should be provided.

C.I. Inspection bend shall be fixed in position at right angle to the drop pipe at the level of the inlet branch drain. The plain C.I. shoe at the bottom shall be fixed in the benching cement concrete 1:2:4 (1 cement : 2 sand : 4 stone ballast $\frac{3}{4}$ " size) so as to discharge into the channel (the joints be lead caulked as per specification for the cast iron pipes for water supply).

45.0 C.I. Pipe Drainage

45.1 C.I. Drainage

C.I. pipe drainage shall be adopted (IS-3989 or IS-1729) in the case mentioned below:-

- a) When the drain passes under a structure.
- b) When the drain passes under a road which is subject top heavy traffic and where the covering cushion is not considered sufficient.
- c) When the drain passes through a place where it is subjected to vibrations.
- d) In hilly places where the slopes are very steep.
- e) When drainage lines run on the surface or above ground.

45.2 Trenches

Specifications for trenches for stoneware pipe drains will apply in this case.

45.3 Pipes

The pipes used shall conform to the Indian Standard specifications for class "A" pipes.

45.4 Fittings

C.I. trap with hopper , C.I inspection bends C.I. inspection Chambers etc., shall conform to Indian Standard specifications for C.I fittings.

47.5 Laying

For laying C.I pipes and fittings , specifications for C.I water mains will apply .

The joints for pipes and fittings shall be lead caulked joints under water supply. the joints shall be leakproof.

All inspection doors etc., shall be provided with felt washers and strong brass bolts and nuts.

45.6 Testing

Testing of joints for C.I pipes and fittings shall be done by smoke test as specified under C.I pipes and fittings.

45.7 Masonry Chamber

C.I inspection chambers and bends for underground shall be enclosed in masonry chambers.

NOTE

In case of non- availability of any particular brand of material as specified in the Bill of Quantities bidder may propose any other equivalent approved brand or material or equipment conforming to the latest I.S specifications subject to the approval of ENGINEER-IN-CHARGE.

46.0 List Of Approved Manufacturer

Sl. No.	Description of Approved Material	Approved Brand / Manufacturer
	<u>Internal Water Supply :</u>	
1	G.I. Pipes - medium class (As per IS-1239, P - I)	TATA.
2	G.I. Pipe fittings (as per IS-1239, P - II) ; of material with Galvanised Cast Iron Fillings, with material code conforming to IS- 1879	HB'/ "NB' / "ZOLOTO"/Leader / - "JSI" fittings ISI approved Heavy
3.0	C.P. on brass fittings	
3.1	CP Bib cock	JAQUAR-Continental /ESSCO'-Delux' or 'sumthing special'/ "Marc"/"Hindware" or as approved by ENGINEER-IN-CHARGE
3.2	CP 'Long Nose' / or' Long Body' Bib cock	- Do -
3.3	CP Angle valve	- Do -

3.4	CP 'Concealed' Stop cock 'Heavy' type with adjustable CP wall Flange	- Do -
3.5	CP Shower Rose	- Do -
4	Gun metal body Ball Float valve with PVC (High pressure) Ball Float	Zoloto" / Leader"/ "Sant" / "Neta
5	15 mm dia. PVC Connector pipe with Symet nuts at both ends. - (for Wash Basin Pillar tap & W.C. & Urinal -Cistern connections)	PRAYAG or as approved by ENGINEER-IN-CHARGE
6	Wall Outlet Connection Flexible Pipe - 15mm dia	"Jaquar" / "Essco"
7	Bronze / Gun metal-body Gate valve with threaded screwed ends, "Non-rising Spindle" type (PN-1.0) / or (PN-1.6) class	Sant / "Leader" / "Zoloto"-for Bronze body / "Neta" / SBM – "Peglar" type
8	Bronze -body Globe valve with 'BSPT(F), threaded screwed ends, "Non-rising Spindle" type (PN-1.0) (PN-1.6) class	Valves of 'Zoloto', or 'Sant' or as approved by ENGINEER-IN-CHARGE.
9	CI body Gate / Sluice valve with flanged ends rising Spindle" type (PN-1.0) /or (PN-1.6) class	'Sant' / 'Zoloto'/Leader / 'Hawa'
10	HYDRO-PNEUMATIC PUMPING SYSTEM - for (B +G+ 2 floors) :- For Kitchen/Canteen & LAB uses :	"Grundfoss' / 'Willo/ "CRI" /"Salmson" / or equivalent.
	Pump of Capacity – 900.0 LPM @ 35.0 M head with 1 pump working and 1800 LPM @ 35.0 M head with 2 pumps working maximum. 8 KW Motor for each pump with maximum 16 KW working load. Each motor of 3-phase integrally coupled Motor with 1 motor VFD drive out of 3 motors.	
11	CP Urinal Spreader-15mm (for Urinals only)	for all Toilets :- Hindware / "Parryware" or as approved by ENGINEER-IN-CHARGE.
12	Soil, waste & vent pipes / and Pipe Fittings & Specials :- C.I. Centri cast (as per 15-3989)	'NECO' / 'HEPCO' / 'KAPILANSH DHATU UDYOG (P) L TD.'
	<u>Sanitary Fixtures & Fittings :</u>	
13	Sanitary wares (Vitreous chinaware) :- W.C. - (European type) - with'S' / 'P' -Trap - Floor mounted type, without PVC Flushing Cistern, ii) Wash Basins - "Flat-back" type rectangular pattern (size=550mm x 400mm) with "Essco" CP Pillar Tap / or "Swan neck" type Mixer, iii) Urinal - Flat back "Small" with CP Spreader, CP Waste coupling, CP Bottle Traps with waste pipes & also with "Jaquar' Sensors with installation box.	1st quality White Vitreous China-wares of 'Hindware- /Parryware' or 'Cera' :- for Vitreous chinaware W.C.:- Floor mounted "Pedestal" type-W.C. - of 'Hindware'-"Popular" without PVC Cistern but with PVC Seat & Lid of 'Hindware', / 'Parryware' or 'Cera', CP Flush Pipe of approved standard make.
		Wash Basin :- 'Hindware' - "Flat-back" type rectangular (size=550mm x 400mm) / or Parryware- equivalent / 'Cera' equivalent Wash Basin Pillar tap equivalent as approved by

		ENGINEER-IN-CHARGE for Wash Basins.
		For WC flushing :- PVC 'Low-level' "Dual- Flush" Cistern of 'Hindware' "SLEEK" or equivalent Parryware or 'Cera' Model.
		Urinals :- Hindware - "Flat Back 'Small'- (size-440 x 315 x 265mm) / or Parryware / or 'Cera' – equivalent.
		& for Urinals :- "Jaquar", "PRESSMATIC"
14	Wall Mirror	6mm thick 'Modiguard' / 'Ashai' / or equivalent as approved by ENGINEER-IN-CHARGE, with 12mm thick hard-board backing
15	C.P. on brass fittings	
15.1	C.P. on brass fittings C.P. Waste Coupling, ii) C.P. Bottle Trap, iii) C.P. Robe Hook, iv) C.P. Towel Rail. v) CP Two way Bib Tap	JAQUAR/ESSCO'-Delux'/Marc /Hindware /or as approved by ENGINEER-IN-CHARGE
15.2	CP Toile. Paper Holder	- Do -
15.3	CP Towel Ring	- Do -
15.4	CP Soap Dish Holder	- Do -
15.5	CP Bottle Trap with CP wall connection Pipe	- Do -
	Sanitary Fixtures & Fittings	
15.6	CP Robe Hooks	- Do -
15.7	CP "Two-way" Bib cock	- Do -
15.8	CP Shower Rose	- Do -
16	Rigid PVC (Concealed) Waste pipe, [Schdl.-40], (as per ASTM D 1785)- (concealed or exposed)	Supreme / Oriplast / Finolex/ Utkarsh
17	Rain Water Pipes :- C.I. – Sand cast "SWR" class, ' as per (IS: 1792)	NECO/'HEPCO/'KAPILANSH DHATU UDYOG (P) LTD.
18	Rain Water Pipe Fittings :- 'Sand cast Iron' - "SWR" class, as per (IS: 1792)	DO
19	Salem Stainless Steel Sink as per AISI 304 (18/8) conforming to I.S.- 13983	"Hindware" "Hafele" ""Nirali" , 'Parryware'
	<u>External Sewerage & Area Drainage</u>	
20	Stone- Ware Pipes , and S.W. Pipe Fittings	Sonali / GINNI / NIRALI / Hind
21	C. I. Manhole Cover (I.S. - 1726) - "Medium" or "Heavy" Grade' (Light duty only on Oil/Grease Trap Chamber)	NECO' / 'HEPCO'/ Swastika / 'BPL'/'BIC".
22	NP-2 class R.C.C. Pipes and Pipe Fittings (i.e., RCC Collars etc.)	Eastern Spuncrete / 'West Bengal Concrete Industries (P) Ltd. /

		'HINDUSTAN' / 'SUR'.
23	Stone- Ware Gully Trap	Sonali / GINNI / NIRALI / Hind
24	C. I. Grating- (Over Catch Pit / Yard Gully Chamber), (I.S. - 1726) - "Medium" or "Heavy" Grade	NECO' / 'HEPCO' / 'BPL'/'Kapilansh Dhatu Udyog"
25	ETP cum STP- 100 cum/day : As per the Detailed Specifications	"THERMAX" / "Aquatreat / "Ion-Exchange"
26	Rain Harvesting Pump : Hydro-pneumatic - integrally coupled with 3 – phase 2900 R.P.M., 415 Volts,	"Grundfoss' / 'Willo'/ "CRI" /"Salmson" / or equivalent
	Pump of Capacity – 900.0 LPM @ 35.0 M head with 1 pump working and 1800 LPM @ 35.0 M head with 2 pumps working maximum. 8 KW Motor for each pump with maximum 16 KW working load. Each motor of 3-phase integrally coupled Motor with 1 motor VFD drive out of 3 motors.	
27	<u>BASEMENT DE-WATERING PUMP</u> It shall be of Submersible- Vertical mounting type Mono-set "De-watering Pump". Pump should be with CI 'Mixed Flow' / 'Radial Flow' type Impellers, integrally coupled with submersible type 3 – phase 2900 RPM 415volts, AC motor capable to withstand a voltage variation of (+/-) 10% and frequency variation of (+/-) 3%, but excluding pump control panel. Pump of capacity – approximate - 200.0 LPM @ 8.0 M head with KW (HP) Motor input, 3 phase integrally coupled "Submersible" type Motor. [1-working + 1-Standby].	Pump :- "CRI" / "MBH" / "Jalrani"/ or equivalent.
	<u>External Water supply</u>	
28	<u>HYDRO-PNEUMATIC PUMPING SYSTEM - for (B +G+ 17 floors)</u> Hydro-pneumatic type 2-stage pumps in a single Skid with (2-working + 1-standby) for transfer of water from U/G Domestic Water Reservoir to directly to individual Toilets Kitchen etc, with an extra provision to connect with the terrace Domestic tank to store the water suitable to suit the drinkable water quality (as per IS-10500). Pumps should be with C.I./SS / Bronze Impeller, integrally coupled with 3 – phase 2900 R.P.M., 415 Volts, A.C. Motor, including Pump Control Panel with "Auto" Start / Stop 3nos. "Indfoss' make Pressure switch with each sets of Pump. Pump of Capacity – 3000.0 LPM @ 108.0 M head – with 90 KW Motor input under peak load condition, 3-phase integrally coupled Motor with 1 motor VFD drive out of 3 motors.	"Grundfoss' / 'Willo'/ "CRI" /"Salmson" / or equivalent
29	"Enclosed" Analogue type Water Meter ("Bulk" Type), conforming to IS- 2373 with Calibration Certificate, including all necessary accessories	"Dashmesh" / 'Kaycee" / "Capstan"/ "Kent".
30	Submersible Borewell Pump for Filling U/G Tank (To supply underground water from subsoil aquifer to the R.C.C underground tank.)	

	Supply, installation in Borewell, testing and commissioning of Submersible multistage pump motor set Capacity- 10.5 M3/Hr. max (i.e., 175 LPM) at 49 to 50 M head with 'Submersible' type suitable HP Rated Motor (min. 2.25 kw , 3 HP) at 2900 / or 1450 RPM; including supplying of 50 Mtr. long suitably rated & suitable cross-sectioned 31/2-core "Submersible" type PVC insulated Sheathed Armoured Cable with Cable Clamps (Cable size as per Manufacturer's standard) as required, and including 415 Volt, 3-phase, 50 Hz Star-delta Starter Panel suitable to withstand +/- 10% voltage variation and +/- 3% frequency variations with Switch Fuse units and Isolators etc, of approved Make/Brand, including all other necessary accessories complete as required.	"CALAMA", / " KSB" / "TEXMO" /or as approved by ENGINEER-IN-CHARGE
	[1-working + 1-Standby-optional]	
31	Bronze body "Parallel Slide" 'Blow-off valve ("Spring loaded, blow-off pressure sellable" type), with flanged ends, also with matching Flanges (PN-1.0) / or (PN-1.6) class	'Zoloto' / Sant –make / Leader
32	Air-Release Valve	
	Bronze body "Parallel Slide" 'Blow-off valve ("Spring loaded, blow-off pressure sellable" type), with flanged ends, also with matching Flanges (PN-1.0) / or (PN-1.6) class	Zoloto' / Sant –make / Leader
33	Bronze / Gun metal -body Ball valve with 'BSPT(F), threaded screwed ends, "quarter turn Lever operated" type (PN-1) / or (pN-1.6) class	Valves of Bronze body :-'Leader', 'Zoloto' – Metal only:- Sant make / Leader
34	Gaskets-CAF 'Full face' conforming to IS-2712, Gr.- C; (3mm thick)	"Klinger" / "Permanite" / "Champion".
35	<u>BOREWELL</u>	
35.1	(i) 3 HP Submersible Pump & Motor having discharge 175 LPM at 49 to 50 Mtr. Head with DOL Stater	Pump :- Calama / Texmo / KSB.
35.2	(ii) Control Panel for 3 HP Pump including Volt Metre, AMP Metre & indicator ncnts	Control Panel :- Siemens / L&T make

TECHNICAL SPECIFICATION
ELECTRICAL WORKS

1.0 EXTERNAL ELECTRIFICATION WORK FOR SERAMPUR BUS TERMINUS

- The Power supply for the Proposed Serampur Bus terminus shall be taken from the 33KV Sub-Station of CESC through 33KV Substation of Serampur Bus terminus by underground cable up to the LT Panel.
- LT Panel shall house the main incoming & outgoing ACB, MCCB, bus bars and outgoing switchgears.
- MLDB, MPDB, MACDB, UPSDB, Utility DB, Fire Panel shall be connected through cable from the AI. Busduct. From the MLDB, MPDB, MACDB & UPSDB, sub-main line shall be taken through cable to the Lighting, Power, Computer & AC Distribution Board of each floor.

1.1 Scope of Work

Scope of work covered under this tender shall be supply of the necessary equipment, installation, erection, testing and commissioning of the system. The skilled & unskilled labours, lifting tools & tackle as well as any other materials or equipment that may be required to make installation complete in all respect, will be provided by the Contractor. The actual extent of work vis-a-vis the distribution system shall be as indicated in the drawings/specifications, but not limited to following: -

- a) Supply, installation, testing and commissioning of 33 kV, Vacuum circuit breaker switch gear with cable box on incomer side and outgoing side.
- b) Supply, installation, testing and commissioning of 33 kV grade XLPE insulated (E) cable wherever shown.
- c) Supply, installation, testing and commissioning of 33kV/433V oil cooled type indoor transformers with OLTC.
- d) Supply, installation, testing and commissioning Main LT panel, LT bus duct(Rising Main) Power/ distribution boards, LDBs, PDBs etc. Power & Control cables, etc.
- e) Supply, installation testing and commissioning of, switch power socket outlets, isolators, terminations of cables, cable trays etc.
- f) Supply, installation, testing and commissioning of lighting fixtures, emergency lighting.
- g) Supply, installation, testing and commissioning of all internal wiring in conduit.
- h) Supply, installation, testing and commissioning of earthing system and lightning protection system.
- i) Supply, installation, testing and commissioning of telephone wiring.
- j) Supply, installation, testing and commissioning of Diesel Generator Sets.
- k) Getting the drawing and complete work approved from Electrical Inspector and any other local statutory body and liasoning with electric Supply Company, if required etc. Liasoning charges and out of pocket expenses for getting electrical connection, approval of work completed from local electrical Inspector and any other local authorities shall be included in the rates quoted.

Client reserves the right to procure any equipment separately for economic reason. Final decision on the same will be conveyed to the successful bidder after price bid opening.

1.2. Applicable Specifications

The specification for the work is as detailed hereinafter. These specifications shall be read in conjunction with the relevant Indian Standard, Indian Electricity Rules and Chief fire officer's recommendations and the obtainable local practice as detailed in various regional handbooks. Where the specifications in any of the standards are at variance with the Specifications detailed herein, the most stringent amongst them shall govern. Contractor shall ensure that execution of total work is in accordance to this.

I.S. No.	Subject
335-1993	New insulating oil for transformers and switchgear (Third revision).
371-1979	Ceiling Roses (Second revision).
613-2000	Specifications for Copper rods for electrical purposes (Third revision).
694-1990	PVC insulated cables for working voltages upto and including 1100 volts (Third revision).
732-1989	Code of Practice for electrical wiring installations. (Third revision)
1293-2005	Specification for plugs and sockets out let of rated voltage upto and including 250 Volts and rated current upto and including 16 Amperes (Third revision).
1569-1976	Capacitors for use in tubular fluorescent, high pressure mercury and low pressure, sodium vapour discharge lamp circuit (First revision).
1646-1997	Code of practice for fire safety of buildings (general) Electrical installations (Second revision).
2215-1983	Starters for fluorescent lamps (Third revision).
2268-1994	Electric call bells and buzzers for indoor use (Third revision).
2309-1989	Code of practice for protection of buildings and allied structures against lightning (Second revision).
2551-1982	Danger notice plates (First revision).
2667-1988	Fittings for rigid steel conduits for electrical wiring (First revision).
2675-1983	Enclosed distribution fuse boards and cutouts for voltages not exceeding 1000volts (Second revision).
3034-1993	Code of Practice for fire safety of industrial buildings-Electrical generating and distribution stations. (Second revision)
3043-1987	Code of practice for earthings (First revision).
3070-(Part 1)-1985	Specification for Surge arresters for Alternating Current systems, Part I- Non-linear resistor type Surge arresters (Second revision).
3070-(Part 2)-1989	Lightning arresters for Alternating Current systems, Part 2. Expulsion type lightning arresters.
3323-1980	Bi-pin lamp holders for tubular fluorescent lamps (First revision).
3324-1982	Holder for starters for tubular fluorescent lamps (First revision).
3419-1988	Fittings for rigid non-metallic conduits (Second revision).
3427-1997	AC Metal enclosed switchgear and control gear for rated voltages above 1 KV and upto and including 52 KV (First revision).
3480-1966	Flexible steel conduits for electrical wiring.
3553-1966	Watertight electric lighting fittings.
3639-1966	Specification for Fittings and accessories for power transformers.
3837-1976	Accessories for rigid steel conduits for electrical wiring (First revision).
4004-1985	Application guide for non-linear resistor-type surge arrestors for Alternating Current systems (First revision).
4160-2005	Specification for Interlocking switch socket outlet (First revision).

4615-1968	Switch socket outlets (non-interlocking type).
4648-1968	Guide for electrical layout in residential buildings.
4710-1968	Switches and switch isolators above 1000 Volts but not exceeding 11000 Volts.
5216-1969 (part 1)- 1982	Recommendation safety procedures and practices in electrical works Part 1: General (First revision).
5216-(Part 11)-1982	Recommendation safety procedures and practices in electrical works Part II: life saving techniques (First revision).
5820-1970	Precast concrete cable covers.
9537 (Part 2)-1981	Condition for electrical installation Part 2: Rigid steel conduit
9537 (Part 3)-1983	Condition for electrical installations Part 3: Plain rigid conduit of insulating material.
9900 (Part 1 to 4) 1981	High Pressure mercury vapour lamps - Part 1 to Part 4
9920 (Part III)-1982	AC switches for voltages above 1000 volts. Part III Design and construction.
9921 (Part 1)-1981	Alternating current disconnectors (isolators) and earthing switches for voltage above 1000 Volts. Part 1: General and Definitions.
9921 (Part 2)-1982	Alternating current disconnectors (isolators) and earthing switches for voltage above 1000 Volts. Part 2: Ratings.
9921 (Part 5)-1985	Alternating current disconnectors (isolators) and earthing switches for voltage above 1000 Volts. Part 5: Information to be given with tender enquiries & orders.
9974 (Part 1 & 2) 1981	High pressure sodium vapour lamps
10028 (Part I)-1985	Code of Practice for selection, installation and maintenance of transformers: Part 1: Selection
10028 (Part 2)-1981	Code of Practice for selection, installation and maintenance of transformers: Part 2: Installation
10028 (Part 3)-1981	Code of Practice for selection, installation and maintenance of transformers: Part 3: Maintenance.
10118 (Part 1)-1982	Code of Practice for selection, installation and maintenance of switch gears and control gears: Part 1: General
10118 (Part II)-1982	Code of Practice for selection, installation and maintenance of switch gears and control gears (superseding IS 3072-75 & 3106-66): Part 2 Selection
10118 (Part III)-1982	Code of Practice for selection, installation and maintenance of switch gears and control gears (superseding IS 3072-75 & 3106-66): Part 3 Installation
10118 (Part IV)-1982	Code of Practice for selection, installation and maintenance of switch gears and control gears (superseding IS 3072-75 & 3106-66): Part 4 Maintenance
11353-1985	Guide for uniform system of marking and identification of conductor and apparatus terminals.
13703 Part 1 & Part 2	Low voltage fuses for voltage not exceeding 1000 V AC or 1500 V DC
13703 (Part 1 to 4) 1993	Specification for Low voltage fuses for voltages not exceeding 1000 V AC or 1500 V DC
13947 - Part 1 1993	Specification for low voltage switchgear and control gear Part 1: General rules.
13947 - Part 3 1993:	Specification for low voltage switch gears and control gear- Part 3 switches, Disconnectors, switch disconnectors and fuse combination unit.

14772-2000	General requirements for enclosures for accessories for house hold and similar fixed electrical insulations.
280	Specification for mild steel wire for general engineering purposes
371	Ceiling roses
694	PVC insulated cables for working voltages up to and including 1100V
732	Code of practice for electrical wiring installation
1258	Bayonet lamp holder
1293	Three pin plugs and socket outlets
1646	Code of practice for fire safety of buildings (general) electrical installation
2147	Degree of protection provided by enclosure for low voltage switchgear and control gears
2215	Starters for fluorescent lamps
2268	Electric call bells and buzzers
2309	Code of practice for protection of building and allied structures against lightning
2418	Tubular fluorescent lamps for general lighting service
2551	Danger notice board
2667	Fittings rigid steel conduits for electrical wiring
3043	Code of practice for earthing
3419	Fittings for rigid non-metallic conduits
3480	Flexible steel conduits for electrical wiring
3646	Code of practice for interior illumination
3837	Accessories for rigid steel conduits for electrical wiring
3854	Switches for domestic and similar purposes
4160	Interlocking switch socket outlets
4615	Switch socket outlets (non-interlocking type)
4648	Guide for electrical layout in residential buildings
5039	Specification for distribution box for voltages not exceeding 1000V
5133	Boxes for enclosure of electrical accessories Part-1: Steel & cast iron boxes
5216	Recommendation safety procedures and practices in electrical works.
8828	Electrical accessories – circuit breakers for house hold and similar application (MCB)
9537	Rigid steel conduits
10118	Code of practice for selection, installation and maintenance of switchgear and control gears
11353	Guide for uniform system of marking and identification of conductors and apparatus
13947	Specification for low voltage switchgear and control gears

1.3. Quality & Completeness of Supply and Installation

It is not the intent to specify completely herein all finer details of the equipment to be supplied. Nevertheless, the equipment shall be complete & operative in all respect and shall conform to highest standard of engineering, design and workmanship.

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 provided without any extra charge.

The contractor shall supply and install all brand new material & accessories, as specified herein and shall conform to these Specifications as well as IS specification. When IS standard does not exist, such material / sample shall be submitted for Client's approval with test certificate from Government approved laboratories.

Contractor shall produce, on demand, such details as called for by the Engineer to prove genuineness of the material. The contractor must replace rejected materials within 7 (seven) days. Actual work shall be carried out by persons holding valid Government wireman license and supervision work by person holding Government supervisory license.

1.4. Water and Power for Construction

Please refer relevant clauses under "General Conditions of the Contract".

1.5. Scaffolding

The nominated subcontractor shall provide all scaffolding and ladders required for the proper execution of the work.

1.6. Measurements

The mode of measurements for quantification shall be as per provisions of the relevant Indian Standards. The nominated subcontractor shall provide all the measuring tapes and other accessories necessary.

1.7. Tools and Plant

The tenderer along with his tender furnishes a list of tools, plant and machinery, which he intends to use on the works. The nominated subcontractor is obliged to use all the machinery mentioned in his list of Consultants consider it necessary.

1.8 Drawings by Contractor

For bidding

The bidder shall submit offer with the following documents in two sets.

- Schedule of deviations from technical specifications.
- List of proposed makes, for the items listed in the tender.
- Technical datasheets & Catalogues major items, highlighting the offered models.
- Other documents and comments, if any.

For approval before construction/erection

The Contractor shall submit the following documents.

- a) For all the supplies, the contractor shall submit the following documents in 4 sets for approval.
 - General arrangement drawings, with all dimensions, showing: space-requirements, weights (for transport and service conditions), requirements of civil works (compatible with the tendered specifications), fixing and mounting facilities, connection devices, etc.
 - Electrical drawings, showing: power single line and functional/control multi line diagrams, terminal blocks, components' list with make, type, quantity, etc.
 - Quality assurance plan and bar-chart showing manufacturing schedule.

The contractor shall incorporate all comments and submit revised drawings in stipulated time till all drawings are finally approved for manufacturing.

- b) For installation work, the contractor shall submit the following documents in four sets for approval:
 - Single line diagrams and substation/ electrical room layouts, based on working drawings of GEL / Contract specification, required for approval of Electrical Inspectorate and required for submission to other local authorities for approval.
 - Detailed lighting layout drawings showing exact locations of lights and other fittings as per site conditions and instructions, conduit routes, phase wise distribution on each LDB, mounting details of each type etc. based on the tender documents.

- Detailed cable and earthing layout drawings showing cable route, cable trays with number of trays and mounting heights, marking of cable numbers in each typical route of cable trays, mounting details of each type etc. based on the tender documents.
- Cable schedule showing cable number, cable sizes and cables route as per layout documents.

Final

The contractor shall submit the following documents, reflecting the true final as built situation, in 6 sets, and one soft copy in CD.

- a) The drawings including wiring diagrams as revised and "as built".
- b) Inspection and preliminary testing certificates and reports and shipping release.
- c) Test certificates of kWh meters from Government approved Lab or Electric Supply Co. of concerned area.
- d) Copies of completion certificates & test reports submitted to Electrical Inspectorate.
- e) Statutory certificates/approvals for materials and equipment.
- f) Guarantee certificates.
- g) Instruction & maintenance manuals, Cataloguers etc.
- h) Any other certificate / report as called for by the Engineer.

Note: All wiring diagrams shall indicate clearly the main switch board, the runs of various mains & sub mains, position of all points and their control. All circuits shall be clearly indicated and numbered in the wiring diagrams and all points shall be given the electrical connections.

1.9. Testing

The contractor shall carry out all required tests, at no extra cost, on different equipment as per specification in the presence of the Client in order to enable the Client to determine whether the equipment comply with the specifications. The Contractor shall offer each and every equipment, before dispatch, for test at the manufacturer's works or otherwise test certificate shall be furnished incase if inspection is waived. All the material shall be approved before starting the work. Wiring shall be got approved before boards or blocks are fixed up.

- Mounting arrangement of each type of fans / light fitting shall be inspected and approved by the Engineer before carrying out work for all items.
- Connections to earth electrodes shall be inspected and got approved by the site Engineer prior to connection.

1.10. Guarantee

Equipment and the installation shall be guaranteed for a period of one year against defective materials and workmanship from the date, the plant and installation has been finally taken over. The Nominated Sub-contractor shall rectify the defects and replace defective materials at his own cost during the guarantee period.

1.11. Approvals

The Nominated Subcontractor shall arrange to obtain necessary statutory approvals / drawing approval including following before starting the work: -

All statutory approvals from:

- Electrical Inspector (PWD) and any other local statutory body as required.
- Electric supply company, wherever required.

1.12. Workmanship

Good workmanship and neat appearance are the prerequisites for compliance with the various sections of these specifications. Work shall be carried out in accordance with the

statutory rules and local regulations in force and conform to relevant I.E Rules and I.S. Specifications. Poor workmanship will be liable for penalization.

1.13. Tools and Spare Parts

The contractor shall obtain himself all special tools and tackle required for erection and assembly of the equipment covered by the contract himself.

All other materials such as foundation bolts, nuts etc. required for the installation of the plant shall be supplied and included in the Contract.

2.0 33 kV HT 4 PANEL VCB

2.1 Scope of Work

Design, Supply and testing of 4 Panel (1 incoming of 1250A & 3 outgoing of 800A) 33 kV, 26.4kA, Vacuum circuit breaker switch gear line up with cable box on incomer side and outgoing side as per specification.

This specification covers complete design, supply and testing at manufacturer's works of specified equipment. All electrical work shall be carried out in accordance with this specification. These specifications shall be read in conjunction with the relevant Indian Standard, Indian Electricity Rules, Handbook and Chief fire officer's recommendations as well as the obtainable local practice as detailed in various regional handbooks. The work shall be executed according to most stringent of these requirements. The Contractor will provide the test instruments including skilled and unskilled labour, necessary tools & tackles, hardware and consumable required for completion of work and any other materials and equipment that may be required.

Client reserves the right to procure any equipment separately for economic reason. Final decision on the same will be conveyed to the successful bidder after price bid opening.

2.2 Following services but not limited to, will form a part of Contractor's work and prices quoted will be deemed to include:

- a) Supply of all equipment, materials, accessories, consumable, hardware, commissioning of spares.
- b) Packing and forwarding of above.
- c) Transporting to site.
- d) Preparation of all manufacturing shop drawing / wiring drawings etc.
- e) Preparation of final As Built drawings of all drawings prepared.

2.3. Quality & Completeness of Supply

It is not the intent to specify completely herein all finer details of the equipment to be supplied. Nevertheless, the equipment shall be complete & operative in all respect and shall conform to highest standard of engineering, design and workmanship.

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 provided without any extra charge.

2.4. Testing

The contractor shall carry out all required tests, at no extra cost, on equipment as per specification in the presence of the Client in order to enable the Client to determine whether the equipment comply with the specifications. All the drawings shall be approved before starting the work.

2.5. Guarantee

Equipment shall be guaranteed for a period of one year against defective materials and workmanship from the date, the plant and installation has been finally taken over by Client. The Nominated Contractor shall rectify the defects and replace defective materials at his own cost during the guarantee period.

2.6. Workmanship

Good workmanship and neat appearance are the prerequisites for compliance with the various sections of these specifications. Work shall be carried out in accordance with the statutory rules and local regulations in force and conform to relevant I.E Rules and I.S. Specifications. Poor workmanship will be liable for penalization.

2.7. Technical Specification

All equipment and components to be supplied for the project shall be designed / derated for following climatic conditions based on manufacturer's recommendation. **Later on no additional cost will be granted for requiring using higher rated component on account of derating due to ambient temperature:**

- Maximum ambient temperature = 45
- Minimum ambient temperature = 5°C
- **Design ambient temperature = 45 °C**
- Relative humidity (average over a month) = 100 %
(Maximum temperature and maximum RH do not occur at the same time)
- Average rain fall per year = 2625mm

2.8. 33kV Circuit Breaker

Circuit breaker shall be of Vacuum type.

The following specifications apply to modular indoor switchboards comprising factory built, metal enclosed switchgear assemblies.

The equipment to be supplied shall consist of modular cubicles satisfying the following criteria:

- open-ended design,
- easy to install,
- safe and easy to operate,
- compact design,
- low maintenance.

The supplier must be able to prove its extensive possess experience in the field of MV switchgear, and has already supplied equipment of the same type & production process, in which has been in operation for at least three years.

Metal clad switchgear with Vacuum circuit breaker on withdraw able truck for 33kV rating and specification as mentioned in BOQ and drawing and as per Annexure with following features.

- Metal clad and Air insulated.
- Single busbar.
- Circuit breaker mounted on withdrawable truck.
- Standards: IS 12729.
- Construction: -

1 General

- a) Cable box on incoming and outgoing sides as per specification.
- b) Structural framework: with foundation/fixing bolts, etc. at the bottom: slotted, for mounting of panels directly on concrete/steel channel base. The switchboard shall be suitable for mounting above cable trenches, crawl spaces or base structures.
- c) Enclosure: metal sheets, CRCA, thickness 2 mm.
- d) Lifting-eyes: minimum 2 nos. for each panel.
- e) Cable entries: from bottom with minimum 3mm thick removable cable gland plate.
- f) Painting: & tank pretreatment for cleaning, pickling with dilute acid, washing and rinsing by water, phosphatising and oven drying followed by one coat of stove type zinc chromate primer, putty application and two coats of stoved synthetic enamel paint. The paint shall have a thickness of at least 50 micrometer and shall be applied to both sides of all sheet metal. The colour shall correspond to the RAL colour range proposed.
- g) Doors, panels and removable covers shall be provided with neoprene-gaskets all around the edges.
- h) Louvers, wherever provided, shall be with screens and filters.
- i) Cubicle doors shall not be open able unless associated switching devices are in OFF-position
- j) Each cubicle shall carry a suitably dimensional identification label clearly indicating the functions and electrical characteristics of the cubicle in accordance with chapter 5.1 of IEC 62 271 -200. Mechanical indications of switching devices shall be visible with closed doors. SERVICE (when withdrawable, power and auxiliary circuits connected), TEST (when withdrawable, only auxiliary circuits connected), WITHDRAWN (when withdrawable, power and auxiliary circuits disconnected), SPRINGS DISCHARGED, ON, OFF positions shall be visible.
- k) Padlock shall be provided for each cubicle door
- m) Withdrawable facility of switching devices shall be operative only in OFF-position, with automatic safety shutters for protection degree IP20 in withdrawn position.
- n) The switchgear and the switchboards shall be designed in such a way that the positions of the various switchgear devices shall be visible by the operator from the front of the switchboard. It shall also be possible to operate the switchgear from the front of the switchboard Operation of switching devices: with closed doors, and mechanical and electrical non-pumping system.
- o) One complete set of Special tools for operation and maintenance for each Switchgear shall be supplied at no extra cost.
- p) The switchboards shall be made up of separate factory built cubicles housing the switchgear (switch-disconnector and switch enclosures shall be mounted horizontally in the cubicles and the circuit breaker shall be disconnectable and mounted vertically). The cubicles therefore form a compartmented distribution switchboard that can be extended if necessary.
- q) The cubicles shall meet the requirements of degree of protection index IP2XC. The galvanised and electro-galvanised sheet metal and metal fittings shall be painted to provide protection against corrosion.
- r) The civil works specifications shall be unique for all cubicles making up the MV switchboard. The cubicle widths shall be multiples of 750 mm and 1000mm. In particular, the civil works for the circuit breaker cubicles shall be identical to the civil works for the switch cubicles. The manufacturer shall provide an installation drawing to serve as a guide for the civil works. In accordance with applicable standards, the

switchboards shall be designed to prevent access to all live parts when in operation as well as during maintenance work

2. Safety Earthing

- a) Earth bus shall be extended throughout the whole length of Switchgear and shall be of the same material and cross-section of phases, coded PE.
- b) Bonding of all non-current carrying metal parts: effectively and direct.
- c) The earthing bars of each of the cubicles making up the switchboard shall be interconnected by a set of busbars, which shall be connectable outside the switchboard.
- d) The cross-section of the busbars shall be determined so as to withstand the rated short-circuit current of the switchgear in accordance with IEC 62 271-200 recommendations
- e) The earthing bar shall be designed for connection to the main earthing bar of the substation without dismantling any of the bars.
- f) Cable earthing shall be carried out by an earthing switch with a short-circuit making capacity, in accordance with IEC 62271-102 recommendations. It shall be possible to operate the earthing switch when the switch or disconnector is open.
- g) A padlocking system shall be provided to lock the earthing switch in either open or closed position. The position of the earthing switch shall be clearly visible from the front of the cubicle.
- h) Mechanical interlocking systems shall be provided to prevent incorrect operations such as the closing of the earthing switch with the switch or disconnector in closed position.
- i) The use of keyed or electric locks to actuate the above mentioned interlocking system shall not be accepted.

3 Busbars

- a) Material & Cross-section: **copper** busbars of uniform cross section, including neutral.
- b) Joints: silver faced, with suitable bimetallic connectors for Al to Cu connections.
- c) Maximum temperature of busbars and bus-connections: 85 degC.
- d) Coding: heat shrinkable Colour coded sleeves for different phases and neutral bus bars.
- e) The busbar compartment shall be located at the top of the cubicle. It shall include three parallel-mounted bars without phase separating means. Connections shall be made to the top pads of the switch or disconnector enclosures. Access to the busbars shall only be possible after removing a single access panel carrying a symbol warning of the danger of electrical shock. No other busbar access system will be accepted.

4 Voltage and current measuring transformers

- a) Cast resin type. Fuses on primary and secondary for voltage transformer.
- b) Earthing and short-circuiting of secondary windings at terminal blocks for current transformer.

5 Instruments

- a) Measuring input values (drops, burden, knees, including impedance of connections): compatible with the parameters of associated measuring transformers.
- b) Protection relays:
 - 1) Flush mounting, with draw out case;
 - 2) Protection against modifying of setting values: preferably key-lockable transparent cover.
 - 3) Trip signaling: mechanical flag type;
 - 4) Reset: manual.
- c) Indicating meters: flush mounting square 96x96-mm size, digital display meter.
- d) Energy-meters: semi-flush mounting, 3-phase, 2-element type. (Enercon / L&T make)

6 Auxiliary circuits

- a) Maximum system voltage: 500 V. AC
- b) Supply: 24V DC for trip circuit & annunciation
 - 1) Incoming: miniature circuit breakers for AC and DC;
 - 2) Monitoring relays: flag type, manual reset.
- c) Cubicle space heaters: thermostatically controlled.
- d) Fuse-holders: closed type.
- e) Annunciator: 4 windows for incomer and 8 windows for outgoing. (With accept, reset and test push buttons).
- f) Auxiliary relays: nominal current of contacts 5 A at 240 V_{AC}.
- g) Number of auxiliary contacts: always 2 NO + 2 NC available on terminal blocks for client (i.e. in addition to those needed for the internal logic of the Switchgear) for all the main components (operation and status of switching devices, Annunciator and protection devices).
- h) Indicating lamps: LED type, lamps replaceable from front; colours: red = ON, green = OFF, white or as specified all other.
- i) Selector-switches: momentary-contact type, 3 positions OFF-0-ON, with spring-driven return on the central 0-position; colour black.
- j) Push buttons: momentary-contact type, colours: green = ON, red = OFF, black = all other.
- k) Terminal blocks:
 - 1) Voltage measuring circuits: disconnecting type
 - 2) Current measuring circuits: short-circuiting type
 - 3) Different voltage groups: segregated and labeled.
 - 4) Spares: minimum 10 %, with minimum 2 numbers.
- l) Wiring:
 - 1) Cables: stranded Cu/PVC 650 V, 2.5 mm² for CT circuits and minimum 1.5 mm² for other circuits; colours: black for AC, red for DC;
 - 2) Terminations: on terminal blocks with crimping type cable lugs and ferrules on each wire.

7 Labeling

- a) Destination: each Switchgear, each panel, each cubicle, each component; components mounted on doors, panels and removable covers, are double-labeled: internally (with the functional diagram code), and externally (with the functional text for the operator).
- b) Material: black synthetic strip, engraved.
- c) Fixing: screwed; gluing or similar is not allowed.
- d) Additional safety: danger-board and other mandatory and usual warnings, on front and on back of each Switchgear.

8 Tests

Acceptance tests are carried out according to contractual standards, for each Switchgear, with all the panels of the same Switchgear assembled together.

- a) Preliminary, at manufacturer-premises before delivery:
 - 1) Visual: general compliance with the contractual documents and with good execution;
 - 2) Mechanical operation of doors shutters, switching devices;
 - 3) Ratio and polarity of measuring transformers;
 - 4) Electrical voltage, at U_i and f_n 50 Hz, of main and auxiliary circuits;
 - 5) Electrical insulation, of main and auxiliary circuits by megger and HV;
 - 6) Pick-up and drop-off test of auxiliary relays;
 - 7) Functional test of control circuits;
 - 8) Simulation and operation of protection relays at set points.
- b) Before commissioning at site, tests 2+5+7+8 above shall be repeated.

DATA SHEET

Sr. No.	DESCRIPTION	SPECIFICATIONS
1.	H.T. panel	Vacuum Circuit Breaker
1.1	No. of panels	4 panel with 1 incoming and 3 outgoing
1.2	Service	Indoor Type (Climatic conditions as per above) Floor Mounted Free Standing
1.3	Supply Conditions	33 kV, 3 Phase 50 Hz
1.4	Rating	1250 Amps / 800 Amps
1.5	Nature of Load	Transformer / power load
1.6	Enclosure	Dust & Vermin proof sheet steel enclosure painted as per specification.
1.7	Breaking Capacity	26.4 kA minimum
1.8	Rating operating duty	B-3m-MB-3m-MB
1.9	Busbars	Copper
1.10	Type	Draw out type
1.11	Closing	Motor operated spring charged and 24Volts Volt D.C. Coil
1.12	Tripping	24 Volt. D.C. Supply
1.13	Sundry Fittings	
	a. Phase indicating lamp	3 Nos. with fuse protection

	b. Set of indicating lamps	C.B. Closed C.B. Open Spring Charged Trip Trip circuit healthy
	c. Auxiliary Contactor	6 Nos. / 6 NC
	d. Anti pumping contactor	To be provided
	e. Mechanical ON/OFF position indicator	To be provided
	f. Mechanical interlock with key	To be provided
	g. Mechanical operation counter	To be provided
	j. Terminals	Incoming 33kV HT XLPE 3C X 240 sqmm & Outgoing 33kV HT XLPE 3C X 185 sqmm
	k. Drying Agent	Electric heater to work on 240 V single-phase supply controlled by a thermostat, which can be adjusted to required temperature to prevent deposition of moisture. Supply of thermostat included in the scope of supply.
	l. Set of safety shutters.	To be provided.
	m. Trip / Neutral / close switch	To be provided.
	n. Surge Diverter	To be provided
1.14	Standards	IS: 3427 IEC 62 271-200 - Alternative current metal-enclosed switchgear and controlgear for rated voltages above 1 kV and up to and including 52 kV, IEC 60265 - High voltage switches for rated Voltages of 52 kV and above IEC 62271-102 - High voltage alternative current disconnectors and earthing switches IEC 60694 - Common specifications for high voltage switchgear and controlgear standard IEC 62271-105 - High Voltage alternative current switch-fuse combinations IEC 62271-100 - High Voltage alternative current circuit breakers IEC 60282-1 - MV fuses, IEC 60185 - Current transformers, IEC 60186 - Voltage transformers, IEC 60801 - Electromagnetic compatibility for industrial process measurement and control equipment. IEC60529 - Degrees of protection provided by enclosures (IP code).
1.15	D.C. Source	110 Volt D.C.
2	Potential Transformer (Metering)	
2.1	Numbers	As required for metering
2.2	Rating	$33000V/\sqrt{3}$ / $110V/\sqrt{3}$
2.3	Burden	100 VA
2.4	Accuracy	Class 0.5
2.5	Standard	IS 3156, IEC156,
3.	Current Transformer (Metering Protection) - Incoming / Outgoing feeder	
3.1	Class	Class 0.5 & Class 5 P.10

3.2	Rating	Manufacturer to provide
3.3	Burden	Manufacturer to provide
3.4	Standard	IS 3156 / IS 2705/ IEC155
4.	Meters	
4.1	Ammeter	Manufacturer to provide.
4.2	Voltmeter (Only on the incoming feeder)	Three voltmeters with fuses on primary and secondary sides of PT
4.3	KW, kWh, RkVA	Manufacturer to provide
4.4	PF Metres	To be provided on incoming feeder
5.	Relays	
5.1	Inverse time over current and instantaneous earth fault relays	Manufacturer to provide
5.2	High speed tripping relay E.E VAJH-13 or equivalent and Auxiliary relay E.E make VAA-11	To be provided for transformer.
5.3	Undervoltage relays	2nos. to be provided for incoming voltage
5.4	8 window Annunciator for indicating the transformer protection system with hooter.	To be provided
5.5 5.6 5.7	Aux. DC Failure Alarm Aux. AC Failure Alarm Minimum Clearances for Air insulated busbars Phase to Phase - Phase to Earth -	As per IS 4237: 127mm 77 mm
5.8	Copper busbars with Colour coded sleeve and Earth Bus bar complete with internal wiring and terminals.	To be provided

2.9. **Installation**

Installation of HT panel shall include but not limited to the following to complete the installation, testing and commissioning:

Transporting materials from stores to exact location of installation.

Supply and installation of required base frame made of MS angle or channel sections and duly painted with black paint.

Positioning, aligning, fixing, assembling, and installation of VCB panel after carrying out proper cleaning and inspection.

Site supervision, testing for proper functioning / operation, and pre-commissioning tests.

2.10. **Commissioning and Testing**

- a) All HT switchboards shall be tested for dielectric test as per IS: 8623.
- b) All earth connections shall be checked for continuity.
- c) The operation of protective devices shall be tested by secondary injection test.
- d) The operation of circuit breaker shall be tested for all interlocks.
- e) Indicating lamps shall be checked for proper working.
- f) Temperature-rise tests,
- g) Short-time withstand current tests,

- h) Mechanical operating tests,
- i) Verification of the degree of protection,
- j) Verification of electromagnetic compatibility.
- k) In addition, for the switches and circuit breakers, the rated making and breaking capacities shall be substantiated by a test report.
- l) For the earthing switch, the making capacity, the short-time withstand current and the corresponding peak value shall be substantiated by a test report.
- m) The routine tests carried out by the manufacturer shall be substantiated by a test report signed by the manufacturer's quality control department.
- n) The report shall cover the following aspects (a) conformity with drawings and diagrams, (b) power frequency tests, (c) manual operating mechanism tests, (d) functional tests of LV auxiliaries and relays.

2.11 Switch Tripping Battery with Charging Equipment

- 2.11.1 The battery shall comprise of 15 cells each of 2 volts having 200 Amperes hours. The cells/batteries shall be manufactured with pag tubular positive plates and pasted type negative plates and shall be assembled in hard rubber containers. These batteries/cells shall conform to 1S-1651.
- 2.11.2 Spray arresters shall be provided to prevent loss of acid by spraying during charge. The battery; shall be completed with support insulators connection between cells, inter row and/ or interior connectors, cable socket for end and tapping connections, quantity of concentrated or diluted acid for first filling and 10% spare acid in glass ware of 5 liters capacity.
- 2.11.3 The charger shall be suitable for operation from single-phase, 50 cycles, 200/250 volts, AC supply system. The output of the charger shall be 1.5 Amps on quick charge and 10/50 MA on trickle charge. The battery charging equipment shall be manually operated.

3.0 33 kV /433V TRANSFORMER

3.1 Scope of Work

Supply of indoor type 3 Nos. 33 kV / 433V, 1500 kVA ONAN transformer with Off load tap changer for $\pm 5\%$ voltage variations Scope of work covered under this tender shall be design, supply and testing at manufacturer's works of the necessary equipment. The skilled & unskilled labours, lifting tools & tackle as well as any other materials or equipment that may be required for testing will be provided by the Contractor. All electrical work shall be carried out in accordance with this specification. These specifications shall be read in conjunction with the relevant Indian Standard, Indian Electricity Rules, Handbook and Chief fire officer's recommendations as well as the obtainable local practice as detailed in various regional handbooks. The work shall be executed according to most stringent of these requirements. The Contractor will provide the test instruments including skilled and unskilled labour, necessary tools & tackles, hardware and consumable required for completion of work and any other materials and equipment that may be required. The equipment offered shall be complete with all parts necessary for their effective and trouble-free operation. Such parts will be deemed to be within the scope of the supply irrespective of whether they are specifically indicated in the commercial order or not

- 3.2 Following services but not limited to, will form a part of Contractor's work and prices quoted will be deemed to include:
 - a) Supply of all equipment, materials, accessories, consumable, hardware, and recommended commissioning spares.

- b) Packing and forwarding of above.
- c) Transporting to site.
- d) Preparation of all manufacturing shop drawing / wiring drawings etc.
- e) Preparation of final As Built drawings of all drawings prepared.

Client reserves the right to procure any equipment separately for economic reason. Final decision on the same will be conveyed to the successful bidder after price bid opening

3.3. Applicable Specifications

The specification for the work is as detailed hereinafter. These specifications shall be read in conjunction with the relevant Indian Standard, Indian Electricity Rules and Chief fire officer's recommendations and the obtainable local practice as detailed in various regional handbooks. Where the specifications in any of the standards are at variance with the Specifications detailed herein, the most stringent amongst them shall govern. Contractor shall ensure that execution of total work is in accordance to this.

IS : 335 - Insulating Oil
IS : 1271 - Classification of insulating materials
IS: 2026 - (Part – I) / IEC Pub. 76 - Power Transformer – General
IS : 2026 - (Part – II) / IEC Pub. 76 - Power Transformer – Temperature rise
IS : 2026 - Power Transformer – Insulation level and (Part III) dielectric tests
IS : 2099 - High Voltage Porcelain bushing screen
IS : 3202 - Code of practice for climate proofing
IS : 3639 - Power transformer fittings and accessories
IS : 6600 - Guide for loading of oil immersed transformer

3.4. Quality & Completeness of Supply

It is not the intent to specify completely herein all finer details of the equipment to be supplied. Nevertheless, the equipment shall be complete & operative in all respect and shall conform to highest standard of engineering, design and workmanship.

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 provided without any extra charge.

The contractor shall supply all branded new material & accessories, as specified herein and shall conform to these Specifications as well as IS specification. When IS standard does not exist, such material / sample shall be submitted for Engineer's approval with test certificate from Government approved laboratories.

Contractor shall produce, on demand, such details as called for by the Engineer to prove genuineness of the material.

The contractor must replace rejected materials within 7 (seven) days.

3.5. Testing

The manufacturer shall carry out all required tests, at no extra cost, on equipment as per specification in the presence of the Client in order to enable the Client to determine whether the equipment comply with the specifications. The Contractor shall offer each and every equipment, before dispatch, for test at the manufacturer's works or incase if Client waives inspection, test certificate shall be furnished for their review and approval. All the drawings shall be approved before starting the work.

3.6. Guarantee

Equipment shall be guaranteed for a period of one year against defective materials and workmanship from the date, the plant and installation has been finally taken over by Client. The Nominated Contractor shall rectify the defects and replace defective materials at his own cost during the guarantee period.

3.7. Workmanship

Good workmanship and neat appearance are the prerequisites for compliance with the various sections of these specifications. Work shall be carried out in accordance with the statutory rules and local regulations in force and conform to relevant I.E Rules and I.S. Specifications. Poor workmanship will be liable for penalization.

3.8 Technical Specification

All equipment and components to be supplied for the project shall be designed / derated for following climatic conditions based on manufacturer's recommendation. **Later on no additional cost will be granted for requiring using higher rated component on account of derating due to ambient temperature:**

- Maximum ambient temperature = 45
- Minimum ambient temperature = 5°C
- **Design ambient temperature = 45 °C**
- Relative humidity (average over a month) = 100 %
(Maximum temperature and maximum RH do not occur at the same time)
- Average rain fall per year = 2625mm

3.8.1. Transformer shall generally conform to the requirements of IS 2026-1962. The transformer shall be of indoor type. The rating of the transformer shall be as per the specification enumerated in bill of quantities and equipment schedule. However, the general ratings with regard to voltage, frequency, etc. shall be as follows:

HT Voltage	33000 Volts
LT Voltage	433 V
Frequency	50 Hertz

Transformer tap changer should be On load type with +10% to –10% voltage variation. The transformer shall be double wound, delta-star connected, as per vector group DYn 11, otherwise called for. The transformer shall be rated for a maximum temperature rise of 45 deg C by thermometer in oil and 55 deg C by resistance at CMR with a daily average ambient temperature of 40 deg C and peak ambient temperature of 45 deg C.

3.8.2 Transformer Core

Transformer core shall be made of high quality non-ageing, low loss, grain oriented, silicon steel laminations conforming to IS 648-1962 and shall have insulation on both sides. The core shall be pressed and tightly held so that hum is minimised. The cores shall be provided with adequate ventilation ducts.

3.8.3 Windings

Winding shall be made of electrolytic copper with circular or rectangular cross section. The windings shall be insulated with class A insulation material as per the specifications of IS 1271-1985. The windings shall have uniform insulation with respect to earth. The insulation

shall withstand impulse voltage as laid down in IS 2026 part –3 -1981 the windings shall be fully dried, pre-shrunk by vacuum presses and impregnated. The coils shall be properly braced and secured to the frame structure both in radial and axial directions to withstand thermal and dynamic (electromagnetic) stress during short circuit. The transformer shall be capable of operation at its rated kVA on any tapping without injury.

3.8.4 Transformer Tank

Transformer tank shall be fabricated from MS plates of proper thickness. The tank shall withstand a pressure test of 1.0kg/cm² in excess of static head of oil. All bolted joints; inspection holds shall be provided with non-deteriorating gaskets. The transformer shall be fitted with, fixed or removable seamless radiator tubes adequately braced to the tank.

3.8.5 Oil

Generally, the transformer shall be filled with oil conforming to IS 335-1972; wherever specifically called for; synthetic liquid filled transformer shall be supplied.

3.8.6 Off load tap changer shall be as detailed below:

It shall comprise:

- a) Operating handle or wheel, accessible from ground level.
- b) Tap position indicator.
- c) Pad locking arrangement.
- d) The tap-changer connections and contacts shall be accessible through an excess hole having a bolted gasketed cover.

3.8.7. Electrical and Performance Requirements

Transformers shall operate without injurious heating at the rated KVA at any voltage within + 10 percent of the rated voltage of that particular tap.

Transformers shall be designed for 110% continuous overfluxing withstand capability.

Overloads shall be allowed within the conditions defined in the loading guide of the applicable standard. Under these conditions, no limitations by terminal bushings, tap/changers or other auxiliary equipment shall apply.

3.8.8. Internal Earthing

The framework and clamping arrangement of core and coil shall be securely earthed inside the tank by copper strap connection to the tank.

3.8.9. Fittings

Generally fittings as enumerated in table X of IS 2026 shall be provided. However, the manufacturer shall provide following minimum fittings:

- a) Rating and diagram plate.
- b) Lifting lugs
- c) Air release plug
- d) Conservator with oil filling hole and drain plug
- e) Buchholz relay with 2 nos. isolating valves and alarm & trip contacts
- f) Explosion vent with double diaphragm, equalizer pipe and oil site glass
- g) 2nos. thermometer pockets
- h) 2nos. earthing terminals
- i) Bottom drain cum filter valve

- j) Top filter valve
 - k) 1no. silica gel breather
 - l) Plain oil level indicator
 - m) Detachable type radiator
 - n) 4nos. bi-directional rollers
 - o) 6" dial type oil temp. indicator with alarm & trip contacts
 - p) 6" dial type winding temp. indicator with alarm & trip contacts
 - q) Magnetic oil level gauge with low level alarm contact
 - r) HV termination – as per specification
 - s) LV termination – as per specification
 - t) Marshalling box with interconnecting cables
- The additional fittings, if required, shall be as per the equipment schedule.

H.V Terminations

Cable box suitable for 3 C x 185 sq.mm 33 kV XLPE (E) cable.

LV Terminations

3000A L.V bus duct flange arrangement.

3.8.10 Testing

Transformer shall be factory tested as per the requirements laid down in IS 2026-1977. The original test certificate shall be furnished for each transformer.

- 3.8.11. All transformers shall be fitted with Buchholz relay with alarm and trip contacts, winding temperature indicator with alarm and trip contacts in addition to the regular tripping and alarm as per regulations. Buchholz relay shall be provided with isolating valves on its both sides.

3.8.12 Installation of Transformers

3.8.12.1 Inspection on Arrival

The transformer shall be examined for any sign of damage in transit. Particular attention will be paid to the following

- (a) Tank sides or cooling tubes dented
- (b) Protruding fittings damaged,
- (c) Oil sight glass broken
- (d) Bushings cracked or broken
- (e) Bolts loose due to vibration in transit and
- (f) Oil leakage (if filled with oil) particularly along the welds or reduction in the pressure of the gas (if filled with gas).

3.8.12.2 Installation

The transformer shall be installed as per the set of record plans to be, supplied by the manufacturer and as described IS-1 0028 (Pt. 2)-1981.

3.8.12.3 Lifting

Transformers shall be lifted by the lugs or shackles provided for the purpose, simultaneous use should be made of such lugs or shackles in order to avoid any imbalance in lifting. Where it is necessary to use jacks for lifting, the projections provided for the purpose of jacking shall be used. Jacks shall never be placed under valves or cooling tube. In certain circumstances jacks may be placed under stiffening curbs on the tank base.

3.8.12.4 Indoor Transformer

Indoor transformers not expected to be installed immediately shall be stored under cover and shall be filled with oil to reduce the extent of possible condensation of moisture and the breathing pipe shall be plugged. Transformers which are required to be kept in storage for long periods shall preferably be drained of oil and the tanks filled with nitrogen under slight pressure. When it becomes necessary to store a partially or completely disassembled transformer the core and coils shall be immersed in dry oil and stored in a dry room having as uniform a temperature as possible. The indoor transformer shall be installed well away from the wall to provide proper ventilation. There shall not be chance of Water dripping either on the transformer or anywhere in the transformer room itself. Chemical fume particularly acid fumes should not be allowed in the transformer room. The air inlets and air outlets shall be of adequate sizes and so placed as to ensure proper air circulation for the efficient cooling of the transformers. The inlets should preferably be as near the floor as possible and the outlets as high as the building allows enabling the heated air to escape readily and be replaced by cooled air. The transformer should be so installed that severe vibrations are not transmitted to its body.

3.8.13 Data sheets

Bidders shall fill in the following technical data

Sr. No.	Technical Details	To be filled in by bidder
1	Type and class of insulation	Indoor
2	Output in kVA (continuously rated)	1500 kVA
3	Rated voltage: • HV (volts) • LV (volts)	33000V 433V
4	Rated current: • HV (amps) • LV (amps)	25.5 (amps) 2056 (amps)
5	No. of phases	3 phase
6	Type of cooling	ONAN
7	Frequency	50Hz
8	Winding connection / vector group	Cu. Winding DY11
9	Tappings	± 2.5% & ± 5%
10	Design ambient temperature	45 deg C
11	Temperature rise of winding	90 deg C
12	Class of insulation	class F insulation
13	Dimensions: • Length (mm) • Width (mm) • Height (mm) • Headroom required for lifting (mm)	TO BE FILLED BY MANUFACTURERE
14	% impedance	6.25%
15	X / R ratio	TO BE FILLED BY MANUFACTURERE
16	Iron losses at normal voltage ratio	TO BE FILLED BY MANUFACTURERE
17	Copper losses at normal voltage ratio at full load	TO BE FILLED BY MANUFACTURERE
18	Efficiency at unity PF • Full load • 75% laod • 50% load	
19	Regulation at • unity PF • 0.8 PF	
20	Approximate weight • core and winding (kgs)	

	• total (kgs)	
21	H.V. box clearances (minimum)- Phase to Phase Phase to Earth	
22	Accessories	
23	Termination Details • HT • LT	Cable box suitable for 1 no. 3Cx185 sqmm XLPE armoured cable. LT busduct of 3000A

4.0 1000 KVA OUTDOOR TYPE DIESEL GENERATOR SETS

4.1. Scope of Work

Design, Supply installation and testing of 3Nos. 1000 kVA outdoor type Diesel Generator sets with Auto Mains Failure, Auto Load Sharing & Auto Synchronizing Panel as per specification. This specification covers complete design, supply and testing at manufacturer's works of specified equipment. All electrical work shall be carried out in accordance with this specification. These specifications shall be read in conjunction with the relevant Indian Standard, Indian Electricity Rules, Handbook and Chief fire officer's recommendations as well as the obtainable local practice as detailed in various regional handbooks. The work shall be executed according to most stringent of these requirements. The Contractor will provide the test instruments including skilled and unskilled labour, necessary tools & tackles, hardware and consumable required for completion of work and any other materials and equipment that may be required.

4.2. Following services but not limited to, will form a part of Contractor's work and prices quoted will be deemed to include:

- a) Supply of all equipment, materials, accessories, consumable, hardware, and recommended spares for 2 years as well as commissioning spares.
- b) Packing and forwarding of above.
- c) Transporting to site.
- d) Preparation of all manufacturing shop drawing / wiring drawings etc.
- e) Preparation of final As Built drawings of all drawings prepared.

Client reserves the right to procure any equipment separately for economic reason. Final decision on the same will be conveyed to the successful bidder after price bid opening.

4.3. Applicable Specifications

The specification for the work is as detailed hereinafter. These specifications shall be read in conjunction with the relevant Indian Standard, Indian Electricity Rules and Chief fire officer's recommendations and the obtainable local practice as detailed in various regional handbooks. Where the specifications in any of the standards are at variance with the Specifications detailed herein, the most stringent amongst them shall govern. Contractor shall ensure that execution of total work is in accordance to this.

4.4. Quality & Completeness of Supply

It is not the intent to specify completely herein all finer details of the equipment to be supplied. Nevertheless, the equipment shall be complete & operative in all respect and shall conform to highest standard of engineering, design and workmanship.

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 provided without any extra charge.

The contractor shall supply all branded new material & accessories, as specified herein and shall conform to these Specifications as well as IS specification. When IS standard does not exist, such material / sample shall be submitted for Engineer's approval with test certificate from Government approved laboratories.

Contractor shall produce, on demand, such details as called for by the Engineer to prove genuineness of the material.

The contractor must replace rejected materials within 7 (seven) days.

4.5. Testing

The contractor shall carry out all required tests, at no extra cost, on equipment as per specification in the presence of the Client in order to enable the Client to determine whether the equipment comply with the specifications. The Contractor shall offer each and every equipment, before dispatch, for test at the manufacturer's works or incase if Client waives inspection, test certificate shall be furnished for their review and approval.

All the drawings shall be approved before starting the work.

4.6. Guarantee

Equipment shall be guaranteed for a period of one year against defective materials and workmanship from the date, the plant and installation has been finally taken over by Client. The Nominated Contractor shall rectify the defects and replace defective materials at his own cost during the guarantee period.

4.7. Workmanship

Good workmanship and neat appearance are the prerequisites for compliance with the various sections of these specifications. Work shall be carried out in accordance with the statutory rules and local regulations in force and conform to relevant I.E Rules and I.S. Specifications. Poor workmanship will be liable for penalization.

4.8. Technical Specification

All equipment and components to be supplied for the project shall be designed / derated for following climatic conditions based on manufacturer's recommendation. **Later on no additional cost will be granted for requiring using higher rated component on account of derating due to ambient temperature:**

- Maximum ambient temperature = 45
- Minimum ambient temperature = 5°C
- **Design ambient temperature = 45 °C**
- Relative humidity (average over a month) = 100 %
(Maximum temperature and maximum RH do not occur at the same time)
- Average rain fall per year = 2625mm

4.8.1. Construction

- a) The Diesel Engine shall be 4 cycle, multi cylinder, heavy-duty industrial type with rated electrical output. Engine shall be rated generally in accordance with the Equipments Schedule.
- b) Cylinder housing and crankcase shall be of high-grade cast iron with overhead valves.

- c) Crank shaft shall be manufactured from solid forging with hardened crank pin and main bearing journals. The entire shaft shall be truly balanced.
- d) Pistons shall be of close grained cast iron or aluminium alloy and provided with necessary compression and scraper rings and a fully floating gudgeon pin.
- e) Connecting rods shall be H-section steel stampings. Camshaft shall be gear driven (fly-wheel end) and easily removable. Flywheel shall be accurately balanced meeting the requirements of cycle variation as set down in BS: 649
- f) Lubrication system shall be complete with necessary gear pump. Piping and drilled oil passage strainer. Oil cooler etc. and relief valve.

4.8.2 Cooling

- a) The engine shall be radiator cooled or through a heat exchanger as specified in the equipment schedule. A thermostatic valve should by-pass the coolant in the primary circuit until a pre-set operating temperature is reached.
- b) The heat exchanger shall be cleanable shall and tube with prime surfaced copper tubes of minimum 15mm dia. The cooling side of the exchanger shall be designed for the system pressures encountered.

4.8.3 Fuel System

- a) Fuel injection equipment shall be driven by the timing gear train and complete with oil strainers, injectors etc. Fuel is to be supplied from the day tank with necessary piping.
- b) A tank of specified capacity shall be provided for lasting at least for 10 hour period or 900 ltrs whichever is lower. The tank should be complete with filter breather unit and drain plug along with oil level indicator and low level switch with DPDT contact.

4.8.4. Filtration

- a) The engine shall have cleanable fuel oil filters. Lub oil filtration shall be through strainers which are capable of being cleaned when the engine is running. Air filtration shall be through oil bath or cleanable dry type filters.

4.8.5 Engine Exhaust & Intake Air

- a) The engine exhaust piping shall be amply sized for minimum back pressure and connected to the engine manifold through flexible connection on one side and to a silencer on them other side. The silencer shall be packed type with adequate attenuation for urban use (Residential type), constructed from heavy guage galvanized steel. The sound absorbent infill shall be non-hygroscopic, vermin proof, non-combustible material. The silencer should be adequately sized to impose minimal additional aerodynamic loading on rotor fans.
- b) The exhaust piping from the silencer on words shall be led upto the top most level and discharged through a rain cowl as shown on drawings. Entire exhaust piping and silencer shall be insulated with 48Kg/cum density fiberglass white wool as shown on drawings and schedule of work. The insulation shall be held in position with galvanized steel wire mesh 0.63 dia 20 mesh and finished neatly with 26 SWG Aluminium cladding.
- c) The exhaust piping shall be fabricated with mild steel as shown in the equipment schedule and all flanged joints shall have spiraget high temperature gasket. The piping shall be installed with necessary thermal expansion facility as required and shown on drawings.

- d) The intake air system shall be complete with necessary manifold and replaceable dry type air cleaner and ducting suitable for low noise operation.

4.8.6. Safety Systems

- a) The Governor is to be driven by bevel gears from the engine camshaft with manual adjustment of engine speed between +5% and –10% of rated speed. The Governor shall control the engine speed with atleast class 'A2' limits permissible under B.S 649/1958. A governor shall trip the engine at the pre-set over-speed and shut-off the fuel supply.
- b) The engine cooling water temperature shall be monitored by a two point thermostat which should actuate an audible cum visible alarm at one point and trip the engine at the second point. Likewise the low oil pressure cut-out shall trip the engine with visible indication.

Other safety controls and indicating instruments shall be as shown in Equipment Schedule

ES 01.

4.8.7 Engine Starting

- a) The engine shall be electrically started and battery shall be 24V lead acid high discharge tubular or planet type and rated for 4 (four) consecutive starting kicks and the continuous drain for signals and controls. All batteries shall be complete with associated charger incorporated in the generator panel. The starting system shall be complete with necessary relays solenoid valves for fuel, control and indicating panels as specified and required.

4.8.8 Mounting and installation

- a) A common rigid bed plate shall be provided for the engine and alternator which shall be flexibly coupled. The coupling must be done after ensuring proper alignment of generator and engine shafts.
- b) The entire engine set shall be mounted on suitable spring vibration mounts with minimum 37.5mm static deflection. The spring buffer assembly shall be mounted on 100mm heavy duty steel skid or on a concrete foundation. Below which rubbers pads of minimum 25mm thickness shall be provided to isolated the concrete floor.

4.9 ALTERNATOR

4.9.1 Type & Rating

- a) Alternator shall be phase, 4 wire 50 cycles 415 volt, brush less screen protected drip proof with self contained excitation systemed and self regulating and conforming to BS 4999/5000 & continuously rated in accordance with BS 2613. The alternator should have the rated capacity at 0.8 PF. The alternator shall be designed to suppress radio interference in conformity with BS 800.
- b) The alternator shall be of fabricated steel construction conforming to IP class specified dynamically balanced rotor with two bearings and damper windings. The unit shall be with a large terminal box for outgoing busduct connections specified. Necessary adaptor box shall be provided wherever required.
- c) Alternator rotor shall be salient pole type with a damper cage and dynamically balanced. Insulation shall be to class 'B' or 'F' (BS 2757/1957). Insulation on other windings of minimum class 'E'. All winding shall be fully impregnated for tropical climates with high quality oil resistant varnish.
- d) Ventilation to the alternators shall be by means of fans fitted on the rotor.

4.9.2 Excitation system

- a) The main exciter shall receive power from a permanent magnet generator via Automatic Voltage regulator. The AVR shall be of solid state circuitry and shall provide regulated voltage to the exciter compensating for all normal variations. The main exit or out put is fed to the main rotor windings via a rotating 3 phase bridge rectifier assembly which shall be protected from voltage surges, short circuit, overload and diode failures. The AVR and control gear shall be mounted in a component box on the side of the machine. Electrical connections to the AVR shall be taken through a multi way plug and socket.
- b) Voltage regulation shall be within +/- 2.5 (two and half percent) under all conditions of load, power factor and temperature including cold to hot variation. Voltage drift shall be negligible. There shall be no radio or television interference. Line voltage wave form shall be as possible with total harmonic distortion not exceeding 3% on 3 Ph load. The response to transient load should be rapid as specified.
- c) The excitation system and engine governor should be such that the alternator is capable of starting up induction motors having a starting **KVA** of not less than 1.8 times the alternator rated KVA.

Manufacturer should indicate the voltage dip and duration under such conditions as required under equipment data.

- d) The neutral of each generating set shall be earthed solidly to ground with facility for isolation through a fully rated contractor or manual switch as shown on drawings.

4.9.3 Automatic Mains Failure, Automatic Load Sharing & Automatic Synchronizing operation

- a) The mains and DG set contractor or breakers shall preferably have 4 poles (3 phase and 1 neutral) mechanically and electrically interlocked. In case of non-availability of 4 pole contractors, 3 pole contractors may be used but a suitably rated contractors shall be placed in the two neutrals so that only neutral of the operating system is connected to ground.
- b) The AMF logic shall start the set automatically only in the event of:
 - i) mains failure
 - ii) phase failure
 - iii) voltage, drop to 85% of 415V (Not fault tripping)

The set shall be capable of starting and taking up the load within the time stipulated in equipment schedule.

- c) The sequence of AMF operation shall be as follows:
 - i) Upon main power failure, the generator shall receive 4 kick-starts and the generator contractor (GC) shall close only after building up of voltage.
 - ii) Hold the Mains Contractor (MC) open.

On restoration of power, AMF logic should provide the following commands

- i) Trip the engine.
- d) The AMF Panels should therefore comprise:

- 1) Incoming & out goings as shown in SLD.
- 2) Battery charger with normal and trickle charging facility and an isolating switch.
- 3) Over load, E/F & REF protection for DG set.
- 4) Meter and indicators as follows :

a) Meter	Generator	as under Equipment Schedule
	Battery	0 – 24V Voltmeter 0 – 5A Ammeter for quick charge. 0 – 75MA ammeter for trickle charge.

b) Indication and Alarm Annunciation	Engine side	As under Equipment Schedule
--------------------------------------	-------------	-----------------------------

Additional	Indication	Alarm
Charger on	/	-
Failed to start	/	/
Low oil pres	/	/
Gen to load	/	-
Mains to load	/	-

- c) Auto-Manual change over switch

Start-Stop Reset	Buttons
Alarm Reset	Buttons
Lamp testing	Buttons

- e) There shall be a 24V high performance sealed tubular lead acid stationary battery with an AH capacity suitable for 4 (four) cranking attempts of (2 seconds each) plus all indicating lamps and alarm before the cell voltage goes down to 1.8V. Battery shall be complete with necessary wooden stand and multistrand flexible copper leads. The battery charger in the AMF Panel shall be capable of floating the battery with quick and trickle charging facility to maintain a cell voltage of 2.2V.

4.9.5 Acoustic Enclosure:

The acoustic enclosure shall be made of 14 gauge CRC sheet. The salient features of the acoustic enclosure are: -

- The enclosure shall be of modular construction with the provision to assemble and dismantle easily at site.
- The sheet metal components shall be hot dip seven tank pretreated before powder coating.
- The enclosure shall be powder coated (inside as well outside) with a special pure polyester based powder. All nut and bolts / external hardware shall be made from stainless steel.
- There shall be provision for filling fuel from outside the enclosure with locking arrangement.
- External drain plugs shall be provided for draining Lub. Oil and diesel.
- The doors are casketed with high quality EPDM gaskets to prevent leakage of sound.

- The door handles are lockable type.
- Sound proofing of the enclosure shall be done with high quality rock wool . mineral wool confirming to IS: 8183. the rock wool shall be further covered with fibre glass tissue and perforated sheet.
- A special residential silencer shall be provided within the enclosure to reduce exhaust noise.
- Specially designed silencer shall be provided to control sound at air entry and exit points.
- Adequate ventilation shall be provided to meet total air requirement, if required, a blower shall be provided to meet total air requirement.
- Temperature of enclosure shall not exceed beyond 5°c of ambient temperature.
- The enclosure shall be provided with high enclosure temperature safety trip.
- There shall be a provision of emergency shutdown from outside the enclosure.
- There shall be an arrangement for illuminating the enclosure from inside.
- Noise level shall be 75 dB (A) at 3 mtrs. Distance.

4.9.6 Testing & Commissioning

a) Shop tests

Necessary routine and acceptance tests are to be carried out at the manufacturer's works on the Diesel engine separately and also on the complete engine – alternator set with recording of the operating electrical, cool out lubrication and mechanical parameters. The operation of protective / safety devices of the package shall be checked during this test.

b) Site test

After installation the set shall be run for a minimum period of 12 hours continuously on no load. On satisfactory completion of the no-load run the set shall be run for a period of three days at 12 hours a day at 100% full load. Demonstrative tests on voltage regulation over the load range, speed response to load charges and rejection transient behavior of the set are to be performed at site depending on the system availability. All consumables including fuel and lub oil required for commissioning the set shall be supplied by the contractor. Test readings as per Annexure V together with a log of the running test shall be furnished.

4.9.7 Mode of measurement

- 1) The diesel generating set complete with:
 - i) Engine and alternator with flexible coupling.
 - ii) Mounting frame with vibration isolation mounts.
 - iii) 24V battery with leads, stand, acid etc.
 - iv) Expansion tank, heat exchanger and piping to and heat exchanger, exp. tank.
 - v) Flexible connection and exhaust piping upto and including Exhaust Silence insulation of the same.
 - vi) Erection, testing and commissioning shall be considered as one unit of measurement

- 2) The Automatic Mains Failure, Automatic Load Sharing & Automatic Synchronizing panel comprising:
 - i) Panel with an AMF section as specified complete with battery charger.
 - ii) Auto Load Sharing and Auto Synchronizing Relays etc.
 - iii) Indication and alarms

Shall be treated as one unit of measurement.

- 3) All control wiring to D.G Power Panel, generating sets shall be through 1.5 sqmm copper PVC insulated armoured and sheathed multi-core cables and this will be paid per unit

length including the elemental cost of terminations, glands, lugs, cable supports etc. No separate payment shall be made for cable supports, terminations, glands etc.

- 4) All power cabling shall be paid for per unit length and all cable joints shall be measure per unit.

EQUIPMENT SCHEDULE ES – 01

DG SET

1.0 ENGINE

1.1 Rating

- | | |
|--------------------------|---|
| i) Minimum Engine Rating | 1 No. 1340 BHP |
| ii) Altitude (m) | 1000 above mean sea level |
| iii) Air humidity | 30% Min. 90% Max. |
| iv) Air temperature (oC) | Minimum 5
Maximum 45
Average 40 |
| v) Duty | <u>Continuous variable load @ 75% L.F unrestricted hours & at specified ambient temperature.</u> |
| vi) Standard | BS 5514 and ISO 3046 |

- 1.2 Overload capacity for one hour 10% over the continuous rating in 12 hours of continuous running

- 1.3 Governor Electronic Governing

1.4 Starting

- | | |
|-----------------------|----------------------|
| i) Method | Electric |
| ii) No of auto starts | 4 (four) |
| iii) Selectivity | Auto / Manual / Test |

1.5 Cooling System

- | | |
|-------------|-----|
| i) Radiator | Yes |
|-------------|-----|

1.6 Exhaust System

- | | |
|---|---|
| i) Running length of exhaust piping from engine onwards | From Engine to the existing exhaust pipe connection |
| ii) Silencer | 1 or 2 high efficiency residential silencer |

iii)	Flexible connection	Engine side connections
iv)	Scrubber	--
1.7	Safety Controls & Instruments	
	i) Over speed Governor	Trip @ 18% over normal
	ii) Two-point thermostat	(a) Audible & visible alarm (b) Trip engine with trip indication
	iii) Lub oil temperature	Audible & visible alarm
	iv) Low oil pressure	Trip engine
	v) Fuel failure	Audible & visible alarm
	vi) Oil Pressure gauge	Yes, required
	vii) Thermometers for water in, out, lub oil, ex.gas	Yes, required 4 Nos.
	viii) Water pressure gauge	Yes, required
	ix) Hour counter	Yes, required
	x) Excessive Engine vibration	Alarm and trip
	xi) Day tank oil level low	Alarm
1.8	Sundry fittings and accessories	
	i) Vibration mounts	Special anti-vibration spring type mounts with 37.5mm static deflection along with 2 x 12mm serrated neoprene isolators.
	ii) Electric pump for fuel filling from barrels & draining engine oil etc.	Existing
	iii) Starting battery and charger	
	iv) Interconnecting cabling and piping	
	v) Local gauge board	
1.9	Pollution	
1.9.1	Sound level @ 1 m from engine	By Vendor
1.9.2	Emission	NOX Less than 2000 mg/m ³ CO Less than 650 mg/m ³ Unburnt Fuel Less than 150 mg/m ³
2.0	ALTERNATOR	
2.1	Rating & 45 Deg. C	
	<u>Continuous duty</u>	<u>1000KVA, 800 KW</u> <u>0.8 PF 3 PH 415V Hz</u> <u>Y-neutral brought out</u>
	<u>Emergency duty</u>	<u>1100 KVA, 880 KW for 1 hour in 12 hours</u>

2.2	Minimum efficiency %	91.0
2.3	Enclosure	IP 21 (IEC) & IS 4691
2.4	Winding	Class B/F insulation
2.5	Cooling	IC 01 IS – 6362
2.6	Excitation System	Brushless exciter with rotating diode assembly
2.7	Over speed %	120
2.8	Transient response & P F and recovery in 20 cycles	Max 20% dip on application of full load at stated Response voltage dip
2.9	Sustained short circuit	Min. 300% FLC for 3 secs.
2.10	Terminal Box	Suitable for 3X 3CX300sqmm cable
3.0	FUEL OIL FACILITY	
3.1	Integral fuel tank	Wherever possible, Integral fuel tank to be supplied with content indicator, fuel fill cap, fuel feed and return lines to engine and drain plug.
3.2	Day tank (10 SWG steel)	As reqd. with supply, over flow, drain, filter and gauge glass.
3.3	Pump	Drum pump outside (existing)
3.4	Piping	From drum to day tank & from day tank to engine set (existing)
4.0	ACOUSTIC INSULATION	As per IS
5.0	CONTROL PANEL	In built control panel shall be equipped with: 1. Circuit breaker with adequate access to incoming and outgoing cable. 2. Measuring instrument Voltmeter Ammeter Frequency meter Run counter Temp. gauge for coolant 3. Individual warning lamps 4. Digital power and energy meter with port.
	RS232	

Notes:

- 1) Diesel and lub. Oil consumption figures at different load conditions and estimated air consumption to be furnished by tenderer.
- 2) After 4 auto starts, engine to lock shut

- 3) Silencer shall be suitable for residential area
- 4) Engine and Alternator ratings shall be for the operating conditions and altitude specified and NOT NTP ratings.
- 5) Engine BHP shall be selected for alternator KW output at emergency loading condition.
- 6) All the technical particulars for Engine & Alternator along with excitation system and AVR are to be furnished by the manufacturers
- 7) Alternator manufacturer shall indicate duration of rating if any, with respect to THD of load.

5.0 33 KV XLPE CABLE

5.1 Standards

The following Standards and Rules shall be applicable amended up to date.

1. IS 7098 (Part-II) –1985 for XLPE cables
2. IEC502/94 -XLPE insulated sheathed cables for electricity supply.

5.2 Conductor

The conductors made from electrical purity aluminium wires, are stranded together and compacted. All sizes of conductors of single or three-core cable are circular in shape. Conductor construction and testing should comply with I.S. 8130-1984.

5.3 Insulation

High quality (XLPE) unfilled insulating compound of natural colour is used for insulation. Insulation is applied by extrusion process and chemically cross-linked by continuous vulcanization process.

5.4 Shielding

All cables above 3.3 kV are provided with both conductor shielding and insulation shielding both conductor and insulation shielding should be from extruded semi conducting compound. Additional insulation should be provided with semi conducting tap and non-magnetic metallic tape screen over the extruded insulation.

Conductor shielding, XLPE insulation and insulation shielding are all extruded in one operation by a special process. This process should ensure perfect bonding of inner and outer shielding with insulation.

5.5 Inner Sheath

Inner Sheath should be extruded PVC inner sheath.

5.6 Armouring

Armouring should be applied over the inner sheath and normally comprises of flat steel strips/wires.

- 5.7 Outer Sheath should be heat resisting type PVC compound type ST2 and as per IS 5831 extruded over the armouring. The outer sheath is embossed with manufacturers name, Voltage grade year of manufacture. The embossing should repeats at every300/350mm along the length of cable.

5.8 Installation

All high-tension cables shall be XLPE belted type conforming to IS: 7098 -1985 XLPE Insulated and suitable for 3 phase 33 kV 50 Hz earthed neutral system. Cables shall be laid and jointed in accordance with IS: 1255.

Cables laid in the route marked in the drawings. Where the route is not indicated, the Nominated Sub-contractor shall mark out the cable route on the site and obtain the approval of the consultant before laying the cables.

Cables shall be bent to a radius not less than **20** times the overall diameter.

Cables laid above ground shall be suitably protected to meet the approval of the Electrical Inspectorate and other statutory regulations. Cables run on wall/ ceiling or readymade masonry trenches shall be supported on trays/brackets fixed to wall / ceiling in an approved manner. Spacers and saddles shall be rendered rustproof. Plastic identification tags shall be provided at the ends and along the length of cable at 15M intervals. Identification tags should be made up of material Lead, in case laid in underground.

5.9 Testing

H.T. Cables shall be tested upon installation with a 2500 V insulation resistance tester and the following readings established: -

1. Continuity on all phases.
2. Insulation resistance.
 - Between Conductors
 - Between all Conductors and ground.
3. High pot test as per I.S. Standard after installation of H.T cable, before commissioning.

For each lot of cables the Nominated Subcontractor shall supply a certificate issued by the manufacturer stating its origin, date of manufacture, constitution and standard to which it complies and the test certificate.

All test readings shall be duly recorded and presented.

5.10 Cable Terminations and Straight Through Joint Kits for 3 Core HT XLPE Cables

- 5.10.1. The cable termination kits and straight through joint kits shall be suitable for HT. XLPE cables shall be of Cold shrinkable or push type on with sound and proven technology. These terminations shall be environmental friendly and flame retardant
- 5.10.2 Each kit shall contain all necessary components accessories, including cable glands wherever required cable lugs (climping type) jointing materials and consumables to make a complete termination in such a way that no live parts of the terminal and connecting lugs are exposed.
- 5.10.3 The basic raw material used in construction of Joints and termination shall be Electrical grade 'EPDM (Ethylene Propylene Diene Monomer Rubber component) with high dielectric strength. The termination shall control the voltage distribution of electrical field effectively and shall minimize the surface stress by uniformly redistributing the electrical field over the entire surface of the insulator. Insulators shall be made of silicon rubber with long service life.
- 5.10.4 The straight through joint kits shall be suitable for underground buried installation with uncontrolled back fill and chances of flooding by water and suitably designed to be protected

against rodent and termite attack. Further the joint kit shall be in capsulated in cast resin compound to provide excellent mechanical & moisture protection in sub soil conditions. While making termination, earthing connection & outer protection arrangement shall also be ensured.

- 5.10.5 The test certificates from the manufacturer for termination kits and straight through joints kits shall mention results of the following tests:
- (i) AC Voltage withstand test (as per IEC-68)
 - (ii) Partial discharge test
 - (iii) Impulse withstand test (as per IEC-68)
 - (iv) Load cycling test (as per VDE-2078)
 - (v) Thermal short circuit test.
 - (vi) DC Voltage withstand test.
 - (vii) Humidity test (as per IEC-166)
 - (viii) Dynamic short circuit test (as per VDE-2078)
 - (ix) Salt Fog (outdoor termination only) test.
 - (x) Impact test (for joints only)

6.0 LT SWITCH GEAR PANEL

- 6.1 LT Switch gear panel shall be Indoor type totally enclosed dust and vermin proof, free standing, fully compartmentalized, extendable in design suitable for 415 volts, 3 phase, 50 Hz, 4 wire AC system conforming to IS: 375 all as specified herein after. Degree of protection shall not be less than IP-51 as per IS: 2147 and it shall be suitable to withstand a Fault level of 50 KA (rms) for one second.
- 6.2 Busbars shall be either of copper or aluminium of rated capacity. Cross section of Busbars for each phase and neutral shall be same. All the Busbars shall be air insulated and will be codified in Red, Yellow, Blue and Black colours as per the standard practices using heat shrinkable sleeves. Copper busbars shall be made of high conductivity 99.9% pure copper of ETP grade. Aluminium busbars shall be made of 63401 WP grade aluminium alloy. All the busbars shall have full round edges and shall be suitably braced with non-hygroscopic SMC supports of 660 volts grade.
- 6.3 LT Switch gear shall be made up of requisite vertical section, which when coupled together shall form continuous dead front switchboard. It shall be readily extensible on both sides by addition of vertical sections after removal of end covers. It shall be constructed only of materials capable of withstanding the mechanical, electrical and thermal stresses as well as the effect of humidity, which are likely to be encountered in the normal service of the panel.
- 6.4 Each vertical section shall consists of: -**
- a) A front framed structure of rolled folded steel channel section of minimum 3mm thickness rigidly bolted/welded together. The structure shall comprise of the components contributing to the major weight of the equipments such air circuit breakers, main bus bars, vertical risers and other front mounted accessories.
 - b) The structure shall be mounted on rigid Base Frame of MS channel of minimum thickness 5mm and height 75 mm. The design shall ensure that the weight of the mounted components is adequately supported without loss or deformation in transit.
 - c) A rear cable chamber housing the cable and connections and power/control cable terminations shall be provided. The design shall ensure generous availability of space for ease of installation & maintenance of cabling & adequate safety in working in any vertical

section without coming in accidental contact with the live parts in the other.

- d) The top most doors in each vertical section shall house ventilating louvers where necessary. All louvers shall be covered with perforated sheet having holes of diameter less than 1 mm to prevent the entry of vermin.
 - e) Front and rear door shall be fitted with Neoprene gaskets with fasteners designed to ensure proper compression of the gasket. Where covers are provided in place of doors, generous overlap shall be provided between sheet surfaces with closely spaced fasteners to preclude the entry of dust.
 - f) The panel will have provision of bottom entry/exit for cables and top entry of busduct.
- 6.5 The height of the panel shall always be less than 2000mm. The depth of panel shall be adequate to cater, for proper cabling space and shall not be less than 1000mm for ACB Panel.
- 6.6 Doors and covers shall be of minimum 2mm thick sheet steel. Sheet shrouds & partitions shall be of minimum 1.6mm thickness. All sheet steelwork forming the exterior as well as interior of the switchboard shall be smoothly finished, leveled and free from flaws. The corners shall be properly rounded without any Burrs.
- 6.7 The switch gears in the panel shall be such arranged so as to facilitate their maintenance and ease of inspection at the same time a adequate degree of safety. Minimum clearance of 25mm and 19mm respectively shall be maintained between phases/phase to neutral/phase to earth and between neutral to earth. When for some reason, these clearances are not available, suitable insulation shall be provided.
- All insulating materials used in the construction shall be non-hygroscopic type duly treated to withstand the effects of high humidity, high temperature tropical ambient service conditions.
- 6.8 Functional units such as circuit breakers, switch fuse unit, MCCBs etc shall be arranged in multitiers except for ACB which shall not be more that two in a single tier.
- 6.9 All doors bearing instruments shall be earthed with the body of the panel. Provision shall be made for permanently earthing the frames and other parts of the switchgear by two independent connections. Earthing busbars (2 Nos) shall be of aluminium of minimum size 50x6mm.
- 6.10 Large clearances & creep age distances shall be provided on the busbar system to prevent the possibility of fault. High tensile bolts and spring washers shall be provided at all busbar joints. The cross section of busbars and risers for various sections shall be adequate from temperature rise tests point of view also.
- 6.11 All sheet metal work incl. frames etc shall be with anti corrosive coating and finally epoxy polyester powder coating of flint grey shade (RAL-7032) all as specified in relevant IS.
- 6.12 The switchgear panel shall be tested for the following and test results for the same from manufacturer shall be submitted to GE -
- (a) Electrical and Mechanical operation test.
 - (b) Insulation test at 2.5 KV for one minute.
 - (c) Heat run test at rated current.
 - (d) Megger test by 1000V megger.
- 6.13 Air Circuit Breakers (ACBs)
- 6.13.1 Air circuit breakers shall be suitable for operational voltage of 415 V AC, 50 Hz, 3 phase 4 wire system for a rated current at ambient temperature of 50 C and conforming to IS : 13947

(Part 3, 1993) and IEC : 60947 (Part I & 2).

- 6.13.2 Breakers shall be electrically operated (AC motor & control) draw out type with cradle with 4 positions in draw out to facilitate maintenance. It shall be suitable for modular construction with Ultimate Breaking Capacity (I_{eu}) of 50 KA (rms), Making capacity of 105 KA (Peak) and short time with stand capacity of 50 KA (Peak) for 1.0 second. The breakers shall with stand Mechanical and Electrical endurance cycles of 2500 and 500 respectively.
- 6.13.3 The operating mechanism shall be of Robust design with a minimum number of linkages to ensure maximum reliability and shall be of aesthetically elegant design incorporating the following features: -
- (a) Unique 'Rating Error Prevention Device' to ensure matching of breakers rating with corresponding cradle.
 - (b) Flag indication for Service/Test/Isolated positions.
 - (c) Common panel cut out for all ratings of draw out breakers to ensure greater flexibility.
 - (d) Easy racking on telescopic rails.
 - (e) Racking handle with housing facility.
 - (f) Safety of operating personnel during operation and maintenance with following inter locking arrangements:
 - (i) Door interlock.
 - (ii) Locking in isolated position.
 - (iii) Racking interlock
 - (iv) Shutter assembly to prevent access to live terminals when breaker is in draw out position.
 - (g) Micro switches for.
 - (i) Position indication
 - (ii) Fault indication
 - (iii) Operation through voltmetric /Electronic releases
 - (h) Lockable trip push button for inter locking
 - (j) In built mechanical anti pumping
 - (k) Mechanical operation counter suitable to display total number of breaker
- 6.13.4 **Protection Devices** - Breaker shall be provided with CT operated 'Solid State Analog Releases' to ensure comprehensive protection against over load, short circuit and ground fault (Earth Fault). The relay shall be self powered type requiring no external power and shall trip the ACBs through Flux Shift Device providing the protections as described below: -
- (a) **Overload Protection:** - The release shall provide inverse time-current characteristics against over load and shall be adjustable from a range of 50% to 100 % of the nominal current. It shall also be suitable for three different trip time of 2.5 second, 13 second and 25 second at six times the rated current.
 - (b) **Short Circuit Protection** - The release shall provide a wide range of protection against short circuit conditions:
 - (i) Current continuously adjustable for 2 to 10 times the nominal current,
 - (ii) Time delay continuously adjustable from instantaneous to 400 m sec.
 - (c) **Ground Fault (earth Fault) Protection** - The release shall provide time-delayed protection against ground fault. The device shall have current and 'Time Delay' adjustable continuously from a range of 0.2 to 0.5 times the nominal current and 100m

see to 400 m see respectively.

6.13.5 **Under-Voltage release**

Breaker shall also be provided with 'Under-Voltage release' to trip the system on low system voltage. It shall be of Type MVR with a built in time delay of 3+ 1 Sec to prevent undesirable tripping of breaker in case of voltage dips due to transient faults. It shall be suitable for 415 V, 50 Hz with range of operation as under

- (a) Pick up: 80% of standard voltage
- (b) Drop off: From 35% to 65% of standard voltage

7.0 **LT CABLES**

7.1 All LT cables shall be of 2/3/3^{1/2} or 4 core aluminium / copper conductors, XLPE insulated heavy duty and suitable for 1100 volts grade and conforming to 1S-7098 (part-1 - 1988).

7.2 The aluminium conductors used shall be stranded, compacted and circular/shaped and the main insulation shall be of cross linked polyethylene (XLPE) with inner sheathing PVC extruded and each core of the cable shall have colour identification all as specified in IS.

7.3 Armour over the inner sheath shall be either of strip or wire type and outer sheath shall be of Extruded PVC conforming to ISS.

7.4 The cables shall be suitable to withstand maximum conductor temperature of 90⁰ C and 250⁰ C during operation and short circuit respectively.

7.5 **Precast Concrete Cable Covers**

Precast concrete cable covers shall comply with 1S: 5820-1970, Specification for precast concrete cable covers and shall be of class and type as indicated in IS. The concrete used in the manufacture of cable covers shall be of a grade not lower than M-20.

8.0 **DISTRIBUTION PILLARS**

Distribution pillars shall be as per 1S: 5039-1983, Specification for Distribution pillars for voltages not exceeding 1000 volts. These shall be double pole and neutral link, triple pole or triple pole and neutral link type 4, 6, 8 and 10 ways.

8.1 For single phase and three phase system rated voltages of 240 volts and 415 volts are preferred. Outgoing or incoming current of distribution pillars shall be 160, 200, 250, 400 and 630 amperes as indicated. Unless otherwise specified the sum of the rated current of the incoming circuits shall be fixed at the 2/3 of the sum of the current ratings of outgoing circuits, rounded upto the nearest higher value of the preferred current.

8.2 **Construction**

It shall be fabricated out of MS sheet, thickness 3.15 mm suitable for outdoor type.

8.3 **Canopy**

The top of pillar shall be fitted with a sloping canopy so that rain water shall not accumulate on the top.

8.4 Distribution pillars shall have a set of double hinged doors at the front. Similar doors shall be provided at the back if indicated. The hinges shall be such that the doors can be swung open by not less than 150°. The hinged design shall permit the doors being completely removed when necessary.

8.5 **Locking**

The doors shall be provided with a suitable locking arrangement.

8.6 Apron

It shall be provided with aprons. They shall be easily removable. Thickness of sheet shall be 3.15 mm.

8.7 Corrosion Protection

It shall be suitably protected against corrosion.

8.8 Rating of Bus Bar

Unless otherwise specified, the rating of the phase bus bars shall take into account the diversity factor given below. The current carrying capacity of the neutral bus bar for DPN and TPN pillars shall be half that of the phase bus bar. In the case of bus bars having a center feeding point it is permissible to have a phase bus bar rating which is 50 percent of the normal rating.

8.9 Rated Diversity Factor

The rated diversity factor of the distribution pillar having several incoming and outgoing circuits is the ratio of the maximum sum at any time, of the assumed currents of all the circuits involved, to the sum of the rated currents of all the circuits of the distribution pillars.

Conventional values of Diversity Factor	
Number of fuse ways	Diversity Factor
2 and 3	0.9
3 and 5	0.8
6 and 9 inclusive	0.7
10 and above	0.6

9.0 EXTERNAL LIGHTING

9.1 High Mast Lighting System

9.1.1 High mast lighting system shall be designed, supplied, installed, tested and commissioned to give average illumination level of 25 lux for non essential supply and 7 lux for essential supply. The quantity of High masts and luminaries etc shall be as per requirement and technical data for High mast and components.

9.1.2 The permissible head load shall have direct relation to the projected area of the luminaries mounted on the top. The tower shall be designed to carry head load of 1.2 sq mtr of projected area in the condition of maximum wind exposure existing at the station, as listed in IS: 875 Part 3 1987,

9.1.3 The easy portability of the complete equipment shall be ensured by mounting these extendible tower sections on a trolley fitted with pneumatic tyres with leaf springs, which also eliminates the shocks Lantern Carriage shall be suitable to mount 4 Nos. Luminaries symmetrically or in one side depending on the lighting requirement. The lantern carriage shall have arrangement to rotate 360 degree manually.

9.1.4 The mobile lighting mast system shall be rugged in design telescopic tubular structure consisting of Two/Three sections. These sections shall be extendible to any height upto 9 meters. The telescopic and tilting action of the tower shall be controlled by winch separately for tilting raising and lowering of tower sections. The motorised winches will be operated by remote control provided with distribution board. The winch used in the system shall be fully self-sustaining without the use of brake or ratchet and pawl to ensure elimination of chances of accidents during the tilting, raising and lowering of the telescopic towers.

- 9.1.5 Two separate sets of Galvanised steel wire ropes for tilting and telescopic operation shall be provided. These wire ropes shall be 10mm dia minimum and of 7x37 (or 7x19) construction and shall be extremely flexible for bending over small pulley radius. The pulleys shall be constructed from carbon steel with bronze bush.
- 9.1.6 The individual tower sections shall be designed with the help of extensive structural calculations for optimum sizes of the tower frame, mobile chassis and outriggers. These shall withstand extreme wind gust speed prevailing in the area of installation for duration as specified in IS: 875 to support the head load area specified.
- 9.1.7 No hydraulic shall be provided in the equipment to make it more simple and robust and all operations of raising and lowering, folding and tilting of tower sections shall be affected with the help of motor operated winch and rope system to ensure minimum maintenance and leakage of oil etc under the deteriorating site conditions.
- 9.1.8 Provision and supply of spirit levels shall be included to ensure vertical and horizontal leveling of the chassis outriggers and structure with respect to each other to avoid unrelated development of fatigue stresses due to eccentric centre or gravity.
- 9.1.9 A universal mounting arrangement shall be provided for mounting of diesel generating set and control panel to make the equipment's self sufficient in its energy requirement.

9.2 Bulk Head Fittings

These shall be robust in construction, made from cast iron, pressed steel or cast aluminium and fitted with Porcelain lamp holder, vitreous enamelled reflectors and hinged water tight front with key and wire or pressed metal guards.

9.3 Mercury Vapour Lamp with Fittings

These fittings shall be of standard type of approved make and shall be complete with mercury vapour lamp, lamp holder, fitting with reflector, choke and starter of appropriate size and quantity, complete with electric connections.

9.4 Sodium vapour lamp with fittings

These fitting shall be of standard make and shall be complete with lamp, lamp holder fitting with reflector, chock, capacitor of appropriate size and quantity complete with electrical connection.

9.5 Metal Hallied lamp and fittings

These fittings shall be of standard make and shall be complete with lamp, lampholder, fitting with reflector, choke, capacitor of appropriate size and quantity complete with electrical connection.

9.6 Street Light Fittings

Shall be of cast aluminium housing and shall comply with the requirements of IS 2149-1970, Specification for luminaries for street lighting.

9.7 Watertight Lighting Fittings

Shall comply with the requirements of IS 3553-1966, Specification for watertight electric lighting fittings.

9.8 Lighting Poles and Junction Box

Lighting Poles shall be steel tubular type as per drawing enclosed and as per bill of materials. Lighting Poles shall be complete with fixing bracket and junction box made of ERP or Moulded type. Junction box shall be suitable for loop-in and loop-out of three cables upto 4c x 16 sq.mm.

The lighting poles shall be coated with bituminous preserving paint on inside as well as on the embedded outside surface. Exposed outside surface shall be coated with two coats of metal primer and finish paint of approved colour and shade.

The ERP or moulded type junction box for the street lighting poles shall be completely weatherproof confirming to IP-55 and provided with lockable door, fixing bracket and HRC fuse mounted on the fuse carrier and fuse base assembly.

Supply and drawing 3 # 1.5 sq.mm. copper conductor PVC wires per fitting from junction box at the bottom of the pole to the fitting at the top of the pole shall be included in the installation charges of the pole.

10.0 PROTECTION OF BUILDINGS AGAINST LIGHTNING

10.1 General

Installation of lightning arrestor system for protection of buildings and allied structures shall be carried out as described in IS 2309-1989, Code of practice for protection of buildings and allied structures against lightning.

10.2 Materials

10.2.1 Copper

Solid or stranded copper wire or flat copper strips shall be of grade ordinarily required for commercial electrical work, generally designated as being of 98 percent conductivity when annealed.

10.2.2 Galvanized Steel

Steel shall be thoroughly protected against corrosion by a zinc coating.

10.2.3 Aluminium.

Aluminium wire and strips shall be at least 99 percent pure, of sufficient mechanical strength and effectively protected against corrosion. Aluminium shall not be used underground in direct contact with walls.

10.2.4 All air terminations shall be of galvanized iron and all down conductors shall be of galvanized iron or aluminium **except where copper is indicated for air terminations and down conductors.**

10.2.5 Shapes and sizes

The recommended shape and minimum sizes of conductors for use above ground and below ground are given as under:

A-For use above Ground

Sl No.	Material and Shape	Minimum Size
1.	Round copper wire	6mm diameter
2.	Stranded copper wire	50 sq.mm. (or 7/3.0mm diameter)
3.	Copper Strip	20x3 mm
4.	Round galvanized iron wire	8 mm diameter

5.	Galvanized iron strip	20x3 mm
6.	Round Aluminium wire	9 mm diameter
7.	Aluminium strip	25x3.15 mm

B-For use below Ground

Sl. No.	Material and Shape	Minimum Size
1.	Round copper wire or copper clad steel wire	8 mm diameter
2.	Copper Strip	32x6 mm
3.	Round galvanized iron wire	10 mm diameter
4.	Galvanized iron strip	32x6 mm

10.3 Air Terminations

For the purpose of lightning, protection, the vertical and horizontal conductors are considered equivalent and the use of pointed air terminations or vertical finials is, therefore, not regarded as essential. However, vertical air termination shall be provided where indicated. A vertical air termination shall have one point and shall project at least 300 nun above the object salient point or network on which it is fixed.

- 10.3.1 Horizontal air terminations shall be interconnected as indicated; such that no part of the roof is more than 9 metre away from the nearest horizontal conductor except that an additional 300 nun may be allowed for each 300 nun by which the part to be protected is below the nearest protective conductor. For a flat roof horizontal air terminations along the outer perimeter of the roof is used. For a roof of larger area a network or parallel horizontal conductors shall be installed as indicated,
- 10.3.2 Horizontal air terminations shall be coursed as indicated, along contours such as ridges, parapets and edges of flat roof and where necessary over flat surfaces in such a way as to join each air termination to the rest and should themselves, form a closed network.
- 10.3.3 All metallic finials, chimneys, ducts, vent pipes, railings, gutters, metallic flagstaff, etc., on or above the main surface of the roof of the structure shall be bonded to form part of the au termination network. If portions of a structure vary considerably in height, any necessary air termination or air termination network of the lower portions shall be addition to their own conductors, be bonded to the down conductors of the taller portions.
- 10.3.4 All air terminals shall be effectively secured against overturning either by attachment to the object to be protected or by means of substantial braces and fixing which shall be permanently and rigidly attached to the building. The method and nature of the fixing shall be as directed.

10.4 Down Conductors

Down conductors shall be distributed around the outside walls of the structure as indicated. They shall preferably be run along the comers and other projections, due considerations being given to the location of air terminations and earth terminations. Lift shafts shall not be used for fixing down conductors.

- 10.4.1 Down conductors shall follow the most direct path possible between the air termination and the earth termination avoiding sharp bends upturns and kinks. Joints shall as far as possible be avoided in down conductors. Metal pipe shall not be used as protection for the conductors.
- 10.4.2 Metal pipes from the roof to the ground may be connected to the down conductors but cannot replace them. Such connections shall have disconnecting joints.

10.5 Joints and Bonds

The lightning protective system shall have as few joints in it as possible. Wherever joints in the down conductor above ground level are necessary they shall be mechanically and electrically effective. In down conductors below ground level there shall be no joints. The joints may be clamped, screwed, bolted, riveted, sweated, braced or welded. The bonding of the external metal forming part of a structure of drain water pipe shall have a cross sectional area not less than that employed for the main conductors. In no case gas pipe, shall be bonded to the earth termination system.

10.6 Testing Points

Each down conductor shall be provided with a testing point in a position convenient for testing but inaccessible for interference. No connection, other than one direct to an earth electrode shall be made below a testing point. Testing points shall be of phosphor bronze, gunmetal, copper or any other suitable material.

10.7 Earth Terminations

Each down conductor shall have an independent earth termination.

10.8 Earth Electrodes

Earth electrodes shall be constructed as specified under Earthing.

10.9 Fasteners

Conductors shall be securely attached to the building or other object to be projected by fasteners which shall be substantial in construction, not subject to breakage and shall be galvanized steel or other suitable materials with suitable precaution to avoid corrosion. The lightning conductors shall be secured at not more than 1.20 meter apart for horizontal run and 1 meter for vertical run.

11.0 SUBSTATION AUXILIARIES INSTALLATION

11.1 Scope.

11.1.1 The scope of work shall cover the following:

- a) Installation, testing and commissioning of equipment specified in this specification.
- b) Supply, laying, testing of HV cable.
- c) Substation earthing, interlocks, safety pads etc,
- d) Firefighting equipment, danger boards, shock treatment chart etc.

11.2 Transformer.

11.2.1 As above

11.3 HV Cabling.

11.3.1 All the routine test certificates as per relevant IS to be furnished while supply of the cable.

11.3.2 Cable shall be laid in the route marked in the drawings. Where the route is not indicated, the contractor shall mark out the cable route on the site and obtain the approval of the architect / consultants before laying the cable.

11.3.3 Cable shall be bent to a radius not less than 20 & 12times the overall diameter for HT & LT cables respectively.

11.3.4 Cable shall run on galvanized sheet steel cable trays or readymade masonry trenches with necessary support of steel. Aluminum identification tags shall be provided at the ends along the length of cable at a distance of 10M.

11.4 **Earthing.**

11.4.1 **Pipe earthing stations.**

12.0 **POWER FACTOR CAPACITOR**

12.1 **Scope**

12.1.1 The scope of work shall cover supply, installation, testing and commissioning of Power Factor improvement Capacitors, PF relay, contactors etc.

12.2 **Standards.**

12.2.1 The following standards shall be applicable.
a) IS 2834 – 1986 Power Capacitors

12.3 **Capacitors**

12.3.1 Capacitors shall be Mixed Di Electric long life (minimum 1,00,000 operating hours) without degradation or loss of capacitance. Capacitors shall have low energy loss (less than 0.5W / KVAR) and totally tropicalised. Each capacitor shall have a discharge register to bring down the residual voltage to 50V within 60sec.

12.3.2 The capacitance output shall be guaranteed for a period of 2yrs. @ +10% and – 5% of the rated value. All capacitors shall be type tested for di electric strength, IR value minimum 50megohms losses surge protection etc. in accordance with the Indian Standards. Capacitor elements shall be canned in a galvanized steel enclosure and sealed to meet IP52 class of protection. All capacitors shall operate at 135 % overload (over voltage or harmonics) without deterioration.

12.4 **Control Panel**

12.4.1 The control panel shall consist of 3sections: (a) Capacitor section (b) Switch section (c) Monitor and control section.

12.4.2 The capacitor section shall house the capacitor and have adequate ventilation and easy access for maintenance.

12.4.3 The switch section shall consist of SFU, Contactor, Volt meter and PF meter.

12.4.3.1 The control section will have microprocessor based control unit, with proper relays to ON / OFF capacitors, the switching system shall be capable of changing the sequence of the capacitor for equated run hour. Multiple push buttons to be provided for manual operation.

12.4.3.2 Earthing of the panel and capacitor will be as described under “Protective earthing.”

12.5 **Testing**

12.5.1 Capacitor units shall be tested to withstand 2500V AC for 1min. and shall yield an IR value of 50megohm after 1min charge with 500V DC megger. The sequence switching shall be functionally tested.

12.5.2 All test reading shall be duly recorded and presented.

12.6 Mode of Measurement

12.6.1 Each capacitor panel will be considered as 1 unit for the purpose of measurement and payment and shall include the following:

- a) Incoming and outgoing feeder fuses, contactors, PF relays, PF meters, indicating lamps, push buttons, control microprocessors necessary CTs in the main panel, control wiring there from etc.
- b) Capacitors in multiple unit duly supported and enclosed, supporting frame and painting,
- c) Installation testing and commissioning.

13.0 LIFT

Conformity with Indian Electricity Act & Rules

All electrical works in connection with installation of electrical elevators shall be carried out in accordance with the provisions of Indian Electricity Act, 1910 and the latest provisions of the Indian Electricity Rules and shall comply with provisions of I.S: 732 -1963

All materials, fittings, appliances etc. used in electrical installation shall conform to Indian Standard Specifications, the materials do not exist, shall be approved by a Competent Authority.

The Contractor should specify on a schedule, particulars of full load current, starting current maximum permissible voltage drop, sizes of switches, and all other details to suit requirements.

All electrical supply lines and apparatus in connection with the lift installation shall be so constructed and shall be so installed, protected, worked and maintained that there may be no danger to persons there from.

All metal casings or metallic coverings containing or protecting any electric supply lines or apparatus shall be efficiently earthed.

Lift pits should be provided with a light, the switch for which should be in the lift well and accessible from the lower terminal floor entrance.

Suitable caution notice shall be affixed near every motor or other apparatus operating at a voltage exceeding 250 volts.

Conformity with Fire Regulations

The installation shall be carried out in conformity with the local fire regulations and rules there under wherever they are in force.

Machine Location & Lift Wells

The machine shall be installed in the machine room on top floor as shown on relevant drawings. The Contractor should study the drawings of machine room carefully and confirm that the equipments offered by the tenders will fit in the rooms. If any minor changes are considered necessary for the installation of equipment in the machine rooms and lift wells, the same should be clearly mentioned at the time of submission of tender.

The design data for the machine room floor slabs shall be furnished by the tenderer along with his offer during tender submission.

Testing

All the elevators shall be tested on completion of work before the elevators are put into normal service and taken over. The tests at site will be in accordance with I.S 14655 Necessary weights and instruments for test shall be arranged by the contractor during test and electric power required for carrying out testing shall be supplied by the Employer.

The installation will be taken over only if the tests are found to be satisfactory and certificate to this effect is issued by the relevant authority of Government of West Bengal. West Bengal Lifts Rules, 1958 or any other rules or statutes laid down by the relevant authority relating to passenger lift / goods lift shall be deemed to be covered by the Contractor in his design and lump sum offer. In case any stipulations by the relevant authority are applicable over and above the specifications laid down by this document, these shall be deemed to be included in the unit rate quoted.

The work shall be considered as complete only after the license to work the lift is obtained by the Contractor from the Government of West Bengal.

Machine Location & Lift Wells

The pit machine shall be installed in the machine room on top floor as shown on relevant drawings. The Contractor should study the drawings of machine room carefully and confirm that the equipments offered by the tenders will fit in the rooms. If any minor changes are considered necessary for the installation of equipment in the machine rooms and lift wells, the same should be clearly mentioned at the time of submission of tender.

The design data for the machine room floor slabs shall be furnished by the tenderer along with his offer during tender submission.

Testing

All the elevators shall be tested on completion of work before the elevators are put into normal service and taken over. The tests at site will be in accordance with I.S 14655/I.S. Necessary weights and instruments for test shall be arranged by the contractor during test and electric power required for carrying out testing shall be supplied by the Employer.

The installation will be taken over only if the tests are found to be satisfactory and certificate to this effect is issued by the relevant authority of Government of West Bengal. West Bengal Lifts Rules, 1958 or any other rules or statutes laid down by the relevant authority relating to passenger lift / goods lift shall be deemed to be covered by the Contractor in his design and lump; sum offer. In case any stipulations by the relevant authority are applicable over and above the specifications laid down by this document, these shall be deemed to be included in the unit rate quoted.

The work shall be considered as complete only after the license to work the lift is obtained by the Contractor from the Government of West Bengal.

14.0 INTERNAL ELECTRIFICATION WORK FOR SERAMPUR BT:

- 14.1 All electrical work shall be carried out in accordance with this specification. These specifications shall be read in conjunction with the relevant Indian Standard, NEC, Indian Electricity Rules, DSR specification and Regulations.
- (a) Relevant Indian Standards
 - (b) Indian Electricity Rules 1956
 - (c) National Electrical Code
 - (d) CPWD DSR specifications

15.0 GENERAL INSTRUCTION

- LT Panel shall house the main incoming & outgoing ACB, MCCB, bus bars and outgoing switchgears.
 - MLDB, MPDB, MACDB, UPSDB, Utility DB, Fire Panel shall be connected through cable from the AI. Busduct. From the MLDB, MPDB, MACDB & UPSDB, sub-main line shall be taken through cable to the Lighting, Power, Computer & AC Distribution Board of each floor.
 - The point wiring for lights, fans and sockets shall be taken in the surface mounted PVC conduits.
 - Internal Electrical wiring shall be in surface mounted PVC conduits with 1.5 sq. mm. PVC insulated FR copper conductor for light point wiring, 2.5 sq. mm. PVC insulated FR copper conductor for 6A socket outlet wiring, and minimum 4 sq.mm PVC insulated FR copper conductor for 6/16A power point wiring and minimum 6 sq.mm PVC insulated FR copper conductor for AC point wiring if not otherwise mentioned in the drawings and BOQ.
 - All panels and DBs shall be earthed to GI earthing pits.
 - For each circuit, neutral and earth wire shall be separate.
 - Wires shall conform to IS: 694 and comply with following features: -
 - FR PVC insulated stranded copper conductors.
 - 1100V grade wires for single phase and 3 phase circuits.
 - Colour coded as below:

Phase-R	- Red
Phase-Y	- Yellow
Phase-B	- Blue
Neutral	- Black
Earth	- Green.
 - Indoor Wiring shall be with rigid PVC conduits.
 - Load on each Lighting circuit shall not exceed 800 W for lighting and 2000W for Power sockets.
- 15.1 The general layout and wiring points and fittings are as shown in the drawings. The exact position of fittings, etc., may be altered by the Client to suit local requirement. Cutting Chases / groove, wherever required and making good is deemed to be included in the contractor's quoted rates and amount in BOQ.
- 15.2 "Loop in" system of wiring shall invariably be followed throughout the installation. Where it is absolutely necessary, junction boxes of approved make may be used as permitted by Client.

Soldered or taped joints are not permitted for jointing under any circumstances. Porcelain connector with metal parts of brass shall be used.

15.3 General Requirements

15.3.1 Materials

All materials, fittings, appliances etc. used in electrical installation shall comply with the requirements of relevant Indian Standard specifications and shall be well finished. Materials for which Indian Standard specifications do not exist, shall conform in quality to the samples maintained by Client or as approved by them or as mentioned in Technical Specification.

The copper wire FR shall be of PVC of approved make / grade ISI marked. All materials for fittings / accessories, cable, etc., to be incorporated in this work shall strictly comply with latest appropriate Indian Standards. If Indian standards have not been issued relevant current British Standards or other standards may be used.

The contractor shall produce sample within one month from the date of acceptance of all such articles of fittings that he proposes to use and get them approved in writing by the Client. The samples shall be displayed in the Client office or as directed by Client. The articles so approved shall be labeled as such and signed by both the contractor and Client. These approved samples shall be kept in custody by Client till the payment of final bill. The samples shall be fitted on a board as approved by the Client.

The rates for point wiring (power / light) in BOQ are with the provision of FR stranded copper conductor.

15.3.2 Execution of work

Unless otherwise exempted under the rule of the Indian Electricity Rules, the work of electrical installation shall be carried out under the supervision of a person holding a certificate of competency issued by the recognized authority. The workmen shall also hold certificate of competency. Good workmanship is an essential requirement for compliance with these specifications.

15.3.3 Testing of Installation

All electrical work executed shall be systematically tested by the Contractor in the presence of Client to ensure compliance with the specifications laid down. Test results shall be recorded and signed by the Contractor and the Client, if the test results are not acceptable, all required repairs, replacement and extra work of removal and relaying or re-fixing shall be carried out by the Contractor at his expense and installation shall be re-tested until test results indicates compliance with the prescribed requirements.

The Contractor shall supply the necessary apparatus, labour and instruments or equipment required for testing.

15.3.4 Record of Installation:

On completion of the work, the Contractor shall submit to Client complete wiring diagram for each of the installation in the case of internal electrical work All circuits shall be clearly indicated and numbered in the wiring diagram and all points shall be given the same number as the circuit to which they are electrically connected.

15.3.5 Electrical Tests:

The following tests as specified in IS-732, code of practice for electric wiring and fittings in building shall be complied with before the complete installation is taken over. The contractor shall carry out the tests in the presence of Client and results recorded in triplicate on form IAFW-404. Electrical wiring test sheet shall be signed both by the contractor's representative and the Client. All testing equipment shall be arranged by contractor without any extra cost.

Insulation resistance shall be measured by 500 volts meggar. The insulation resistance in mega ohm of the installation shall not be less than 50 divided by the number of points on the circuit and the resistance of the whole installation shall not exceed one ohm and resistance including earth mass as 5 ohm.

Testing Polarity of Switches:

A test shall be made to verify that all non linked single pole switches have been fitted in the same conductor throughout and that such conductor has been connected to an other or phase conductor or to the non earthed conductor of the supply.

15.3.6 Safety procedures & Practices:

In all major electrical installations such as substations, industrial establishments, transmission & distribution lines and cable networks, safety procedure instructions for working on low, medium and high voltage mains and apparatus and safety practices listed in IS-5216: Guide for safety procedures and practices in electrical works shall be followed to the extent applicable. The Contractor shall provide all workmen with safety devices and appliances.

15.3.7 Fire safety:

All electrical equipment shall satisfy the requirements laid down in IS-1646: Code of practice for fire safety of buildings (general) electrical installation and IS-3034: Code of practice for fire safety of industrial buildings, generating stations and distribution stations to the extent applicable.

16.0 BLANK

17.0 CONDUIT WIRING:

17.1 Scope

The scope under this section covers rigid PVC surface mounted conduit wiring for the following: -

- Lighting circuits
- Power circuits
- Computer points
- AC points
- 3-Phase power points

17.2 System of Wiring

17.2.1 All wiring shall be carried out with PVC insulated stranded FR copper wires of 1100 volts grade. The circuit wiring for points shall be carried out in looping in system and no joint shall be allowed in the length of the conductors. Circuit wiring shall be laid in separate conduit originating from distribution board to switch board for light / fan. A light / fan switch board may have more than one circuit in same conduit as for point wiring. Looping circuit wiring shall be drawn in same conduit as for point wiring. Each circuit shall have a separate neutral board. A

separate red colour wire shall be used for earth For point wiring red, yellow or blue colour PVC insulated wire for RYB phase wire respectively and black colour PVC insulated wire for the neutral wires. Bare copper wire shall be used as dearth continuity conductor and shall be drawn along with other wires. No wire shall be drawn into any conduit until all work of any nature, that may cause injury to wire is complete. 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 conduit, the conduits shall be thoroughly cleaned of moisture, dust and dirt.

17.2.2 Joints:

All joints shall be made at main switches, distribution board socket and switch boxes only. No joint shall be made in conduits and junction boxes. Conductors shall be continuous from outlet to outlet.

17.2.3 Mains and Submains:

Mains and sub main cable where called for shall be of the rated capacity and approved make. Every main and sub main shall be drawn into an independent adequate size conduit. Adequate size draw boxes shall be provided at convenient locations to facilitate easy drawings of the sub main and main cables. Cost of junction box/drawn box is deemed to be included in the rates of sub main wiring. Three phase sub main shall be provided with two earth wire.

Where mains and sub mains cables are connected to the switchgear, sufficient extra lengths of sub main and mains cable shall be provided to facilitate easy connections and maintenance. For termination of cables crimping type cable socket / lugs shall be provided. Same colour code as for circuit wiring shall be followed.

17.2.4 Load Balancing:

Balancing of circuits in three phase installation shall be planned before the commencement of wiring and shall be strictly adhered to.

17.2.5 Colour Code for Circuit And Submain Wiring

Colour code for circuit and sub main wiring installation shall be Red, Yellow, Blue for three phases. Black for neutral and yellow / green or green insulated earth wire.

17.2.6 Conductor Size:

Wiring shall be carried out with following sizes of PVC insulated stranded single core copper conductor wire / cable.

i) Light Point	1.5 sqmm
ii) Ceiling / Cabin / Exhaust Fan Point	1.5 sqmm
iii) Call bell point	1.5 sqmm
iv) Plug point (5/6A Switch Socket outlet)	2.5 sqmm
v) Circuit Wiring	2.5 sqmm
vi) General power point	4.0 sqmm
vii) Power Point for AC unit (for 1 & 1.5 Tr.)	4.0 sqmm
viii) Power point for geyser	4.0 sqmm
ix) Power Point for AC unit (for 3 Tr.)	6.0 sqmm

17.2.7 Not more than 8 (eight) light circuit points should run on one circuit and no more than 2 (two)

power points on one circuit.

17.2.8 Wiring is to be terminated in metal boxes in inner plate and cover suitable for mounting required nos. of modular switches / sockets as applicable with fixing hard wares.

17.3 Surface Conduit Wiring:

For installations requiring surface conduit wiring, the supply, routing and laying of PVC conduit of minimum size 20mm in walls/ceiling, from lighting panels up to fittings, receptacles, inspection/junction boxes etc. shall be in the Contractor's scope.

The Contractor shall closely co-ordinate his work with that of the Civil Contractor. The contractor shall prepare detailed shop drawing & submit for the approval of the Client well before commencing the work. The shop drawings shall show setting out details for all components such as conduits and cable routes indicating the number and size of wires in each section of conduit.

The layout of conduits shall be such that any condensation or sweating inside the conduit is drained out. Suitable precaution shall be taken to prevent entry of insects inside the conduit. No cable or wire shall be installed until the inside of conduit has been cleaned.

Suitable junction/inspection boxes according to requirements shall be provided to permit periodical inspection and to facilitate replacement of wires, if necessary. The boxes shall be mounted on the wall or ceiling. Junction boxes with minimum 75 mm depth shall be used in roof slabs and depth of boxes in other places shall be as per IS: 2667, 1976.

Pull boxes shall not be located in a conspicuous manner. Number and location of pull boxes shall be clearly indicated on shop drawings and shall be got approved by the Client before commencing the work.

The chases in the wall shall be neatly made and with ample dimensions to permit the conduit to be fixed in the manner desired (in case of concealed wiring).

Fixing of standard bends of elbows shall be avoided as far as practicable & all curves maintained by bending the conduit pipe itself with a long radius which will permit easy drawing in of conductors. All threaded joints of conduits pipes shall be treated with some approved 'preservative compound' to secure protection against rust. Open conduit ends shall be properly protected to prevent the ingress of dirt and rubbish.

Provisions shall be made at expansion joints, where they occur in the building structure, PVC pipe with coupling to be installed to prevent damage to structure/conduits and finishes. Continuity through all such joints shall be maintained.

All Conduits shall be kept clear of other services, except where intentionally earthed or bonded. Conduits shall be fixed to prevent contact with same at the following minimum spacing:

- a) 150 mm away from hot water services
- b) 50 mm away from all other services.

17.4 **Standard**

The following standards and rules shall be applicable: -

- 1) IS: 732 : Code of practice for Electrical Wiring installation (System

Voltage not exceeding 650V).

- 2) IS: 1646 : Code of practice for fire safety of Buildings (General) Electrical Installation.
- 3) IS: 1554 : PVC insulated cables
- 4) IS: 3854 : Switches for Domestic and similar purposes
- 5) IS: 1293 : 3 pin plugs and sockets.
- 6) IS: 4648 : Guide for electrical layout in residential building
- 7) IS: 3419 : Specification for fittings for rigid non metallic conduits. Conduit fittings shall be of unplasticised PVC.

17.5 Type and size of Conduits

All rigid PVC conduits used shall conform to IS: 9537. The conduit may be threaded type and shall be used with the corresponding accessories. The conduits shall be designated by their nominal outside diameters.

17.6 Bunching of Cables

Conductors of different circuits / different phases / different voltages shall be bunched in separate conduits. Maximum number of PVC insulated cables conforming to IS: 732, 1989 that can be drawn in one conduit shall be as follows:

Nominal Cross Sectional Area of Conductor in Sq.mm.	SIZE OF CONDUIT											
	20mm		25mm		32mm		40mm		50mm		63mm	
	S	B	S	B	S	B	S	B	S	B	S	B
1.5	7	5	12	10	20	14	-	-	-	-	-	-
2.5	6	5	10	8	18	12	-	-	-	-	-	-
4	4	3	7	6	12	10	-	-	-	-	-	-
6	3	2	6	5	10	8	-	-	-	-	-	-
10	2	-	5	4	8	7	8	6	-	-	-	-
16	-	-	2	-	4	3	7	6	-	-	-	-
25	-	-	-	-	3	2	5	4	8	6	9	7
35	-	-	-	-	2	-	4	3	7	5	8	6
50	-	-	-	-	-	-	2	-	5	4	6	5

Note: 1. The above table shows the maximum capacity of conduits for a simultaneous drawing of cables.

2. The columns headed 'S' applies to runs of conduit which have distance not exceeding 4.25 m between draw in boxes & which do not deflect from the straight by

an angle of more than 15°. The columns headed 'B' apply to runs of conduit, which deflect from the straight by an angle of more than 15°.

17.7 Conduit joints:

Conduits shall be joined by means of screwed couplers and screwed accessories only. Where there are long runs of straight conduit, inspection type couplers shall be provided at intervals. Threads on conduits in all cases shall be 13 mm to 19 mm long, sufficient to accommodate full threaded portion of couplers or accessories. For conduit fittings and accessories reference may be made to IS: 2667. Cut ends of conduits shall have neither sharp edges nor any burrs as otherwise these may damage the insulation of conductors while drawing them through such pipes.

17.8 Fixing of Conduits:

Conduit pipes shall be fixed by heavy gauge saddles and spacing plates secured to suitable wood plugs or other approved plugs with screws in an approved manner, at a distance of 300mm from the center of such fittings. The saddle shall comply with the requirements of IS: 3837.

Where conduit pipes are laid along the trusses, steel joists etc. the same shall be secured by means of ordinary clips or girder clips as required. Where it is not permitted to drill holes in the truss members, suitable clamps with bolts and nuts shall be used. The width and thickness of the ordinary clips or girder clips shall not be less than as given in following table:

Size of conduit (mm)	Width of clip (mm)	Thickness of clip (mm)
20	20	0.9
25	20	0.9
32 and above	25	1.25

For concealed conduit, above requirements shall be applicable and in addition, following clauses shall also be complied with.

Making of chases

Chases in the wall shall be made neatly and shall be of ample dimensions to permit the conduit to be fixed in the desired manner. In the case of building under construction, conduits shall be buried in the wall before plastering and shall be finished neatly after erection of conduit. In case of exposed brick / rubble masonry work, special care shall be taken to fix the conduit and accessories in the position along with the building work.

Fixing of conduit in chase

Conduit pipe shall be fixed by means of staples or by means of saddles not more than 600mm apart. Fixing of standard bends or elbows shall be avoided as far as practicable and all curves shall be maintained by bending the conduits itself with a higher bending radius, which will permit easy drawing in of conductors. All threaded joints of conduit shall be treated with approved preservative compound to secure protection against rust.

Fixing of MS/cast iron conduit boxes in wall

Conduit boxes of mild steel or cast iron shall be fixed in the wall with cement and sand mortar 1:2. No screwing of conduit boxes shall be required when fixed in recessed conduit wiring system.

Inspection Boxes

Inspection boxes shall be provided to permit periodical inspection and to facilitate replacement of wires, when necessary. These shall be mounted flush with the wall. Suitable ventilating holes shall be provided in the inspection cover box.

To facilitate drawing of wires in the conduit, galvanized iron fish wire of 3.25mm diameter shall be provided along with laying of recessed conduit.

17.9 Bends in conduit

All necessary bends in the system including diversion shall be done by bending conduit or by inserting suitable solid or inspection type normal bends, elbows or similar fittings or by fixing cast iron inspection boxes as approved by PM . Conduit fittings shall be avoided, as far as possible, in outdoor installations. Radius of bends in conduit shall not be less than 75mm.

- 17.10. Heat may be used to soften the conduit for bending and forming joints in case of plain conduits. Caution should be exercised in the use of this conduit in locations where the ambient temperature is 40° C or above. Use of such conduits in places where ambient temperature is 45° C or above is prohibited.
- 17.11 Conduits to be rendered continuous before pulling the wires.
- 17.12 Conduits to be free from sharp edges and burrs and necessary check nuts & spring washers etc. to be provided for fixing of conduit at each junction box and out boxes.

18.0 POINT WIRING

Whenever asked for, if installation is to be carried out on point wiring basis, the supply of following shall be deemed to be included as part of the installation work.

- a) 650/1100V lighting wires for conduit wiring, minimum size of 1.5 sq.mm PVC insulated copper conductor.
 - b) PVC conduit with all relevant accessories and junction/inspection boxes. Minimum size 20 mm for exposed/concealed conduits respectively.
 - c) 650/1100V, PVC, copper-conductor, armoured cables (when wiring without conduits).
 - d) Ceiling rose or connector (in case of ceiling/exhaust fan points).
 - e) Back plate (in case of suspended light fixtures).
 - f) Wiring of each lighting fitting/receptacle unit/ceiling fan/bell point/exhaust fan, etc. shall be considered as one point.
- 18.1 Light /fan/call bell point wiring shall be carried out with 1.5 sq.mm. copper PVC wires of 1100V grade along with neutral looping method in conduits as specified in BOQ.
 - 18.2 Earthing continuity conductor for Light /fan/bell point from DB shall be 1.5 sq.mm Copper conductors.
 - 18.3 Three core flexible wires of required length shall be provided from ceiling JB/ ceiling rose to the fittings.
 - 18.4 In case of group control point wiring for group of points up to 6 shall be controlled by 5/6A SP modular type switch and group of above 6 points shall be controlled by 15A SP modular type switch.
 - 18.5 Point wiring shall start from switch board or from boards where circuit mains are provided.
 - 18.6 Control switches to be connected to phase conductor only.
 - 18.7 Point wiring for light / fan / bell in buildings shall be carried out with ISI mark 2 nos 1.5 sq.mm. FR stranded PVC insulated copper wire 1.1 kV grade with accessories conforming to IS complete erected with ISI mark modular type switch / bell push erected on MS box with base & cover plate including fixing accessories and ISI mark ceiling rose / circular JB with top of PVC cover as complete in all respect.
 - 18.8 Point wiring for 6A socket on light or fan board in I buildings shall be carried out with ISI mark 2nos. 1.5 sq.mm FR stranded PVC insulated copper wire 1.1 kV grade with 1.5 sq.mm FR stranded PVC insulated copper wire 1.1 kV grade in green colour used for earthing for plug both of ISI mark (earth wire shall be taken from DB or intermediate switch board).

18.9 Point wiring for independent plug shall be carried out with ISI mark 2 nos minimum 2.5 sq.mm. FR stranded PVC insulated copper wire 1.1 kV grade with 2.5 sq.mm ISI mark FR stranded PVC insulated copper wire 1.1 kV grade in green colour used as continuous earth wire end to end complete in all respects in an approved manner.

18.10 Fittings and accessories

18.10.1 Ceiling Rose and similar attachments.

18.10.2 A ceiling rose or any other similar attachment shall not be used on a circuit, the rated voltage of which exceeds 250 V AC.

18.10.3 Only one flexible cord shall be attached to a ceiling rose. Specially designed ceiling rose shall be used for multiple pendants.

18.10.4 A ceiling rose shall not embody fuse terminals as an integral part of it.

18.11 Control Switches, sockets and plugs (Modular type):

18.11.1 The control switches and sockets shall be with ISI marking and of rated capacity. This shall comply with the following features:-

- Control switches
- Silver contacts with shrouded current carrying terminations.
- All switches and sockets shall be made of fire retardant, self extinguish poly carbonate plastic, able to withstand the glow wire test at 960 degree Celsius.
- The switches shall conform IS 3854:1997. The internal design of terminals and contact shall make the switch capable of high overload conditions. The switch shall be of flush type with silver inlay contact on pure copper.
- All 6 and 16 Amp switches shall be modular type of 240 volts AC grade. All switches shall be fixed on modular plate.
- All socket shall fully comply with IS 1393:1988 specifications. The connector shall be of phosphor bronze for modular type.
- All 6 Amp socket shall be 3 pin types. All 16 Amp socket shall be 6 pin type suitable for 16/6 Amp.
- All switches, sockets or fans shall be connected to the phase wire of the circuit. Switch board shall be located at 1200 mm. above finished floor level unless otherwise indicated on drawings.

18.11.2 6A switch or bell push and other accessories shall be fixed on modular box with base & cover plate.

18.11.3 A Socket outlet shall not embody fuse terminals as an integral part of it, but the fuse may be embodied in the plug.

18.11.4 Every Socket outlet shall be controlled by a switch, which shall be combined therewith.

18.11.5 The switch controlling the socket outlet shall be connected to the live side.

18.11.6 Socket outlet may be fixed at any convenient place about 230 mm. from the floor level, and shall be away from the danger of mechanical injury. In situations where the socket outlet is accessible to children, it is necessary to install an interlocked plug and socket.

18.11.7 In an earthed system of supply, a socket outlet with plug shall be of three pin type with the third terminal connected to earth. When such socket outlets with plug are connected to any current consuming device of metal or any non-insulating material or both, conductors connecting such current consuming devices shall be of flexible cord with an earthing core. The earthing core shall be secured by connecting between the earth terminal of plug and the current consuming devices.

18.11.8 Every Plug containing a fuse shall be non-reversible and shall be so arranged and connected that the fuse controls a phase conductor or the non-earthed conductor of the circuit.

18.12 **Porcelain Connectors:**

Porcelain connectors shall be provided inside the box for fan and utility fittings. The wiring shall be done in such a way that wires from connectors to the fan are not visible. In situations where ceiling rose is proposed for fan and tube light fittings, the porcelain connector need not be provided.

All materials, fittings, appliances etc. used in electrical installation shall comply with the requirements of relevant Indian Standard specifications and shall be well finished. Materials for which Indian Standard specification do not exist, shall conform in quality to the samples.

18.13 **Terminal Boxes:**

In surface type wiring and concealed conduit wiring the terminal point for power /light sockets, outlets, switching, etc., shall terminate in recessed cast iron or galvanized mild steel boxes fitted with wall surface. The cover of boxes for surface type wiring shall be of Hylam Sheet 3mm thick. Rates for point wiring shall be deemed to be included for the above provision. All such terminal boxes shall be properly earthed and connected to earth dolly. Terminal blocks used in prewired DBs / panels shall be of polyimide insulating material as per IEC / IS meeting V / V2 inflammability class. All metal parts shall be copper alloy and shall be suitable to mount on DIN / rail as per requirement for item in the schedule. The terminal block shall with stand vibrations / arcing effects and shall be shock proof.

19.0 **EARTHING:**

19.1 Earthing shall be done in accordance with IS-3043 of 1987.

19.2 Earth stations shall be provided for electrical system and required number for lightning protection as per IS – 2307.

19.3 Distance between two earth pits shall be minimum 3M

19.4 **Equipment to be earthed.**

Except for equipment provided with double insulation, all the non-current carrying metal parts of electrical installation are to be earthed properly. Especially body of lamp, fan, fan regulator and metallic parts of fluorescent fittings are to be earthed. In case of medium voltage installation, all metal conduits, trunking, cable sheaths, switchgear, distribution boards and all other parts made of metal shall be bonded together and connected by means of two separate and distinct connections with earth.

19.5 **Structural metal work -**

Earthing of the metallic parts shall not be effected through any structural metal work which houses the installation. Where metallic parts of the installation are not required to be earthed and are liable to become alive should the insulation of conductors become defective, such metallic parts shall be separated by durable non-conducting material from any structural work.

19.6 **Systems of earthing –**

Equipment and portions of installation shall be deemed to be earthed only if earthed in accordance with the direct earthing system. In all cases, the relevant provisions of Rules 33 and 61 of the Indian Electricity Rules, 1956 shall be complied with.

19.7 **General Rules Applying to All Systems of Earthing**

Method of earthing:

(a) Connections to earthing conductors:

- 1) Main earthing conductor – It shall be taken from the earth connection at the main switchboard to an electrode to which the connection is to be made or to an earthing terminal provided by the supplier near service cutouts.
- 2) Sub-main earthing conductor– It shall run from the main switch board to distribution board.
- 3) Circuit earthing conductor – It shall run from the exposed metal of equipment and shall be connected to any point on the main earthing conductor, sub-main earthing conductor, earth connection at it's distribution board or to an earth leakage circuit breaker.

(b) Earthing of equipment (General)

Unless otherwise provided in (c) to (f) the exposed metal of equipment shall be earthed according to a (1) & (3) above.

(c) Conduits, cable sheathing and armouring –

They shall be earthed at the ends adjacent to switch boards at which they originate or other wise at the commencement of the run by an earthing conductor connected to an earth clip, clamp or gland in effective electrical contact with the conduit or cable sheathing and armouring.

(d) Equipment mounted on metal frame work –

The exposed metal of equipment shall be deemed to be earthed if the metal framework on which it is mounted and is in effective electrical contact with which it is directly earthed.

(e) Exposed metal of equipment connected by flexible cord –

Where equipment is connected by flexible cord, all exposed metal parts of the equipment shall be earthed by means of an earthing conductor enclosed with the current carrying conductors within the flexible cords.

(f) Switches, accessories, lighting, fittings, etc. (use of screwed conduits for earthing)

Such fittings which rigidly secured effective electrical contact with a run of screwed conduit by screwing, lock-nuts or clamps may be considered as a part of the run of conduit for earthing purpose, provided that the run of conduit is earthed.

(g) Prohibited connections –

Sprinkler pipes or pipes conveying gas, water or flammable liquid conduit, metallic enclosures of cables and conductors and lightning protection system shall not be used as a means of earthing an installation or even as a link in an earthing system.

19.8 Metallic enclosures for wiring – continuity and resistance –

19.8.1 **Continuity:**

The metallic enclosures for wiring shall be mechanically and electrically continuous.

19.8.2 **Resistance:**

The electrical resistance of metallic enclosures for cables and conductors measured between earth connection at the main switch board and any other point on the completed installation shall be low enough to permit the passage of current necessary to operate fuse, circuit breaker or the earth leakage release of the circuit breaker protecting the circuit and shall not exceed 2 ohms.

19.9 **Earthing Conductor –**

Every earthing conductor shall be either stranded, flat strips or circular or rectangular bar. Protection against mechanical injury shall be provided where necessary. The earth conductor may be of high conductivity copper or aluminium or galvanised solid iron.

19.10 **Installation of Earthing Conductor –**

- a) Position, fixing and protection of earth conductors: Earthing conductors shall be so placed and connected that it shall not be accidentally damaged or cut. It shall be fixed over its entire length by clamps, clips, saddles, staples, clouts etc. which in no way will damage the conductor. Aerial earthing conductor shall be supported on suitable insulators and shall be clearly identified.
- b) Buried earthing conductor – It shall be protected against mechanical damage.
- c) Earth connections – Any connection between an earthing conductor and electrode or the metallic sheathing of under ground supply cables shall be accessible, shall in no case be in a damp situation and shall be suitably protected where likely to be exposed to mechanical damage.
- d) Joints – Joints in main earthing conductors shall be made by soldering, brazing or welding for conductors of size up to 7/1.70mm; for larger main earthing conductors, mechanical clamping may be used. Joints in either earthing conductors shall be made by soldering or by mechanical clamping.

19.11 **Earth clips –**

Paint, enamel compound, corrosion and other non-conducting material shall be removed from the surface of the metal section to which earth clip is attached.

19.12 **Earth electrodes:**

Earthing Stations

Pipe earthing with 80mm dia highly conductive, corrosion free 80-100 microns galvanized outer pipe and inner pipe complete, filled with Anti corrosive conductive compound (Crystalline Conductive Mixture) and bottom and top of outer pipe sealed with base plate, the inner pipe shall be extended with a GI bar with hole for fixing strip etc. as reqd. The job includes necessary digging of soil and refilling the same with mixture of Back fill compound with excellent moisture retaining capacity. The back fill compound reduces the soil resistivity and helps in faster dissipation of fault current. The number of earthing stations shall be as shown on the drawings.

Power conducting Apparatus

Metallic conduit shall not be accepted as an earth continuity conductor. A separate bare earth continuity conductor size of 12 SWG GI wires shall be used.

The earth continuity conductor (ECC) shall be clamped to the conduit at one-meter intervals using approved copper earth clamps.

Non-metallic conduit shall have an insulated earth continuity conductor. All metal junction and switch boxes shall have an inside earth stud to which the ECC shall be connected. The insulated ECC shall be distinctly coloured (green) for easy identification. The joint in the earth continuity conductor shall be done by welded lap joint with separate back plate of size larger than conductor itself.

Armoured cables shall be earthed by distinct earth connections to the armouring at both the ends and the size of connection being as for the metallic conduit.

3 ph. power panels and distribution boards shall have 2 distinct earth connections with brass studs of minimum 16mm dia. for two independent earth connections of the size shown or as co-related to the incoming cable size. Sizes of all earth connections shall be co-related to the incoming cables.

All G.I. strips shall be hot dip galvanized with minimum zinc coating of 350 grams / sq.m.

3 phase apparatus shall have two distinct earth connections

For 1 Phase apparatus, the single earth connections shall be provided of the above size. For all light fittings and fans a single earth connections with 1.5 sq.mm. Copper shall be provided.

An equipment-earthing grid is established. All earth connections to all panels; DB's and Equipment shall be connected to the nearest point of the earthing grid.

The installation shall be complete in all respects for efficient and trouble free service. All work shall be carried out in a first class quality and neat workmanship. Grounding conductors shall be handled carefully to avoid kinking and cutting of the conductors during their installation. All exposed ground conductors run shall be taken in a neat manner horizontal, vertical and parallel to the building walls or columns and shall not be laid haphazardly. All connections to the grounding grid shall be made with GI strip welded to grid and bolted at equipment ends.

Earthing design impedance to ground shall not exceed 1 ohm.

For all connections made to equipment or to the structures, the grounding conductor, connectors and equipment enclosures shall have good clean contact surfaces. Grounding conductor connection to all electrical equipment, switchgear, transformers, motors, panels, tray/conduit systems, equipment enclosures, distribution boards, equipment frames, bases, steel structure etc. shall be by pressure type or bolting type connectors.

All lap, cross and tee connections between two grounding conductors both below and above ground shall be made by thermo welding process for GI or compression type connector when copper conductor is used. The various joints shall have adequate mechanical strength as well as necessary electrical conductivity not less than that of the parent conductors of the joints.

All accessories for grounding installation shall be of good quality and design approved by the Owner / Consultant. All welded joints laid underground shall be treated with bitumen paint and covered with hassien tape.

Grounding conductors, when crossing underground trenches, directly laid underground pipe and equipment foundation, if any, shall be at least 600 mm below the bottom elevation of such trenches / pipes.

Testing

The following earth resistance values shall be measured with an approved earth meggar and recorded: -

1. Each Earthing Station
2. Earthing System as a whole (shall be less than one ohm)
3. Earth Continuity conductors.

20.0 LIGHTING FITTINGS:

- 20.1 Every lighting fitting shall be controlled by a switch and where control at more than one point is necessary, by as many two-way and intermediate.
- 20.2 Where lighting fitting is supported by one or more flexible cords, the maximum weight to which the twin flexible cords may be subjected shall be as follows.

Nominal cross- sectional area of twin flexible cord (mm ²)	Number and diameter in mm of wires	Maximum permissible weight(kg)
0.4	12/0.200	1.4
0.65	22/0.200	2.3
1.00	32/0.200	3.5
1.2	38/0.200	4.5

- 20.3 No inflammable or low melting point material shade shall form a part of lighting fitting unless such shade is well protected against all risks of fire.
- 20.4 Where conductors are required to be threaded through tubes or channels formed in the metal work of fittings, such tubes and channels shall be of such size as will enable them to be wired with the conductors used for the final sub circuits without removing the braiding taping or outer covering. All tubes or channels shall be of sufficient size to permit 'looping back' wires. Where, with prior approval of the PM, 'Electrolier wire' is used for wiring fitting, the sub circuit leads shall terminate in a ceiling rose or connector from which this wire is carried to the fittings.
- 20.5 All nipples of the fittings shall not be less than 12mm (half inch).
- 20.6 Fittings and lamp holders for gas filled lamps shall be adequately ventilated.
- 20.7 Lamp Holders
 - 20.7.1 Lamp holders shall be metal cased type or insulated type as indicated and shall comply with IS-1258:1979, specification for bayonet lamp holder. Lamp holder shall be suitable for fixing in pendent or to bracket or angular as required. Lamp holder for use on brackets etc. shall have not less than a half inch female nipple and all those for use with flexible pendants shall be provided with cord grips. All cases must be solid and substantial.
 - 20.7.2 Edison Screw holders shall not be provided for lamps 100W and below.
 - 20.7.3 All lamp holders shall be provided with shade carrier ring.

- 20.7.4 Where center contact Edison screw lamp holders are used, the outer or screw contact shall be connected to the 'middle wire', the neutral or the earthed conductor of the circuit.
- 20.8 Outdoor lamp holders
- 20.8.1 External and road lamp shall have weather proof fitting of approved design so as to effectively prevent the admission of moisture. An insulating distance piece of moisture proof material shall be inserted between the lamp holder nipple and the fitting. Flexible cord and cord grip lamp holder shall not be used where it is exposed to weather. In verandah and similar exposed situations where pendants are used, they shall be fixed by rod type.
- 20.8.2 Lamps
All incandescent lamps, unless otherwise specified in the drawings, BOQ, special conditions of contract and suitably protected, shall be hung at a height of minimum 2.45M (8ft) above floor level.
- 20.9 Fans, Regulators and clamps
- 20.9.1 All ceiling fans shall be suspended from hooks or shackles with insulators between hooks and suitable length of suspension rods. Supply and fixing fan hooks or shackles are part of the electrical works. There shall be no joints in the suspension rod, but if joint is unavoidable then such joints shall be screwed to special couplers of 5cm minimum length and both ends of pipes shall touch together with couplers and shall in addition be screwed by means of split pins. Alternatively, the two pipes may be welded.
- 20.9.2 Fan clamps shall be of suitable design according to the nature of construction of ceiling on which these clamps are fitted. In all cases fan clamps shall be fabricated from tested mild steel of suitable sizes and they shall be as close to fitting as possible. Fan clamps for reinforced concrete roofs shall be buried in the concrete and due care shall be taken to tie them with the reinforcement properly. Fan clamps for wood beams shall be of suitable flat iron fixed on two sides of the beam and according to size and section of the beam, one or two MS bolts passing through the beam shall hold both flats irons together. Fan clamps for steel joints shall be fabricated from tested flat iron to fit rigidly to the bottom flange of the beam. Care shall be taken during fabrication that the metal does not crack while hammering to shape. Other fan clamps shall be made to suit the position, but in all cases care shall be taken to see that they are rigid and safe.
- 20.9.3 The canopy and wood block at the top of the suspension rod shall effectively hide the suspension. Canopies on bottom of suspension rod shall effectively hide connection to fan motor.
- 20.9.4 All ceiling fans shall be wired to ceiling roses or to special connector boxes. The leading in wire shall be of nominal cross sectional area not less than 1.5sq.mm. and shall be protected from abrasion.
- 20.9.5 All fans shall be hung 2.9M (9ft & 6 inches) above floor or as directed by the Client.
- 20.10 Exhaust Fans
- 20.10.1 For fixing of an exhaust fan, a circular hole shall be provided in the wall to suit the size of the frame, which shall be fixed by means of rag-bolts, embedded in the wall. The hole shall be neatly plastered with cement and brought to the original finish of the wall. The exhaust fan shall be connected to exhaust fan point by means of flexible cord, care being taken that the blades rotate in proper direction.
- 20.11 Attachment of fittings and accessories

20.11.1 All ceiling roses, brackets, pendants and accessories attached to wall or ceiling shall be mounted on substantial polished teak wood blocks except in case of conduit wiring for workshop type installation; after all fixing holes are made in them. Ceiling rose shall be surface type and shall comply with IS: 371-1979, specification for roses having two or three terminal plates and of outside diameter not less than 63.5mm. ceiling roses shall be provided with means for gripping flexible cords which shall not damage the insulation and/or sheath of the cord and shall be such that the load on the cord is not transmitted to the terminals.

21.0 DISTRIBUTION BOARDS:

21.1 Scope

The scope under this section covers supply, fixing, testing and commissioning of distribution board.

21.2 Standards

The latest edition of following standards and rules shall be applicable: -

- 1) IS: 2675 : Enclosed Distribution Fuse Boards and cut-outs for Voltages not exceeding 1000V.
- 2) IS: 2607 : Air break isolator for voltages not exceeding 1000V.
- 3) IS: 5578 : Marking and arrangement of switch gear busbars, main connections and Auxiliary wiring.
- 4) IS: 8828 : Miniature circuit breaker
- 5) IS: 12640 : Earth leakage circuit breaker
- 6) IS: 13947 : Moulded Case Circuit breaker
- 7) IS: 8623 : Low voltage switchgear and control gear assemblies.

21.3 Construction:

The distribution boards shall be complete with: -

- Sheet steel enclosure suitable for recessed, semi-recessed or surface mounting on wall / structure as required and shall be of 16 SWG, sheet steel enclosure. Distribution feeder pillar shall be as per IS-5039. These shall be double pole and neutral link, triple pole or triple pole & neutral link type.
- 2 nos. Earthing terminals for connection to external earthing conductor.
- Circuit diagram indicating load distribution.
- Phase barriers of insulating materials

21.4 Busbars:

The busbars shall be as follows: -

- The electrical high conductivity electrolytic grade insulated copper busbars suitable for incoming feeder with minimum 100A.
Neutral busbar – 50% of phase busbar
- Individual phase and neutral bars located in respective phase cubicle for.
- The Main Distribution Board / Sub Distribution Board shall be designed that the cables are not directly terminated on the terminals of switch fuse / fuse switch etc. but are terminated on cable termination links.

21.5 All final-distribution enclosures shall be selected from the same range, rated for an incoming current of up to 250 A. Whatever the installation method (flush or surface mounted), they shall comply with Indian standards.

The Distribution Board shall be of CRCA Sheet Steel for indoor installation. It shall be powder coated after seven tank processing. The degree of protection shall be

- IP30 for enclosures without a door.
- IP43 for enclosures with a door.

Enclosures used as Sub power distribution boards (MCCB incomer), Access to devices shall be protected by a door with a two-point closing mechanism guaranteed by the manufacturer.

For three phase configuration Distribution Boards shall have Per Phase Neutral Bars so as to give phase isolation in case of fault on any phase and suitable interconnecting wire sets with Insulated shorting Busbar for electrical isolation.

Enclosures used as final distribution boards. The door shall be equipped with a closing system locked. Outgoings will be identified by labels affixed on front of the switchboard, at least 5 cm high, aligned with each device.

Common devices such as measurement and indication devices, pushbuttons, emergency off switches and socket-outlets shall be installed together in the same part of the enclosure and easily accessible to users. For enclosures equipped with a door, access to the above devices shall be possible without opening the door.

For cable entry enclosure should have detachable gland plates with adequate knockout holes of appropriate size and number shall be provided on top & bottom. Fixing screws shall have captive washers.

Enclosures shall be equipped with a removable chassis enabling cabling operations on a workbench, even if the back of the enclosure is already set on the wall. Chassis installation in the enclosure must be stable and functional even before it is permanently secured by screws. In case of double door, the door shall be with spring loaded hinged & shall also be reversible in case of space constraints.

The shorting links (Busbar) shall be insulated. The Neutral bars shall be insulated from the enclosure. The Distribution boards shall have two nos. of external Earth Stud (welded) to ensure better Earth continuity. Neutral Terminator shall be provided to terminate the Incoming Neutral in case of 3P MCCB as I/C.

It must be possible to install flush-mount enclosures without use of mortar. The front panels shall be perfectly seated, even if the rear part (flush-mount case) is imperfectly set or if the wall is irregular at the point of installation. Cement spill protector shall be provided with the enclosure so as to avoid dust & dirt at the time of the construction.

The colour of the enclosures shall be:

- metal-like grey , white for fronts providing access to devices.

It shall be possible for users to personalise doors without risk of touching live parts (non-transparent, transparent, images, wall paper, etc.). When a number of enclosures are installed side by side, with or without socket-outlets, the overall system must remain aesthetically and functionally consistent.

Suitable size insulated bus bars made of high conductivity copper and mounted on non hygroscopic (FRLS) insulating supports shall be provided. Neutral and earth bus bar shall be with taped holes and brass screws spring washers, etc., complete.

22.0 MOULDED CASE CIRCUIT BREAKERS:

22.1 General

The present specification applies to moulded-case circuit breakers (MCCB) from 16A to 630A for AC (50/60Hz) low voltage electrical installation from 220V to 415V. MCCB shall be equipped with a trip unit that offers the appropriate level of performance to fit to the application.

1. MCCBs shall be designed for both vertical and horizontal mounting, without any adverse effect on electrical performance. It shall be possible to supply power either from the upstream or downstream side.
2. For a MCCB rating frame given, MCCBs dimensions shall be the same whatever the ultimate breaking capacity.
3. MCCB shall have a rated operational voltage of 415 V and insulation voltage of 750 V (AC50/60 Hz)

Compliance with Standards

Standard	Title	Usage
IS /IEC 60947-1& 2	Low-voltage Switchgear and control gear Part 2 : Circuit Breaker	Characteristics of circuit-breakers:- <ul style="list-style-type: none"> • Operation and behavior in normal service • Operation and behavior in case of overload and operation and behavior in case of shortcircuit • Dielectric properties

The breaking capacity performance certificates shall be available for category A to the above mentioned standards. The MCCBs shall have a rated service breaking capacity (Ics) equal to the ultimate breaking capacity (Icu) at defined operational voltage.

Circuit breaker design

Safety

1. For maximum safety, the power contacts shall be insulated in an enclosure made of a Thermo setting material from other functions such as the operating mechanism, the case, the trip unit and auxiliaries (ON/OFF/Trip Contact, Shunt, Under Voltage etc.)
2. All poles shall operate simultaneously for circuit breaker opening, closing and tripping.

Isolation

In order to ensure suitability for isolation complying with IEC 60947-2 & 7-27:

1. MCCBs shall be actuated by a toggle or handle that clearly indicates the three positions: ON, OFF and TRIPPED.
2. MCCB should clearly indicate the suitability for isolation in the name plate identified by the symbol.

3. The operating mechanism shall be designed such that the toggle or handle can only be in OFF position (O) if the power contacts are all actually separated, in OFF position, the toggle or handle shall indicate the isolation position.
4. MCCBs shall be able to receive a device for locking in the “isolated” position, with up to 3 padlocks, Ø8 maximum.
5. MCCBs shall be equipped with a “push to trip” button in front to test operation and the opening of the poles.
6. MCCB rating, “push to trip” button, performances and contact position indication must be clearly visible and accessible from the front, through the front panel or the door of the switchboard.

Class II Front Face

MCCBs shall be designed to prevent access to live parts when the cover is removed, means main current path of the circuit breaker should be isolated from auxiliary section i.e MCCB shall offer class –II front face.

Current limitation, durability

1. From 16 A to 630 A rating frame, MCCBs shall equip a double breaking type rotary contact mechanism, having current- limiting feature to limit let through energy on the installation.
2. The electrical durability of MCCBs, as defined by IEC 60947-2 standard, shall be at least equal to 3 times the minimum required by the standard (8000 operations up to 250A & 4000 operations up to 630A).

Auxiliaries and accessories

MCCBs shall be designed to enable safe on-site installation of auxiliaries such as voltage releases (shunt & under voltage releases) and indication switches as follows:

1. Field installable auxiliary contacts for signalling different functions, as: open/closed position, fault signal, electrical fault (including earth fault) signal, all auxiliaries shall be common for the entire range,
2. They shall be separated from power circuits,
3. All electrical auxiliaries shall be of the snap-in type and fitted with terminal blocks,
4. Auxiliary function and terminals shall be permanently engraved on the case of the circuit breaker and the auxiliary itself.
5. The addition of auxiliaries shall not increase the volume of the circuit breaker.
6. Rotary handle, shall not mask or block device settings, and should indicate three positions O (OFF),I (ON) and tripped.
7. Rotary handle should have push to trip button.
8. Rotary handle should have provision to install lock and key arrangement for interlocking purpose (Example: 2 lock 1 key 3 lock two key etc.)
9. Rotary handle shall ensure IP40 for direct type and IP 55 for extended Rotary handle.

Protections requirements

MCCBs shall comprise a device, designed to trip the circuit-breaker in the event of high-value shortcircuit currents. This device shall be independent of the thermal-magnetic or electronic trip unit.

1. MCCBs up to 250A shall be equipped with Thermal magnetic trip unit.
2. MCCBs with ratings over 250A shall be equipped with electronic trip units.

Thermo-magnetic trip unit from 16 to 250 A

Trip units shall offer:

1. Adjustable thermal protection from 70 – 100% times the current rating
2. Protection setting shall apply to all circuit breakers pole thru single knob from the front of MCCB without opening the front cover of the MCCB.
3. Fixed magnetic protection for current ratings up to 250 A.

Electronic trip units from 400A to 630A

Trip units shall offer:

1. Adjustable over load protection from 50 -100% times the current rating
2. Variable short circuit protection from 2 to 10 I_r
3. Protection setting shall apply to all circuit breakers pole thru single knob from the front of MCCB without opening the front cover of the MCCB
4. In case of 4 pole MCCB neutral should be adjustable as a Neutral unprotected or Neutral protection at 0.5 I_n or Neutral protection at I_n.

Earth protection

Earth Fault protection: Where ever specified, MCCB should have Earth fault protection as provision. MCCB earth fault protection should have following settings.

1. Selection of I_r MCCB rating.
2. Earth fault sensitivity selection from 10 – 60% I_n
3. Time delay selection in case of Earth Fault from 0.5 to 3 Sec. or instantaneous.

Environmental requirements

1. Circuit breakers shall conform to environmental directives like ROHS & WEEE.
2. The manufacturer shall implement non polluting production processes that do not make use of chlorofluorocarbons, chlorinated hydrocarbons, ink for cardboard markings, etc.

23.0 MINIATURE CIRCUIT BREAKER

- 23.1 Miniature circuit breakers shall be of approved design and make. Circuit breakers shall be equipped with individually insulated, braced and protected connectors. The front face of all the breakers shall be flush with each other. The incoming MCBs shall be provided with insulator shoes.

MCBs shall be suitable for operation at 230V/415V, 50Hz supply. The MCB ratings shall be available from 0.5-125A in 1P/2P/3P/3P+N/4P versions. The rated short circuit capacity according to IS8828 shall be of 10,000A. MCBs shall be offered with either C or D tripping characteristics as per the BOQ requirements. The MCBs shall be suitable for conductor cross-sections upto 35sq mm and shall be suitable for mounting on a 35mm DIN rail. The mechanical life shall be in line with the requirements of the standards, namely IS8828.

MCB shall ensure complete electrical Isolation of downstream circuit or equipment, when the MCB is switched OFF (to be marked on the MCB in symbolic form)

IP 20 Degree of Protection shall be ensured to prevent electrical shocks by accidental touch to any live parts, by providing finger touch proof terminals.

Energy Limitation Class-3 shall be to ensure minimum let through energy in the event of a fault, for safety & longevity of downstream circuit equipment. (to be mentioned on the MCB as per standards)

Low Power Loss must be ensured i.e. MCBs should have low power loss, in any case not more than prescribed limits of standards. Energy efficient MCBs having lesser power loss than prescribed in relevant standards will be preferred.

MCBs shall have minimum 25 sq.mm. terminals for ratings below 32A, and 35 sq.mm. for ratings of 32A and above, to ensure perfect termination of connections. Terminals of MCBs shall have captive screws.

Basic technical parameters, rating, operating voltage, etc. shall be printed on front face of MCB for ease of identification.

Operating knob can be sealed in ON / OFF condition without affecting any automatic tripping Availability of Auxiliaries like Auxiliary Contact, Shunt Trip to remotely trip or indicate the circuit breaker status shall be fitted to MCB easily.

24.0 BUS DUCT & RISING MAIN (SANDWICH CONSTRUCTION)

24.1 Scope

The specification covers design, manufacturing, supply, installation, testing and commissioning of Sandwich type bus duct for connecting transformer to panel, DG to panel or panel to panel and/or rising main for use as plug in at different floor levels.

24.2 System detail

The sandwich bus duct/rising main shall be suitable for operation in a 600/1000V 3-phase 4-wire system, with frequency 50Hz having 100% neutral and 50% integral/internal earth. Minimum short time withstands rating for 1 second of the aluminium bus duct/bus riser shall be as per following:

KA level	Current level (A)
30KA	up to 500
40KA	500<A<=800
50KA	800<A<=1350
65KA	1350<A<=2000
90KA	2000<A<=2500
100KA	2500<A<=3200

120KA
150KA

3200<A<=4000
4000<A<=5000

For current greater than 5000A copper bus-riser will be deemed mandatory and short circuit withstand current for such riser has to be furnished by the manufacturer.

24.3 Standards

The bus duct/rising main shall be designed and manufactured in accordance with the following international standards for bus-risers.

IEC 60439-2: Particular requirements of busbar trunking system
IEC 60695-2-10 to 2-13: Insulating material resistance test to abnormal temperatures.
IEC 60332 part 3: Flame propagation resistance test
IEC 40639-1: LV circuit insulation and PE protective circuit continuity.
IEC 60529: Degree of protection

The rising main shall conform to IEC/IEEE/NEMA/BUI/JIS for seismic protection certification.

24.4 Testing

Every current rating must be tested and certified by reputed international test laboratory (ASTA, KEMA ASEFA or CPRI) as per IEC 60439. For the rising mains following 14 tests shall be performed to get the certificates.

1. Temperature-rise limits
2. Dielectric properties
3. Short-circuit strength
4. The effectiveness of the protective circuit
5. Clearances and creepage distances
6. Mechanical operation
7. The degree of protection
8. The resistance of insulating materials to abnormal heat.
9. Electrical characteristics of busbar trunking system
10. Structural strength
11. Cushing resistance
12. Resistance to flame propagation
13. Fire barrier in building penetration
14. EMC testing

ASTA diamond and KEMA-KEUR certification will be preferred though not the only criteria for selection. Manufacturers must ensure that the products produced in their factory are identical to those tested in the laboratory.

24.5 Manufacturer

The manufacturer must have an established track record in design and manufacture of sandwich busduct/rising mains and must have supplied such systems for atleast 5-10 years. The design, material, manufacturing of the rising main should have international standards and acceptance. The manufacturer must have ISO 9001 certification for design manufacture and testing of the busbar and ISO 14001 for the manufacturing facility.

24.6 Design and construction requirements – Sandwich busduct/rising main

- a. General: The busduct/rising main shall be of sandwich construction, non ventilated design

- b. Bus bar: Bus bar can be of **Aluminium up to 5000A and Copper above it.**
- c. Joints: **Joints shall be of copper fused silver plated and single block design for aluminium and silver plated for copper in the whole length of the rising main.**
- d. Plating on the bus bar except on joints: **Tin.**
- e. Neutral: Neutral will be 100% of phase conductor.
- f. Earthing: Earth conductor shall be separate, integral or internal of the same material as the phase conductor running straight throughout the length of the rising main.
- g. Insulation: **The busbars shall be insulated by preferably Dupont Mylar.** If any other insulation (epoxy/polyester mica etc) is used manufacturer will submit their electro chemical & mechanical properties especially the dielectric strength properties vis-à-vis mylar.
- h. Plug-in contacts: **The plug in contacts shall also be of silver plated copper to avoid electro chemical corrosion and to minimize contact resistance.**
- i. Degree of ingress protection: Degree of ingress protection for the busduct shall be minimum IP66 and for rising main it shall be minimum IP54.
- j. Housing: The rising main housing shall be made of 1.5mm thick electrogalvanized steel/aluminium to reduce hysteresis and eddy current loss and shall be provided with a suitable protective finish of RAL7032 pebble grey /ANSI 49 grey epoxy paint. The busduct/rising main housing shall be totally enclosed non-ventilated for protection against mechanical damage and dust accumulation. It should endure 500 hrs salt spray testing. The totally enclosed housing shall be made by the manufacturer of the busbar themselves. Housing made by other manufacturer than the busbar manufacturer shall be completely rejected.
- k. Temperature rise: **The maximum allowable temperature rise of the busbar shall be 55 degree above ambient at full load.** Each busbar shall be insulated of class minimum B.
- l. Voltage drop: The voltage drop shall be based on the rising main operating at full load and at stabilized temperature condition.

24.7 Accessories – Sandwich busduct/rising main

- a. **Elbows/Double elbows:** Horizontal/vertical flatwise/edgewise elbows/double elbows shall be of similar internal construction as that of the busduct straight lengths and ensure minimum heat loss at them. Designing of the route shall be such that it uses minimum number of elbows.
- b. **Flanged ends:** They shall allow the busduct to be connected to a switchboard's busbar, or to the terminals of an transformer, generator set, etc in a manner so that minimum heat loss is ensured.
- c. **Flexibles:** They shall connect the flanged end to the to the terminals of a transformer, generator etc to reduce the effect of vibration in the transformer/generator/panel etc and heat loss is remained at minimum level.
- d. **Adaptor box:** Adaptor boxes shall be considered wherever applicable. Adaptor boxes shall be of same color as that of the panels.
- e. **Expansion joints:** If the runs are made of straight runs without any elbow and two ends are fixed for greater than 30 meters or busduct is going through two different buildings then suitable expansion joints and blocking means to direct the expansion in right direction shall be considered so that load variations in its service life can be taken care of. Expansion joint shall be capable to +/-35mm adjustments.

- f. **End Closure:** End closure shall protect and insulate the conductors in the last section of busduct/rising main.
- g. **Cable end box for riser:** If rising main is not connected directly to panel through busduct then cable end box shall be connected in the rising main with ACB/MCCB as an isolator incomer. ACB/MCCB shall be according to their respective specifications.

24.8 **Tap-off/plug in unit from the rising main:**

- a. The contact of the plug-in/tap-off should be of silver plated copper. Plug in unit shall be plugged directly onto the full thickness of the busbar through opening to ensure proper contact.
- b. On the rising main there can be 3 dead front hinged cover type openings for plug-in/tap off boxes however one opening of sufficient rating at operable height may be used. The height of the tap off box/plug-in will be decided during detail engineering of the riser keeping in view the floor plan.
- c. In case of more than one opening all shall be usable simultaneously.
- d. While plugging on the bus duct earth connection should be produced first then the phases.
- e. Spring design of connecting jaw shall ensure maximum strength on the contact area between the plug-in unit and the busbar.
- f. Plug in/Tap off units of circuit breaker type of fusible switch type shall be operated with visible blade quick make quick break type.
- g. Transparent shield shall be there to avoid direct contact with human.
- h. Rising main shall be so installed that the plugs are side mounted to make practical use of the plug-in openings.
- i. It shall be possible to inspect the plug-in openings and the busbar prior to the installation of the plug-in/tap off units.
- j. Covers of all plug-in units must have interlocks to prevent the cover from being opened in case the circuit breaker is on.

24.9 **Support of the busduct/rising main:**

Suitable edgewise/flatwise hanger supports shall be used in the busduct and spring hangers for rising main to ensure distribution of load and to avoid the transmission of building forces to the busduct/rising main (expansion and vibration). It is important the joint blocks shall not be positioned where spring hangers will be there on the floor. Necessary cross channels/beams etc to be considered by the contractor/erection partner/manufacturer for proper fixing of the busducts/rising main. In no way any joints in the busduct/rising main shall be kept loose or additionally stressed or forcefully tightened over permissible Nm/pound which may lead to additional heat loss and temperature rise over 55 degree Celsius above ambient for full load current.

24.10 **Drawings:**

After award of the order the manufacturer shall submit the following documents for approval:

General arrangement showing the Plan, Elevation, different views, detailed typical cross-section of Busduct/rising main, details of end termination, bus bar arrangements, erection details with necessary supports. Test certificates if needed. Complete technical Particulars of the components of Bus duct commissioning and maintenance instruction manual for the Busduct/rising main.

25.0 CABLE TRAYS:

The hot dipped galvanized perforated cable trays and their fittings shall conform to the Indian Standards or their latest amended editions or equivalent International Standard. The bidder shall specify in the bid to which standard the material supplied shall conform.

The MS Ladder type cable trays and their fittings shall conform to the Indian Standards or their latest amended editions or equivalent International Standard. The bidder shall specify in the bid to which standard the material supplied shall conform.

25.1 Design Requirements:

25.1.1 The hot dipped galvanized steel perforated cable trays having rectangular channel section 30mm deep shall be designed for a uniform load of at least 400N per 1000 mm ladder length for 200 mm wide tray. The trays shall be fabricated in a length of 2.5 m to 3m.

The MS ladder type cable trays having angle section 50mm deep shall be designed for a uniform load of at least 1600N per 1000 mm ladder length for 600 mm wide tray. The trays shall be fabricated in a length of 2.5 m to 3m.

25.1.2 The perforated cable trays shall be manufactured from good commercial, high grade strength sheet steel having minimum thickness of 2mm and shall be hot dip galvanized according to BS-729-1971 or equivalent standard suitable for indoor/outdoor use having moderate humidity and air pollution. The MS ladder type tray will be manufactured from good commercial, high strength steel angle having minimum thickness of 15mm. The zinc coating thickness shall work out by applying a 610 gm of zinc per square meter surface with an approximate thickness of 80 micron. The zinc coating shall be smooth, clean and uniform thickness and free from defects like **ash and** dross inclusions, bare patches, black spots, pimples, lumpiness, rust stains, blisters etc. The galvanizing shall not adversely affect the mechanical properties of the coated material; the quality of the coating will be established by tests as per IS-2633. All manufacturing process including punching, cutting, bending and welding of perforated / ladder type cable trays shall be completed and burrs shall be removed before the application of galvanization process is applied. Zinc conforming to at least Grade Zn 98 as specified in IS-209-1966 shall be used for the purpose of galvanizing. The ladder type cable trays shall be painted with 2coats of red oxide primer and one coat of black enamel paint.

25.1.3 The joints of two trays shall be butt construction and shall be made with the help of coupler plates by nuts and bolts. The coupler plate and nuts and bolts shall also be properly hot dip galvanized, where the bends of the trays are required at site the same shall be supplied by the bidder without any extra cost. The spacing of rungs shall be max. 400mm centre to centre. While adopting the modules at site if cutting of any length is required the same shall be cut at site and joined by nuts and bolts with the help of coupler plates.

25.1.4

- i) The cable trays shall be supported on the solid supporting arrangement made from channel of minimum size 100x50mm and angle iron of size 50x50x6mm thick angle approximately at a distance of 0.1 to 1.2m center to center either from ground/wall or ceiling. However, the supporting system shall be designed by bidder suitable to bear the uniform load of respective tray. The calculations in respect of this design shall be supplied by the successful bidder during design stage. M.S. angle iron brackets shall be further supported/anchored either to wall or ceiling/ground as per the site requirement. The brackets and supporting system shall be painted with two coats of zinc chromate primer followed by two coats of synthetic enamel paint of approved colour conforming to relevant Indian standard.
- ii) Where cables trays shall be routed in trenches, the necessary angle iron side support should be provided by the bidder.

- iii) The provision for fixing of brackets support system of vertical side of approach tunnel should be made by the bidder for fixing the supporting system. However, bidder is requested to visit the site before preparation of this bids.
 - iv) Bidder is at its liberty to manufacture the cable supports arrangement at site or at his own workshop. Bidder shall have to bring all the tools/tackles, including welding machines etc. for the manufacturing of these cable supports.
- 25.1.5 The depth of trays shall be 30 mm and thickness 2 mm (min.) with width of 200 mm in case of perforated tray and depth of trays shall be 50 mm and thickness 15 mm (min.) with width of 600 mm in case of ladder type tray. Necessary standards equal and unequal 90 deg. Bends, tees and cross connections shall also be designed properly as per site requirement.
- 25.1.6 The free vertical distance between parallel trays/racks/ladder shall be at least 250mm and the trays shall be 50mm away from the walls. The trays shall be fixed to the brackets with proper nuts and bolts system.
- 25.1.7 The trays shall be free from sharp edges and burns etc. so that joint between two trays shall be without any clearance and matched in proper shape.
- 25.1.8 At the bends the curvature in all axis of trays/racks shall be 20R or maximum size of cable.
- 25.1.9 The supporting brackets/fixing bolts size shall be so calculated that the design load as specified under sub clause of clause 10.1 does not exceed.
- 25.1.10 The trays shall be installed in such a way that as far as possible the cables can be laid directly in place rather than be pulled through.
- 25.1.11 The current carrying cables shall be laid separately than the H.T. cables, L.T. cables and D.C. cables shall be laid in different trays.
- 25.1.12 The cables shall be fixed in the trays by means of plastic ties or plastic coated wires etc.
- 25.1.13 The number of tray shall be sufficient in order to accommodate all cables indicated in the BOQ for cables. However, the approximate quantity of different trays have been given in BOQ, which can be ensured by the bidder by visiting the site before filling the tender.

26.0 TELEPHONE SYSTEM

26.1 Scope

- 26.1.1 The scope of work shall cover supply installation commissioning and testing of (a) Telephone cable (b) telephone tag blocks (c) telephone wiring in conduits.
- 26.1.2 The client shall supply the telephone exchange and handsets.

26.2 Conduits

- 26.2.1 Conduit shall be of heavy gauged galvanized steel. The conduit shall be as specified under "conduit wiring".

26.3 Cable and Wire

- 26.3.1 The type of cable and services shall be as follows:

INDOOR

- i) laid on cable tray - multipair PVC insulated and armoured and sheathed of specified diameter.
- ii) inside conduit – twin core or 1pair PVC insulated wire of specified diameter.

OUTDOOR

- i) multipair PVC insulated jelly filled and armored with wires of specified diameter.

26.3.2 All multipair cable and wire shall be of tinned copper conductor of not less than 0.5mm dia and shall be colour coded twisted pair with rib code

26.3.3 The electrical characteristic shall be as follows :

Conductor mm	-	0.5 to 0.6mm
Loop resistance	-	190ohm / km
Insulation resistance	-	1500megohm/km
Capacitance unbalance	-	550PF/km @ 1KHz.

26.3.4 Cables laid underground or locations subject to dampness and flooding shall be filled with polythene compound and shall have sufficient protection against moisture and water ingress and armored as mechanical protection.

26.3.5 All armoring will be galvanized steel wire and protected against corrosion by an outer sheath of PVC in the case of indoor cables and polythene in case of outdoor cable.

26.3.6 All armored single core cable and inner sheath of armored cable shall be provided with ripcord.

26.3.7 All single pair cable for final extension to the telephone outlet box shall be unarmored tinned copper conductor of not less than 0.5mm dia and shall be drawn in conduit. All telephone outlets shall consist of 2A 2pair polythene connector in galvanized box with a telephone socket.

26.4 Tag Blocks

26.4.1 The telephone tag blocks shall be KRONE or equivalent suitable for the multicore telephone cables. Connectors shall splice unskinned cable up to 0.6mm dia and shall terminate both in and out line.

26.4.2 The tag block shall be mounted inside fabricated galvanized sheet steel boxes with removable hinged covers and shall be fully accessible.

26.5 Installation

26.5.1 The installation of conduits shall generally be as specified under “Conduit Wiring”

26.5.2 All cable shall be on cable racks and neatly stitched together.

26.6 Mode of Measurement

26.6.1 All cable will be paid as stated in MV cabling.

26.6.2 The multipair tag block shall consist of telephone connector KRONE or equivalent make and shall be measured and paid as one unit complete with galvanized enclosure box.

26.6.3 The conduit wiring for telephone out shall include single pair 0.5mm dia cable in conduits and shall include junction boxes, pull boxes and shall be paid per unit length with no. of pairs as

shown in schedule of work. Telephone outlets shall be paid per unit and shall cover outlet terminal connector, plate type outlet box wiring etc complete.

27.0 UNINTERRUPTIBLE POWER SUPPLY (UPS)

This specification describes a three-phase, on-line, continuous operation, solid-state uninterruptible power supply (UPS). The UPS shall operate as an active power control system, working in conjunction with the building electrical system to provide power conditioning and on-line power protection for the critical loads.

Description

- A. The UPS shall consist of the following easy to repair modular rectifier/inverter sections and easy to install internal and external modular battery units.
- B. The UPS shall be provided with separate feeds for rectifier/inverter section and the static bypass switch.
- C. Modes of operation: The UPS shall operate as an on-line system in the following modes:

Normal: The inverter and the rectifier shall operate in an on-line manner to continuously regulate the power to the critical load. The rectifier shall derive power from the AC input source and supply DC power to float charge the battery.

Battery: Upon failure of the AC input source, the critical load shall continue being supplied by the main inverter without any switching. The inverter shall obtain its power from the battery. There shall be no interruption in power to the critical load upon failure or restoration of the AC input source.

Recharge: Upon restoration of the AC input source, the UPS shall simultaneously recharge the battery and regulate the power to the critical load.

Bypass: The static bypass switch shall be used for transferring the critical load to input supply without interruption. Automatic re-transfer to normal operation shall also be accomplished with no interruption in power to the critical load. The static bypass switch shall be fully rated and shall be capable of manual operation.

The UPS shall be able to recharge the batteries while supplying full power to the load via the static bypass switch.

Internal maintenance bypass: The UPS shall be provided with an internal manual bypass to simplify the installation and shall be used for supplying the load directly from the mains supply, while the UPS is taken out for maintenance.

External maintenance bypass [optional]: The external maintenance bypass switch shall be used for supplying the load directly from the mains supply, if the UPS is to be replaced. An UPS input, output, and bypass switch shall be housed in the same low-voltage assembly. The bypass switch must be monitored by the UPS via an auxiliary contact. The maintenance bypass must be housed in a wall mounted low-voltage assembly that complements the appearance of the UPS.

- D. The UPS shall be provided with RS-232 signalling and WEB/SNMP integration. This system must provide a means for logging and alarming of all monitored points plus email notification.
- E. The UPS shall have nominal voltage of 3×400/230V (adjustable for 3×380/220V, 3×415/240V), 50Hz 3 and 4-wire + earth configurations.

The UPS shall be compatible with all types of data centers, data rooms and facilities. Dedicated service to one specific environment shall not be acceptable.

Standards

- a) Safety: EN50091-1-1 / IEC 62040-1-1
- b) Emissions: EN50091-2/IEC 62040-2
- c) Performance: EN/IEC 62040-3
- d) IEC 61000-3-2
- e) IEC 61000-3-3,

Classification

Classification according to EN/IEC 62040-3: VFI-SS-112

Product

GENERAL

- i. The UPS shall be housed in a free standing enclosure. The enclosure shall be designed to blend into an IT environment. The cabinet shall be equipped for fork truck lifting. The UPS cabinet shall be painted with the manufacturers standard colour, black. All service and installation access shall be from the front and top
- ii. The UPS shall be in a self contained cabinet and comprise 10kVA, 15kVA, 20kVA, 30kVA or 40kVA power section; Bypass Static Switch; Battery for standard run time and interface LCD display all mounted in a separate cabinet. The UPS shall permit user installable and removable battery units. The power section shall be of the Double Conversion On-Line topology with power factor corrected inputs.
 1. The UPS shall be sized for 5 / 10 kVA and 4 / 8 kW load.
 2. The UPS battery shall be sized for 5 / 10 kVA at a power factor of 0.95 for 10 minutes.
- iii SYSTEM INPUT
 1. Nominal Input voltage rating: 3x400V (adjustable for 3x380V or 3x415V)
 2. Input Voltage range: 304-477V
 3. Earthing principle: [TN-S] [TN-C-S] [TN-C] [TT] or [IT].
 4. Input frequency: 40-70 Hz (auto sensing)
 5. Input power factor: 0.98
 6. Magnetizing inrush current: NONE, if optional input isolating transformer is installed then 500% of nominal input current for less than one cycle
 7. Input current distortion with no additional filters:
 8. < 5% THD at 100% load
 9. Power walk-in/Soft-Start: Shall be linear from 0 to 100% of the load over a 15-second period
- iv System Output
 1. Nominal Output voltage rating: 3x400V.
 2. Earthing principle: [TN-S] [TN-C-S] [TN-C] [TT] or [IT].
 3. Output voltage regulation for steady state and transient variations (at default parameter settings):
 - a. $\pm 1\%$ steady state for a static 100% balanced load.
 - b. $\pm 1\%$ steady state for a static 100% unbalanced load.
 - c. $\pm 5\%$ for a 0 to 100% load step.
 4. Max. voltage transient recovery time: 50 milliseconds to nominal.
 5. Output frequency regulation:

- a. Synchronised to mains over the range of 47-53Hz or 57-63Hz in normal operation
- b. 50 Hz \pm 0.1 Hz in battery operation.
- 6. Output voltage harmonic distortion:
 - a. <2% THD maximum and 1% single harmonic for a 100% linear load
 - b. <5% THD maximum for a 100% non-linear load
- 7. Overload capability:
 - a. 150% for 30 seconds in normal operation.
 - b. 110% continuous in bypass operation
 - c. 800% for 500 milliseconds in bypass operation
- 8. Phase displacement:
 - a. 20 degrees \pm 1 degree for balanced load.
 - b. 20 degrees \pm 1 degree for 50% unbalanced load.
 - c. 20 degrees \pm 3 degrees for 100% unbalanced load.
- 9. Output Power Factor Rating: For loads exhibiting a power factor of 0.5 leading to 0.5 lagging, no derating of the UPS shall be required.
- 10. Short circuit withstand: The UPS must withstand a bolted-fault short circuit on the output without damage to the UPS module.
- 11. System AC-to-AC efficiency 100% load
 - a. 10kVA **95.7%**
- 12. System AC-to-AC efficiency 50% load
 - a. 10kVA **94.1%**
- 13. Acoustical noise: dB(A) of noise, typically, measured at 1 meter from the operator surface:
 - a. 10kVA 64

v. Components

a. Rectifier

- 1. Each UPS power module shall include an active power factor corrected, Insulated Gated Bipolar Transistor (**IGBT**) rectifier.
- 2. DC buss voltage shall be \pm 192Vdc nominal.
- 3. The battery charging shall keep the DC bus float voltage of +/- 220v, +/-1%
- 4. The DC buss voltage shall be compensated against temperature variations (Battery Temperature Compensation) to always maintain optimal battery float charging voltage for temperature excursions above or below 25°C. Temperature compensation rate shall be 320mV/°C for ambient temperatures > 20°C and 0mV/°C for ambient temperatures < 20°C.
- 5. DC ripple voltage shall be less than \pm 1% of nominal with no battery connected.
- 6. Input power factor shall be 0.98 lagging at 100% load without the use of passive filters. Rectifier shall employ electronic waveform control technology to maintain the current sinusoidal.
- 7. Pulse Width Modulation (PWM) current control shall be used. Digital Signal Processors (DSP) shall be used for all monitoring and control tasks. Analog control is not acceptable.
- 8. Reflected input current Total Harmonic Distortion (THD) shall not exceed **5% at 100% load.**
- 9. Input voltage window: **304-477V.**
- 10. Typical battery recharge time per IEEE 485.

b. Batteries

1. Standard battery technology shall be Valve Regulated Lead Acid (VRLA).
2. Batteries shall be housed in the same rack as the power section. Batteries shall be modular on pull out shelves for quick replacement and servicing.
3. Battery voltage shall be Battery Temperature Compensated as outlined in the rectifier section above.
4. End of discharge: $\pm 160\text{Vdc}$.
5. For longer runtimes, external battery frames in the same design should be offered.
6. Battery Charge Current Limit: The UPS shall be capable of limiting the energy sourced from the mains for purposes of battery charging. As a default setting, the battery charge energy will be set to 100% of its nominal value. When signaled by a dry contact, (such as from an emergency generator) the UPS shall be capable of limiting the battery charge energy taken from the mains. This shall take place in user selectable increments of 75%, 50%, 25%, 10% and 0% of the nominal charge power. The selection shall be made from the UPS front panel display/control unit.
7. The battery charging circuit shall remain active when in Static Bypass and in Normal Operation.

c. Inverter

1. The inverter shall consist of fast switching IGBT power module.
2. Inverter shall be PWM controlled using DSP logic. Analog control shall not be acceptable.
3. The inverter modules shall be rated for an output power factor at 0.8.
4. Nominal output voltage shall be 3x400V and adjustable for 3x380V or 3x415V, 50Hz, L1,L2,L3,N,PE.
5. Efficiency of each module at full load: Not less than
 - 10kVA **94.7%**
6. Output Voltage Total Harmonic Distortion at full load:
 - Less than 2% for 100% resistive load.
 - Less than 5% for computer load as defined by EN50091-3/IEC 62040-3.
7. Output voltage regulation
 - Static: Less than 1% at full linear load.
 - Dynamic: 5% at 100% step load.
8. Output frequency: 50Hz free running.
9. Crest factor: Unlimited but regulates it down to 2.7.
 - a. Remote Emergency Power Off (EPO) shall be standard (wall switch and wiring shall be provided by the electrical contractor).
 - Static Bypass Switch

1. The static switch shall consist of fully rated Silicon Controlled Rectifiers (SCRs). Part rated SCRs with a wrap around contactor are not acceptable.
2. The static bypass switch shall automatically transfer the critical load to bypass input supply without interruption after the logic senses one of the following conditions:
 - Inverter overload beyond rating.
 - Battery runtime expired and bypass available.
 - Inverter failure.
 - Fatal error in control system.
3. The static bypass switch shall automatically retransfer from bypass to the inverter, when one of the following conditions occurs:
 - After an instantaneous overload-induced transfer has occurred and the load current has returned to less than 100% of the system rating.
 - The inverter is active (on).
4. The static bypass switch shall be equipped with a manual means of transferring the load to bypass and back to inverter.
5. If more than 10 transfers from and to inverter occur in a 10 minutes period, the load shall be locked on static bypass. An alarm communicating this condition shall be annunciated.

vi Mechanical

a. SUVT

1. The UPS power section, Static Bypass Switch, internal manual bypass switch and the VRLA batteries shall be housed in a free standing enclosure in a matching black color having the following specifications:
 - Colour finish. Black
 - Dead front construction
 - Caster fitted for mobility. Leveling feet shall be supplied as standard.
 - The cable entry shall be from the bottom on the back of the UPS.
 - The SUVT UPS enclosure shall meet an ingress level of min. IP20.

vii Display, Controls and Alarms

- a. A microprocessor controlled display unit shall be located on the front of the system. The display shall consist of an alphanumeric display with backlight, an alarm LED, and a keypad consisting of pushbutton switches.
- b. The following metered data, shall be available on the alphanumeric display:
 1. Year, Month, Day, Hour, Minute, Second of occurring events
 2. Input AC Voltage
 3. Output AC voltage
 4. Output AC current
 5. Input Frequency
 6. Battery voltage
 7. Highest Internal Battery temperature
 - a. The display unit shall allow the user to display an event log of all active alarms and of the 64 most recent status and alarm events. The following minimum set of alarm conditions shall be available:
 1. Static bypass switch on
 2. EPO Active

3. Mechanical bypass activated
4. External bypass switch (Q3) activated
5. Battery discharged
6. Return from low battery
7. Low battery
8. Load not powered from UPS
9. UPS in bypass
10. Runtime calibration aborted
11. Runtime calibration started
12. Runtime calibration complete
13. Battery self test aborted
14. Battery self test started
15. Battery self test completed
16. Number of battery modules decreased
17. Number of battery modules increased
18. Fan fault
19. SBS fault
20. System not in sync.
21. Bypass not available, frequency/voltage out of range
22. Mains voltage/frequency out of range
23. Site wiring fault
24. Low battery voltage shut down
25. XR battery breaker or fuse open
26. Defective battery detected
27. Runtime is below alarm threshold
28. Load is above alarm threshold
29. Battery over-voltage warning
30. Battery over-temperature warning
31. Emergency power supply fault
32. Output overloaded

b. The following controls or programming functions shall be accomplished by use of the display unit. Pushbutton membrane switches shall facilitate these operations.

1. Silence audible Alarm
2. Set the alphanumeric display language
3. Display or set the date and time
4. Enable or disable the automatic restart feature
5. Transfer critical load to and from static bypass
6. Test battery condition on demand
7. Set intervals for automatic battery tests
8. Adjust set points for different alarms
9. Program the parameters for remote shutdown.

c. The following shall make up the UPS front panel user interface.

1. Indicating LED's
 - Load On When Green, this LED indicates the load is being supported by the UPS output
 - On Battery When Yellow, this LED indicates the UPS is running from Battery power
 - Bypass When Yellow, this LED indicates the load is being supported by static bypass/mechanical bypass
 - Fault When Red, this LED indicates there is a fault condition present in the UPS.
2. Push Button User Controls
 - Up Arrow
 - Down Arrow
 - Help Key
 - Escape Key
 - Enter Key

a. Potential Free (Dry) Contacts

The following potential free contacts shall be available on an optional relay interface board:

- Normal Operation
- Battery Operation
- Bypass Operation
- Common Fault
- Low Battery
- UPS Off

b. For purposes of remote communications with the UPS the following shall be available and contained within the UPS on a removable, "hot swappable" "smart slot" interface card:

1. RJ-45 Interface port for remote communications with a network via web browser or SNMP, or APC InfraStruXure Manager.
2. Environmental monitoring feature, capable of locally monitoring temperature and humidity as well as one additional generic set of user determined dry contacts capable of taking an input signal from any APC or third party on/off signal, such as water detection, smoke detection, motion, or fire detection.

viii Battery

1. The UPS battery shall be of modular construction made up of user replaceable, hot swappable, fused, battery modules. Each battery module shall be monitored to determine the highest battery unit temperature for use by the UPS battery diagnostic, and temperature compensated charger circuitry.
2. The battery blocks housed within each removable battery module shall be of the Valve Regulated Lead Acid (VRLA) type.

Minimum VAH Shall be **9900VAH**

Execution

i. FACTORY ASSISTED START-UP

If a factory assisted UPS start-up is requested, factory trained service personnel shall perform the following inspections, test procedures, and on-site training:

A. Visual Inspection:

Inspect equipment for signs of damage.
Verify installation per manufacturer's instructions.
Inspect cabinets for foreign objects.
Inspect Battery Units.
Inspect Power Module(s).

B. Mechanical Inspection:

1. Check all UPS and external maintenance bypass cabinet internal power wiring connections.
2. Check all UPS and external maintenance bypass cabinet terminal screws, nuts, and/or spade lugs for tightness.

C. Electrical Inspection:

1. Verify correct input and bypass voltage.
2. Verify correct phase rotation of all mains connections.
3. Verify correct UPS control wiring and terminations.
4. Verify voltage of all battery modules.
5. Verify neutral and ground conductors are properly landed.

6. Inspect external maintenance bypass switch for proper terminations and phasing.

D. Site Testing:

1. Ensure proper system start-up.
2. Verify proper firmware control functions.
3. Verify proper firmware bypass operation.
4. Verify proper maintenance bypass switch operation.
5. Verify system set points.
6. Verify proper inverter operation and regulation circuits.
7. Simulate utility power failure.
8. Verify proper charger operation.
9. Document, sign, and date all test results.

E. On-Site Operational Training: During the factory assisted start-up, operational training for site personnel shall include key pad operation, LED indicators, start-up and shutdown procedures, maintenance bypass and AC disconnect operation, and alarm information.

28.0 ELECTRICAL DRAWINGS TO BE SUBMITTED BY CONTRACTOR

For approval before construction/erection

The Contractor shall submit the following documents.

- a) For all the supplies, the contractor shall submit the following documents in 4 sets for approval.
- General arrangement drawings, with all dimensions, showing: space-requirements, weights (for transport and service conditions), requirements of civil works (compatible with the tendered specifications), fixing and mounting facilities, connection devices, etc.
 - Electrical drawings, showing: power single line and functional/control multi line diagrams, terminal blocks, components' list with make, type, quantity, etc.
 - Quality assurance plan and bar-chart showing manufacturing schedule.

The contractor shall incorporate all comments and submit revised drawings in stipulated time till all drawings are finally approved for manufacturing.

- b) For installation work, the contractor shall submit the following documents in four sets for approval:
- Single line diagrams and substation/ electrical room layouts, based on working drawings of GEL / Contract specification, required for approval of Electrical Inspectorate and required for submission to other local authorities for approval.
 - Detailed lighting layout drawings showing exact locations of lights and other fittings as per site conditions and instructions, conduit routes, phase wise distribution on each LDB, mounting details of each type etc. based on the tender documents.
 - Detailed cable and earthing layout drawings showing cable route, cable trays with number of trays and mounting heights, marking of cable numbers in each typical route of cable trays, mounting details of each type etc. based on the tender documents.
 - Cable schedule showing cable number, cable sizes and cables route as per layout documents.

Final

The contractor shall submit the following documents, reflecting the true final as built situation, in 6 sets, and one soft copy in CD.

- a) The drawings including wiring diagrams as revised and "as built".
- b) Inspection and preliminary testing certificates and reports and shipping release.
- c) Test certificates of kWh meters from Government approved Lab or Electric Supply Co. of concerned area.
- d) Copies of completion certificates & test reports submitted to Electrical Inspectorate.
- e) Statutory certificates/approvals for materials and equipment.
- f) Guarantee certificates.
- g) Instruction & maintenance manuals, Cataloguers etc.
- h) Any other certificate / report as called for by the Engineer.

Note: All wiring diagrams shall indicate clearly the main switch board, the runs of various mains & sub mains, position of all points and their control. All circuits shall be clearly indicated and numbered in the wiring diagrams and all points shall be given the electrical connections.

29.0 LIST OF RECOMMENDED MAKES OF MATERIAL

Sl.	ITEM	APPROVED MAKES
1	Relays	SCHNEIDER / SIEMENS / L&T
2	Meters	ENERCON/ NEPTUNE / AEI
3	Ammeter/Voltmeter selector switch	L&T/ KAYCEE / SALZER
4	Indicating Lamp	SIEMENS/VAISHNO/ L&T
5	Push Buttons / Indicating Lamps	L & T (RISHAB) / SIEMENS / BCH / VAISHNO
6	H. T. Cable	CCI / POLYCAB / NICCO
7	L. T. Power, control and signal cable	CCI / POLYCAB / NICCO
8	H. T. cable termination kit	M-SEAL / FRONTEC / RAYCHEM
9	Cu. Wires	MESCAB / FINOLEX / RR KABEL
10	MCB / RCCB / RCCBO	SCHNEIDER / SIEMENS / L&T
11	Lighting Fixture	PHILIPS / GE / BAJAJ
12	Wall/ Ceiling / Exhaust Fans	USHA / CROMPTON / KHAITAN
13	MCB Distribution Board	SCHNEIDER / SIEMENS / L&T
14	MCCB / Contactor	SCHNEIDER / SIEMENS / L&T
15	Air Circuit Breaker	SCHNEIDER / SIEMENS / L&T
16	PVC conduit & Accessories	ISI Marked
17	Power Factor Correction Relay	SCHNEIDER / SIEMENS / L&T
18	Power Factor Correction Capacitors	SCHNEIDER / SIEMENS / L&T
19	Ceiling / Exhaust Fan	USHA / KHAITAN / BAJAJ
20	Industrial Power Socket Outlets	SCHNEIDER / SIEMENS / L&T
21	Switches and Sockets modular type	SCHNEIDER / SIEMENS / L&T
22	M.S.Conduit	JINDAL / TATA / GST
23	HT VCB	SCHNEIDER / SIEMENS / L&T
24	LT Cable termination materials	DOWELLS / COMET / LOTUS
25	Cable Tray	FABRICATED
26	CT	KAPPA / AUTOMATIC ELECTRIC / BCH
27	Diesel engine	CUMMINS / CATERPILLAR / KIRLOSKAR

28	Alternator	KIRLOSKAR / STAMFORD / AREVA
29	33KV Rubber Mat	ISI marked
30	33KV Rubber Hand Gloves	ISI marked
31	Transformer	SCHNEIDER(Areva) / RPG / VOLTAMP
32	Lift	OTIS / KONE / MITSUBISHI / THYSENCRUP
33	Busduct / Rising main	SCHNEIDER / LEGRAND / GE

MATERIALS NOT MENTIONED HERE SHOULD BE ISI MARKED OR OF BEST LOCAL MAKE

30.0 LIST OF WORKS AND PRICES FOR INTERNAL ELECTRIFICATION

Notes:

1. All quantities in this schedule are PROVISIONAL.
2. The rates of all items are for supplying, fixing, connecting up and testing complete all as specified except where otherwise stated in this schedule.
3. The cost of materials and labour for leaving / forming / cutting necessary holes, chases, recesses, etc. in walls, ceiling, floors etc and making good in cement and sand mortar (1: 3) and finishing to match the adjoining surfaces, shall be deemed to be included in the quoted rate.
4. All internal wiring shall be carried out with surface type conduit of PVC. This type of wiring shall be applicable for the entire building. Earthing wire for individual circuits and / or sub main circuits should run inside the Conduit itself. Earthing conductor shall NOT be laid/ run separately outside the conduit. The minimum size of conduit shall be 20mm. Conduit sizing shall otherwise be made as per applicable standards.
5. Earth continuity shall be checked and so approved by the client.
6. Light fixtures inclusive of lamps, all as specified.
7. Switch boards with switches, sockets, for both power and lighting, all as specified.
8. Call bells with bell push, all as specified.
9. Internal wiring complete in all respect including earth pits and earthing connections as specified.
10. Modular switch / Socket, Bell push, as specified.

The cost of materials and labour for pressed steel circular fan box with hook complete shall be included in the civil item.

TECHNICAL SPECIFICATION
FIRE PROTECTION SYSTEM

FIRE PROTECTION SYSTEMS :

1.0 Scope:

This specification covers the general requirements for Supply, site/shop fabrication, excavation and execution, testing, cleaning/flushing ,back filling and mending good all the damages in walls / floors, etc. and painting with approved paints wherever necessary and commissioning of M.S.- Black, ERW, "Heavy" class (as per IS-1239, P-I), Pipes for 150mm NB and below and as per IS-3589 for 200mm NB of 6.35mm thickness and Pipe Fittings, Valves and accessories. Fire Fighting system shall be designed as per the National Building Code Of India, NFPA and latest Indian standards.

2.0 General:

All piping materials and testing shall conform to the relevant IS specifications of pipes, valves and other accessories unless otherwise specified.

All pipe work shall be in conformity with the requirements of the applicable drawings and specifications.

Piping shall also comply with applicable State, local or other Governmental laws and codes. In case of conflict with this specification the more rigid specification shall govern.

All works shall be performed in accordance with the best modern practice for this type of work and shall be of the highest quality of workmanship.

Any deviation from this specification must have the written approval of the Employer/the Engineer.

The eligible Contractor should obtain the "No Objection Certificate" (N.O.C.) for Execution of Works at Site and also the all requisites (if any) from The Fire Statutory Bodies of West Bengal / India; for this Tendered Job by his own accord on-behalf of the Client.

3.0 Fabrication:

All M.S.-Black, ERW, Pipes (inside pump room and the pump suction pipe, and the Hydrant "Ring Main", Wet Riser, Hydrant Posts, Sprinkler Main etc) shall conform to **IS:1239, Part-I - for 150m NB and below and as per IS-3589 for 200mm NB 6.35mm thick**, including the necessary welding works / site fabrication of 'Long' / 'short' radius Bends, Tees, etc (**as per ANSI B 16.11 class**) as specified in the drawings and BOQ.

All pipe fittings for required nominal diameters shall be of fabricated and welded fittings especially on pump suction pipe side. No screwed fittings shall be used on pump suction pipe side unless otherwise specified.

Flat face or raised face flanges with full face or ring type CAF gaskets shall be used to mate with respective flange of same standard and dimension of the equipment.

Welding elbows (either fabricated at site) shall be of long radius type unless otherwise specified.

All completed piping both bend and welded, shall conform to the fabrication dimensional tolerance specified in the IS / ASTM standards of the pipe fabrications and shall in no case deviate the tolerance limits mentioned therein.

All butt welded pipe fittings are used/fabricated especially for 150mm and 200mm nominal diameter pump suction pipes etc. and each fittings (i.e. butt weldable bends, Tees, etc .) shall have the inside diameter and wall thickness equal to as more than the pipe to which they are welded.

3.1 Pipe Fabrication:

Templates shall be used in laying out headers, laterals and other irregular details to ensure accurate cutting and proper fitting.

Machine cut bevels to form the welding groove are preferred , but smooth, clean, slag free flame cut bevels are acceptable but all flame cut bevels are to be properly machined before welding joint works to be taken up.

In fitting up details preparatory to final welding, spacers shall be used while tack welding the pipe and connections in position so that a proper gap is made for full penetration of welds. The following are the recommended gaps:

- For pipe size below 150mm : 1.5mm weld gap.
- For pipe size of 150mm nominal dia : 3mm weld gap.
- For pipe size of 200mm nominal dia : -DO-

Only small tack welds which penetrate to the bottom of the welding groove shall be used and shall become a part of the finished weld. Tack welds having penetration are not acceptable and must be chipped out. Each weld shall be cleared of all scale, slag, flux and other foreign matters before additional welding beads are applied.

4.0 Pipe Joints:

In general all pipe joints (in the Pump Room) shall be screwed or welded as specified in the applicable valve and piping specifications.

Flange faces shall be in a plane perpendicular, true and square to the center line of the pipe to which they are welded.

Bolts on flanged joints shall be drawn to provide even and adequate pressure on gaskets as required.

Bolt holes shall straddle normal center lines in the vertical and horizontal planes unless otherwise specified.

All gaskets used in pipes and pipe fittings / valves etc. should be of **CAF (compressed asbestos fibre) gaskets** except joints, where rubber gaskets are to be used in some special cases; as per **IS:5382** of SBR quality are used. However, Neoprene rubber gaskets may be used only on some special requirements as per the direction of the Engineer in-charge.

All pipe threads in case of pipes, fittings and valves shall conform to British Standard pipe threads **BS:21/IS** unless otherwise specified.

5.0 Jointing and laying :

For jointing Gaskets on joints, a suitable jointing tackle is preferred and the Gasket is pushed through inside through the pipe flange to flange joints until the compressed gasket sealed properly the gap between the two flanges. For pulling the pipes/fittings, if required suitable crow bar or a suitable pulling mechanism like TIRFOR may be used alternately a chain rope pulley also may be used. After jointing is complete the proper position of the gasket is

confirmed by inserting a feeler gauge into the gap between the socket and the spigot to ensure that joint deflections if any are within the allowable tolerances.

5.1. Jointing of Flanged joints of Pipes & fitting:

All flanged joints should be of **(PN-16)** rated. The faces of the flanges are cleaned and made free from dirt or particles of foreign matter. The gaskets to be used between the flanges of pipes and fittings should be of **3mm thick** and of compressed asbestos fibre **(IS:2712)** or 3mm thick neoprene rubber **(as per IS:638)**. All joints below G.L. should be of CAF gaskets of at least 3mm thick. Flanged joints should be bolted in correct sequence and to the appropriate torque.

5.2. Jointing of pipes & pipe Fittings/ Valves, etc. with screwed ends:

All threaded pipes, fittings and valves etc. shall conform to British Standard pipe threaded **BS:21**-male or female threaded unless otherwise specified. All threaded joints are jointed and tightened, after applying Teflon thread seal and after wrapping in correct sequence. Proper tightening of the threads are necessary but with caution to avoid any damages to the thread and thread seal.

Pipes / fittings to HDPE pump priming tank joining is done by G.I. jam nut (i.e. coupling nut with rubber / PVC washer) with washers.

A Pump Priming Tank is to be used (of **at least 500 litres** capacity) with necessary piping arrangement for Priming.

All Underground pipes shall be laid through RCC pipes at road crossings atleast at depth of approximately 1m below road level.

6.0 Pipe Bends :

All M.S. Pipe bends of respective nominal sizes shall be of Butt weldable or fabricated bends suitable for Butt welding.

Pipe bends of 25mm nominal dia or less can be of threaded type, only if required for connection for screwed Gate valves of respective sizes.

All hot fabricated pipe bends of respective diameters shall be done with the pipe filled with sand. Following the bending operation, the bend shall be allowed to cool slowly in still air before the sand is removed. The minimum radius shall be 6 times the nominal pipe diameter.

All cold bends be made to a radius of 6 times the nominal pipe diameter or greater may be made without subsequent stress relieving. No cold bending is allowed on pipe larger than 50mm nominal diameter.

7.0 Welding :

Welding procedures shall be qualified in accordance with the requirements of the codes and **IS-817/1966**. Welders should and must have valid welding certificates and should be of 6-G compatible. Horizontal and vertical welding qualifications shall be shown on qualification papers.

All welding shall have full thickness penetration and shall be done by the Electric Arc process. The initial root run of all but welds shall be carried out with electrodes not exceeding 12 SWG.

Welding electrodes used for GI piping work (only inside Pump room) shall be in accordance with **IS:6013** and of high quality from reputed manufacturers – like Advani Oerlikon/ Essab, etc.

In multiple pass welding the slag shall be cleaned from each layer and any serious defects chipped out before the next layer is applied. Peening shall be done if necessary to prepare a bead for the next pass.

The completed weld shall be cleaned off slag and spatter metal on all surfaces and when possible the inside bead shall be ground smooth.

No under cutting of pipe adjacent to the completed weld will be permitted.

Finished welds shall project not less than 1.5mm but not more than 3mm from the outer surface of the pipe.

Contractor may be requested to carry out any spot radiography test against the payment of the cost incurred for the same for any particular special reasons.

8.0 Installation & Erection:

Piping shall be grouped in banks wherever possible but must be at the same time have neat and economical layout with minimum number of fittings.

All flanged joints shall be fitted up so that the gasket contact faces bear uniformly on the gasket and then made up with relatively uniform bolt stress. The gasket shall be properly compressed in accordance with the design principles applicable to the type of gasket used. All bolts shall extend completely through their nuts.

Grouting of all rotary equipments (i.e. pumps & motors, etc.) shall be done before the connected piping has been installed and properly anchored or imported.

Valved Air release points shall be provided as per the marked locations in the water supply. Master Plan layout drawing to release trapped air inside the pipe line network, especially at all distant bend points or any other special locations as per approval of the Employer/Engineer in-charge.

After piping is erected/installed in final position, it shall be tested, cleaned and flushed and dried out where required.

Necessary to be done to minimize as far as possible the number of butt welded joints and flanged / screw joints in case of pipes and to minimize the number of flanged gasket joints.

All pipes and pipe fittings / valves shall be thoroughly cleaned off oil and grease using a solvent degreaser, which must then be allowed to dry. All rust, soil and other unwanted matter must be removed prior to solvent degreasing by chipping, manual scrapping and wire brushing.

All external surfaces of underground pipes (i.e., Hydrant Ring Main, Sprinkler Main) and Pump suction pipes to be given a wrapping coating of “PYPKOTE” make Coal Tar based Resin bonded HMDPE Film of 4mm thick, as per IS-10221, for anticorrosive treatment with a Lapping of joints for at least 15mm and that to be followed by the necessary ‘Holiday’ Testing for any gaps or Blow-holes testing etc.

All external surfaces of pipes remaining exposed to air above ground level (inside the pump room or outside) should be painted with 2 coats of synthetic enamel paint (**colour- Red as per IS:2379**) of approved make as per IS codes after application of a ready mixed priming coat of red oxide paint **only after the successful Hydrostatic Testing of pipes with the**

specified Test Pressure as per the Tender / direction of the Engineer in charge of the Client / Consultant with a minimum “Holding Time” of two hours.

Care should be taken to avoid any damages scratches to the paint film thickness especially for the anti-corrosive paints below ground level etc. during lowering and installation of pipes.

Sufficient time to be given to dry the anti-corrosive Wrapping Coating of pipes before back filling of the earth in case of all underground GI pipes.

9.0 Flanges:

Minimum number of flanges must be provided to facilitate servicing, inspection and maintenance. Particular attention must be paid to flanging of lines where there is possibility of blockage (particularly below road crossing areas). In such cases consideration should be given to locate flanges immediately on either side of the road through which the pipeline passes. All flanges to be fixed with MS-Black pipes should be of MS **ASA#150 class flanges (slip-on type) as well as Blind flanges**. All flanges to be painted with anti corrosive paint also if fitted with underground pipes.

10.0 Valves:

Valves shall be provided on all mains entering the building or any small/medium scale plant areas as required and mentioned in the Hydrant Pipe – Master Plan(layout) drawing.

All underground valve points should be provided with a valve chamber of brick masonry with PCC bed with CI pit cover, as mentioned in the above mentioned drawing and in BOQ.

All swing check (wafer type) valves should be fixed and installed in the vertical runs of individual pump discharge pipes.

All wafer type Butter-fly valves, lever operated (with a locking devise) shall be installed in the vertical runs of individual pump discharge pipes.

All Non-rising spindle type, hand wheel operated **Gate / Sluice valves** to be used in the pump suction and discharge piping along with ‘Y’ type strainers only on the pump suction side.

A by-pass line with a spring loaded (with a set pressure) pressure release valve is to be provided and installed on the delivery pipe of the pumps.

11.0 Clearance & Cover:

Where not otherwise specified on the drawings, valves shall be located and installed so as to provide the following clearance:-

- i) Below valves : 300mm minimum
- ii) Above valves : Sufficient to remove bonnet with wedge.

The minimum cover for field run for buried pipes at road crossing areas shall be at least 1 meter at the crossing under roads.

12.0 Inspection & Testing:

Air Release Valve, Pressure release valves which do not have test pressure indicator shall be removed or blanked off in order to exclude from the test.

All blank-off shall be flanged or visibly marked so that they may be easily identified for removal after testing.

All metal welds shall be hammer tested and all welds shall be visually inspected for leaks while at test pressure. Carpenters blue chalk shall be used to detect any leakage through welds.

All piping network should be hydrostatically tested either for a test pressure of 11Kg/cm² (gauge) or 1.5 times the working pressure whichever is higher, and the hold time should be at least 2 hours.

Piping to be buried or otherwise made inaccessible after installation shall be inspected and pressure tested before it is buried or installed.

All exposed pipes shall be hydrostatically tested and found "OK" before taking up the painting work.

Pipes shall be "Spot Radiographed" by the Contractor if being asked by the Client / Consultant.

Lines repairs by welding /screwing subsequent to a pressure test shall be tested in sections in order to permit completion of work in an area , however, a section found "OK" after testing shall be blanked and tagged accordingly and subsequently tested as a complete system prior to final acceptance.

Test Reports shall in all cases be maintained on log sheets and duly certified by the Client / Consultant.

The test gauge shall be installed at the highest point of the pipe loop being tested and the test pump (preferably hand driven water pump / or Gear Pump as suitable) at the lowest level.

The test shall be started preferably during early morning and late afternoon hours of the day.

All manufacturer's material test certificate must be submitted by the contractor to the employer with a copy to the consultant (Gherzi East) for pipes, valves and all other accessories below the execution of work, and has to obtain clearance from the employer and the engineer in-charge of the Consultant.

FIRE FIGHTING PUMPS PANEL:

13.0 FIRE PUMP M.C.C.

GENERAL

13.1 Installation

Installation of all LT panels shall include but not limited to the following to complete the installation, testing and commissioning:

- a) Design, fabrication, assembly & supply of the panels
- b) Transporting materials from stores to exact location of installation.
- c) Supply and installation of required base frame made of MS angle or channel sections and duly painted with black paint.
- d) Positioning, aligning, fixing, assembling, and installation of LT panel
- e) Site supervision, testing for proper functioning / operation, and pre- commissioning tests.

13.2 Commissioning and Testing

- a) All switchboards shall be tested for dielectric test with 1000V megger.
- b) All earth connections shall be checked for continuity.
- c) All busbar connections shall be checked and tightened properly.
- d) All cable terminations and terminal shrouding shall be checked if they are properly done.
- e) The operation of protective devices shall be tested by secondary injection test.
- f) The operation of circuit breaker shall be tested for all interlocks.
- g) Functional test shall be done for all ACBs, MCCBs and other components.
- h) Indicating lamps and meters shall be checked for proper working.

13.3 Moulded Case Circuit Breaker (MCCB)

- a) MCCB shall be capable of breaking short-circuit currents upto levels as specified in Bill of Quantities/drawing.
- b) MCCB shall be made of insulating case and cover made of high strength, heat resistant and flame-retardant thermosetting insulating material conforming to 1S:2516, IEC 947 Part 2 of 1989, BS 3871, 1965 or other applicable standards.
- c) The switching mechanism shall be quick make/quick-break type utilizing a trip free toggle mechanism. The handle position shall give positive indication of whether the breaker is ON(top), OFF(down) or TRIP (midway). For overload protection, three bimetal magneto-thermal release and electromagnetic releases for short circuit protection to be provided. The magneto-thermal release shall be variable and direct acting. All releases shall operate on a common trip bar so that all phases are disconnected in the event when fault occurs even on only one of them. The tripping mechanism shall be of an inverse time characteristics to prevent tripping on temporary overloads and shall not be affected by normal variation in ambient temperature.
- d) Rotary handles shall be provided for ease in operation.
- e) The contacts shall be made of silver alloy and arc chutes shall be made of de-ion plates. These plates shall be housed in a vulcanized fiber casing. The arc chutes shall be capable of quenching the arc rapidly and drawing away the arc from contact tips.
- f) The terminals shall have sufficiently large dimensions to accept links or cable lugs of suitable sizes. These shall be of a reputable manufacturer.

13.4 Starters

The starters for rotating machines shall be as follows:-

- 11 KW & below : Direct on Line.
- above 11KW to 200 KW : Star Delta
- Above 200 KW : Soft start

The starters shall comply the following features: -

- Main and auxiliary contacts of required capacity with coils and 2 nos. NC and NO spare contacts each.

- Automatic change over for star-delta / DOL required, regulated with Fall/Rise in Line Pressure Switch / Flow Switch.
- Bimetallic over load relays and single phase prevention relays.
- Illuminated start stop push buttons with latch.
- Internal wiring and accessories including CT's wherever required.

a) Contactor

Motor starter contactors shall be of the electromagnetic type rated for uninterrupted duty as defined in applicable standards.

Main contacts of motor starter contactors shall be of silver plated copper.

Each motor-starter contactor shall be provided with two NO and two NC auxiliary contacts.

Insulation class of operating coils shall be class B or better.

Operating coils of contactors shall be suitable for operation from the specified control supply system.

Contactors shall be of the double break, non-gravity type.

One number spare auxiliary contactor with 4 NO / 4NC contact along with its coil completely wired up to the terminal should be provided.

b) Direct-On-Line Starters

Direct-on-line starters shall be suitable for Class AC 3 utilization category.

c) Reversing Starters

Reversing starters shall comprise forward and reverse contactors, electrically interlocked with each other. Reversing starters shall be suitable for Class AC 4 duty.

d) Thermal Overload Relays

Starters shall be complete with three elements, positive acting, ambient temperature compensated, time lagged thermal overload relay with adjustable settings. The settings range shall be properly selected in accordance with the rating of the motor.

Thermal overload relays shall be hand-reset type.

'Stop' push button of the starter and hand-reset device shall be separate from each other.

Overload relay hand reset push button shall be brought out on the front of the compartment door.

Overload relay shall be provided with at least one 'NO' and one 'NC' or one changeover contact.

e) Control and Selector Switches

Control and selector switches shall be:

- i. Rotary type
- ii. Adequately rated for the purpose intended (Minimum acceptable rating is 10A continuous at 240V AC and 1A inductive break) 220V DC.
- iii. Provided with escutcheon plates clearly marked to show the positions.

Control switches for circuit breakers shall be provided with pistol grip type handles.

Control switches for circuit breaker control shall be provided with:

- a) Contact development and sequencing device.

Selector switches shall be:

- i. Of the maintained contact stay put type. Switches in ammeter circuits shall have make-before-break type contact.
- b) Provided with oval handles.

f) Push Buttons

Push button shall be :

- a) of the momentary contact, push to actuate type rated to carry 10A at 240V AC and 1A (inductive breaking) at 220V DC.
- b) fitted with self reset, 2 NO and 2 NC contacts.
- c) provided with integral escutcheon plates marked with its function. 'Start', 'Open', 'Close' push buttons shall be green in colour. 'Stop' push buttons shall be red in colour. All other push buttons shall be black in colour.

'Emergency Stop' push buttons shall be of the lockable in the pushed position type and shall be shrouded to prevent accidental operation. Key shall not be required for the operation of the push button.

13.5 Meters and Indicators

The meters and relays shall comply the following:-

- Class-I accuracy.
- Ammeter, Voltmeter, trivector meter with recorder, PF meter should be electronic digital type compatible to PC.
- A, V meters 96 x 96 mm. square or square bezel flush mounting type with selector switches and back up fuses for A & V meters.
- Maximum demand electronic meters trivector with integration time of 30 minutes, wherever specified.
- Energy and demand meters

Indicating lamps shall be LED type with fuses. Phase indicating lamps shall be colour coded.

14.0 RECOMMENDED MAKES OF MATERIALS

<u>Sl. No.</u>	<u>Description</u>	<u>Make</u>
1	Relays	Siemens / Schneider / L & T
2	Meters	IMP / Neptune
3	Ammeter/Voltmeter selector switch	Kaycee / Salzer / AE
4	Indicating Lamp	Siemens/ Schneider
5	Wires (copper conductor)	Mescab / Polycab/ Havells/ Nicco / Gloster
8	MCCB	Siemens/ Schneider / L & T
14	CT	Kappa

15.0 APPROVED MAKES OF MAJOR ITEMS DESCRIBED IN B.O.Q.

Service : Fire Hydrant Piping Down-comer cum Wet-Riser

Working pressure: 9.3Kg/cm2(g)

Working temperature: Within 100°C

System Test Pressure : 15 Kg/cm2(g)

Sl. No.	Description	Size mm NB From To	Material	Type	Standard/ Class/Rating	Makes
1.	MS-Black Main Pipes-Hydrant	150 80	M.S.- Black, "Heavy"	ERW (IS-1239) Butt weldable /threaded (for 50mm to 150mm dia) & ERW (IS 3589), with plain/ beveled ends, 6.35mm thick for 200mm dia Pipes	IS:1239 Part-I (Heavy) for 150mm dia Pipe IS-3589-for 200mmdia Pipe of thickness =6.35mm IS:1239 Part-I (Heavy)	Jindal / TATA/ Nezone/ Utkarsh
2.	MS-Black Main Pipes-Hydrant	50 15	-DO-	-DO-	(IS:210,GR-210) , ASA-150 Class	Jindal / TATA/ Nezone/ Utkarsh
3.	Gate valve	25	Brass	Screwed (F) BS-21	BS-5155	Leader/ Sant /Zoloto
4.	Butter fly valve (PN1.0)	200 65	C.S.	lever / Wheel operated to be fitted between flanges, PN-1.0	IS- 4038	Crawlie & Ray /Leader /Intervalve/ Sant/ Zoloto

5.	Foot Valve with Strainer	200	150	CI	-'ISI'-approved	BS:1414-150 Class/ API 600	Kirloskar
6.	Sluice / Gate Valve.	200	80	CS	Flanged(PN-1.6) class, Non-rising spindle type.		Leader / Sant /Zoloto Kirloskar
7.	N.R.V.	80 to 150		CS	"Swing"- Horizontal type,with Flap & SS Hinges, Steel Hook, CS / MS Disc, PN-16 rated, ASA#150 Class.	BS:1868, class-150 With horizontal "swing" Flap.	Leader / Sant / Amco /Zoloto
8.	(i) Main Hydrant Pump (incl. Standard based frame,base plate)-as per mfg.'s standard /motor. (Hydrant)	Cap. - 2850 LPM @ 93M head :- 2 nos.		CI Impeller SS /CI	Horizontal, Centrifugal type, 75KW.	Capacity- & Head – as per Tender	'KSB'/ 'Kirloskar' /"Mather & Platt" / "Grundfoss Motor- Kirloskar / C.G. / ABB
	(ii) Jockey Pump- (incl. Standard based frame,base plate)-as per mfg.'s standard /motor. (Hydrant & Sprinkler)	Cap. - 180 LPM @ 93M head :- 1 no		DO	Horizontal, Centrifugal type, 11KW.	DO	DO
	(iii) Diesel Pump (incl. Standard base- frame,	Cap. - 2850 LPM @ 70M head :- 1 no.		CI Impeller SS /CI	Horizontal, Centrifugal type, 125HP Diesel Engine.	DO	Pump :- 'KSB'/ 'Kirloskar' /"Mather &

	base plate)-as per mfg.'s standard /motor. (Hydrant)					Platt" / "Grundfoss
	(iv) Sprinkler Pump (incl. Standard based frame, base plate)-as per mfg.'s standard (Sprinkler)	Cap. - 2850 LPM @ 93M head :- 1 no.	CI Impeller SS /CI	Horizontal, Centrifugal type,	Capacity- & Head – as per Tender	Engine :- 'Koel' / 'Greaves'/ 'Cummins'
9.	R.C.C. pipes (NP-3)	300 450	R.C.C.-	With R.C.C. Collars, Class-NP-3	IS-778, class-1	'KSB/ 'Kirloskar' /"Mather & Platt" / Grundfoss
10.	Hydrant Valve	63 mm dia	Single Head, Flanged type.	IS-5290		Eastern Spuncrete / W.B. Concrete Industries Pvt. Ltd./ Hindustan.
11.	CP fire Hose with G.M. Nozzle.	65 mm dia	Attached with Rubber gasket coupling.	IS-8423 –for CP Hose, & IS-903 –for GM Nozzle.		Fire Shield /Minimax, Surex –all ISI marked.
12.	Gate Valve	25mm dia	Screwed.	BSPT-Female threaded	(0-to-10Kg/cm2)-rated – 100mm dia dial.	Leader/ Sant /Zoloto.
13.	Pressure Gauge			Bourdem tube type with CP 'U' Syphone tube with Bull cock.	IS-778, (PN-16) Class.	Fiebig /Guru
14.	Gate Valve	15 25	Bronze / or Gunmetal	Screwed to BS-21.	TEFC, 2900 RPM other specifications as per manufacturer's standard.	Zoloto / Sant /Leader
15.	Motor. (For Pumps)			3Phase,squirrel cage Induction Motor.Fan Cooled.	ISI - Approved	Kirloskar /ABB/Crompton Greeves/

16.	Hose Box		16 SWG MS Sheet made, Glass fronted.	MS body, Glass Fronted, "Break-glass Open" type		
17.	<u>Fire Extinguisher</u>					
a)	D.C.P.- 5 Kg.- including MS fastening Clamps for mounting on walls/columns	Cap.- 5 Kg. (ISI marked)			IS-2171	Fireshield /Protector/ /Surex /Minimax- all ISI approved.
b)	CO ₂ 4.5 Kg.- including MS fastening Clamps for mounting on walls/columns	Cap.- 5 Kg. (ISI marked)			IS-2878	DO
c)	Water CO ₂ including MS fastening Clamps for mounting on walls/columns	Cap.- 9 Ltrs. (ISI marked)			IS-940	DO
d)	A B C – Powder type (Mono Ammonium Phosphate base) - including MS fastening Clamps for mounting on walls/columns	(ISI marked)				DO

16.0 SPRINKLER SYSTEM :

Service : Fire Sprinkler Piping Network

Working pressure: 9.3Kg/cm2(g)

Working temperature: Within 100°C

System Test Pressure : 15 Kg/cm2(g)

Sl. No.	Description	Size mm NB From To	Material	Type	Standard/ Class/Rating	Makes
1.	MS-Black Main Pipes-Sprinkler	150 50	M.S.-Black, "Heavy"	ERW (IS-1239) Butt weldable /threaded.	IS:1239 Part-I (Heavy) for 150mm dia Pipe IS-3589-for 200mmdia Pipe of thickness =6.35mm	Jindal/ TATA
2.	MS-Black Main Pipes-Sprinkler	50 50	-DO-	-DO- ony for Sprinkler Wet Riser Drain Pipe	IS:1239 Part-I (Heavy)	Jindal / TATA
3.	Gate valve	25	Brass	Screwed (F) BS-21	(IS:14846) , PN-1.6 Class	Leader/ Sant /Zoloto
4.	Butter fly valve	200 65	C.I.	Water slim-seal, lever operated to be fitted between flanges.	-Do-	Leader/ Intervalve/ /Crawlie & Ray /Sant/ /Zoloto
5.	'Y'-strainer	150	CI	Flanged to ASA#150 Class	-Do-	Kirloskar/L eader/ Sant /Zoloto
6.	Foot Valve with Strainer	200 80	CI	-do-		Upadhyay/ Kalpana /Leader/ Sant

7	Pressure Release Valve		Flanged to ASA#150 CLASS, Rt. angled pattern	Spring loaded, wrench operated, with settable to blow off pressure of 6.5Kg/cm2.	/Zoloto Kirloskar/ Leader/ Sant /Zoloto
8.	Sluice Valve.		CI	Flanged(PN-1.6) class, Non-rising spindle type.	Leader/ Sant /Zoloto
9.	N.R.V.		CI	"Swing"- (IS-5312) - Wafer type, with Flap & SS Hinges, Steel Hook, CS / MS Disc, PN-16 rated, ASA#150 Class.	Leader/ Sant /Zoloto- 1081 /Amco
10.	Fire Sprinklers (both pendent & Up-Right type)	15mm dia		"UL", / "ULC" Listed -(with a Mean Flow Rate of 60.0 LPM / Minimum Design Flow per Sprinkler=28 US GPM= 105.0 LPM.	'TYCO' / 'VIKING' / 'Omex' / "Central"- ELO 16 / Crawlie & Ray

17.0 SPECIFICATIONS OF FIRE PUMPS / MOTORS :-

17.1 MOTOR DRIVEN MAIN FIRE PUMP –(Hydrant Service):- (2850.0 LPM & 93.0 M HEAD) :-

2.0 Nos.

PUMP :-

Make :-	Kirloskar / KSB / Mather & Platt
Discharge :-	171.0 M ³ / hr. (2280 LPM)
Head :-	93.0 M Head.
Sp. Gravity of liquid :-	1.0
Pump type :-	Horizontal end suction direct coupled "Back pull-out" type Centrifugal Pump.
Suction dia :-	125 mm.
Delivery dia. :-	100 mm.
MOC – Casing :-	C.I.
MOC- Impellar :-	Bronze.
MOC- Shaft :-	S.S. / C45
MOC- Shaft Sleeve :-	S.S.
Sealing :-	Gland packing.
Efficiency :-	As per Manufacturer's Pump Performance Curve.
NPSHR :-	DO.
Shut-off Head :-	As per Manufacturer.
Pump Input KW :-	55.0 KW.
Recommended Prime-Mover :-	75.0 KW.
Speed :-	2900 RPM.
Protection :-	IP 55.
Accessories :-	MS Base Frame with ISMC & MS Base Plate.
Coupling :-	Flexible.
Coupling Guard :-	As suitable.
Foundation Bolt Sets:-	DO.

MOTOR :-

Make :-	Kirloskar / Crompton Greaves / Alstom / ABB.
Type :-	Squirell Cage, TEFC / SI duty, Temperature Rise Class "B" Motor.
Approval :-	TAC approved.
Method of Starting: -	Auto Start regulated by Pressure Switch or Flow switch / or by Deluge Valve.

Starter type :-	Automatic Star-Delta.
Protection :-	IP 55
Motor KW :-	7 5.0 KW
Insulation Class :-	"F".
Duty :-	Continuous.
No. of Phase :-	Three.
Voltage :-	415 Volts.
Frequency :-	50 cycles.
Motor Efficiency :-	As per Manufacturer's Standard.

Type of Coupling :- Flexible / Love-joy.
Enclosure :- TEFC.

17.2 MOTOR DRIVEN JOCKEY FIRE PUMP –(Hydrant cum Sprinkler) :- (180.0 LPM & 93.0 M HEAD) :- 1.0 NO.

PUMP :-
Make :- Kirloskar / KSB / Mather & Platt
Discharge :- 11.0 M³ / hr. (180 LPM)
Head :- 93.0 M Head.
Sp. Gravity of liquid :- 1.0
Pump type :- Horizontal end suction direct coupled “Back pull-out” type Centrifugal Pump.
Suction dia :- 65 mm.
Delivery dia. :- 50 mm.
MOC – Casing :- C.I.
MOC- Impellar :- Bronzze.
MOC- Shaft :- S.S. / C45
MOC- Shaft Sleeve :- S.S.
Sealing :- Gland packing.
Efficiency :- As per Manufacturer’s Pump Performance Curve.
NPSHR :- DO.
Shut-off Head :- As per Manufacturer’s standard.
Recommended Prime-Mover :- 11 KW.
Speed :- 2900 RPM.
Protection :- IP 55.
Accessories :- MS Base Frame with ISMC & MS Base Plate.
Coupling :- Flexible.
Coupling Guard :- As suitable.
Foundation Bolt Sets: - DO.

MOTOR :-
Make :- Kirloskar / Crompton Greaves / Alsthom / ABB.
Type :- “Squirell Cage, TEFC / SI duty, Temperature Rise Class “B” Motor.
Approval :- TAC approved.
Method of Starting :- Auto Start regulated by Pressure Switch or Flow switch/Deluge Valve.
Starter type :- Automatic Star-Delta.
Protection :- IP 55
Motor KW :- 11.0 KW
Insulation Class :- “F”.
Duty :- Continuous.
No. of Phase :- Three.
Vlotage :- 415 Volts.
Frequency :- 50 cycles.
Motor Efficiency :- As per Manufacturer’s Standard.
Type of Coupling :- Flexible / Love-joy.
Enclosure :- TEFC.

17.3 DIESEL ENGINE DRIVEN MAIN FIRE HYDRANT PUMP :- (2850.0 LPM & 93.0 M HEAD) :- 2.0 nos.

PUMP :-
Make :- Kirloskar / KSB / Mather & Platt
Discharge :- 171.0 M³ / hr.
Head :- 93.0 M Head.
Sp. Gravity of liquid :- 1.0
Pump type :- Horizontal end suction "End Suction, Radial Split-Case" type / 'Horizontal Centrifugal' type.
Suction dia :- 125 mm.
Delivery dia. :- 100 mm.
MOC – Casing :- C.I.
MOC- Impellar :- Bronze.
MOC- Shaft :- S.S. / C45
MOC- Shaft Sleeve :- S.S.
Sealing :- Gland packing.
Efficiency :- As per Manufacturer's Pump Performance Curve.
NPSHR :- DO.
Shut-off Head :- DO.
Recommended Prime-Mover :- Diesel Engine of 85 – to – 90 HP.
Speed :- 1450 RPM.
Protection :- IP 55.
Accessories :- MS Base Frame with ISMC & MS Base Plate.
Coupling :- Flexible.
Coupling Guard :- As suitable.
Foundation Bolt Sets :- DO.

DIESEL ENGINE :-

Make :- KOEL / CUMMINS / GREAVES.
Type :- "Heat Exchanger cooling" type.
Approval :- TAC approved.
Method of Starting :- Auto Start – by Engine 'Self' starter regulated by Pressure Switch or Flow switch, Pressure switch / or by Deluge Valve.
Starter type :- Automatic Start by "Self Starter", with Battery.
Protection :- IP 55
HP :- 125.0 HP (as per Manufacturer's standard).
Fuel Tank :- 500 Ltrs. Capacity MS Tank.
Duty :- Continuous.
Type of Coupling :- Spider / Hoist / SBI coupling.

Note :- The Engine shall have both "Auto" & Manual Starting facility. Normally "Auto" Start driven by the Line Pressure Switch shall be employed. The Engine shall be with features that it can be started within a very short period against full Load after even a considerable period of idleness.

18.0 SPECIFICATIONS OF SPRINKLER PUMPS / MOTORS :-

18.1 MOTOR DRIVEN MAIN SPRINKLER PUMP –(only for Sprinkler) :- (2850.0 LPM & 93.0 M HEAD) :- 1.0 NO.

PUMP :-

Make :-	Kirloskar / KSB / Mather & Platt
Discharge :-	171.0 M ³ / hr. (2850 LPM)
Head :-	93.0 M Head.
Sp. Gravity of liquid :-	1.0
Pump type :-	Horizontal end suction direct coupled “Back pull-out” type Centrifugal Pump.
Suction dia :-	125 mm.
Delivery dia. :-	100 mm.
MOC – Casing :-	C.I.
MOC- Impellar :-	Bronze.
MOC- Shaft :-	S.S. / C45
MOC- Shaft Sleeve :-	S.S.
Sealing :-	Gland packing.
Efficiency :-	As per Manufacturer’s Pump Performance Curve.
NPSHR :-	DO.
Shut-off Head :-	As per Manufacturer.
Pump Input KW :-	55.0 KW.
Recommended Prime-Mover :-	75.0 KW.
Speed :-	2900 RPM.
Protection :-	IP 55.
Accessories :-	MS Base Frame with ISMC & MS Base Plate.
Coupling :-	Flexible.
Coupling Guard :-	As suitable.
Foundation Bolt Sets: -	DO.

MOTOR :-

Make :-	Kirloskar / Crompton Greaves / Alsthom / ABB.
Type :-	“Squirell Cage, TEFC / SI duty, Temperature Rise Class “B” Motor.
Approval :-	TAC approved.
Method of Starting :-	Auto Start regulated by Pressure Switch or Flow switch /or by Deluge Valve.

Starter type :-	Automatic Star-Delta.
Protection :-	IP 55
Motor KW :-	75.0 KW
Insulation Class :-	“F”.
Duty :-	Continuous.
No. of Phase :-	Three.
Voltage :-	415 Volts.
Frequency :-	50 cycles.
Motor Efficiency :-	As per Manufacturer’s Standard.
Type of Coupling :-	Flexible / Love-joy.

Enclosure :- TEFC.

18.2 DIESEL ENGINE DRIVEN INTERMEDIATE LEVEL SPRINKLER PUMP –(only for Sprinkler) :- (2850.0 LPM & 93.0 M HEAD) :- 1.0 NO.

PUMP :-
Make :- Kirloskar / KSB / Mather & Platt
Discharge :- 171.0 M³ / hr.
Head :- 93.0 M Head.
Sp. Gravity of liquid :- 1.0
Pump type :- Horizontal end suction “End Suction, Radial Split-Case” type / ‘Horizontal Centrifugal’ type.
Suction dia :- 125 mm.
Delivery dia. :- 100 mm.
MOC – Casing :- C.I.
MOC- Impellar :- Bronzze.
MOC- Shaft :- S.S. / C45
MOC- Shaft Sleeve :- S.S.
Sealing :- Gland packing.
Efficiency :- As per Manufacturer’s Pump Performance Curve.
NPSHR :- DO.
Shut-off Head :- DO.
Recommended Prime-Mover :- Diesel Engine of 85 – to – 90 HP.
Speed :- 1450 RPM.
Protection :- IP 55.
Accessories :- MS Base Frame with ISMC & MS Base Plate.
Coupling :- Flexible.
Coupling Guard :- As suitable.
Foundation Bolt Sets: - DO.

DIESEL ENGINE :-
Make :- KOEL / CUMMINS / GREAVES.
Type :- “Heat Exchanger cooling” type.
Approval :- TAC approved.
Method of Starting :- Auto Start – by Engine ‘Self’ starter regulated by Pressure Switch or Flow switch, Pressure switch / or by Deluge Valve.
Starter type :- Automatic Start by “Self Starter”, with Battery.
Protection :- IP 55
HP :- 125.0 HP (as per Manufacturer’s standard).
Fuel Tank :- 500 Ltrs. Capacity MS Tank.
Duty :- Continuous.
Type of Coupling :- Spider / Hoist / SBI coupling.

Note :- The Engine shall have both “Auto” & Manual Starting facility. Normally “Auto” Start driven by the Line Pressure Switch shall be employed. The Engine shall be with features that it can be started within a very short period against full Load after even a considerable period of idleness.

19.0 Fire Extinguishing System ; (By Portable Fire Extinguishers)

- The whole Building is to be covered under the coverage with Fire Extinguishers – as per N.B.C. Norms / Guidelines.
- The following types of Extinguishers are used –(as per NBC) for the coverage of following Fires as under :-
 - i. DCP Type Extinguishers each of 5 KG capacity (as per IS-2171) are used suitable for Class B & C type Fires erupting from either Flammable Liquid, Plastics, & Electrical Fires.
 - ii. CO₂ each of 4.5 KG capacity (as per IS-2878) are used, suitable for Class B & C - Fires, involving with materials like Live Electrical Equipments, Electrical Machineries, in this Training Institution.
 - iii. Water CO₂ type each of capacity = 9 Litres (as per IS-13385), suitable for any Fires erupting from Wood, Paper, Textiles etc.
 - iv. ABC “Stored Pressure” type (as per IS-13849) each of 0.5 Kg capacity , suitable for Fires erupting from Liquid Inflammable Oil (like Diesel, Grease)
 - especially inside the Fire Pump Room, combustible materials like Wood, Paint, Paper & plastics etc.

A B C Type Dry Powder Fire Extinguisher :

An exclusive range of **Fire Extinguisher - A B C Type Dry Powder (Stored Pressure) is suitable for use**, that the manufacturer produces in diverse forms. The product is appropriate for dousing A B C & E class of fire originating from paper, wood, cotton, petrochemical products, paints, resins, pigment, varnish, gases in the compressed form like oxygen, acetylene, LPG and CNG. Our range comes in a variety of thicknesses, diameters, fire rating as per the conditions of clients.

19.1 Operation Instructions of Portable Extinguishers :-

A Quick reference guide on how to use a Fire Extinguishers :

Before using your fire extinguisher, be sure to read the instructions before it's too late. Although there are many different [types of fire extinguishers](#), all of them operate in a similar manner. Use this acronym as a quick reference (it is a good idea to this reference and pin it next to your fire extinguisher) :-

P A S S

Pull the Pin at the top of the extinguisher. The pin releases a locking mechanism and will allow to discharge the extinguisher.

Aim at the base of the fire, not the flames. This is important - in order to put out the fire, one must extinguish the fuel.

Squeeze the lever slowly. This will release the extinguishing agent in the extinguisher. If the handle is released, the discharge will stop.

Sweep from side to side. Using a sweeping motion, move the fire extinguisher back and forth until the fire is completely put out. Operate the extinguisher from a safe distance, several feet away, and then move towards the fire once it starts to diminish. One must be sure to read the instructions on Fire Extinguisher - different Fire Extinguishers recommend operating them from different distances. It is recommended to Aim at the base of the fire, not at the flames!!!!

A typical fire extinguisher generally contains 10 seconds of extinguishing power. This could be less if it has already been partially discharged. One should always read the instructions that come with the Fire Extinguisher beforehand and become familiarized with its parts. It is highly recommended by fire prevention experts to get hands-on training before operating a fire extinguisher. Most local fire departments offer this service.

Once the fire is out, one should not walk away! Instead it is recommended to Watch the area for a few minutes in case it re-ignites. It is statutory to Recharge the Extinguisher immediately after use.

19.1.1 General information pertaining to inspecting and maintaining a fire extinguishers:

Inspect fire extinguishers at least once a month (more often in severe environments). **Fire extinguisher maintenance** is important for everyone's safety.

One must ensure that:

- The extinguisher is not blocked by equipment, coats or other objects that could interfere with access in an emergency.
- The pressure is at the recommended level. On extinguishers equipped with a gauge (such as that shown on the right), the needle should be in the green zone - not too high and not too low.
- The nozzle or other parts are not hindered in any way.
- The pin and tamper seal (if it has one) are intact.
- There are no dents, leaks, rust, chemical deposits and/or other signs of abuse/wear. Wipe off any corrosive chemicals, oil, gunk etc. that may have deposited on the extinguisher.

Some manufacturers recommend shaking the dry chemical extinguishers once a month to prevent the powder from settling/packing.

Fire extinguishers should be pressure tested (a process called hydrostatic testing) after a number of years to ensure that the cylinder is safe to use. It is recommended to Consult the owner's manual, Extinguisher label or the manufacturer to see when one may need such testing.

If the extinguisher is damaged or needs recharging, replace it immediately!

19.1.2 IMPORTANT: Recharge all extinguishers immediately after use regardless of how much they were used.

The difference between a fire extinguisher inspection and Fire Extinguisher maintenance are below :

INSPECTION

An inspection is a "quick check" to give reasonable assurance that a fire extinguisher is available, fully charged and operable. The value of an inspection lies in the frequency, regularity, and thoroughness with which it is conducted. The frequency will vary from hourly to monthly, based on the needs of the situation. Inspections should always be conducted when Extinguishers are initially placed in service and thereafter at approximately 30-days intervals atleast.

MAINTENANCE

Fire Extinguishers should be maintained at regular intervals (at least once a year), or when specifically indicated by an inspection. Maintenance is a "thorough check" of the extinguisher. It is intended to give maximum assurance that an extinguisher will operate effectively and safely. It includes a thorough examination and any necessary repair, recharging or replacement. It will normally reveal the need for hydrostatic testing of an extinguisher.

REFUGE AREA

Refuge floor in essence means an empty floor without any walls or any combustible materials like wiring etc. which in case of fire brigade and residents can use as a temporary haven instead of being trapped in choked smoke filled Interior. Fire brigade personnel can also operate from here rather than having to move up and down all the time. The refuge floor ruling – a mandatory fire safety stipulation for high rise buildings over 24 metres has been introduced in the terraces.

Pressurised Staircase

One staircase has been reserved exclusively for fire escape purposes to act as a pressurized exit in case of breaking out of Fire. The ambient pressure will be slightly above the normal atmospheric pressure through a dedicated Air Handling Unit (separate from HVAC system), which will start automatically sensing smoke/heat.

20.0 Fire Alarm System :

A fire alarm system, manually operated or automatic functions through detectors distributed in the premises to be protected, which causes the alarm to be actuated automatically or upon operating push button whenever there is a fire. The system helps evacuation of the premises, and to bring fire fighting facilities into action as quickly as possible and thus preventing possible loss of life and / or property by warning the occupants.

The following points should be kept in mind while making the provisions of Fire Alarm System:

- i. A push switch is installed on all floors, in the lift lobby with a glass front and duly marked 'Fire Alarm'.
- ii. An electric bell (fire gong) of special character is provided on each floor, having audible range of 90 decibels by Hooter system.
- iii. All these Hooters /bells and switches are so connected that all such bells would start functioning if any of the push button of the fire alarm is operated.
- iv. The Manual Call Points are so arranged at a height of 1M to sound one or more sounders so as to ensure that all occupants of the building are warned whenever any Call Point is actuated.
- v. The Manual Call Points are installed especially in the easy accessible places e.g, Corridors, Stair-cases, Lobbies etc.
- vi. Automatic fire alarm system shall be in the form of heat or smoke detectors or Beam Detectors etc, duly provided
- vii. An Indicating Main Fire Alarm panel with a Re-peater Panel with Talk-back facility is to be provided on the ground floor (Main Panel in the Lobby and the Re-peater panel in Security Room) and both are interlinked and connected to the fire alarm Detectors, through Monitor Modules & Control Modules installed in each floor.

21.0 Fire Detection & Alarm System

- The whole Building is to be covered with Fire Detection, Alarm & P.A. System by Supply, installation, testing and commissioning of (FACP) Fire Alarm Control panel (Micro-processor based) with repeater panel, including 650 watts amplifier, Battery and Battery charger, necessary (upper armoured type cabling of 2 C x 2.5 sq. mm and 2 C x 1.5 sq. mm with GI / PVC Conduit/pipes, Ionisation / Photo Smoke Detectors, Heat Detector, and Beam Detector including its control modules, Manual Call Points, weather proof Manual Call points (for external use) and its monitor modules, necessary fixing arrangements, supports, fixing screws, bolts, nuts washers etc. strobe lamps, hooters / speakers etc.

- The Repeater panel is essentially to be installed as provided in the Drawing inside the Security Room for Annunciation & Alert the Security Men (especially in the event of any Fire break out during the Night time), after the normal Official working hours. Hence the Repeater panel is extremely important to be stationed in the Security Room only.

21.1 GENERAL

21.1.1 DESCRIPTION:

The work shall consist of furnishing, installation , testing & commissioning of a complete high quality advanced technology early detection Intelligent Analogue Soft Addressable fire alarm system as shown on the drawings and specified herein.

21.1.2. REFERENCES FOR INSTALLATION:

- A. German Standards VDE (Verband Deutcher Electrotechniker) DIN VDE14675 and VDE 0833 Fire Alarm Systems
- B. NFPA- National Fire Protection Association NFPA 72
- C. British Standard Institute / European Standards / American Standards All Applicable codes and standards including BS EN 54.
- D. System operation description including method of operation and supervision of each type of circuit and sequence of operations for all manually and automatically initiated system inputs. Description shall cover this specific project.
- E. Product certification signed by the manufacturer of the fire alarm system components certifying that their products shall comply with any one of the referenced standards, completely with specifications and VD's approval or equal.

21.1.3 TRANSPORTATION, HANDLING AND STORAGE:

- A. All the components of fire alarm system shall be provided in manufacturer's original new and unopened packing bearing manufacturer's name and label.
- B. Store materials, not in actual use, in covered and well ventilated area and protect them from dirt, dust, moisture, direct sunlight and extreme temperatures.
- C. For further requirements follow manufacturer's written instructions regarding storage and handling.
- D. Addressable Fire Alarm Specifications Fire Alarm System.

21.1.4 WARRANTY

Submitted written guarantee signed by the contractor, manufacturer and installer of fire alarm system for the period of 1 year from the date of substantial completion. The guarantee shall cover the repair and replacement of material with manufacturing defects and workmanship as directed by the engineer.

21.1.5 QUALITY ASSURANCE:

- a. Manufacturer's Qualifications: Firms regularly engaged in manufacture of fire alarm systems and components, whose products have been in satisfactory use in similar services for not less than 3 years period, and be subject to approval of engineer.
- b. Installer Qualifications: An experienced specialist sub-contractor who is authorized by the system manufacturer, and subject to approval of the engineer.

- c. All the components and installations shall comply with the requirements of DIN VDE 14675 & VDE 0833/NFPA for design & installation.
- d. Provide system and components specified in this section that are listed and approved by VDS & conform to equivalent FM standards.
- e. Single source responsibility: All components and accessories shall be product of single manufacturer.

21.2 PRODUCTS

21.2.1 SYSTEM DESCRIPTION:

- A. The fire detection and alarm system shall comprise of Automatic Soft Addressable Modular design main fire alarm control panels, optical smoke & heat Sensors , manual call points, electronic wall mounted Alarm sounder/flasher devices, Transponder interface units, each with its own short circuit built-in isolators. All loop cabling and any other components and accessories deemed necessary for a safe, reliable and satisfactory system shall conform to the relevant and applicable requirements and recommendations of DIN EN 54. The system shall be fully programmed to accommodate fire alarm zones. The system shall be configured to allow on site modifications with the minimum of disruption using the PC based software to facilitate future changes or alterations to existing buildings/network on site.
- B. The fire alarm and detection system shall provide the following facilities as a minimum:
The system shall be intelligent in operation with advanced decentralised intelligence technology. Each detector shall have its own processor with algorithms built in the device to take a fire or fault decision. System with centralised intelligence by providing signal levels to the control panel are not acceptable.

Addressable Fire Alarm Specifications

Fire Alarm System

The system will be capable of providing fire, fault disablement and supervisory monitoring facilities as required by DIN EN 54 Pt 2. All devices on a loop shall have built in SHORT CIRCUIT LINE ISOLATORS for wiring fault isolation to protect the system. "Group Circuit Monitors" which isolate/protect sections of a loop circuit, i.e. a group of field devices are not acceptable. In case the component is not having Inbuilt Isolators then the Isolator Modules should be implemented before and after every individual Detectors and Devices as per NFPA 72 CLASS A wiring and Style 7 wiring.

All system components and devices shall be connected to two-wire loop circuits (as shown in the Tender Drawings) with each component having its own individual built-in isolator, Removal or disconnection of any component from the loop shall not affect the functioning and performance of other components and the system.

Please note that the group isolators, which are used to isolate a section of a loop in case of fault, are not acceptable.

System shall be of automatically addressable type i.e. all the devices on the loops of the FACP shall be allocated addresses automatically from the PC / Panel at the time of system power. The loop devices shall also be able to commission by using PC interface without the need of FACP, and also given an address during commissioning, the value of which shall be stored in nonvolatile memory, within the electronics module of the outstation. This value shall be read during loop allocation and provided it is valid shall be used to setup the outstations primary address.

Automatic Addressing shall cover the benefits of Soft Addressing and also overcome the limitations of Hard Addressing. This means that If the devices are inserted or removed all the existing devices shall keep the same address and programmed activations and use labels remain unchanged. The panel with PC shall allocate the address to ensure that it is

impossible for two devices to have the same address. Fire Detection and Alarm Systems, which rely only on Coding , Programmer or hard addressing techniques are not acceptable.

Facilities shall be provided to constantly monitor and check the following circuits and fault conditions:

- The power supply to the loop /s;
- For open-circuit, short-circuit, earth fault and any other fault condition in the loop wiring;
- For communication failure and errors in all cards and loops
- For faults in keyboard and printer circuits
- All devices, etc. shall be installed on the same loop.

All devices shall be assigned a maximum of 320 character or 4 lines of max. 80 characters each with a LCD Display. In case of fire, fault or warning, the label of device sensing threshold shall appear on visual display unit of the panel. Any event i.e. Fire, fault or warning shall be recorded with time, date and place of occurrence in the memory of FACP. These events can either be displayed on LCD Display of the FACP or printed, as required. Provision shall be done at the Fire Alarm Control Panel to silence the loop powered alarm sounders but the visual indication shall remain until the system is reset. The detectors shall have auto learn sensitivity adjustments. The main Fire Alarm Control Panel shall be located as shown on the schematics and the floor drawings.

Addressable Fire Alarm Specifications

Fire Alarm System

GENERAL

- A. All major component of Fire Alarm system shall be product of a single manufacturer and shall conform to the requirement of EN54, Vds, UL approved and be designed acc. to DIN VDE14675 and VDE 0833/NFPA Fire Alarm Systems CODE OF PRACTICE FOR SYSTEM DESIGN, INSTALLATION AND SERVICING.
- B. The power supply breakers for FDA system shall be marked “ DO NOT DISCONNECT. FIRE ALARM SUPPLY”.

22.0 ANALOGUE ADDRESSABLE FIRE ALARM CONTROL PANEL (FACP)

- A. In the event of a fire being reported from the Smoke / Heat Detectors, activation of Manual Call Points or Sprinkler operation the sequence of alarm operation shall be as follows: If a fire condition is reported from a smoke detector then the evacuation will be done initially by the local integral sounder. Then after a certain delay (to be agreed at the time of commissioning) the evacuation Alarm shall be sounded on that fire zone only. If after 3 minutes the alarm has not been acknowledged, the Alarm shall also be executed on the other adjacent zones. All other zones shall be given the Alarm. The evacuation of the building shall be staged in phases to allow orderly movement of people.
- B. If a Manual Break Glass Unit is activated or a sprinkler flow switch is operated, then the evacuation shall be transmitted immediately to the affected fire zone plus the adjacent zones.
- C. Activation of the fire alarm system shall directly initiate some or all of the following to be agreed as a part of the overall engineering policy.
 - Signal to all elevator machine rooms indicating fire status (to control lifts)
 - Release doors normally locked by magnetic devices.

- Release doors normally held open by magnetic devices
- Shutdown mechanical equipment ventilation plant
- Shutdown general exhaust fans
- Start up smoke extract fans
- Start up exhaust make up fans
- Start up stair vestibule pressurization fans
- Automatically operate fire dampers
- Initiate alert signals to panels in the adjacent office tower.
- Sprinkler valves, flow switches and other monitored valves shall be directly supervised by the fire alarm systems.

These shall include but not limited to the following:

- Building automation system via WINMAG OPC
- Repeater Panel.
- Security system.

Addressable Fire Alarm Specifications

Fire Alarm System

22.1 SYSTEM COMPONENTS AND DEVICES

FIRE ALARM CONTROL PANEL: (FACP)

- A. The panel shall be modular Multifunctional computer controlled using **32 bit processor**. Decentralised control and monitoring functions to be realised on the loop and spur. The panel shall be complete with, but not limited to, the following elements:
- 1) Visual display unit capable of displaying 8 lines 40 characters backlit display .
 - 2) Built-in full numeric keyboard with function keys.
 - 3) 64 Single Zone Indicator expandable upto 192 SZI
 - 4) USB Port
 - 5) Ethernet connection
 - 6) SMART Card media slot.
 - 7) Keyswitch to prevent unauthorised operation of keypad.
 - 8) Integral sealed lead acid battery and charger, with 24 hour back up in the event of supply mains failure.
 - 9) Essential controls – Delay, panel reset, Audible alarm off, Disconnect master box, additional messages, verify/cancel fault buzzer. Fire, Pre-Alarm, Trouble, Disconnection lamps. Each lamp shall also have appropriate indication (Releasing Systems activated, Master box, Delay , Verify, CPU failure, Inoperation normal condition & failure of power supply / battery) Simple menu driven function keys with password protection shall allow users to an extensive range of software based features such as:
 - Overview
 - Service
 - Time functions
 - Information
 - Last 10000 system events
 - Current fault and warning logs.
 - Interrogation of sensor cleanliness
 - On/Off, Enable/ disable sensors, zones, sounders, interface unit channels.
 - Status of detectors
 - Alarm counters
 - Printer on, off, line feed and test facilities.
 - 10) All control buttons and keyboard shall be enclosed behind a lockable cover, Up to 127 device capacity per 3.5km loop and a TTY/ RS 485 communication option.

- 11) In addition to the above, all other necessary controls, elements and accessories shall be included to provide a complete and efficient panel conforming to the requirements of DIN EN 54/UL.

Addressable Fire Alarm Specifications

Fire Alarm System

12) LOOP PARAMETERS:

Individual loop circuits will be capable of accommodating the following.

Up to a maximum of 127 addressable devices on 3.5 kms loop length

Up to 32 loop powered IQ8 Alarm addressable Sounders.

Up to 32 loop powered IQ8 Alarm electronic Strobes.

The detection loop shall have the ability to support both sensors and sounders connected on the same 2 core loop circuit.

Up to 127 loop powered input modules.

Should have the ability to spur off the detection loop without using 'T' breaker devices, without any degradation.

22.2 FIELD DETECTION DEVICES

GENERAL: ANALOGUE DETECTORS & BASES

All analogue detectors and bases shall be provided by the same manufacturer of the control system. No other make of detectors will be permissible. All analogue detectors shall have real intelligence itself. This means even without control panel the detector can make decision, adapt to different environmental condition and diagnose itself. They shall have decentralised intelligence, automatic function self test, CPU failure mode, alarm and operating data memory and integrated short circuit line isolators. The detector bases for interfacing between the loop wiring and the detector head shall be manufactured by means of injection moulded ABS plastic coloured white and shall not contain any electronics for addressing. The base fixings should be suitable for any industry standard BESA or conduit boxes. All bases (if required) shall include the option to provide a programmable relay output for interfacing, providing a dry contact for third party.

All bases shall be provided with a plastic removable dust cover for protection during site construction as well as an IP rated sealing gasket to prevent dirt and moisture from entering through from the fixing surface.

Each base shall include a lock and removal of locked detectors shall be achievable only through the use of the appropriate removal tools as specified by the manufacturer of the detectors. Detectors removal tools are to be handed over on completion of the contract as part of the spare parts to the client. Removal of a detector from it's associated base shall not affect the continuity of the detection loop.

Addressable Fire Alarm Specifications

Fire Alarm System

The Fire alarm manufacturer shall have the complete range of following analogue ADDRESSABLE detectors with de-centralised intelligence as standard so as to meet the specific applications of the site.

- a. Heat Detectors (fixed & ROR temperature).
- b. Optical Smoke Detector.
- c. Dual angle Optical/Heat Detector or Multi-criteria detector.
- d. Manual Call Points.

All of the above shall be compatible with the aforementioned base providing interchangeability between detector heads, without the requirement for switch settings. All detectors shall also have an integral short circuit isolator, which in the event of a single cable

fault will isolate the “culprit” piece of cable and retain all devices on the loop operationally. Each detector shall possess two integral LED giving a red flashing indication for fire and green for normal operation. For remote locations, each detector shall be capable of connection to a remote LED unit by means of 2 core wire connection.

Detectors shall be white in colour and manufactured from ABS plastic. All electronics and associated sensing elements will be housed within this unit, these components being hermetically sealed to prevent their operation from being impaired by dust, dirt and humidity.

The sensitivity of all detectors shall be adjustable from a software. It shall be possible to programme detector sensor sensitivity directly on the loop using interface with a laptop PC and appropriate programming software from manufacturer.

For MULTI SENSOR detectors, disablement of each sensor element shall be possible individually or for whole loop. Also this disablement feature shall be possible to have manually or time / event controlled.

All detectors shall be provided with a plastic removable dust cover for protection during site construction.

A semi-flush recessing kit for analogue detectors shall be available for each detector type incorporating the standard detector base.

Addressable Fire Alarm Specifications Fire Alarm System

22.3 HEAT DETECTORS

Install as shown in the drawings. These shall comply with the requirements of EN 54: Part 5 and shall be VdS/UL approved. This shall be a dedicated heat only detector to provide fixed temperature heat as well as rate of rise sensing. It should be fully compliant with EN54 part 5 to provide grades of A1.

22.4 OPTICAL SMOKE DETECTOR:

Install as shown in the drawings .Analogue Addressable Optical Smoke Detectors. These shall be of Automatic addressable Optical type with inbuilt isolator in a single head. The optical element shall detect visible smoke from slow smoldering fires. Smoke sensing design shall comply with EN 54 part 7 and shall be VdS/UL approved. It shall have microprocessors, short-circuit isolators and all electronic components and circuitry suitable for an Analogue addressable system. The detectors shall also have 360 degree viewing LED fire indicator. Detectors mounted in the false ceilings shall be provided with semi flush mounting kits.

22.5 DUAL ANGLE OPTICAL/HEAT DETECTOR :

It shall be installed as shown in the drawings .These shall comply with the requirements of EN 54: Part 5 & 7 and shall be VdS/UL approved. This device shall combine two individual sensing elements to provide excellent cover for both “types” of fires. (Slow smouldering and fast free burning).

OPTICAL SENSING: Shall be carried out by 2 infra-red LED transmitters across 2 separate Optical detection angles. This sensor shall process both the forward and backward scattered Light caused by entering the detection chamber of device, allowing the detector to Differentiate between real smoke and non-smoke particles e.g. Steam & Dust.

22.6 MANUAL CALL POINTS

Install as shown in the drawings. The manual initiation devices shall be electrically compatible with all of the aforementioned detector types and shall be complete with allelectronic

components and circuitry for an automatic safe addressable device. The manual call point shall have an inbuilt short circuit isolator and an inbuilt microprocessor to ensure a response time of less than 1 second.

The MCP unit shall also handle all communication to the control panel. All electronic devices contained within the MCP shall be hermetically sealed so as to prevent damage from hostile environment conditions: e.g dust with minimum rating of IP43.

The MCP operating voltage shall be 8-42 volts DC, RED similar to RAL 3020. If the MCP are located in public areas a transparent cover shall be provided as a protection to prevent inadvertent activation. MCP shall be available in two designs Large & small for aesthetic purposes to architects.

Addressable Fire Alarm Specifications

Fire Alarm System

The MCP shall have an input facility to connect conventional devices. It should have an option of using either frangible glass allowing for complete removal upon operation or plastic panel resettable function. There shall be no text but SYMBOLS on the MCP (burning house /press to break).

The device can be tested functionally without the need to either remove the front cover and/or breaking the glass, with a special test key (supplied as standard). The key shall insert the underside of the MCP ensuring easy access of the key at all times. These devices will comply fully with EN 54 part 1.

23.0 FIELD ALARM DEVICES

Electronic sounders, combined sounder/strobe and standalone strobes shall be loop powered for direct connection to the 2 core detection loop shall be electrically compatible with all initiation devices. These wall mounted units shall be available in red or white and suitable for both indoor and outdoor applications with an ingress protection rating of IP31 and IP65 respectively.

All electronic sounders, sounder/strobe and strobe only versions shall have alarm signals Synchronised across all the detection loops of the fire alarm control panel.

All alarm devices shall have a short circuit isolation device provided as an integral component of the device.

All sounders shall have a 'soft start' feature controlled by the fire alarm panel, whereby a low initial volume can be set and then increased at a defined rate upto a maximum volume setting.

All alarm devices shall be provided by the same manufacturer of the control system. No other make of detectors will be permissible The Fire alarm manufacturer shall have the complete range of following alarm devices with built in short circuit line isolators so as to meet the specific applications of the site.

a) Addressable Sounder

23.1 ADDRESSABLE SOUNDER

A combined electronic sounder and flasher shall be capable of providing a minimum sound level of 97dBA \pm 2dBA @ 1 metre. The sounder shall be capable of providing 4 different sound signals which are selected/configured from 19 tone types store in the device.

The unit shall have its own microprocessor to handle loop communications and monitoring of the internal flasher element for faults in both the quiescent and alarm conditions. The

microprocessor shall also monitor the sound producing element during an alarm condition to ensure that faulty devices can be automatically identified during the weekly test procedure.

Addressable Fire Alarm Specifications

Fire Alarm System

All associated electronic components shall be hermetically sealed to provide protection from hostile operating environments.

The unit shall be manufactured from ABS plastic with a polycarbonate lens. Body and lens colour shall be Red body / red lens.

These devices shall allow for direct connection to the detection loop. It shall be possible to connect upto 32 combined electronic sounder/flasher to each detection loop of the fire alarm control panel.

23.2 BATTERIES :

Batteries shall be provided and shall be the dry sealed lead-acid type. The batteries shall have ample capacity. With primary power disconnected, to operate the fire alarm system for a period of 24 hours. Following this period of operation via batteries. The batteries shall have ample capacity to operate all components of the system, including all alarm signaling devices in the total alarm mode for a minimum period of 30 minutes.

23.3 WIRING

All cables associated with Fire Alarm installation connecting with the Control module (CMX) and Monitor module (MMX) shall be of fire resistant 2 core 1.5 sq. mm Twisted pair . Cables shall comply with BS 6207 Part 1.

All other Cables connecting the FACP (Fire Alarm Control Panel) to the RP (Repeater Panel) shall be of CU, PVC insulated sheathed armoured type of 2 core 2.5 sq.mm. and the cable connecting the FACP to the floor Control Module / and Monitor Module shall be of CU, PVC insulated sheathed armoured type of 2 core 1.5 sq.mm.

23.4 EXECUTION

23.4.1 INSTALLATIONS

The entire fire alarm system shall be installed in accordance with DIN / BS EN54 /NFPA Standards and manufacturer's approved shop drawings, written instructions and recommendations.

23.4.2 TESTING

Fire alarm system shall be tested in accordance to Local Civil Defence regulations and put into operation by the manufacturer or his authorized representative in the presence of engineer. Fault and alarm conditions shall be simulated and all data and alarm indicators checked with full events recorded on system printer according to the testing procedure.

Addressable Fire Alarm Specifications

Fire Alarm System

24.0 APPROVED MANUFACTURERS

Acceptable Manufacturers shall be approved either by **EN 54/VDS/FM/ LPCB** approved by the Local Civil Defense and subject to total compliance with the above specifications

LIST OF PREFERRED MAKES

<u>S.NO</u>	<u>Subject</u>	<u>Approved makes</u>
1	FIRE ALARM PANEL	ESSER,Notifire,Simplex, Morley-system sensor.
2	DETECTORS	ESSER, Notifire, Simplex, Morley-system sensor.
3	MODULES/ MCP	ESSER, Notifire, Simplex, Morley-system sensor.
4	RESPONSE INDICATOR	AS Approved by Engineer In-charge.
5	CABLE	Finolex or equivalent.
6	PVC CONDUIT	ISI Make.

Working Principle of Monitor Modules :-

Four different monitor modules are available for Notifier's intelligent control panels for a variety of applications. Monitor modules supervise a circuit of dry-contact input devices, such as conventional heat detectors and pull stations, or monitor and power a circuit of two-wire smoke detectors (FZM-1(A)).

The Manufacturer's shall offer a standard-sized Monitor Module (typically mounts to a 4" [10.16 cm] square box) that provides either a Style D (Class A) or Style B (Class B) circuit of dry-contact input devices.

The manufacturer's standard Monitor Modules is a miniature monitor module a mere 1.3" (3.302cm) H x 2.75" (6.985 cm) W x 0.5" (1.270 cm) D that supervises a Style B (Class B) circuit of dry-contact input devices.

Its compact design allows to often be mounted in a single-gang box behind the device it monitors is a standard-sized module that monitors and supervises compatible two-wire, 24 volt, smoke detectors on a Style D (Class A) or Style B (Class B) circuit.

The manufacturer's standard Monitor Modules is a standard-sized dual monitor module that monitors and supervises two independent two-wire Style B (Class B) dry-contact initiating device circuits (IDCs) at two separate, consecutive addresses in intelligent, two-wire systems.

FlashScan ® (U.S. Patent 5,539,389) is a communication protocol developed by the Supplier that greatly increases the speed of communication between analog intelligent devices. Intelligent devices communicate in a grouped fashion. If one of the devices within the group has new information, the Panel CPU stops the group poll and concentrates on single points. The net effect is response speed greater than five times that of other designs.

25.0 TRAINING & FIRE DRILL

Training of personnel to handle a fire situation and effectively operate both Portable fire Extinguishers and fixed Fire fighting equipments; installed within the premises is of high necessity. In the event of a fire emergency, the people around and who are responsible for the safety and security of the premises, must respond very quickly and put to gainful use of all equipment. It is advised to the competent Fire Fighting Agency to impart training to all those Users concerned at various levels.

Conduction of fire drills and operating Fire equipments at a regular interval is statutory and will keep the users on alert and equipments in proper running condition.

Documentation by logging of Records of such drills and exercises is also necessary.

In additions, a 'Disaster Plan' should also be worked out by the Competent Fire Fighting Agency and made known to all the persons working within the premises. Copies of such a Plan should be displayed at prominent places and also sent to the local Fire Brigade.

This Training programme and use of 'in-house' protection equipments by the security people is ONLY to supplement the Fire Brigade who are expected to take control of the situation once they arrive at the site.

**CONSTRUCTION OF A PERMANENT MODERN BUS TERMINUS
AT G.T. ROAD NEAR ESI HOSPITAL WITH A
MULTI STORIED COMMERCIAL COMPLEX OF (B+G+5)
FLOORS ALONG WITH BASEMENT INCLUDING ALL CIVIL
WORKS, SANITARY & PLUMBING WORKS, ELECTRICAL
WORKS INCLUDING LIFT AND OTHER ANCILLARY WORKS
UNDER SERAMPORE MUNICIPALITY, HOOGHLY,
WEST BENGAL**

TENDER DOCUMENTS

(NIP NO. HRBC/PL. & DN./07 of 2013-2014, dt: 12.09.2013)

**BOOK -1
Volume III**

HOOGHLY RIVER BRIDGE COMMISSIONERS

(A Statutory Organisation under Government of West Bengal)

TRANSPORT DEPARTMENT

MUNSHI PREMCHAND SARANI

(ST. GEORGE'S GATE ROAD)

KOLKATA 700 021

OCTOBER 2013

**CONSTRUCTION OF A PERMANENT MODERN BUS
TERMINUS AT G.T. ROAD NEAR ESI HOSPITAL WITH A MULTI
STORIED COMMERCIAL COMPLEX OF (B+G+5) FLOORS ALONG
WITH BASEMENT INCLUDING ALL CIVIL WORKS, SANITARY &
PLUMBING WORKS, ELECTRICAL WORKS INCLUDING LIFT AND
OTHER ANCILLARY WORKS UNDER SERAMPORE MUNICIPALITY,
HOOGHLY, WEST BENGAL.**

TENDER DOCUMENTS

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BOOK – 1

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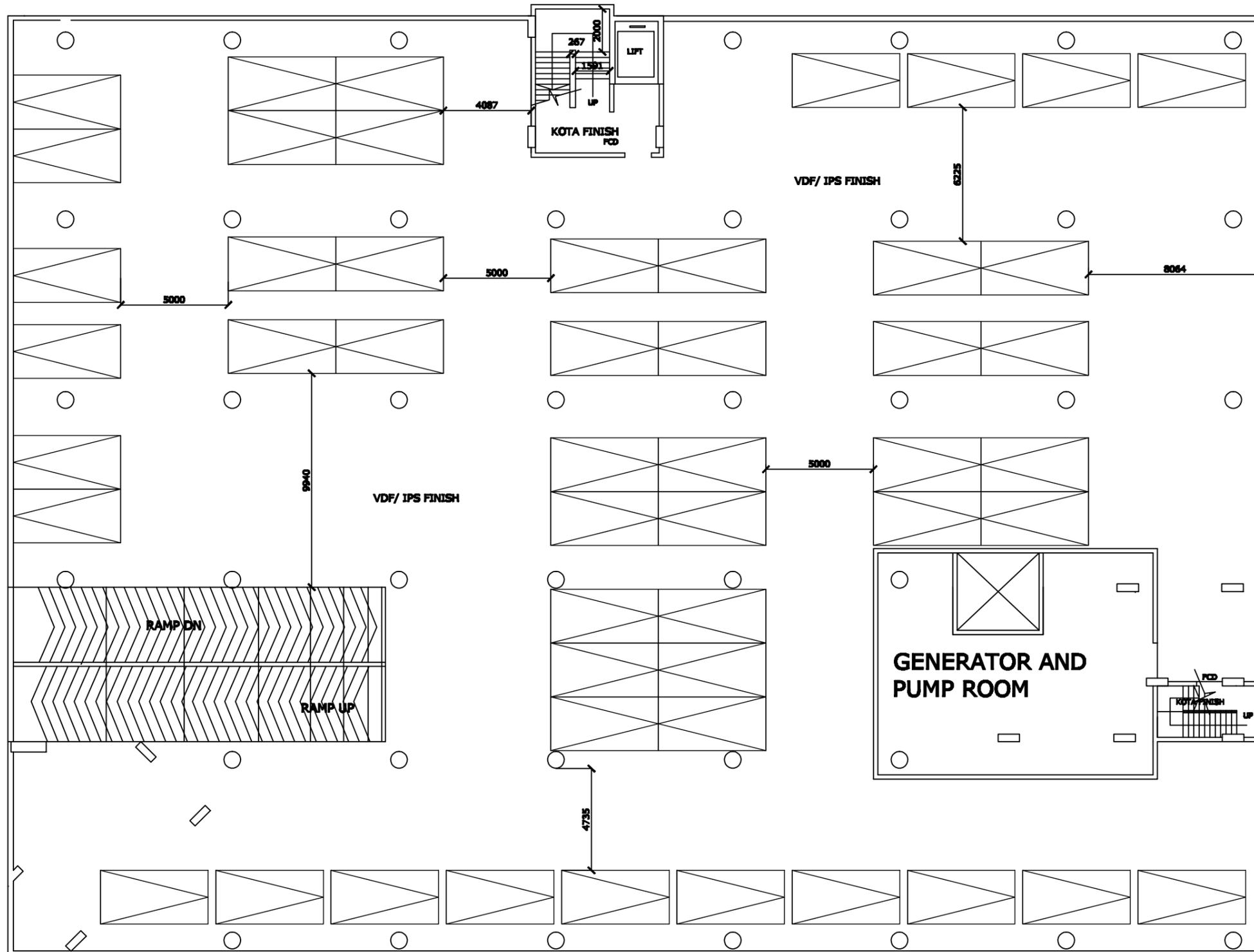
**Volume III
Contract Drawings**

HOOGHLY RIVER BRIDGE COMMISSIONERS
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TRANSPORT DEPARTMENT
MUNSHI PREMCHAND SARANI
(ST. GEORGE'S GATE ROAD)
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OCTOBER 2013

LIST OF TENDER DRAWINGS

Sl. No.	DRAWING NO.	DRAWING TITLE
ARCHITECTURAL DRAWINGS		
1	MFI/T/A/01	MASTER PLAN
2	MFI/T/A/02	BASEMENT PLAN
3	MFI/T/A/03	GROUND FLOOR PLAN
4	MFI/T/A/04	FIRST FLOOR PLAN
5	MFI/T/A/05	TYPICAL FLOOR PLAN
6	MFI/T/A/06	ROOF PLAN
7	MFI/T/A/07 (SHEET 1 OF 2)	SECTION
8	MFI/T/A/07 (SHEET 2 OF 2)	SECTION
9	MFI/T/A/08	ELEVATION
10	MFI/T/A/09	SEWERAGE & FIRE HYDRANT
STRUCTURAL DRAWINGS		
11	MFI/T/CE/01	LAYOUT & R.C. DETAILS OF PILE, BASEMENT & WALL
12	MFI/T/CE/02	GROUND FLOOR BEAM LAYOUT PLAN
13	MFI/T/CE/03	COLUMN LAYOUT PLAN
14	MFI/T/CE/04	COLUMN REINFORCEMENT DETAILS
15	MFI/T/CE/05	BEAM LAYOUT PLAN
16	MFI/T/CE/06	TYP. R.C. DETAILS OF BEAM
17	MFI/T/CE/07	TYP. R.C. DETAILS OF SLAB
18	MFI/T/CE/08	R.C. DETAILS OF LIFT & STAIR
ELECTRICAL		
19	MFI/T/E/01	ELECTRICAL SINGLE LINE DIAGRAM



BASEMENT

TENDER PURPOSE ONLY

-:NOTES:-

1. CONTRACTOR TO CHECK & VERIFY ALL DIMENSIONS BEFORE EXECUTION OF WORK.
2. ALL DIMENSIONS ARE IN MILLIMETER UNLESS OTHERWISE MENTIONED.
3. FIGURED DIMENSIONS SHALL BE FOLLOWED.
4. FOR DETAILS BELOW FINISH REFER STRUCTURAL DRAWING.
5. DEPTH OF FOUNDATION OF 8MM UNDERGROUND WATER RESERVOIR SHOULD NOT EXCEED THE DEPTH OF FOUNDATION OF THE BUILDING.
6. ALL EXTERNAL WALLS ARE 200MM THICK AND CONSTRUCTED WITH 1:5 CEMENT SAND MORTAR.
7. THIS DRAWING IS THE SOLE PROPERTY OF THE CONSULTANT & NO COPY OF IT SHOULD BE MADE WITHOUT THE EXPRESS WRITTEN PERMISSION FROM THE CONSULTANT.

AREA STATEMENT

LAND AREA	6410.92 SQ.M (AS PER SURVEY)
PERM. GR. COVG.	2564.37 SQ.M
PERM. FAR	16027.3 SQ.M
PROPOSED	
BASEMENT	2557.53 SQ.M
GROUND FLOOR	2559.76 SQ.M
TYPICAL FLOOR	2523.67 SQ.M
TOTAL BLT.UP	17735.64 SQ.M
GROUND COVG.	2566.00 SQ.M
TOTAL FLAREA (EX. BASEMENT)	15178.11 SQ.M

DOOR SCHEDULE

DOOR MKD.	DIMENSIONS IN MM			NO.	REMARKS
	WIDTH	HEIGHT	LINTEL		
D	2700	2100	2100		SINGLE LEAF
D1	2244	2100	2100		SINGLE LEAF
D2	2000	2100	2100		SINGLE LEAF
D3	1800	2100	2100		SINGLE LEAF
FCD	1200	2100	2100		SINGLE LEAF
D4	1248	2100	2100		SINGLE LEAF
D4A	1000	2100	2100		SINGLE LEAF
D5	780	2100	2100		SINGLE LEAF

WINDOW SCHEDULE

WINDOW MKD.	DIMENSIONS IN MM			NO.	REMARKS
	WIDTH	HEIGHT	SILL		
W	2000	1200	900		ALUMINIUM WINDOW
W1	1800	1200	900		ALUMINIUM WINDOW
W2	1000	1200	900		ALUMINIUM WINDOW
W3	780	900	1200		ALUMINIUM WINDOW
W4	1800	680	1480		ALUMINIUM WINDOW

Sign. of the Approval Authority

PROPOSED B+G+5 STORIED BUS TERMINUS CUM COMMERCIAL BUILDING AT SRIRAMPUR, UNDER SRIRAMPUR MUNICIPALITY, HOOGLY, WEST BENGAL.

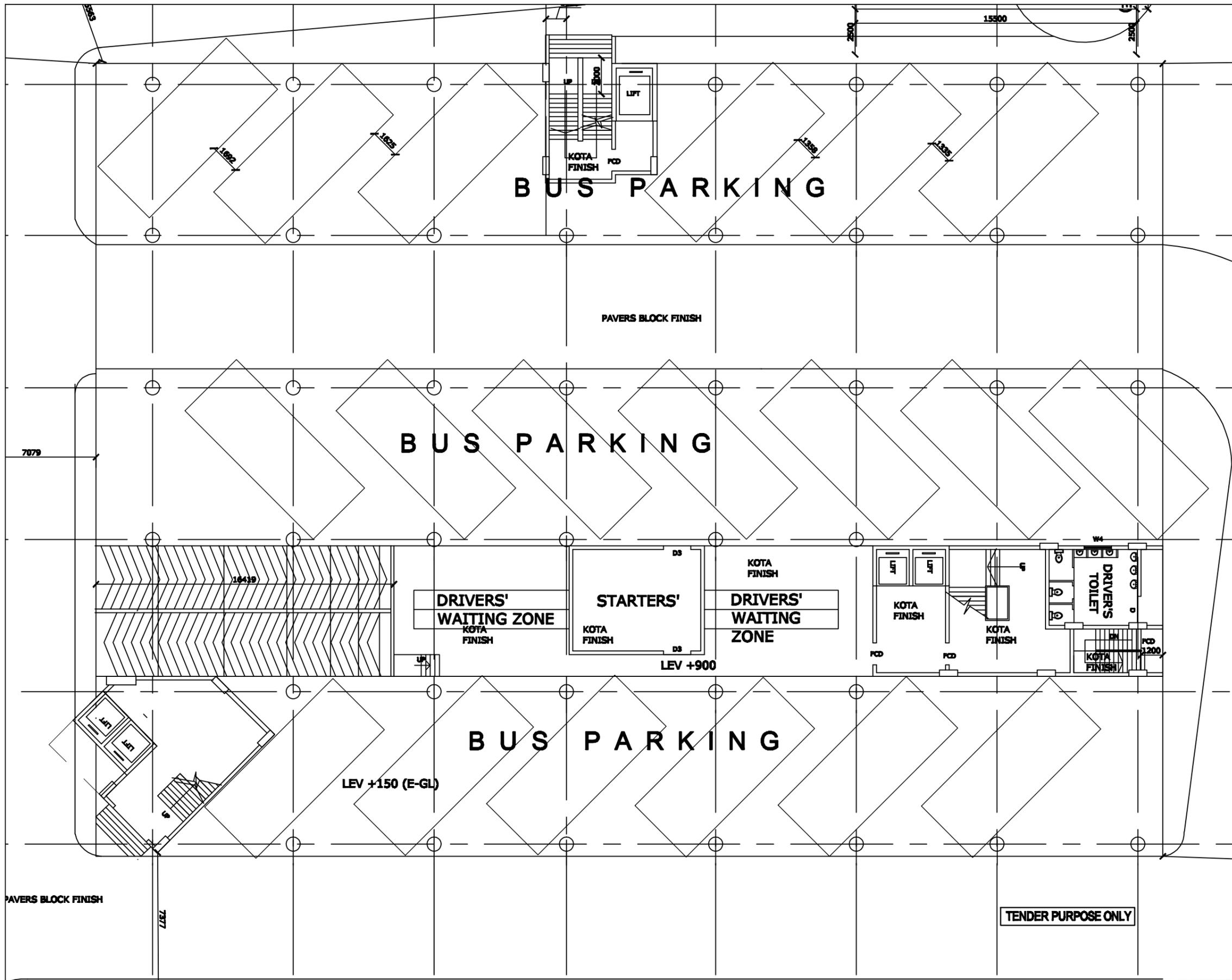
TITLE :-
BASEMENT PLAN

DWG. BY	REV. NO.	DATE
SCALE 1:100	DRAWN :-	
DATE:28.08.13	CHECKED:-	

HOOGHLY RIVER BRIDGE COMMISSIONERS
ST. GEORGE'S GATE ROAD KOLKATA - 700 021.

DESIGN CONSULTANT :
MS FARGO INFRAPROJECTS
313, CANAL STREET KOLKATA - 700048





:-NOTES:-

1. CONTRACTOR TO CHECK & VERIFY ALL DIMENSIONS BEFORE EXECUTION OF WORK.
2. ALL DIMENSIONS ARE IN MILLIMETER UNLESS OTHERWISE MENTIONED.
3. FINISHED DIMENSIONS SHALL BE FOLLOWED.
4. FOR DETAILS BELOW PLINTH LEVEL REFER STRUCTURAL DRAWING.
5. DEPTH OF FOUNDATION OF SEMI UNDERGROUND WATER RESERVOIR SHOULD NOT EXCEED THE DEPTH OF FOUNDATION OF THE BUILDING.
6. ALL EXTERNAL WALLS ARE 200MM THICK AND CONSTRUCTED WITH 1:5 CRIST SAND MORTAR.
7. THIS DRAWING IS THE SOLE PROPERTY OF THE CONSULTANT & NO COPY OF IT SHOULD BE MADE WITHOUT THE EXPRESS WRITTEN PERMISSION FROM THE CONSULTANT.

AREA STATEMENT

LAND AREA	6410.92 SQ.M (AS PER SURVEY)
PERM. GR. COVG.	2564.37 SQ.M
PERM. FAR	16027.3 SQ.M
PROPOSED	
BASEMENT	2557.53 SQ.M
GROUND FLOOR	2559.76 SQ.M
TYPICAL FLOOR	2523.67 SQ.M
TOTAL BLT.UP	17735.64SQ.M
GROUND COVG.	2566.00 SQ.M
TOTAL FL.AREA (EX. BASEMENT)	15178.11 SQ.M

DOOR SCHEDULE

DOOR MKD.	DIMENSIONS IN MM		LINTEL	NO.	REMARKS
	WIDTH	HEIGHT			
D	2700	2100	2100		SINGLE LEAF
D1	2844	2100	2100		SINGLE LEAF
D2	2000	2100	2100		SINGLE LEAF
D3	1800	2100	2100		SINGLE LEAF
FCD	1200	2100	2100		SINGLE LEAF
D4	1248	2100	2100		SINGLE LEAF
D4A	1000	2100	2100		SINGLE LEAF
D5	780	2100	2100		SINGLE LEAF

WINDOW SCHEDULE

WINDOW MKD.	DIMENSIONS IN MM		NO.	REMARKS
	WIDTH	HEIGHT		
W	2000	1200	900	ALUMINIUM WINDOW
W1	1800	1200	900	ALUMINIUM WINDOW
W2	1000	1200	900	ALUMINIUM WINDOW
W3	780	900	1200	ALUMINIUM WINDOW
W4	1800	680	1480	ALUMINIUM WINDOW

Sign. of the Approval Authority

PROPOSED B+G+5 STORIED BUS TERMINUS CUM COMMERCIAL BUILDING AT SRIRAMPUR, UNDER SRIRAMPUR MUNICIPALITY, HOOGLY, WEST BENGAL.

TITLE :-

GROUND FLOOR PLAN

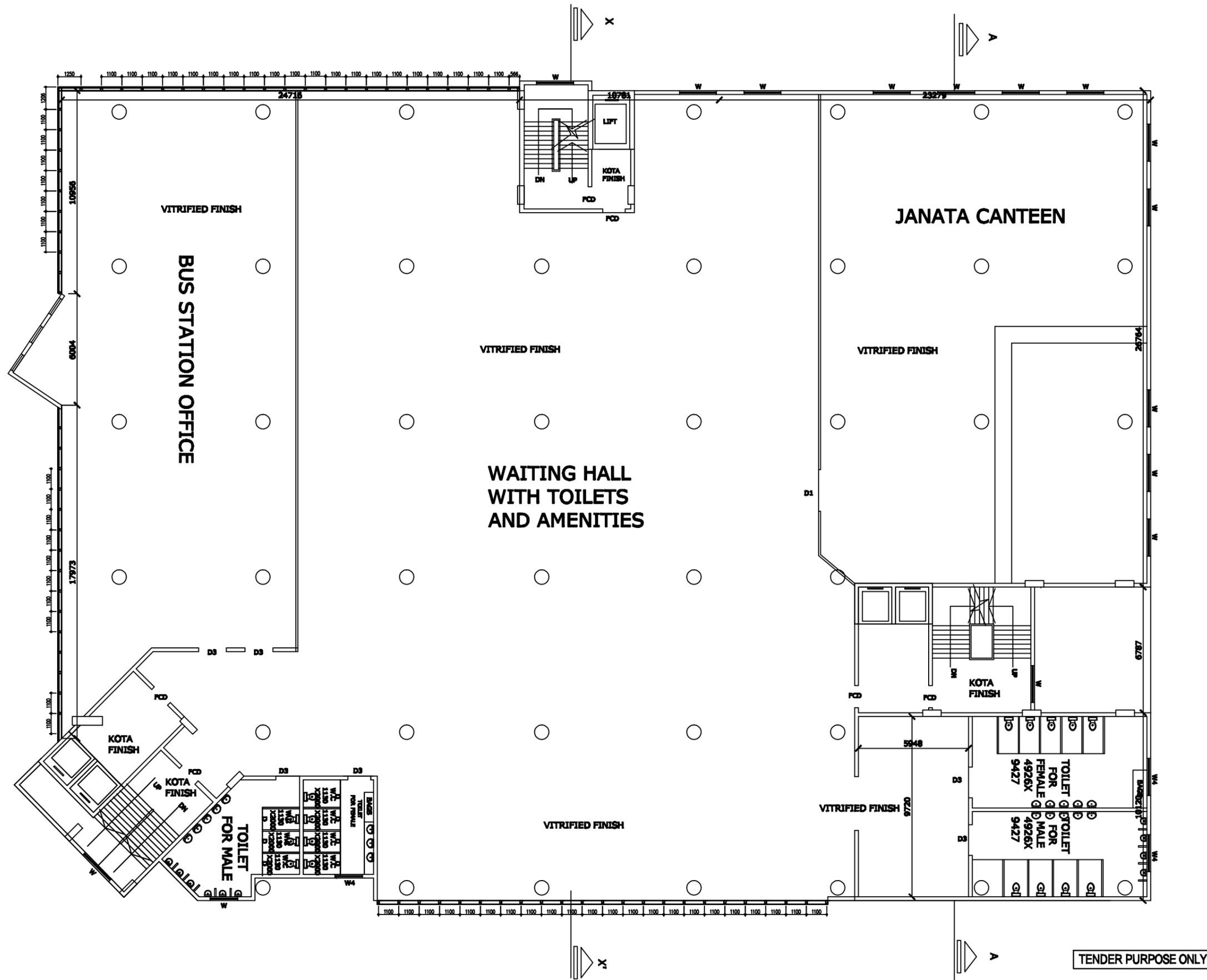
DWG. BY	REV. NO.	DATE
SCALE 1:100	DRAWN :-	
DATE:28.09.13	CHECKED:-	

HOOGHLY RIVER BRIDGE COMMISSIONERS
ST. GEORGE'S GATE ROAD KOLKATA - 700 021.

DESIGN CONSULTANT :
MS FARGO INFRAPROJECTS
313, CANAL STREET KOLKATA - 700048



TENDER PURPOSE ONLY



:-NOTES:-

1. CONTRACTOR TO CHECK & VERIFY ALL DIMENSIONS BEFORE EXECUTION OF WORK.
2. ALL DIMENSIONS ARE IN MILLIMETER UNLESS OTHERWISE MENTIONED.
3. FIGURED DIMENSIONS SHALL BE FOLLOWED.
4. FOR DETAILS BELOW PLINTH LEVEL REFER STRUCTURAL DRAWING.
5. DEPTH OF FOUNDATION OF BEHIND UNDERGROUND WATER RESERVOIR SHOULD NOT EXCEED THE DEPTH OF FOUNDATION OF THE BUILDING.
6. ALL EXTERNAL WALLS ARE 200MM THICK AND CONSTRUCTED WITH 1:6 CEMENT SAND MORTAR.
7. THIS DRAWING IS THE SOLE PROPERTY OF THE CONSULTANT & NO COPY OF IT SHOULD BE MADE WITHOUT THE EXPRESS WRITTEN PERMISSION FROM THE CONSULTANT.

DOOR SCHEDULE

DOOR MKD.	DIMENSIONS IN MM			NO.	REMARKS
	WIDTH	HEIGHT	LINTEL		
D	2700	2100	2100		SINGLE LEAF
D1	2344	2100	2100		SINGLE LEAF
D2	2600	2100	2100		SINGLE LEAF
D3	1900	2100	2100		SINGLE LEAF
PCD	1200	2100	2100		SINGLE LEAF
D4	1243	2100	2100		SINGLE LEAF
D4A	1000	2100	2100		SINGLE LEAF
D5	780	2100	2100		SINGLE LEAF

WINDOW SCHEDULE

WINDOW MKD.	DIMENSIONS IN MM			NO.	REMARKS
	WIDTH	HEIGHT	SILL		
W	2000	1200	900		ALUMINIUM WINDOW
W1	1800	1200	900		ALUMINIUM WINDOW
W2	1000	1200	900		ALUMINIUM WINDOW
W3	780	900	1200		ALUMINIUM WINDOW
W4	1500	800	1400		ALUMINIUM WINDOW

Sign. of the Approval Authority

PROPOSED B+G+5 STORIED BUS TERMINUS CUM COMMERCIAL BUILDING AT SRIRAMPUR, UNDER SRIRAMPUR MUNICIPALITY, HOOGLY, WEST BENGAL.

**TITLE :-
FIRST FLOOR PLAN**

DWG. BY: REV. NO.: DATE:
SCALE 1:100
of as mentioned
DATE: 28.08.13

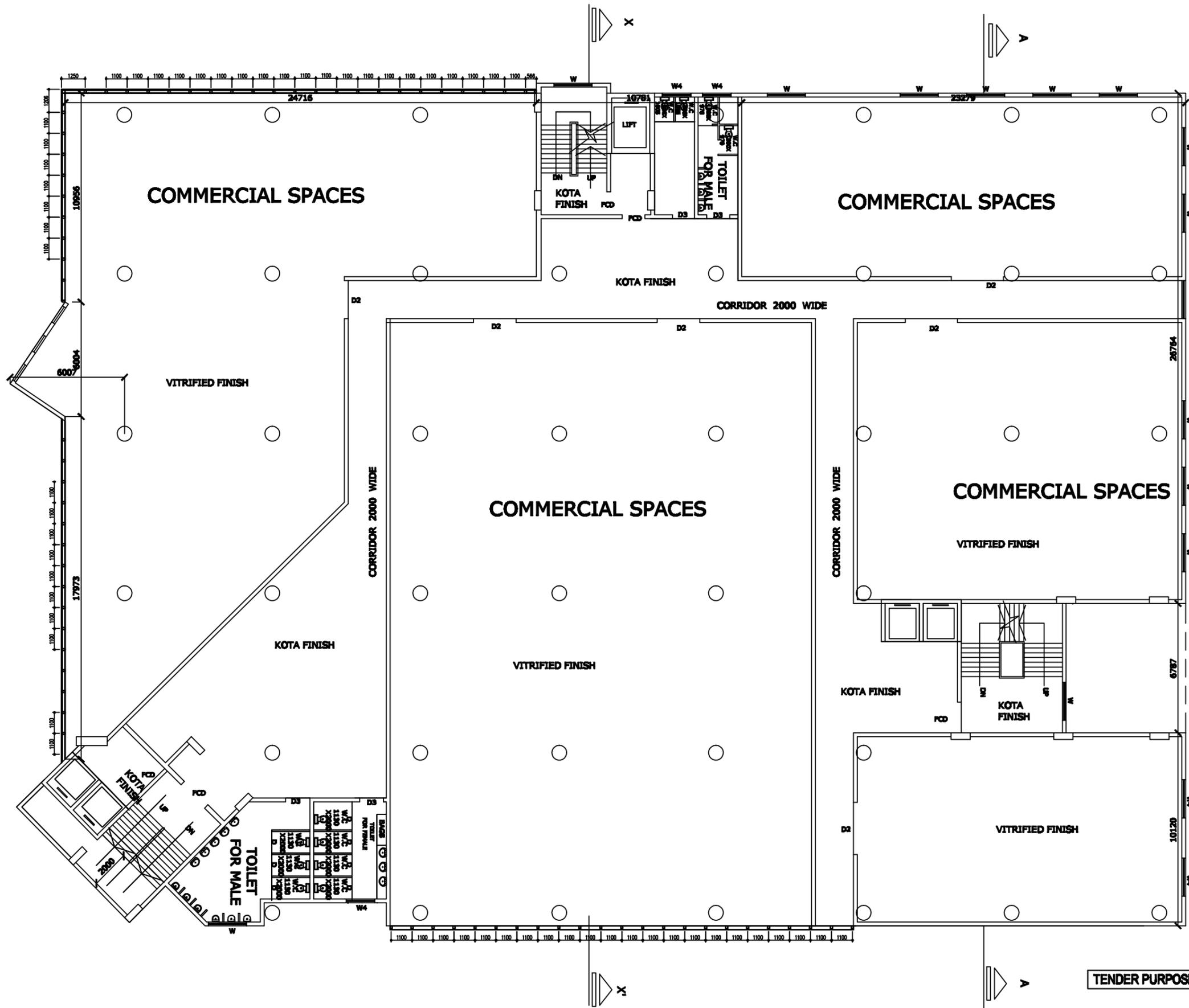
DRAWN :-
CHECKED:-

HOOGLY RIVER BRIDGE COMMISSIONERS
ST. GEORGE'S GATE ROAD KOLKATA - 700 021.

DESIGN CONSULTANT :
MS FARGO INFRAPROJECTS
313, CANAL STREET KOLKATA - 700048



TENDER PURPOSE ONLY



:-NOTES:-

1. CONTRACTOR TO CHECK & VERIFY ALL DIMENSIONS BEFORE EXECUTION OF WORK.
2. ALL DIMENSIONS ARE IN MILLIMETER UNLESS OTHERWISE MENTIONED.
3. FIGURED DIMENSIONS SHALL BE FOLLOWED.
4. FOR DETAILS BELOW FLOOR LEVEL REFER STRUCTURAL DRAWING.
5. DEPTH OF FOUNDATION OF 88M UNDERGROUND WATER RESERVOIR SHOULD NOT EXCEED THE DEPTH OF FOUNDATION OF THE BUILDING.
6. ALL EXTERNAL WALLS ARE 200MM THICK AND CONSTRUCTED WITH 1:6 CEMENT SAND MORTAR.
7. THIS DRAWING IS THE SOLE PROPERTY OF THE CONSULTANT & NO COPY OF IT SHOULD BE MADE WITHOUT THE EXPRESS WRITTEN PERMISSION FROM THE CONSULTANT.

DOOR SCHEDULE

DOOR MKD.	DIMENSIONS IN MM		LINTEL	NO.	REMARKS
	WIDTH	HEIGHT			
D	2700	2100	2100		SINGLE LEAF
D1	2344	2100	2100		SINGLE LEAF
D2	2000	2100	2100		SINGLE LEAF
D3	1800	2100	2100		SINGLE LEAF
FCD	1200	2100	2100		SINGLE LEAF
D4	1343	2100	2100		SINGLE LEAF
D4A	1000	2100	2100		SINGLE LEAF
D5	780	2100	2100		SINGLE LEAF

WINDOW SCHEDULE

WINDOW MKD.	DIMENSIONS IN MM			NO.	REMARKS
	WIDTH	HEIGHT	SILL		
W	2000	1200	900		ALUMINIUM WINDOW
W1	1800	1200	900		ALUMINIUM WINDOW
W2	1000	1200	900		ALUMINIUM WINDOW
W3	780	900	1200		ALUMINIUM WINDOW
W4	1800	880	1400		ALUMINIUM WINDOW

Sign. of the Approval Authority

PROPOSED B+G+5 STORIED BUS TERMINUS CUM COMMERCIAL BUILDING AT SRIRAMPUR, UNDER SRIRAMPUR MUNICIPALITY, HOOGLY, WEST BENGAL.

**TITLE :-
TYPICAL FLOOR PLAN**

DWG. BY	REV. NO.	DATE

SCALE 1:100
or as mentioned

DATE: 28.08.13

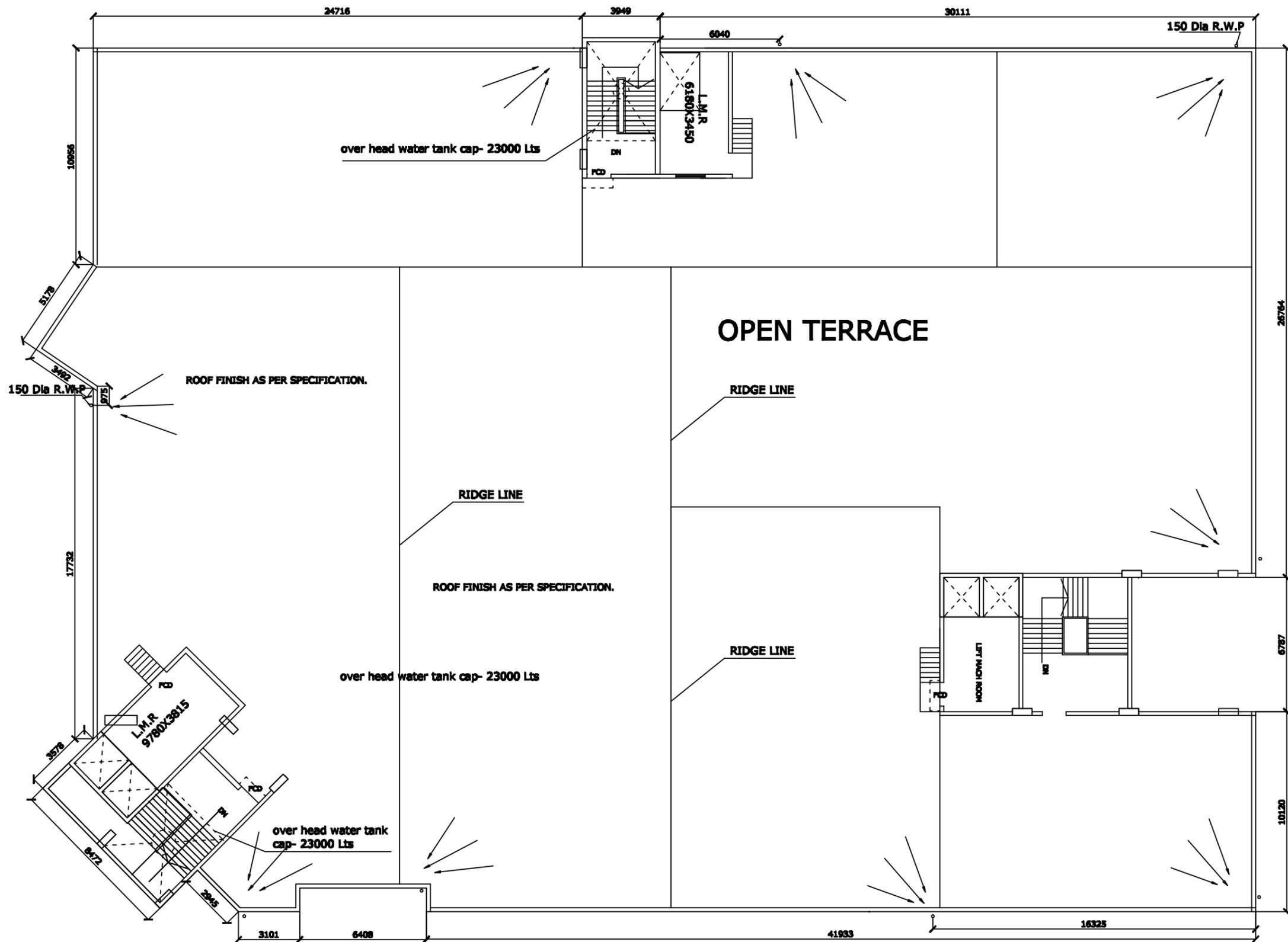
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CHECKED :-

HOOGHLY RIVER BRIDGE COMMISSIONERS
ST. GEORGE'S GATE ROAD KOLKATA - 700 021.

DESIGN CONSULTANT :
MS FARGO INFRAPROJECTS
313, CANAL STREET KOLKATA - 700048



TENDER PURPOSE ONLY



TERRACE FLOOR

TENDER PURPOSE ONLY

:-NOTES:-

1. CONTRACTOR TO CHECK & VERIFY ALL DIMENSIONS BEFORE EXECUTION OF WORK.
2. ALL DIMENSIONS ARE IN MILLIMETER UNLESS OTHERWISE MENTIONED.
3. FIGURED DIMENSIONS SHALL BE FOLLOWED.
4. FOR DETAILS BELOW PLINTH LEVEL REFER STRUCTURAL DRAWING.
5. DEPTH OF FOUNDATION OF SEMI UNDERGROUND WATER RESERVOIR SHOULD NOT EXCEED THE DEPTH OF FOUNDATION OF THE BUILDING.
6. ALL EXTERNAL WALLS ARE 200MM THICK AND CONSTRUCTED WITH 1:5 CEMENT SAND MORTAR.
7. THIS DRAWING IS THE SOLE PROPERTY OF THE CONSULTANT & NO COPY OF IT SHOULD BE MADE WITHOUT THE EXPRESS WRITTEN PERMISSION FROM THE CONSULTANT.

DOOR SCHEDULE

DOOR MKD.	DIMENSIONS IN MM			NO.	REMARKS
	WIDTH	HEIGHT	LINTEL		
D	2700	2100	2100		SINGLE LEAF
D1	2244	2100	2100		SINGLE LEAF
D2	2500	2100	2100		SINGLE LEAF
D3	1800	2100	2100		SINGLE LEAF
PCD	1200	2100	2100		SINGLE LEAF
D4	1248	2100	2100		SINGLE LEAF
D4A	1000	2100	2100		SINGLE LEAF
D5	780	2100	2100		SINGLE LEAF

WINDOW SCHEDULE

WINDOW MKD.	DIMENSIONS IN MM			NO.	REMARKS
	WIDTH	HEIGHT	SILL		
W	2000	1200	800		ALUMINUM WINDOW
W1	1800	1200	800		ALUMINUM WINDOW
W2	1000	1200	800		ALUMINUM WINDOW
W3	780	800	1200		ALUMINUM WINDOW
W4	1800	800	1480		ALUMINUM WINDOW

Sign. of the Approval Authority

PROPOSED B+G+5 STORIED BUS TERMINUS CUM COMMERCIAL BUILDING AT SRIRAMPUR, UNDER SRIRAMPUR MUNICIPALITY, HOOGLY, WEST BENGAL.

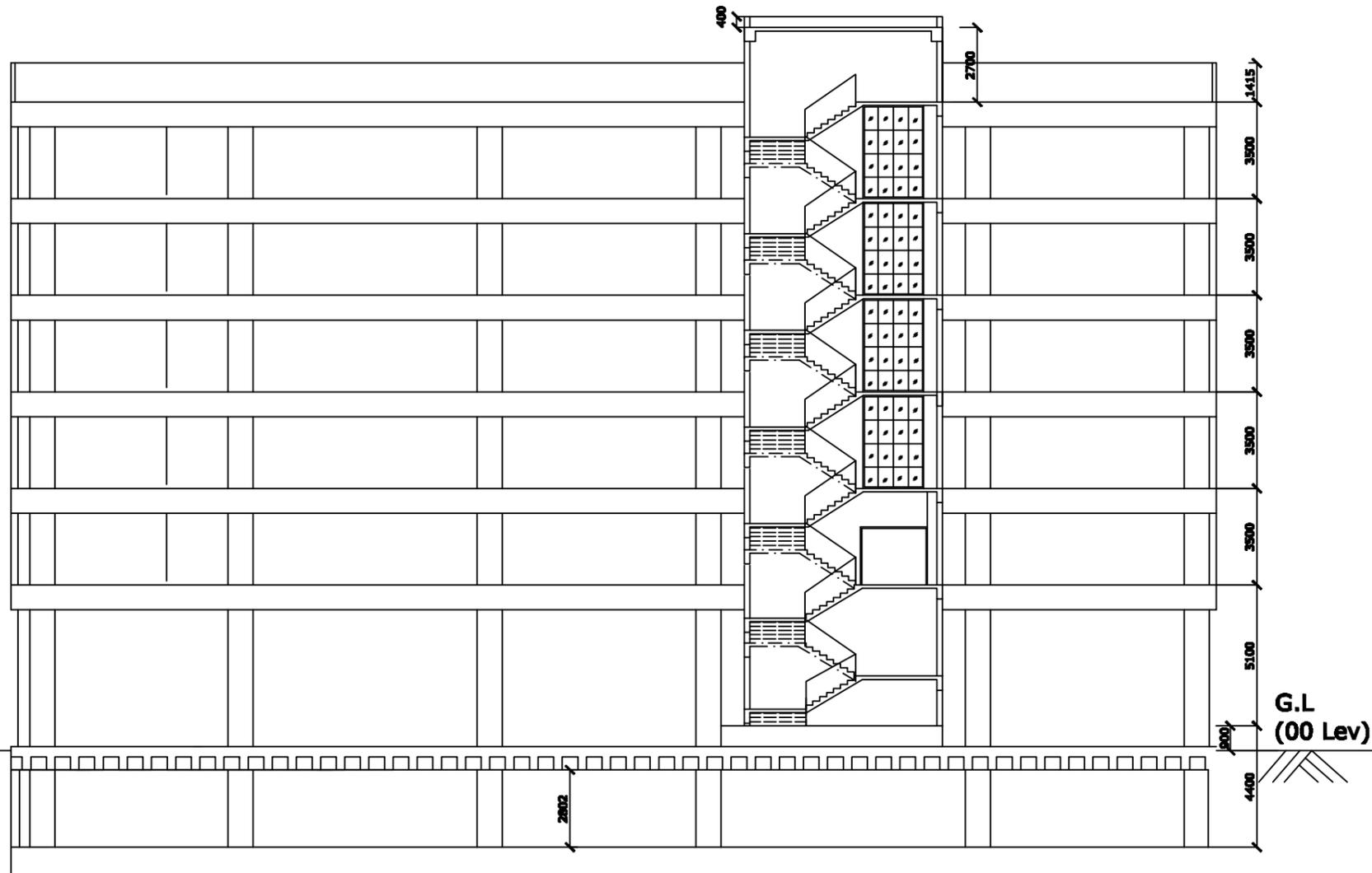
**TITLE :-
TERRACE FLOOR PLAN**

DWG. BY	REV. NO.	DATE
SCALE 1:100 or as mentioned	DRAWN :-	CHECKED:-
DATE:20.08.13		

HOOGHLY RIVER BRIDGE COMMISSIONERS
ST. GEORGE'S GATE ROAD KOLKATA - 700 021.

DESIGN CONSULTANT :
MS FARGO INFRAPROJECTS
313, CANAL STREET KOLKATA - 700048





SCH SECTION A-A

TENDER PURPOSE ONLY

:-NOTES:-

1. CONTRACTOR TO CHECK & VERIFY ALL DIMENSIONS BEFORE EXECUTION OF WORK.
2. ALL DIMENSIONS ARE IN MILLIMETER UNLESS OTHERWISE MENTIONED.
3. FIGURED DIMENSIONS SHALL BE FOLLOWED.
4. FOR DETAILS BELOW FINISH LEVEL REFER STRUCTURAL DRAWING.
5. DEPTH OF FOUNDATION OF 80% UNDERGROUND WATER RESERVOIR SHOULD NOT EXCEED THE DEPTH OF FOUNDATION OF THE BUILDING.
6. ALL EXTERNAL WALLS ARE 200MM THICK AND CONSTRUCTED WITH 1:3 CEMENT SAND MORTAR.
7. THIS DRAWING IS THE SOLE PROPERTY OF THE CONSULTANT & NO COPY OF IT SHOULD BE MADE WITHOUT THE EXPRESS WRITTEN PERMISSION FROM THE CONSULTANT.

DOOR SCHEDULE

DOOR MKD.	DIMENSIONS IN MM		NO.	REMARKS
	WIDTH	HEIGHT	INTEL.	
D	2700	2100	2100	SINGLE LEAF
D1	2344	2100	2100	SINGLE LEAF
D2	2000	2100	2100	SINGLE LEAF
D3	1800	2100	2100	SINGLE LEAF
PCD	1200	2100	2100	SINGLE LEAF
D4	1248	2100	2100	SINGLE LEAF
D4A	1000	2100	2100	SINGLE LEAF
D5	780	2100	2100	SINGLE LEAF

WINDOW SCHEDULE

WINDOW MKD.	DIMENSIONS IN MM		NO.	REMARKS
	WIDTH	HEIGHT	SILL.	
W	2000	1200	900	ALUMINIUM WINDOW
W1	1800	1200	900	ALUMINIUM WINDOW
W2	1000	1200	900	ALUMINIUM WINDOW
W3	780	900	1200	ALUMINIUM WINDOW
W4	1800	880	1480	ALUMINIUM WINDOW

Sign. of the Approval Authority

PROPOSED B+G+5 STORIED BUS TERMINUS CUM COMMERCIAL BUILDING AT SRIRAMPUR, UNDER SRIRAMPUR MUNICIPALITY, HOGLY, WEST BENGAL.

**TITLE :-
SECTION**

DWG. BY REV. NO. DATE

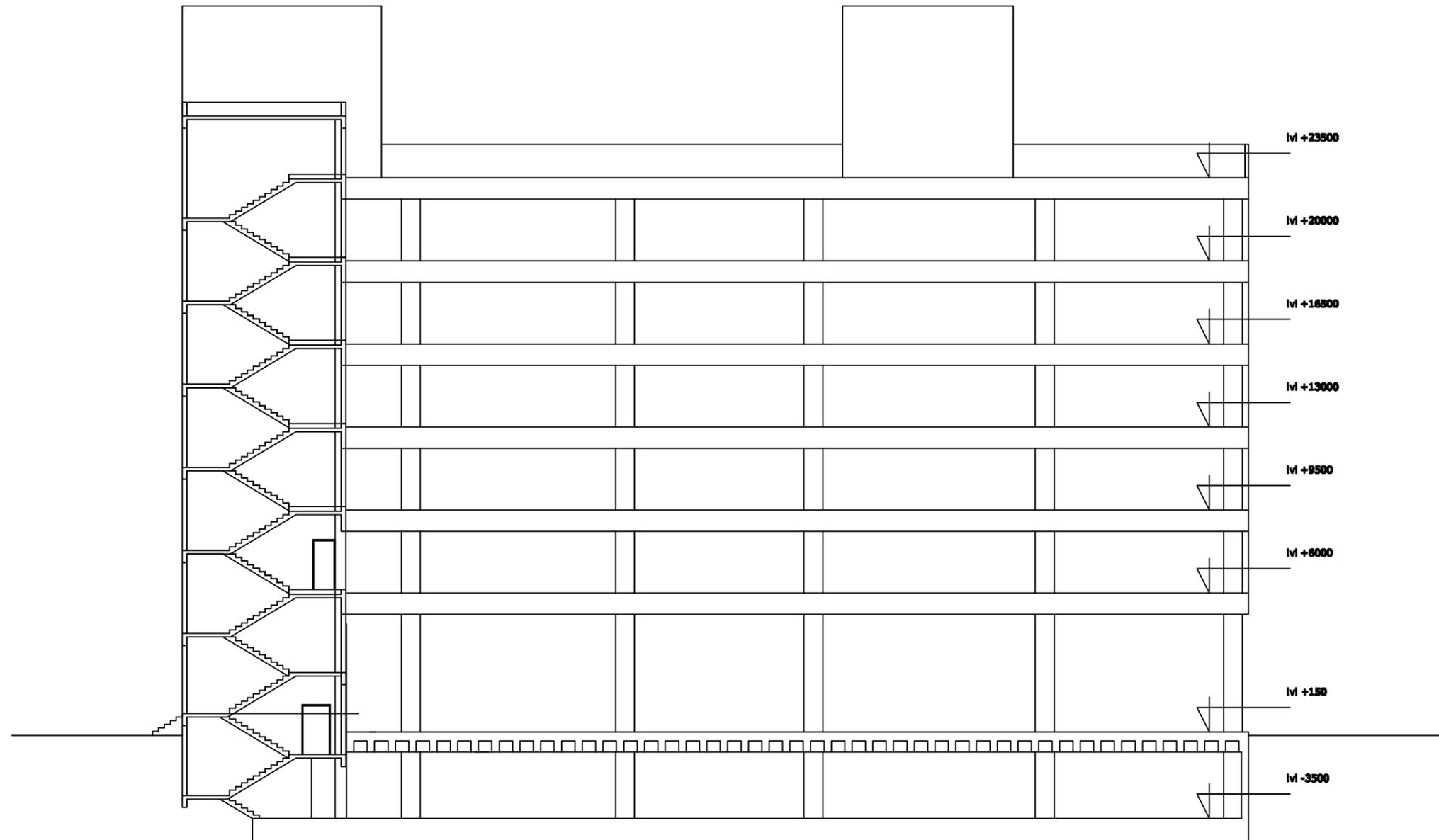
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DATE: 28.08.13
DRAWN :-
CHECKED:-

HOGLY RIVER BRIDGE COMMISSIONERS
ST. GEORGE'S GATE ROAD KOLKATA - 700 021.

DESIGN CONSULTANT :
MS FARGO INFRAPROJECTS
313, CANAL STREET KOLKATA - 700048



DRG.NO. MFI / T / A / 07 (SHEET 1 OF 2)



SCH. SECTION X-X'

TENDER PURPOSE ONLY

:-NOTES:-

1. CONTRACTOR TO CHECK & VERIFY ALL DIMENSIONS BEFORE EXECUTION OF WORK.
2. ALL DIMENSIONS ARE IN MILLIMETER UNLESS OTHERWISE MENTIONED.
3. FIGURED DIMENSIONS SHALL BE FOLLOWED.
4. FOR DETAILS BELOW FINISH LEVEL REFER STRUCTURAL DRAWING.
5. DEPTH OF FOUNDATION OF SEMI UNDERGROUND WATER RESERVOIR SHOULD NOT EXCEED THE DEPTH OF FOUNDATION OF THE BUILDING.
6. ALL EXTERNAL WALLS ARE 200MM THICK AND CONSTRUCTED WITH 1:6 CEMENT SAND MORTAR.
7. THIS DRAWING IS THE SOLE PROPERTY OF THE CONSULTANT & NO COPY OF IT SHOULD BE MADE WITHOUT THE EXPRESS WRITTEN PERMISSION FROM THE CONSULTANT.

DOOR SCHEDULE

DOOR MKD.	DIMENSIONS IN MM			NO.	REMARKS
	WIDTH	HEIGHT	LINTEL		
D	2700	2100	2100		SINGLE LEAF
D1	2344	2100	2100		SINGLE LEAF
D2	2000	2100	2100		SINGLE LEAF
D3	1800	2100	2100		SINGLE LEAF
FCD	1200	2100	2100		SINGLE LEAF
D4	1248	2100	2100		SINGLE LEAF
D4A	1000	2100	2100		SINGLE LEAF
D5	780	2100	2100		SINGLE LEAF

WINDOW SCHEDULE

WINDOW MKD.	DIMENSIONS IN MM			NO.	REMARKS
	WIDTH	HEIGHT	SILL		
W	2000	1200	900		ALUMINIUM WINDOW
W1	1800	1200	900		ALUMINIUM WINDOW
W2	1000	1200	900		ALUMINIUM WINDOW
W3	780	900	1200		ALUMINIUM WINDOW
W4	1800	900	1400		ALUMINIUM WINDOW

Sign. of the Approval Authority

PROPOSED B+G+5 STORIED BUS TERMINUS CUM COMMERCIAL BUILDING AT SRIRAMPUR, UNDER SRIRAMPUR MUNICIPALITY, HOGLY, WEST BENGAL.

TITLE :-
SECTION

DWG. BY: REV. NO. DATE
SCALE 1:100
OF AS MENTIONED
DATE: 28.09.13

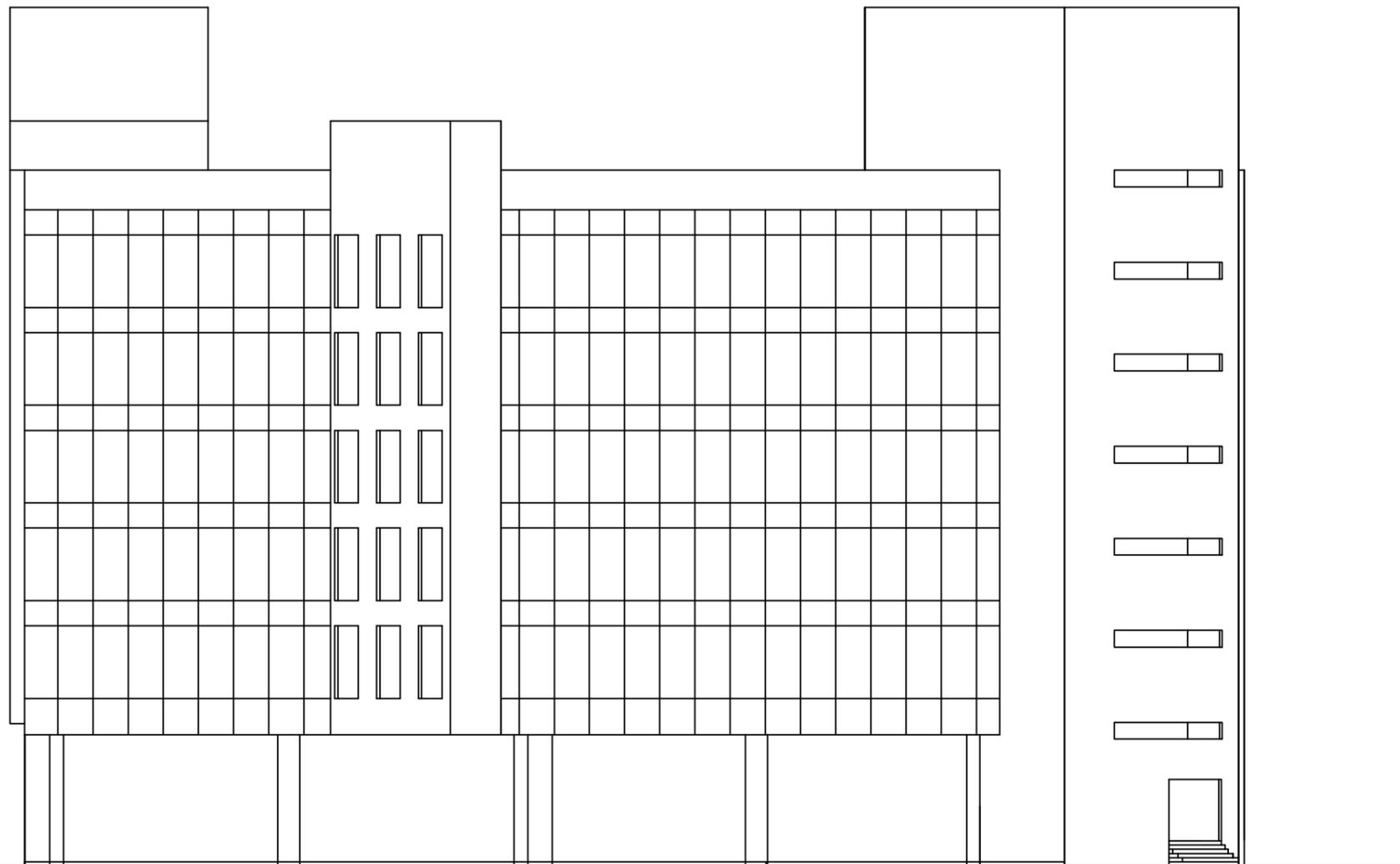
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HOGLY RIVER BRIDGE COMMISSIONERS
ST. GEORGE'S GATE ROAD KOLKATA - 700 021.

DESIGN CONSULTANT :

MS FARGO INFRAPROJECTS
313, CANAL STREET KOLKATA - 700048





SOUTH ELEVATION

TENDER PURPOSE ONLY

:-NOTES:-

1. CONTRACTOR TO CHECK & VERIFY ALL DIMENSIONS BEFORE EXECUTION OF WORK.
2. ALL DIMENSIONS ARE IN MILLIMETER UNLESS OTHERWISE MENTIONED.
3. FIGURED DIMENSIONS SHALL BE FOLLOWED.
4. FOR DETAILS BELOW FINISH LEVEL REFER STRUCTURAL DRAWING.
5. DEPTH OF FOUNDATION OF SEPTIC UNDERGROUND WATER RESERVOIR SHOULD NOT EXCEED THE DEPTH OF FOUNDATION OF THE BUILDING.
6. ALL EXTERNAL WALLS ARE 200MM THICK AND CONSTRUCTED WITH 1:6 CEMENT SAND MORTAR.
7. THIS DRAWING IS THE SOLE PROPERTY OF THE CONSULTANT & NO COPY OF IT SHOULD BE MADE WITHOUT THE EXPRESS WRITTEN PERMISSION FROM THE CONSULTANT.

DOOR SCHEDULE

DOOR MKD.	DIMENSIONS IN MM			NO.	REMARKS
	WIDTH	HEIGHT	LENTEL		
D	2700	2100	2100		SINGLE LEAF
D1	2244	2100	2100		SINGLE LEAF
D2	2000	2100	2100		SINGLE LEAF
D3	1800	2100	2100		SINGLE LEAF
PCD	1200	2100	2100		SINGLE LEAF
D4	1243	2100	2100		SINGLE LEAF
D4A	1000	2100	2100		SINGLE LEAF
D5	780	2100	2100		SINGLE LEAF

WINDOW SCHEDULE

WINDOW MKD.	DIMENSIONS IN MM			NO.	REMARKS
	WIDTH	HEIGHT	SILL		
W	2000	1200	900		ALUMINIUM WINDOW
W1	1800	1200	900		ALUMINIUM WINDOW
W2	1000	1200	900		ALUMINIUM WINDOW
W3	780	900	1200		ALUMINIUM WINDOW
W4	1800	680	1480		ALUMINIUM WINDOW

Sign. of the Approval Authority

PROPOSED B+G+5 STORIED BUS TERMINUS CUM COMMERCIAL BUILDING AT SRIRAMPUR, UNDER SRIRAMPUR MUNICIPALITY, HOOGLY, WEST BENGAL.

**TITLE :-
ELEVATION**

DWG. BY	REV. NO.	DATE

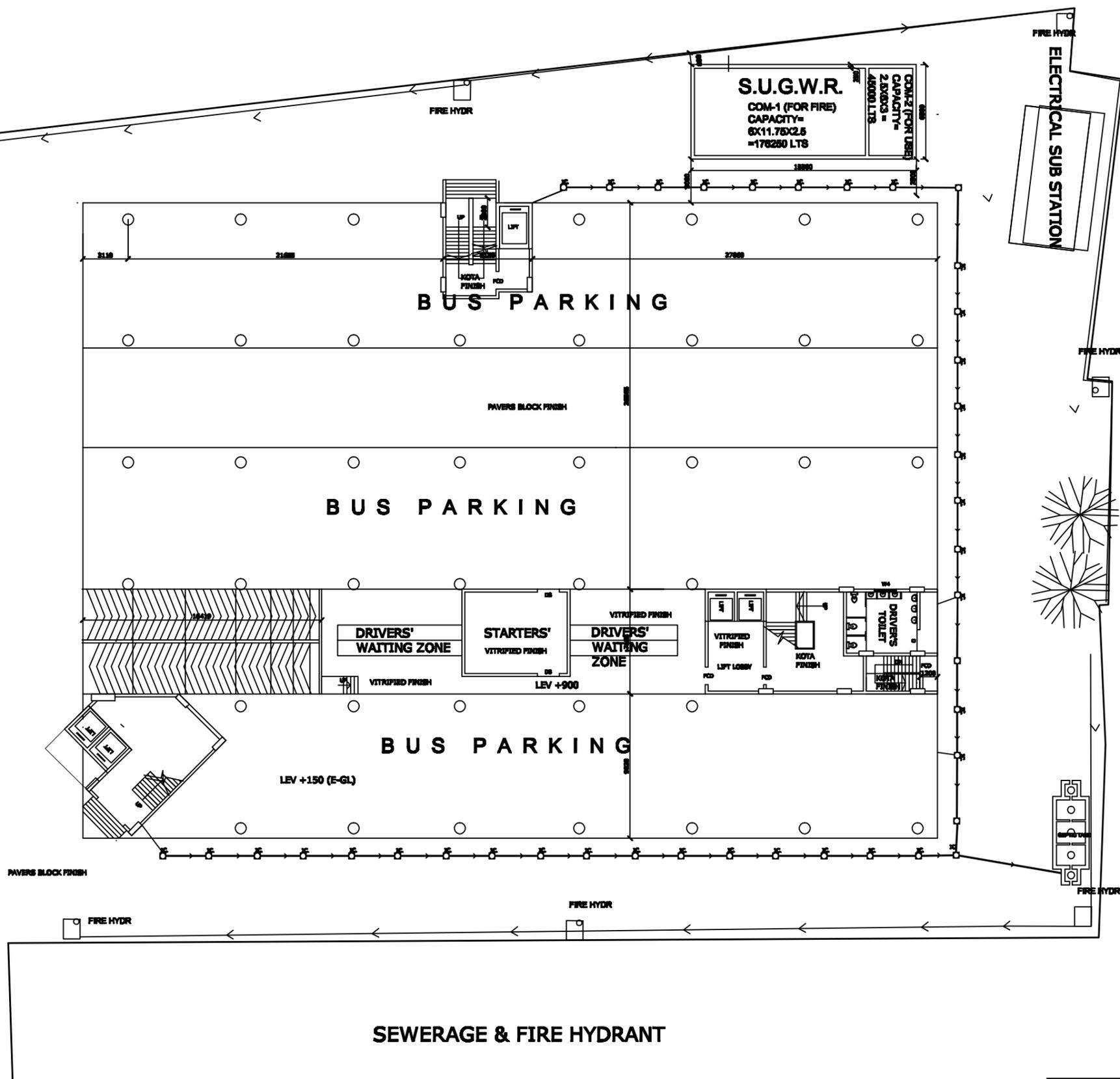
SCALE 1:100
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DATE:20.08.13

DRAWN :-
CHECKED:-

HOOGHLY RIVER BRIDGE COMMISSIONERS
ST. GEORGE'S GATE ROAD KOLKATA - 700 021.

DESIGN CONSULTANT :
MS FARGO INFRAPROJECTS
313, CANAL STREET KOLKATA - 700048





:-NOTES:-

1. CONTRACTOR TO CHECK & VERIFY ALL DIMENSIONS BEFORE EXECUTION OF WORK.
2. ALL DIMENSIONS ARE IN MILLIMETER UNLESS OTHERWISE MENTIONED.
3. FIGURED DIMENSIONS SHALL BE FOLLOWED.
4. FOR DETAILS BELOW FLOOR LEVEL REFER STRUCTURAL DRAWING.
5. DEPTH OF FOUNDATION OF SUMP UNDERGROUND WATER RESERVOIR SHOULD NOT EXCEED THE DEPTH OF FOUNDATION OF THE BUILDING.
6. ALL EXTERNAL WALLS ARE 200MM THICK AND CONSTRUCTED WITH 1:3 CEMENT SAND MORTAR.
7. THIS DRAWING IS THE SOLE PROPERTY OF THE CONSULTANT & NO COPY OF IT SHOULD BE MADE WITHOUT THE EXPRESS WRITTEN PERMISSION FROM THE CONSULTANT.

DOOR SCHEDULE

DOOR MKD.	WIDTH	HEIGHT	LINTEL	NO.	REMARKS
D	2700	2100	2100		SINGLE LEAF
D1	2344	2100	2100		SINGLE LEAF
D2	2000	2100	2100		SINGLE LEAF
D3	1800	2100	2100		SINGLE LEAF
PCD	1200	2100	2100		SINGLE LEAF
D4	1248	2100	2100		SINGLE LEAF
D4A	1000	2100	2100		SINGLE LEAF
D5	780	2100	2100		SINGLE LEAF

WINDOW SCHEDULE

WINDOW MKD.	WIDTH	HEIGHT	SILL.	NO.	REMARKS
W	2000	1200	900		ALUMINIUM WINDOW
W1	1800	1200	900		ALUMINIUM WINDOW
W2	1000	1200	900		ALUMINIUM WINDOW
W3	780	900	1200		ALUMINIUM WINDOW
W4	1800	900	1480		ALUMINIUM WINDOW

Sign. of the Approval Authority

PROPOSED B+G+5 STORIED BUS TERMINUS CUM COMMERCIAL BUILDING AT SRIRAMPUR, UNDER SRIRAMPUR MUNICIPALITY, HOOGLY, WEST BENGAL.

TITLE :- LAYOUT PLAN OF SEWERAGE & FIRE HYDRANT

DWG. BY	REV. NO.	DATE

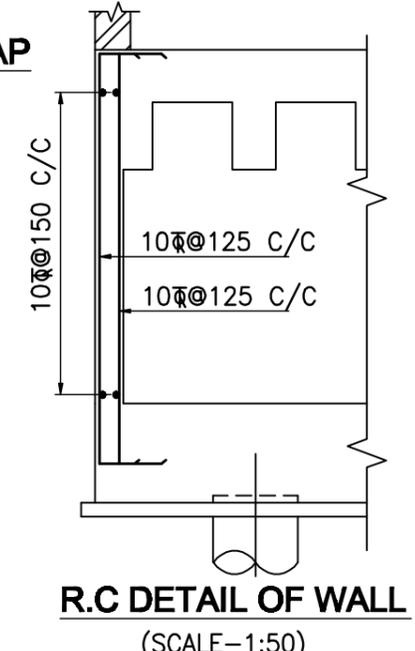
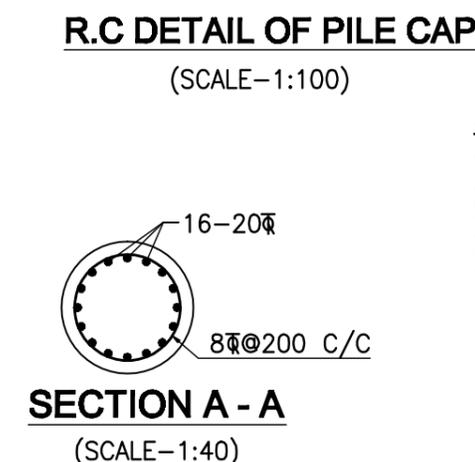
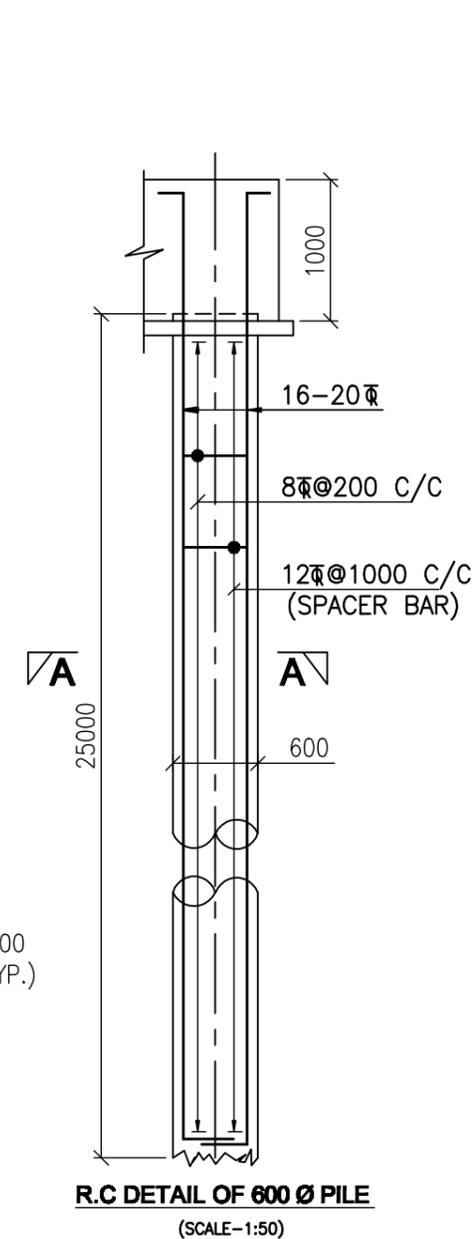
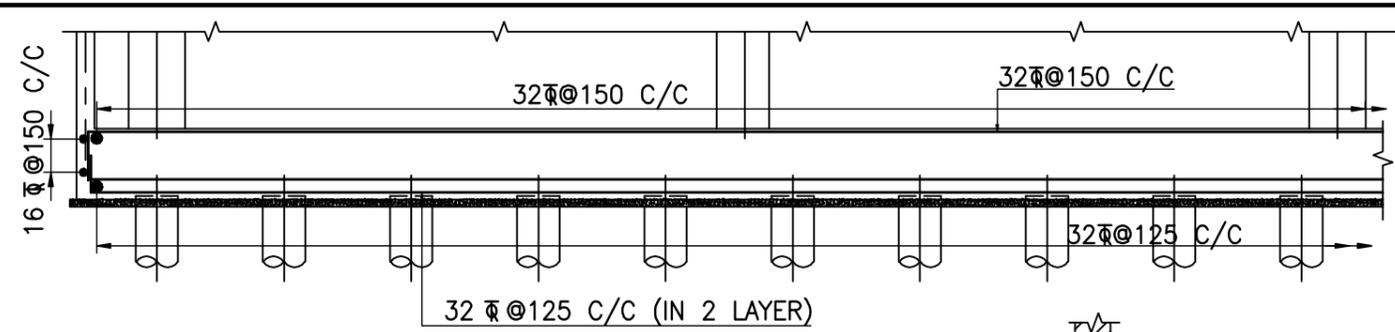
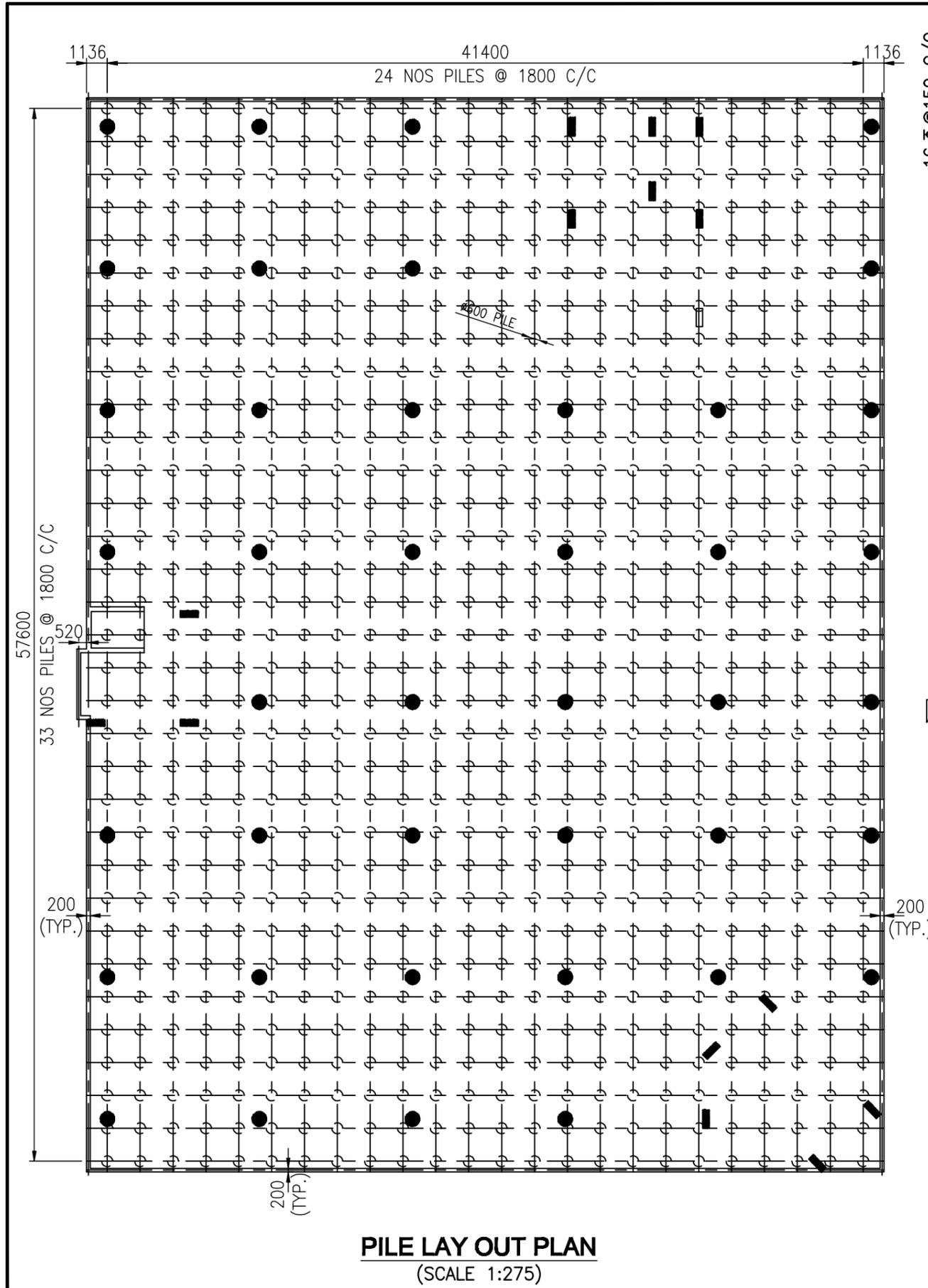
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DATE:28.08.13

HOOGHLY RIVER BRIDGE COMMISSIONERS
ST. GEORGE'S GATE ROAD KOLKATA - 700 021.

DESIGN CONSULTANT :
MS FARGO INFRAPROJECTS
315, CANAL STREET KOLKATA - 700046



TENDER PURPOSE ONLY

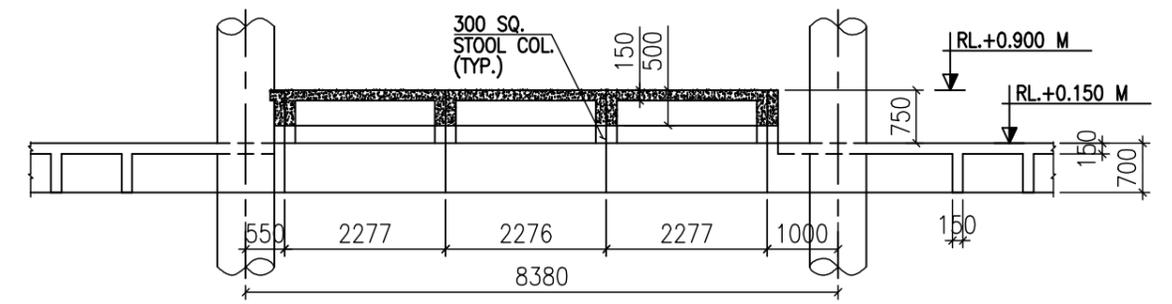
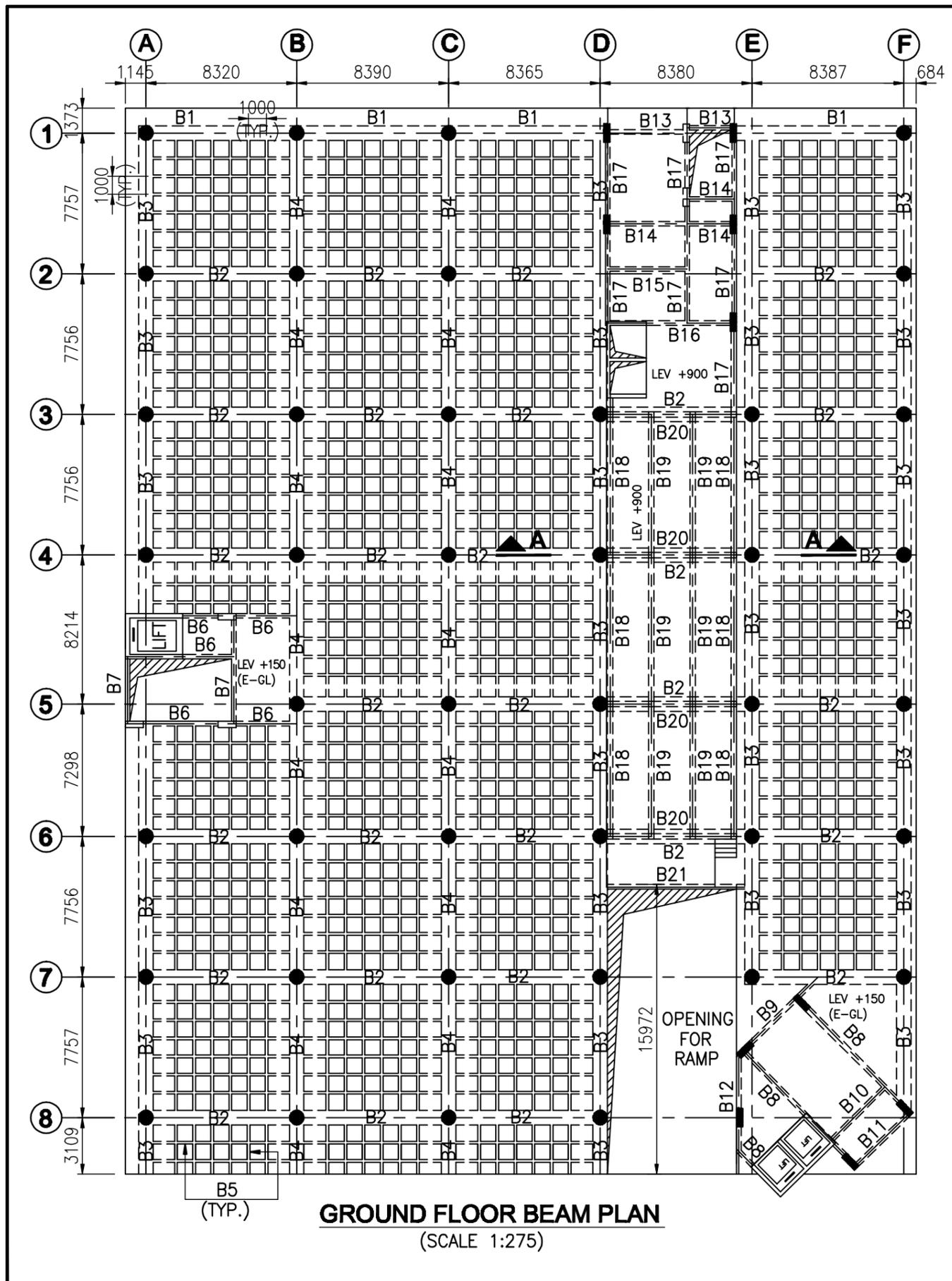


NOTES

- 1) ALL DIMENSION ARE IN MM. & LEVELS ARE IN M.
- 2) THIS DRG. SHALL BE READ IN CONJUNCTION WITH ARCHITECTURAL DRG.
- 3) FLAT SLAB CONSTRUCTION METHOD IS TO BE ADOPTED AS PER I.S:456
- 4) GRADE OF CONC. SHALL BE M35 CONC. UNLESS OTHERWISE NOTED.
- 5) 'ϕ' DENOTES H.Y.S.D BARS CONFIRMING TO GRADE Fe-500 AS PER I.S:1786
- 6) CLEAR COVER SHALL BE AS FOLLOWS.
 - a) BEAM = 30 mm
 - b) FOUNDATION & BASE SLAB = 50 MM

TENDER PURPOSE ONLY

HOOGHLY RIVER BRIDGE COMMISSIONERS ST. GEORGE'S GATE ROAD KOLKATA - 700 021.					
PROJECT : PROPOSED B+G+5 STORIED BUS TERMINUS CUM COMMERCIAL BUILDING AT SRIRAMPUR, UNDER SRIRAMPUR MUNICIPALITY, HOOGHLY, WEST BENGAL.					
DESIGN CONSULTANT : MS FARGO INFRAPROJECTS 313, CANAL STREET KOLKATA - 700048					
DATE : 08.10.2013	TITLE : LAYOUT & R.C. DETAILS OF PILE, BASEMENT & WALL				
SCALE : AS NOTED.	DESIGNED BY.	CHKED. BY.	APPROVED BY.	DWG. NO.	REV. NO.
	(Rajesh)	(S.M.G.)	(S.M.G.)	MFI/T/CE/01	R0



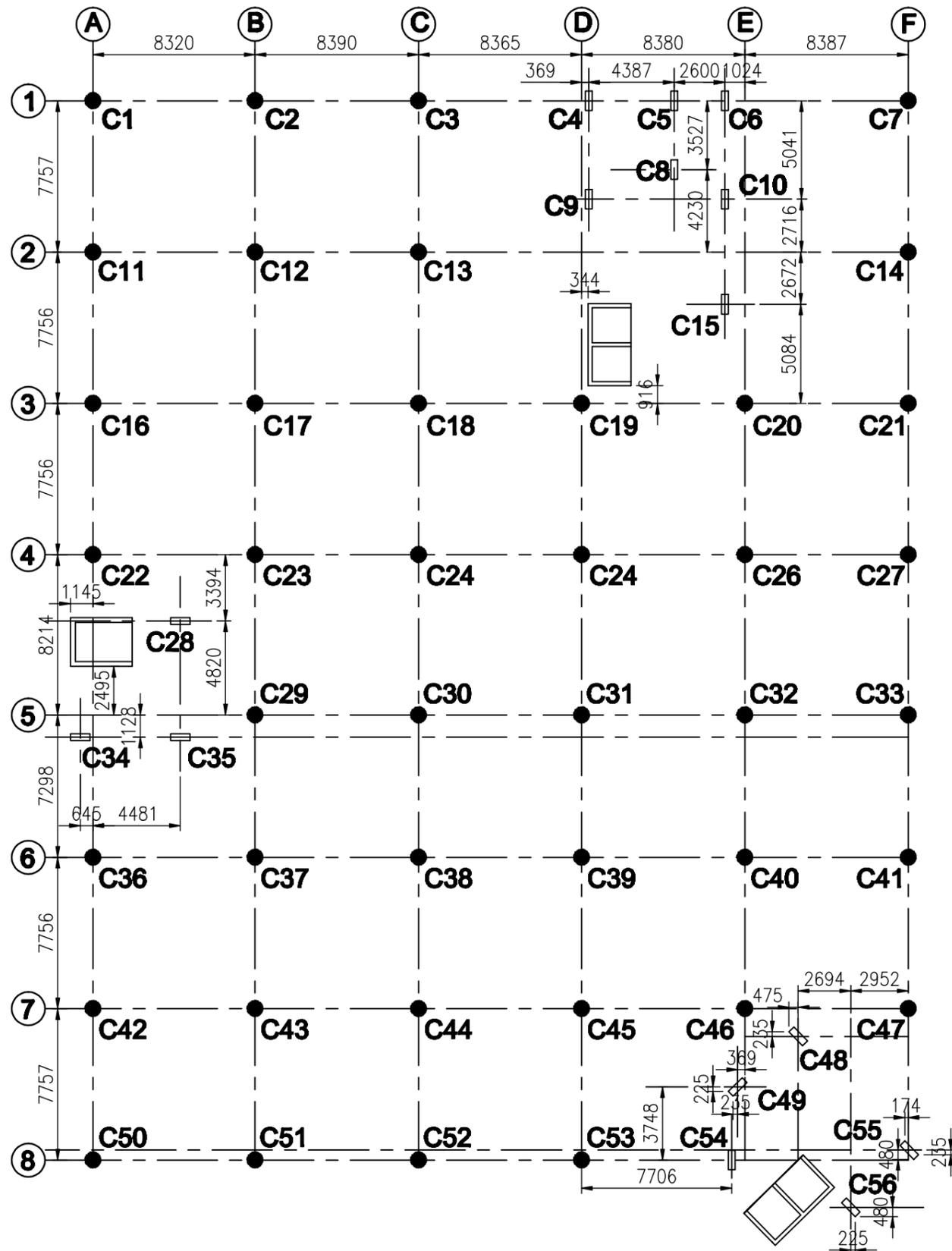
SECTION A - A
(SCALE 1:100)

NOTES :

1. ALL DIMENSIONS ARE IN MM. & LEVELS ARE IN M.
2. THIS DRAWING IS BASED ON DRG. NO. SMU/TE/A/01 TO 09
3. FOR RC. DETAILS REFER SEPARATE DRAWINGS.
4. ALL DIMENSIONS ARE TENTATIVE AND MAY CHANGE DURING DETAILED DESIGN.

TENDER PURPOSE ONLY

HOOGHLY RIVER BRIDGE COMMISSIONERS ST. GEORGE'S GATE ROAD KOLKATA - 700 021.					
PROJECT : PROPOSED B+G+5 STORIED BUS TERMINUS CUM COMMERCIAL BUILDING AT SRIRAMPUR, UNDER SRIRAMPUR MUNICIPALITY, HOOGHLY, WEST BENGAL.					
DESIGN CONSULTANT : MS FARGO INFRAPROJECTS 313, CANAL STREET KOLKATA - 700048					
DATE : 08.10.2013	TITLE : GROUND FLOOR BEAM LAYOUT PLAN				
SCALE : AS NOTED.					
DRAWN BY. (Ravi)	DESIGNED BY. (S.M.G.)	CHKED. BY. (S.M.G.)	APPROVED BY.	DWG. NO. MFI/T/CE/02	REV. NO. R0



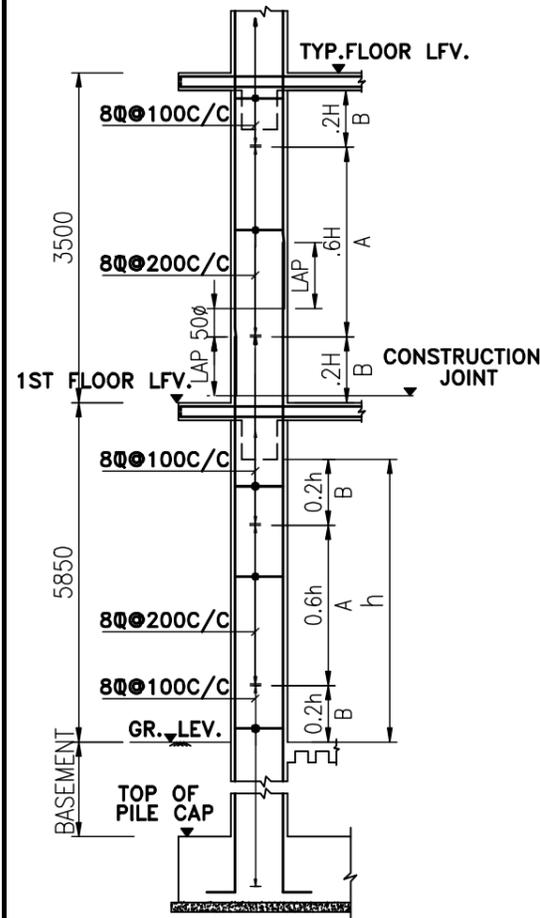
COLUMN LAYOUT PLAN
(SCALE 1:275)

NOTES

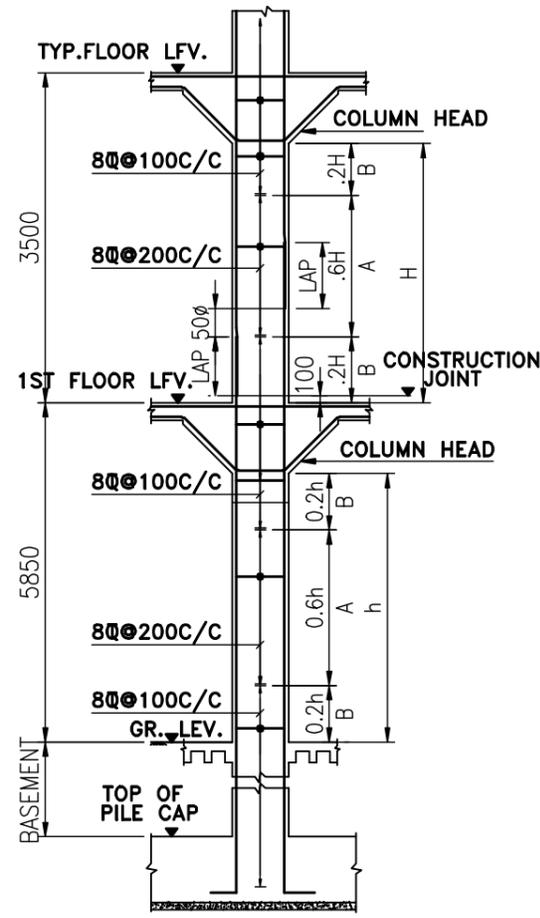
- 1) ALL DIMENSION ARE IN MM. & LEVELS ARE IN M.
- 2) THIS DRG. SHALL BE READ IN CONJUNCTION WITH ARCHITECTURAL DRG.
- 3) FLAT SLAB CONSTRUCTION METHOD IS TO BE ADOPTED AS PER I.S:456
- 4) GRADE OF CONC. SHALL BE M35 CONC. UNLESS OTHERWISE NOTED.
- 5) 'Φ' DENOTES H.Y.S.D BARS CONFIRMING TO GRADE Fe-500 AS PER I.S:1786
- 6) CLEAR COVER SHALL BE AS FOLLOWS.
 - a) BEAM = 30 mm
 - b) COLUMN = 40 MM

TENDER PURPOSE ONLY

HOOGHLY RIVER BRIDGE COMMISSIONERS ST. GEORGE'S GATE ROAD KOLKATA - 700 021.					
PROJECT : PROPOSED B+G+5 STORIED BUS TERMINUS CUM COMMERCIAL BUILDING AT SRIRAMPUR, UNDER SRIRAMPUR MUNICIPALITY, HOOGHLY, WEST BENGAL.					
DESIGN CONSULTANT : MS FARGO INFRAPROJECTS 313, CANAL STREET KOLKATA - 700048					
DATE : 08.10.2013	TITLE : COLUMN LAYOUT PLAN				
SCALE : AS NOTED.					
DRAWN BY. (Rajesh)	DESIGNED BY. (S.M.G.)	CHKED. BY. (S.M.G.)	APPROVED BY.	DWG. NO. MFI/T/CE/03	REV. NO. R0



DETAIL OF END COLUMN
(SCALE 1:100)



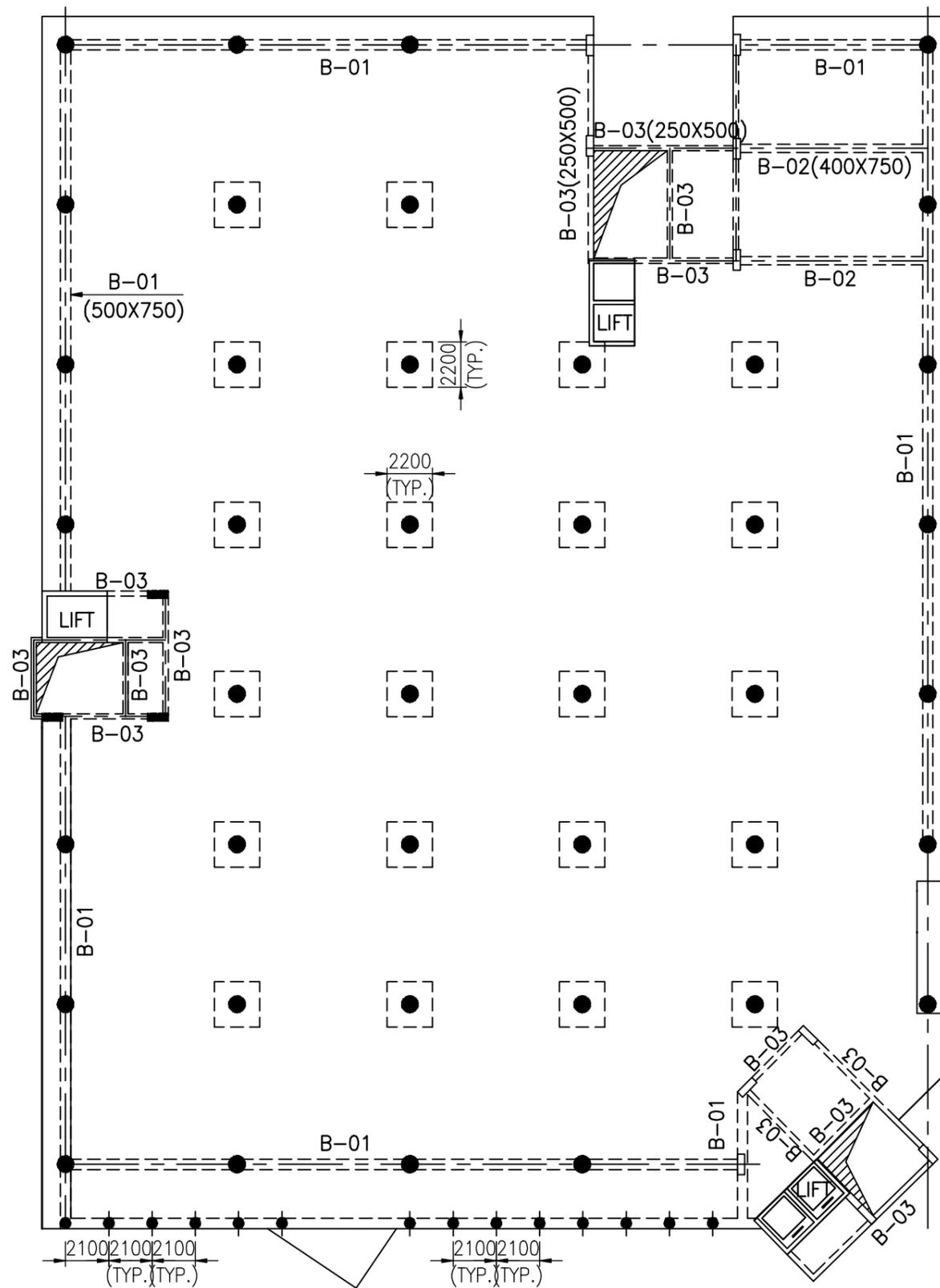
DETAIL OF INTERMEDIATE COLUMN
(SCALE 1:100)

COLUMN REINFORCEMENT SCHEDULE

COLUMN MKD.	COLUMN HIGHT	COLUMN SIZE	REINFORCEMENT		
			LONGITUDINAL	TIES IN ZONE	
				A	B
C1,C2,C3,C7, C11 TO C14, C16 TO C27, C29 TO C47, C50 TO C53,	FROM FDN. TO ROOF LVL.	800∅	20-32∅	8∅@200C/C	8∅@100C/C
C4,C6,C8,C9,C10, C15,C28,C34,C35, C47,C48,C54,C55, C56	FROM FDN. TO ROOF LVL.	350X1000	18-25∅	8∅@200C/C	8∅@100C/C
C5,C8	FROM FDN. TO GROUND FLOOR LVL.	350X1000	8 NOS 25∅	8∅@200C/C	8∅@100C/C

TENDER PURPOSE ONLY

HOOGHLY RIVER BRIDGE COMMISSIONERS ST. GEORGE'S GATE ROAD KOLKATA - 700 021.					
PROJECT : PROPOSED B+G+5 STORIED BUS TERMINUS CUM COMMERCIAL BUILDING AT SRIRAMPUR, UNDER SRIRAMPUR MUNICIPALITY, HOOGHLY, WEST BENGAL.					
DESIGN CONSULTANT : MS FARGO INFRAPROJECTS 313, CANAL STREET KOLKATA - 700048					
DATE : 08.10.2013	TITLE :				
SCALE : AS NOTED.	COLUMN REINFORCEMENT DETAILS				
DRAWN BY.	DESIGNED BY.	CHKED. BY.	APPROVED BY.	DWG. NO.	REV. NO.
(Rajesh)	(S.M.G.)	(S.M.G.)		MFI/T/CE/04	R0



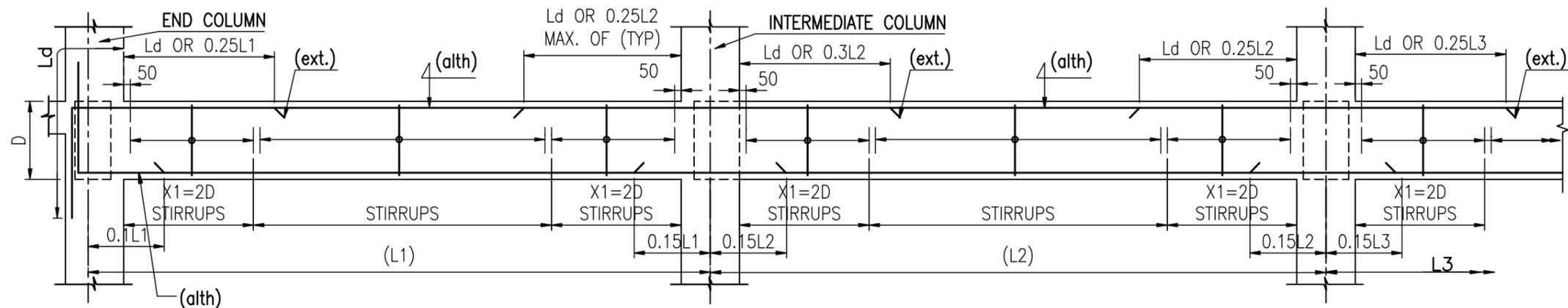
FLOOR BEAM PLAN
(SCALE 1:275)

NOTES :

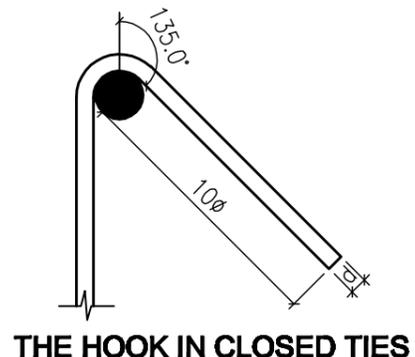
1. ALL DIMENSIONS ARE IN MM. & LEVELS ARE IN M.
2. GRADE OF CONCRETE SHALL BE M-30. UNLESS STATED.
3. ALL HYSD REINFORCING STEEL OF GRADE Fe-500 CONFORMING TO IS: 1786 SHALL BE USED.
4. COVER TO REINFORCEMENT SHALL BE AS FOLLOWS
 - (i) IN COLUMN = 50 mm,
 - (ii) IN BEAM = 30 mm
5. MINIMUM LAP LENGTH SHALL BE 50 TIMES THE BAR DIA.
6. THE LAPS SHALL BE STAGGERED. NOT MORE THAN 1/3 OF THE TOTAL REINFORCEMENT SHALL BE LAPPED AT A SINGLE SECTION.

TENDER PURPOSE ONLY

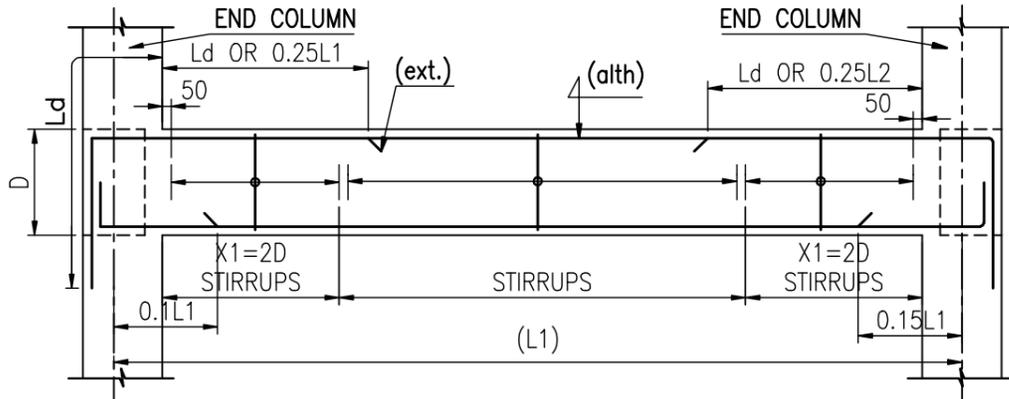
HOOGHLY RIVER BRIDGE COMMISSIONERS ST. GEORGE'S GATE ROAD KOLKATA - 700 021.					
PROJECT : PROPOSED B+G+5 STORIED BUS TERMINUS CUM COMMERCIAL BUILDING AT SRIRAMPUR, UNDER SRIRAMPUR MUNICIPALITY, HOOGHLY, WEST BENGAL.					
DESIGN CONSULTANT : MS FARGO INFRAPROJECTS 313, CANAL STREET KOLKATA - 700048					
DATE :	TITLE :				
08.10.2013	BEAM LAYOUT PLAN				
SCALE :					
AS NOTED.					
DRAWN BY.	DESIGNED BY.	CHKED. BY.	APPROVED BY.	DWG. NO.	REV. NO.
(Rajesh)	(S.M.G.)	(S.M.G.)		MFI/T/CE/05	R0



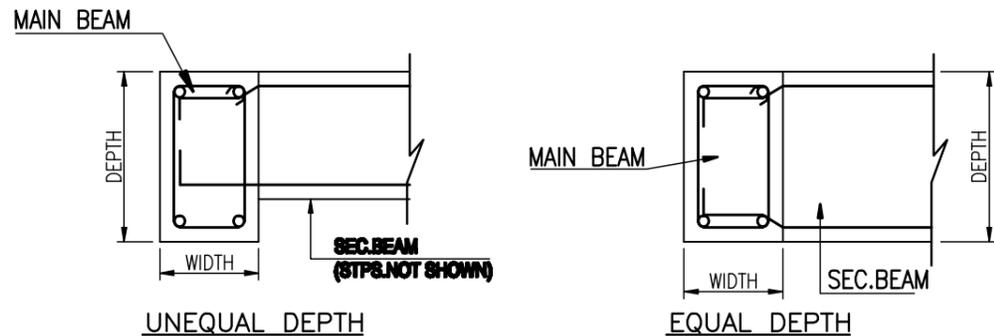
TYPICAL RC DETAILS OF MULTI-SPAN BEAMS
[REF.TABLE FOR REINFORCEMENT]



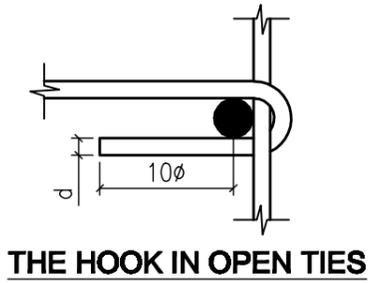
THE HOOK IN CLOSED TIES



RC DETAILS OF SINGLE SPAN BEAMS
[REF.TABLE FOR REINFORCEMENT]



TYPICAL JUNCTION OF MAIN & SEC. BEAM
(SCALE :- 1:25)



THE HOOK IN OPEN TIES

NOTES :

1. ALL DIMENSIONS ARE IN MM. & LEVELS ARE IN M.
2. THIS DRG. SHALL BE READ IN CONJUNCTION WITH BEAMS PLAN.

DETAILS OF BEAM REINFORCEMENT FOR FLOOR & ROOF

SL.NO.	BEAM MARKINGS	WIDTH (B)	DEPTH (D)	REINFORCEMENTS				SHEAR STIRRUPS	
				SUPPORT		SPAN		IN ZONE - X1	REMAINING ZONE
1.	B-1	500	750	4-25 +4-25	4-25	4-25	4-25	2L-10 @100C/C	2L-10 @200C/C
2.	B-2	400	750	4-25 +4-25	4-25	4-25	4-25	2L-10 @100C/C	2L-10 @200C/C
3.	B-3	250	500	2-25 +4-25	2-25	2-25	2-25	2L-10 @100C/C	2L-10 @200C/C

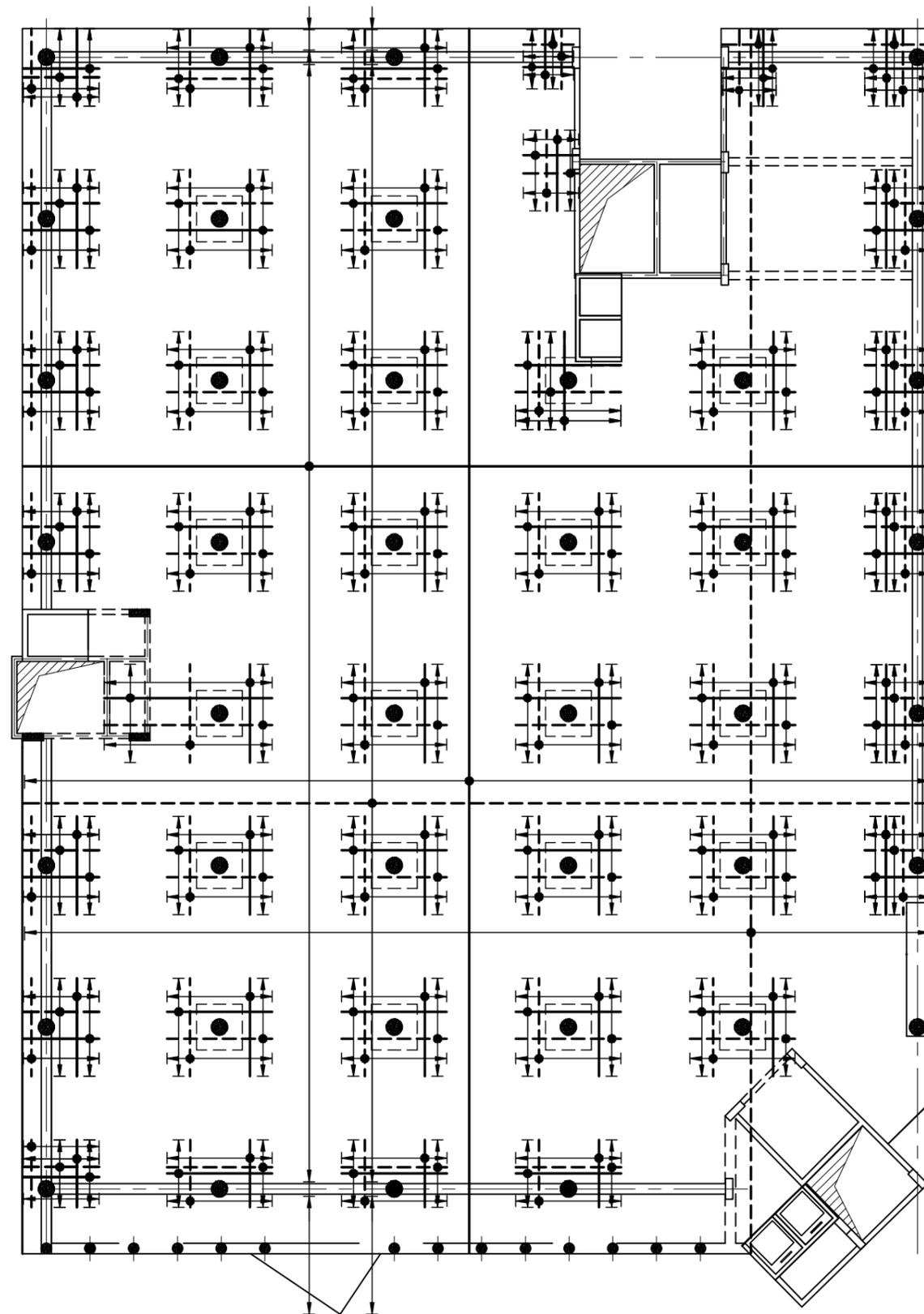
TENDER PURPOSE ONLY

HOOGHLY RIVER BRIDGE COMMISSIONERS
ST. GEORGE'S GATE ROAD KOLKATA - 700 021.

PROJECT : **PROPOSED B+G+5 STORIED BUS TERMINUS CUM COMMERCIAL BUILDING AT SRIRAMPUR, UNDER SRIRAMPUR MUNICIPALITY, HOOGHLY, WEST BENGAL.**

DESIGN CONSULTANT :
MS FARGO INFRAPROJECTS
313, CANAL STREET KOLKATA - 700048

DATE : 08.10.2013	TITLE : TYP. R.C. DETAILS OF BEAM
SCALE : AS NOTED.	
DRAWN BY: (Rajesh)	DESIGNED BY: (S.M.G.)
CHKED. BY: (S.M.G.)	APPROVED BY:
DWG. NO. MFI/T/CE/06	REV. NO. R0



R.C. DETAIL OF TYPICAL FLAT SLAB REINFORCEMENT

(SCALE 1:275)

SCHEDULE OF BASEMENT BASE SLAB REINFORCEMENT

CONCRETE USED M-35		STEEL USED Fe - 500			
DIRECTION	SLAB THK.	COLUMN STRIP		MIDDLE STRIP	
		TOP	BOTTOM	TOP	BOTTOM
LONG	250	16 $\bar{\phi}$ @ 150 C/C	12 $\bar{\phi}$ @ 150 C/C	16 $\bar{\phi}$ @ 300 C/C	12 $\bar{\phi}$ @ 300 C/C
SHORT	250	16 $\bar{\phi}$ @ 150 C/C	12 $\bar{\phi}$ @ 150 C/C	16 $\bar{\phi}$ @ 300 C/C	12 $\bar{\phi}$ @ 300 C/C

NOTES :

1. ALL DIMENSIONS ARE IN MM. & LEVELS ARE IN M.
2. GRADE OF CONCRETE SHALL BE M-30. UNLESS STATED.
3. ALL HYSD REINFORCING STEEL OF GRADE Fe-500 CONFORMING TO IS: 1786 SHALL BE USED.
4. COVER TO REINFORCEMENT SHALL BE AS FOLLOWS
(i) IN COLUMN = 50 mm,
(ii) IN BEAM = 30 mm
5. MINIMUM LAP LENGTH SHALL BE 50 TIMES THE BAR DIA.
6. THE LAPS SHALL BE STAGGERED. NOT MORE THAN 1/3 OF THE TOTAL REINFORCEMENT SHALL BE LAPPED AT A SINGLE SECTION.

TENDER PURPOSE ONLY

HOOGLY RIVER BRIDGE COMMISSIONERS

ST. GEORGE'S GATE ROAD KOLKATA - 700 021.

PROJECT : **PROPOSED B+G+5 STORIED BUS TERMINUS CUM COMMERCIAL BUILDING AT SRIRAMPUR, UNDER SRIRAMPUR MUNICIPALITY, HOOGLY, WEST BENGAL.**

DESIGN CONSULTANT :

MS FARGO INFRAPROJECTS

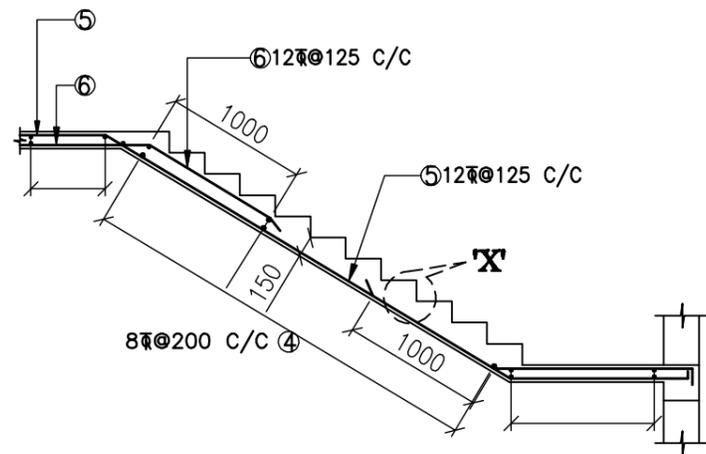
313, CANAL STREET KOLKATA - 700048

DATE :
08.10.2013
SCALE :
AS NOTED.

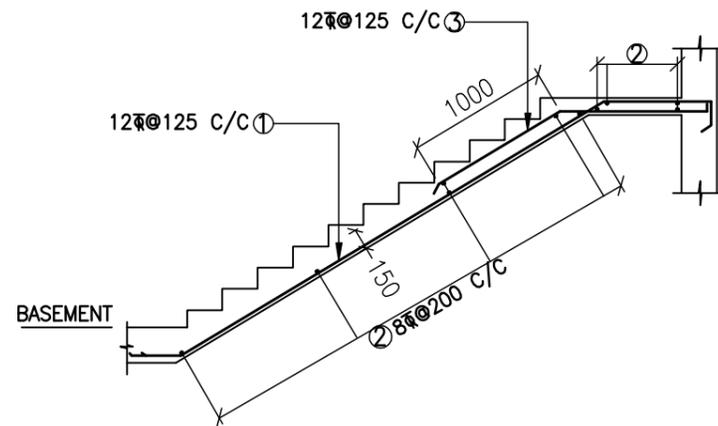
TITLE :

TYP. R.C. DETAILS OF SLAB

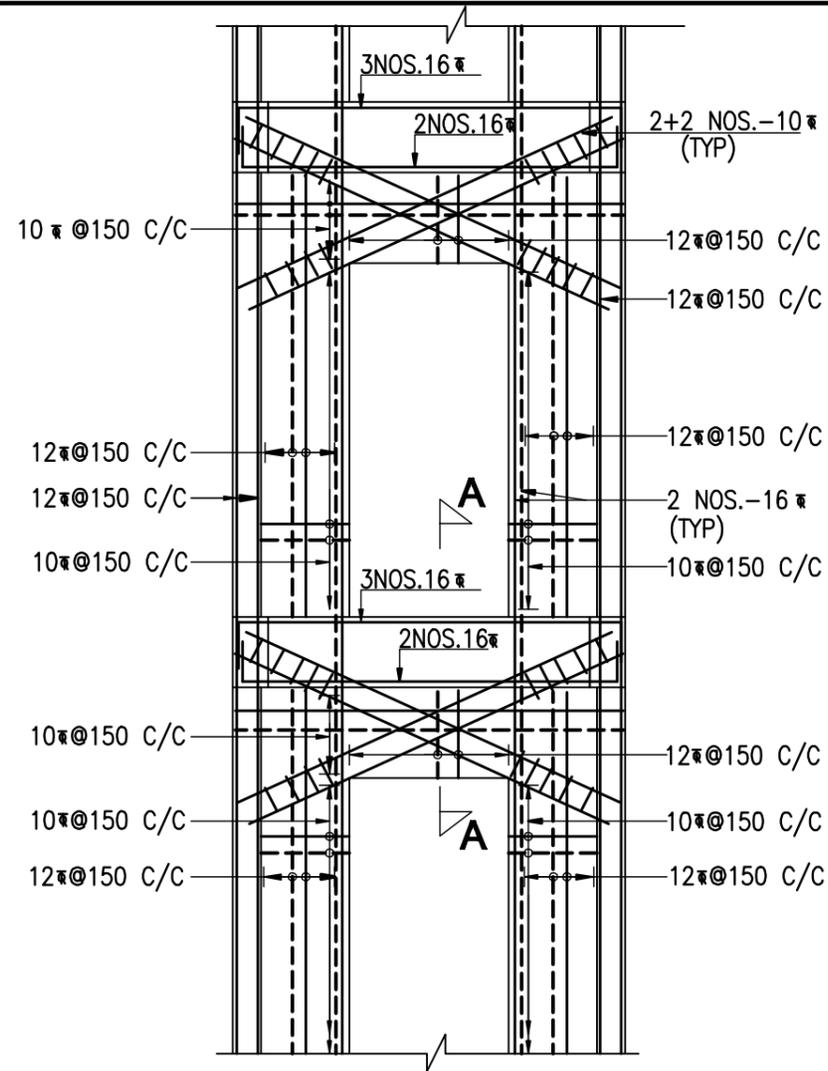
DRAWN BY.	DESIGNED BY.	CHKED. BY.	APPROVED BY.	DWG. NO.	REV. NO.
(Rojesh)	(S.M.G.)	(S.M.G.)		MFI/T/CE/07	R0



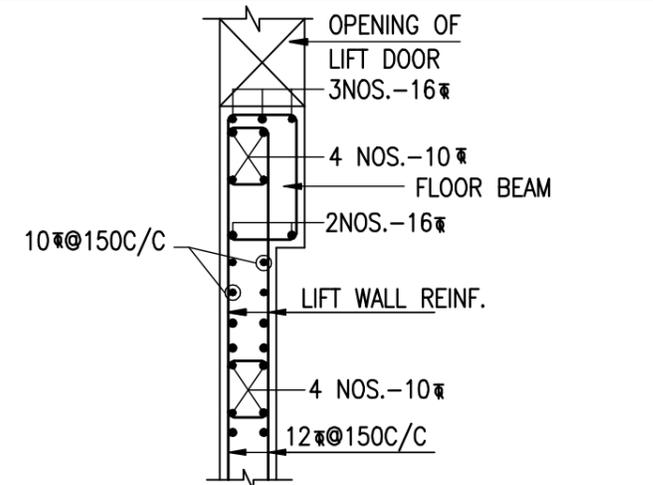
RC DETAILS OF STAIRCASE



RC DETAILS OF STAIRCASE



R.C. DET. OF OPENING OF LIFT WALL
(SCALE-1:40)



CROSS SECTION OF EDGE BEAM

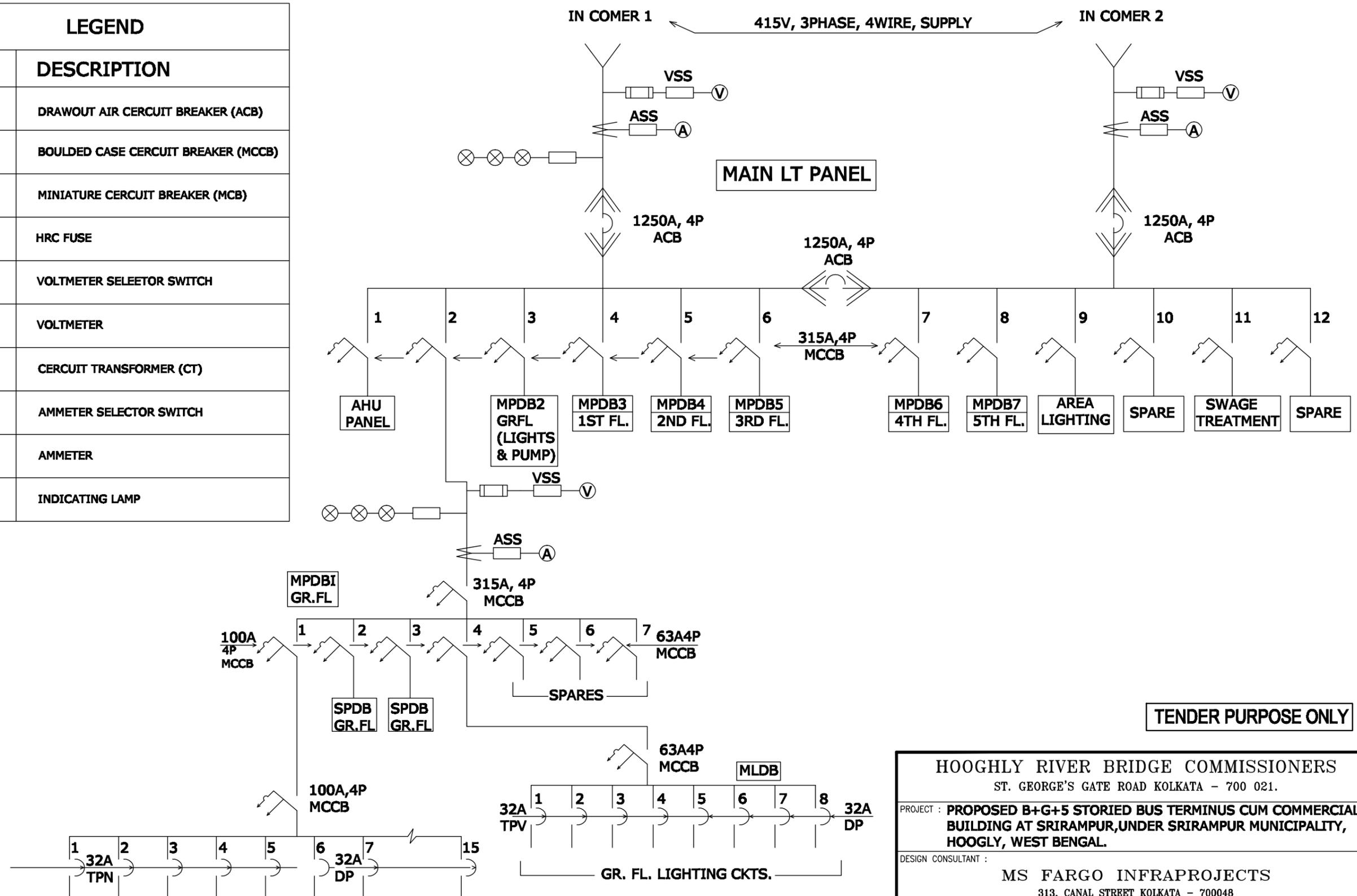
NOTES :

1. ALL DIMENSIONS ARE IN MM. & LEVELS ARE IN M.
2. GRADE OF CONCRETE SHALL BE M-30, UNLESS STATED.
3. ALL HYSD REINFORCING STEEL OF GRADE Fe-500 CONFORMING TO IS: 1786 SHALL BE USED.
4. COVER TO REINFORCEMENT SHALL BE AS FOLLOWS
 - (i) Wall = 30 mm,
 - (ii) IN BEAM = 30 mm
5. MINIMUM LAP LENGTH SHALL BE 50 TIMES THE BAR DIA.
6. THE LAPS SHALL BE STAGGERED. NOT MORE THAN 1/3 OF THE TOTAL REINFORCEMENT SHALL BE LAPPED AT A SINGLE SECTION.

TENDER PURPOSE ONLY

HOOGLY RIVER BRIDGE COMMISSIONERS					
ST. GEORGE'S GATE ROAD KOLKATA - 700 021.					
PROJECT : PROPOSED B+G+5 STORIED BUS TERMINUS CUM COMMERCIAL BUILDING AT SRIRAMPUR, UNDER SRIRAMPUR MUNICIPALITY, HOOGLY, WEST BENGAL.					
DESIGN CONSULTANT :					
MS FARGO INFRAPROJECTS					
313, CANAL STREET KOLKATA - 700048					
DATE :	TITLE :				
08.10.2013	R.C. DETAILS OF LIFT & STAIR				
SCALE :					
AS NOTED.					
DRAWN BY.	DESIGNED BY.	CHKED. BY.	APPROVED BY.	DWG. NO.	REV. NO.
(Rajesh)	(S.M.G.)	(S.M.G.)		MFI/T/CE/08	R0

LEGEND	
SYMBOL	DESCRIPTION
	DRAWOUT AIR CERCUIT BREAKER (ACB)
	BOULDED CASE CERCUIT BREAKER (MCCB)
	MINIATURE CERCUIT BREAKER (MCB)
	HRC FUSE
	VOLTMETER SELEETOR SWITCH
	VOLTMETER
	CERCUIT TRANSFORMER (CT)
	AMMETER SELECTOR SWITCH
	AMMETER
	INDICATING LAMP



TENDER PURPOSE ONLY

HOOGLY RIVER BRIDGE COMMISSIONERS ST. GEORGE'S GATE ROAD KOLKATA - 700 021.				
PROJECT : PROPOSED B+G+5 STORIED BUS TERMINUS CUM COMMERCIAL BUILDING AT SRIRAMPUR, UNDER SRIRAMPUR MUNICIPALITY, HOOGLY, WEST BENGAL.				
DESIGN CONSULTANT : MS FARGO INFRAPROJECTS 313, CANAL STREET KOLKATA - 700048				
DATE : 08.10.2013	TITLE : ELECTRICAL SINGLE LINE DIAGRAM			
SCALE : AS NOTED.				
DRAWN BY.	DESIGNED BY.	CHKED. BY.	APPROVED BY.	DWG. NO. MFI/T/E/01
				REV. NO. R0