DELHI AVIATION FUEL FACILITY PRIVATE LIMITED
AVIATION FUELLING STATION
SHAHBHAD MOHAMMADPUR
IGI AIRPORT
NEW DELHI-110061

TENDER NO: DAFFPL/MOD/FF/2015-16/16

INVITING TENDER FOR CONSTRUCTION OF FIRE WATER PUMP HOUSE

BID DUE DATE & TIME: 1500 Hrs. IST on 11th February, 2016

OPENING OF TECHNICAL BIDS: 1100 Hrs. IST on 12th February, 2016

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Sign & Stamp of Bidder

Contents

NOTE: BIDDERS ARE REQUESTED TO SIGN AND STAMP ALL THE PAGES OF THE TENDER DOCUMENT AND SEND THE SAME BACK IN THEIR OFFER AS A TOKEN OF UNCONDITIONAL ACCEPTANCE OF TENDER FIRMS.

THE DEVIATIONS, IF ANY, SHOULD BE MENTIONED SEPARATELY ON BIDDER‟S LETTER HEAD IN TECHNICAL BID. THE DEVIATIONS MENTIONED ANYWHERE ELSE SHALL NOT BE CONSIDERED. IN ABSENCE OF DEVIATION SHEET IT WOULD BE CONCLUDED THAT BIDDER HAS ACCEPTED THE TENDER TERMS WITHOUT ANY DEVIATIONS. CORRECTIONS IN TENDER DOCUMENT WILL NOT BE ACCEPTED.

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Sign & Stamp of Bidder

DELHI AVIATION FUEL FACILITY PRIVATE LIMITED

TENDER NOTICE
DELHI AVIATION FUEL FACILITY PRIVATE LIMITED

INVITING TENDER FOR CONSTRUCTION OF FIRE WATER PUMP HOUSE AS PER SPECIFICATIONS AS REQUIRED

TENDER NO: DAFFPL/MOD/FF/2015-16/16

Delhi Aviation Fuel Facility (P) Ltd (DAFFPL) invites sealed bids under single stage two bid system from eligible bidders for construction of Fire Water Pump House

Brief Scope of work:

We intends to provide new Fire Water Pump House as per specification as required. Scope of supply includes construction of new Fire Water Pump House at our DAFFPL office.

Bid Security (EMD):	As mentioned in the Tender document
Date, Time & Venue for Voluntary Pre-bid Meeting:	27th January, 2015 @ 1500 Hrs (IST) at DAFFPL, Aviation Fuelling Station, Shahabad Mohammadpur, New Delhi-110061
Bid Due Date, Time & Place of Submission:	Upto 15:00 HRS (IST) on 11th February, 2016 at the office of the Chief Executive Officer, DAFFPL, Aviation Fuelling Station, Shahabad Mohammadpur,

Detailed Invitation for Bids (IFB) along with Pre-qualification Criteria, Bid Document Corrigenda can be viewed and downloaded from DAFFPL's website: **http://www.daffpl.in**

Chief Executive Officer
DAFFPL, New Delhi
8826120066

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CHAPTER 1: INTRODUCTION (COVERING NOTE)

Delhi Aviation Fuel Facility Private Limited (DAFFPL) is a Joint Venture comprising Indian Oil Corporation Ltd. (IOCL), Bharat Petroleum Corporation Ltd. (BPCL), and Delhi International Airport (P.) Ltd. (DIAL). We provides the infrastructure aimed at ensuring an uninterrupted flow of Aviation Turbine Fuel (ATF) to all type of aircrafts at the Indira Gandhi International Airport, New Delhi (IGI Airport) as per international benchmarking.

The bidder/ contractor shall refer to various sections of this tender document for detailed scope of work. It is contractor's responsibility to execute the job in all respects as per detailed drawings, documents / specification furnished by consultant / owner and as per applicable codes, standards & in line of statutory requirements.

The field circumstances shall also be taken into consideration and methods suitable to the site conditions shall be adopted with concurrence of the Engineer-in-charge and in line with manuals, instructions of respective equipment and specified codes and standards. The successful accomplishment of the project is greatly influenced by the team work, workmanship of the workers and supervisors.

The Contractor shall employ only such workers and supervisors who have considerable experience of similar work and who can work, temperamentally in good harmony and co-operation.

Delhi Aviation Fuel Facility Private Limited (DAFFPL) invites sealed tenders in prescribed tender form under two-bid system. For viewing details including EMD, BID QUALIFICATION CRITERIA etc. please visit our web site www.daffpl.in and go to tender section by clicking the link "Tenders". Tender documents are available on our website.

The bid documents can also be collected from our office and the bids are to be submitted in Physical form in the Tender Box kept at the office of the **Delhi Aviation Fuel Facility Private Limited (DAFFPL)** at Shahabad Mohammadpur, New Delhi-110061, India.

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1. The Tender is floated in Two Bid system consisting of Technical Bids (Bid Qualification Criteria - BQC, Technical plus Commercial) and Price Bids.

   Part-I : Bid Security / EMD in accordance with tender document.
   Part-II : BQC (Bid qualification criteria), Technical & commercial Bid, duly filled in & along with all supporting as requested to be submitted in Physical form in the Tender Box.
   Part –III : Price Bid.

2. The bidder should be able to construct the entire size/type/quantity bidded by them. Bidders cannot bid for part items or part quantity.

3. Firstly the Technical bid (BQC & Techno commercial bids) shall be opened. The Bids shall be initially scrutinized by a team as per tender requirements of BQC (Bid qualification criteria). Technical cum commercial bids of only those vendors who qualify the BQC will be processed further. The price bids of only techno-commercially qualified bidders will be opened, evaluated and shortlisted for Placement of Work Order.

4. Each page of bid documents is to be duly signed & stamped by the bidder before submitting the Tender.

5. The bids submitted should be valid for **four months** from the due date of bid submission for Owners acceptance. Once accepted it will remain firm till completion of contracts/orders.

6. We request the bidder to carefully go through all tender documents before submitting the offer. Please note that any exceptions or deviations to the tender document are necessarily to be recorded in the attached deviation statement only. Any exceptions/deviations brought out elsewhere in the bid shall not be considered.

7. The bidders may be invited for a presentation to DAFFPL during Techno-commercial evaluation before price bid opening.

8. The bidders to provide their bank details/ PAN / Sales Tax /WCT Registration numbers/Service Tax Registration No. / VAT registration No., as applicable for updating vendor master file. You are also requested to keep us informed of any change in address / status of your business / contact details including email address etc.

9. Party can quote with the deviations as referred in Point No.6 above. Please refer query end date / time in tender calendar after which no query posted by bidder

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shall be considered. However DAFFPL reserves the right to respond the queries after cutoff date / time mentioned in tender calendar.

10. Please note that queries related to scope of job, tender specifications, terms & conditions etc., should be submitted by means of letter/E mail to reach the owner's office not later than one week before the meeting .It may not be practicable to answer queries received late, but queries and responses/clarifications will be posted in the form letter, E-mail within one week from the date of Pre Bid Meeting. Any modification in the bid document that may become necessary as a result of the Pre Bid meeting shall be made by the owner exclusively through the issues of corrigendum/ addendum posted at web site and not through the minutes of the pre bid meeting.

11. UNSOLICITED POST BID MODIFICATION
    Bidders are advised to quote strictly as per terms and conditions of the Bidding Document. After tender submission due date & time/ extended due date & time (as the case may be) the bidders shall not make any subsequent price changes, whether resulting or arising out of any technical / commercial clarifications sought/allowed on any deviations or exceptions mentioned in the bid unless discussed and agreed by DAFFPL in writing.

12. EMD & Techno Commercial bid shall be opened on 12th February, 2016 **at 11:00 Hrs (IST)** in the presence of authorized representative of bidders (Restricted to one [1] person per bidder only) at the office of DAFFPL. Price Bid of only those bidders whose offer is found meeting both PQC & techno-commercially acceptable, shall be opened on a later date as per convenience of DAFFPL after intimation to the qualified bidders.

13. DAFFPL reserves the right to accept any tender in whole or in part or reject any or all tenders without assigning any reason. DAFFPL reserves right to accept any or more tenders in part. Decision of DAFFPL in this regard shall be final and binding on the bidder.

QUERIES AND CLARIFICATIONS: Any query or clarification with regard to this tender may please be referred to below address & phone nos. on any working day during office working hours

Mr M Vishnu Vardhan / Manish Kumar Project Officer Vishnu.vardhan@daffpl.in, bksingh@daffpl.in, consultant@daffpl.in 8826000228, 9810640818	Mr V S Thakur (Consultant) Project Manager Virender.Thakur@mottmac.com 91-120-3992308 9313834546

14. GOVERNING LAWS: The laws of Union of India shall govern all matters concerning the tender. Any issue arising related to the tender or the selection process shall be adjudged by the courts in Delhi alone.

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15. A Pre-bid meeting is scheduled for **27/01/2016 at 1500 Hrs IST** at the office of DAFFPL, New Delhi. All prospective bidders can participate in the same. Any clarification with regard to tender shall be sorted out during the pre-bid meeting.
    a. The purpose of the pre-bid meeting is to clarify any doubts of the BIDDER on the interpretation of the provisions of tender.
    b. Bidder(s) are requested to submit their queries, mentioning form name, clause no. & clause, by a letter / e-mail to our office as per schedule in order to have fruitful discussions during the meeting.
    c. All the Bidder(s) are requested to attend the pre-bid meeting to be held at DAFFPL Office as per schedule.

16. **Tender document can be purchased from our office located at Shahabad Mohammadpur at a cost of Rs 1000/- and also can be downloaded from our website www.daffpl.in.**
    - **A bidder who downloads the document from website has to submit a separate DD for an amount of Rs.1000/- along with the EMD document.**
    - **Bidders who purchase the document from our office have to submit a DD for an amount of Rs.1000/- at the time of purchase.**

17. **Earnest Money Deposit (EMD) (also referred to as Bid Security):** Bidder shall be required to submit the Earnest Money Deposit (EMD), either in the form of Bank guarantee as per format (provided as Annexure) or PAY ORDER or BANK DRAFT (in favour of Delhi Aviation Fuel Facility Private Limited, payable at New Delhi) at our office. The EMD in either form has to be submitted on or before the due date & due time of bid submission of this tender with a covering note mentioning the tender no.

    a. The bidders not submitting EMD by due time & date shall be rejected & their bids shall not be evaluated further.
    b. **The EMD amount shall be 1.0 Lakhs INR**
    c. Firms registered with National Small scale Industries (NSIC)/MSME of India are exempted from submission of bid security .Central Public Sector Enterprises of India and Firms registered with Nation Small Scale Industries Corporation (NSIC) of India are exempted from submission of Bid Security. Central Public Sector Enterprises are requested to give a self-declaration on their letter head to this effect. Bidders registered with NSIC of India are also requested to submit self-declaration on their letter head to this effect along with a copy of their Valid Registration certificate, specifying limit of volume and other details which should be submitted.

18. **Site Restriction:** The job has to be done in licensed area which is inside the premises of DAFFPL Fuel Facility. Successful bidder will have to follow all the security norms and procedures for entry and exit to the facility. The job timings will

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have to change as per the permissions obtained from Operation Dept. All the entry procedures for labours / machinery / raw materials as per the rules of the DAFFPL will have to be followed by the vendor. Contractor shall visit the site and ensure familiarity with the working condition / limitation at the site. Also the entire works are to be carried out in an operating Location. The contractor may have to follow the timings of the facility and have to work under restricted conditions. The normal working hours of plants is 0930 Hrs to 1800 Hrs on Monday to Saturday except holidays. Working beyond above normal working hours / holidays/ Sundays are to be with prior permission of Engineer in charge and relevant facility officers. Contractor is required to plan his work within the normal working hours and days and accordingly he has to mobilize the resources to complete the job within the scheduled time. However all efforts will be made by DAFFPL to give extended working time beyond normal working time in order to help the contractor for early completion of the job. No additional payment / charges shall be payable for such works. Not getting permission for working on holidays/ Sundays or beyond normal working hours will not be considered as reason for delay in work. The contractor and his personnel have to obey all rules and regulations of the plant. Trained and experienced supervisor/ engineer are required to be present at the work spot always.

All hot work like welding, cutting, grinding etc. needs to be done in the closed booth of asbestos cloth. No extra claim on account of the same will be considered. Also the shutdown jobs may get delayed due to operational requirement. Any extra claims on account of the same will not be entertained.

Vendor to note that DAFFPL will not provide water for construction; vendor has to arrange the same at his risk and cost.

The tenderer must visit the site of the tender and familiarize himself with location, operating / working conditions as well as any other local factors which could influence the working before quoting for the job. His quote should take care of any such restrictions; conditions etc and any claim afterwards will not be entertained. **It is suggested that the Tenderer must visit the site in order to have a better idea of site conditions and factors.**

19. **Completion Time:** Time is the essence of the contract. The time period of contract is **4 (Four) months** from the date of Letter of Intent including monsoon period. **The time includes necessary time required for mobilizations and demobilizations after the execution of work and includes monsoon period.** Successful bidder is required to provide a bar chart /schedule showing the activities/events with time along with the Technical bid to be scheduled accordingly.

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20. The work is required to be done in a working/operating location, the party has to get necessary Hot/cold work permits from the concerned officer in plant as per OISD standards and all workmen should be provided with necessary safety helmet, safety belts, safety shoes and other standard safety equipment's. Any delay on account of non-adherence to safety norms, rules and regulations of plant as well as obtaining work permits from the plant shall not be accounted for the delay in completion of job.

21. **Receipt & storage of material at Site**: Contractor is required to make his own arrangement for unloading and storage of materials at site. Contractor is required to inform us prior to dispatch of materials and his representative required to be available for receipt and unloading of materials at site.

22. The successful vendor has to arrange and submit to fuel facility the proper **POLICE VERIFICATION DOCUMENTS** of all the labours, site in charges, supervisors, welders, grinders and all associated workmen who will be coming inside the terminal for carrying out related jobs.

23. For carrying out the jobs inside the depot the vendor has to arrange working water, associated tools, tackles, manpower, machinery of his own and no extra payment will be made to vendor on account of the same.

24. All the debris, scrap, cut pieces, etc coming out of fabricated plates, excavated earth, area cleaning will have to be shifted by the vendor to a location inside or outside the terminal premises as per the instruction of DAFFPL site in-charge and no extra payment will be done for the same.

THE FORMS /ATTACHMENTS TO THIS TENDER ARE AS UNDER:

1. Covering Note – CHAPTER: 1
2. Instructions To Bidders - CHAPTER: 2
3. Bid-Qualification Criteria - CHAPTER: 3
4. Performance of Work – CHAPTER: 4
5. General Purchase Conditions- CHAPTER: 5
6. Technical Specification Documents - **(Attached separately as Annexure I)**
7. Annexure attached are as follows:
   - Annexure II – DEVIATION SHEET
   - Annexure III – DECLARATION SHEET
   - Annexure IV – FORMAT FOR DRAFT BANK GUARANTEE IN LIEU OF BID SECURITY (EMD)

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- Annexure V - FORMAT DRAFT COMPOSITE BANK GUARANTEE FOR SECURITY DEPOSIT/PERFORMANCE GUARANTEE
- Annexure VI – FORM OF LETTER OF UNDERTAKING
- Annexure VII – DECLARATION TO BE SUBMITTED ALONGWITH Technical BID
- Price Bid

Thanking you,
Yours faithfully,
For DELHI AVIATION FUEL FACILITY (P) LTD.

Chief Executive Officer
DAFFPL, New Delhi

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CHAPTER 2: INSTRUCTIONS TO BIDDERS

1. The bidder shall bear all costs associated with the preparation and submission of the bid and Owner will in no case be responsible or liable for these costs, regardless of the conduct or outcome of the bidding process.

2. Vendor is requested to submit their bids taking full notice of all the technical specifications, terms and conditions, forms & attachments to this tender. Bids must be submitted in Physical form only.

3. Owner reserves the right to accept / reject any or all bid qualification documents at their sole discretion without assigning any reason whatsoever.

4. Owner is not responsible for any delays from bidder end.

5. Owner reserves the right to make any changes in terms and conditions of purchase before due date of bid submission and to reject any or all bids received incomplete.

6. Undertaking by the bidder:
    a. I/we hereby undertake that the statements made herein/information given in the bids through Physical Tendering system/annexure/forms referred are true in all respects and that in the event of any such statement or information being found to be incorrect in any particular, the same may be construed to be a misrepresentation entitling DAFFPL to avoid any resultant contract.
    b. I/we further undertake as and when called upon by DAFFPL to produce, for its inspection, original(s) of the document(s) of which copies have been annexed hereto.

7. Owner, at its discretion reserves the right to verify information submitted by the bidders.

8. Bidder to submit documents/information to satisfy the bid qualification criteria. Bidders should also be in a position to produce further information as and when required by DAFFPL with in a time limit of 15 days.

9. DAFFPL reserves their right to negotiate the quoted prices with lowest bidder.

10. Bidders would be qualified based on data and documents submitted by them.

11. Owner's decision on any matter regarding short listing of vendors shall be final and no corresponding in this regards will be entertained.

12. The vendors who are on IOCL/BPCL/DIAL holiday list or delisted will not be

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considered.

13. The bidder is expected to examine all instructions, forms, attachments, terms and specifications in the tender document. The entire tender document together with all its attachments thereto, shall be considered to be read, understood and accepted by the bidder, unless deviations are specifically stated seriatim by the bidder. Failure to furnish all information required in the tender document or submission of a bid not substantially responsive to the tender documents in every respect will be at bidder risk and may result in the rejection of his bid. The bidder scope of supplies as specified in the material requisition shall be in strict compliance with the scope detailed therein and in the bid document.

14. Bidders in their own interest shall ensure that they submit their bid, complete in all respects, well within the specified bid due date and time. No relaxation shall be given for delay due to any unforeseen event in submission of bid.

15. At any time prior to the bid due date, we may, for any reason, whether at its own initiative or in response to a clarification requested by a prospective bidder, modify the bid document. The amendment will be notified through our portal www.daffpl.in to all prospective bidders and will be binding on them. In order to afford prospective bidder, reasonable time in which to take the amendment into account in preparing their bids, we may, at our discretion, extend the bid due date.

16. The bid prepared by the bidder and all correspondence/ drawings and documents relating to the bid exchanged by bidder and the owner shall be written in ENGLISH language, provided that any printed literature furnished by the bidder may be written in another language so long as accompanied by an ENGLISH translation, in which case, for the purpose of interpretation of the bid, the ENGLISH translation shall govern.

17. Declaration with the bid qualification criteria that bidder has not been banned or delisted by any Government or quasi Government agencies or Public Sector Undertaking (PSU) as per declaration format (provided as annexure) of the tender document should be submitted along with the bid.

18. Bidders are advised to submit bids based strictly on the terms & conditions and specifications contained in the tender document and not to stipulate any deviations. Each Bidder shall submit only one bid. A Bidder who submits more than one bid will be rejected. Alternative bids will not be accepted.

19. The Owner may, at its discretion, extend the bid due date, in which case all rights and obligations of the Owner and the Bidders, previously subject to the bid due date, shall thereafter be subject to the new bid due date as extended. The same will be hosted in the web site.

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20. Bids shall be kept valid for 4 months from the bid due date. A bid valid for a shorter period shall be considered as non-responsive and rejected by the Owner. Notwithstanding above, the Owner may solicit the Bidder consent to an extension of the period of bid validity. The request and the responses thereto shall be made in writing. The EMD (bid security) shall also be accordingly extended.

21. Telex/ Telegraphic/ Telefax / E-mail offers will not be considered and shall be rejected.

22. No bid shall be modified subsequent to the due date & time or extension, if any, for submission of bids. Bidder(s) to note that Price changes after submission of bid shall not be allowed. In case any bidder gives revised prices/price implication, his bid shall be rejected. No bid shall be allowed to be withdrawn in the interval between the deadline for submission of bids and the expiration of the period of bid validity specified by the Bidder. Withdrawal of a bid during this interval shall result in the forfeiture of Bidder s EMD.

23. Bids that do not meet the Bid qualification criteria as specified in the bid document shall be rejected. A bid with incomplete scope of work and/or which does not meet the technical requirements as specified in the bid document, shall be considered as non-responsive and rejected. Conditional bids will be liable for rejection.

24. The Owner will examine the bids to determine whether they are complete, whether any computational errors have been made, whether the documents have been properly signed and whether the bids are generally in order.

25. The bids without requisite EMD and/or not in the prescribed Performa and the time limit will not be considered and bids of such bidder(s) shall be rejected.

26. PRICE EVALUATION CRITERIA: As award is on overall landed lowest basis, part offers will be rejected. Bidder has to quote for all items in a lot for us to consider them.

27. Prior to the expiration of period of bid validity, the owner will notify the successful bidder in writing or by e-mail, that his bid has been accepted. The Notification of Award will constitute the formation of the Contract. Delivery Period shall be counted from the date of notification of award (Letter/Fax/e-mail of Intent).

28. Any efforts by a bidder to influence the owner/ in the owner bid evaluation, bid comparison or contract award decisions may result in the rejection of their bid.

29. ISSUE OF CONTRACT/ PURCHASE ORDER: After the successful bidder has been notified that his bid has been accepted, DAFFPL will send to such bidder a detailed

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contract/purchase order incorporating all the terms and conditions agreed between the parties. Within 15 days of receipt of the detailed purchase order, the bidder shall sign and return to the owner the duplicate copy of the order as a token of their acknowledgement.

30. Vigil Mechanism: DAFFPL has developed the Vigil Mechanism to deal with references/ grievances, if any, that is received from bidders who participated / intends to participate in the tender. The details of the same are available on our website www.daffpl.in

31. VERIFICATION BY OWNER: All statements submitted by bidder regarding experience, manpower availability, equipment and machinery availability etc., are subject to verification by the owner either before placement of order or after placement of order. If any data submitted by the bidder at the bid stage is found to be incorrect, the offer is liable to be rejected or the contract/order is liable to be terminated.

32. SEALING & MARKING OF BIDS

A. Bids shall be submitted separately in THREE SECTIONS in sealed envelopes superscribed with the Bid Document number, bid due date and time, item and nature of bid as under:

- **SECTION - I (Envelope No. 1): Bid Security / EMD:**
  Bid security in accordance with tender document.

- **SECTION - II (Envelope No. 2): Technical Bid:**
  a. Information and documentary evidence establishing bidder's claim for meeting qualification criteria as stipulated in IFB. This section/envelope should necessarily contain all the required back-up documents for Bid Qualification.
  b. Technical bid complete with all technical and commercial details, covering letter and un-priced copy of price Schedule with prices substituted with 'QUOTED' or 'NOT QUOTED' or 'NOT APPLICABLE'. **Deviation sheet duly filled with deviations, if any, shall form part of technical bid.**

- **SECTION - III (Envelope No. 3): Price Bid:**

  a. PRICE BID WITH FULL PRICE DETAILS. The price bid shall contain prices only in the prescribed price schedule formats, without any technical and commercial details. Technical specifications or commercial terms given in unpriced schedule will only be evaluated and the same will be binding on the Bidder. The bids shall be sealed

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and kept in a single envelope with marking as Section - III (Price Bid) / Envelope No. 3 : "Original'

b. The bidder shall quote the final prices (including taxes, Cess, duties and other levies etc) in the 'PRICE SCHEDULE FORMAT' of bid document ONLY. Prices quoted in any other format shall not be considered for evaluation.
c. The Price bid shall be kept in a larger envelope duly sealed and shall bear the name and address of the bidder.

B. The envelopes containing Section -I, Section -II, Section -III of bid shall be enclosed in a larger envelope duly sealed and pasted and shall bear the name and address of the bidder.
C. Bidder to note that if bid security / EMD (in the Proforma attached with these documents) in original and/or bid document fee (if the bid document is downloaded) is kept in any other envelope and not found in envelope no. 1, the offer of the bidder(s) will be REJECTED during opening.
D. Bidder to note that prices are to be quoted in the format provided in the price schedule formats provided along with the tender without any conditions. Price bids submitted in any other format and conditional price bids will be liable to be rejected. Price bids received in open condition (not in sealed envelope) or kept in any other Section of the bid (i. e, Section - I or II) will also be liable for rejection.
E. If the outer envelope is not sealed and not marked as required, then DAFFPL will assume no responsibility for the bid's misplacement or premature opening.
F. Bidders in their own interest shall ensure that they send their bid complete in all respects well in time to reach the specified office within the specified bid due date and time. No relaxation shall be given for delay due to any unforeseen event in submission of bid.
G. Central Public Sector Enterprises and Firms registered with NSIC are exempted from submission of Bid Security. Central Public Sector Enterprises are requested to give a self declaration on their letter head to this effect, which should be submitted in a sealed envelope marked as Bid Security.
H. Bidders registered with NSIC are also requested to submit self declaration on their letter head to this effect along with a copy of their Valid Registration certificate, specifying limit of volume and other details which should be submitted in a separate sealed envelope no. 1 marked as Bid security.
I. Bid Security strictly in the Proforma attached with these documents shall be submitted in Original along with the Bid. Bids received without original bid security, shall not be opened for evaluation.
J. Tender document complete in all respects must be submitted in the tender box provided at the DAFFPL office before due date and time

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33. DOCUMENTS COMPRISING THE BIDS

The bid prepared by the Bidder shall comprise the following components:

I. **ORIGINAL BID SECURITY (Section - I):** Bidders are advised to instruct their banks not to post Bid Security directly to Owner as the same has to accompany with the bid.

II. **TECHNICAL BID (Section -II):**

- Documentary evidence establishing Bidder's claim for meeting qualification criteria as stipulated in the Bid Document.
- Notarized Audited Annual Report of previous three financial years.
- Documentary evidence establishing Bidder's eligibility to bid and that the offered Goods conform to the Bid Document.
- Price Schedule (with Price figures blanked) completed in accordance with the requirements specified in the bid document.
- Agreed Terms & Conditions duly filled-in.
- Deviation Sheet, if any.
- Declaration with the bid qualification criteria that bidder has not been banned or delisted by any Government or quasi Government agencies or PSU's.
- Any other information/details/documents/data required as per Bid Document.
- Parent Company Guarantee, if applicable

III. **PRICE BID (Section -III):** Bid Form and Price Schedule (Both given along with tender) duly filled in.

34. BID FORM & PRICE SCHEDULE

The bidders shall complete the Bid Form and appropriate Price schedule furnished of Bid Document, indicating the required information for all quoted items.

35. FORMAT AND SIGNING OF BID

a. The Bidder shall prepare required number of copies of the bid, clearly marking each 'Original Bid' and 'Copy of Bid' as appropriate. In the event of any discrepancy between them, the 'Original Bid' shall govern.
b. The original and all copies of the bid shall be typed or written in indelible ink and shall be signed by the Bidder or a person or persons duly authorized to sign on behalf of the bidder on all pages of the bid. Such authorization shall be indicated by written Power of Attorney accompanying the bid. The name and position held by each person signing must be typed or printed below the signature. The person or persons signing the bid shall initial all pages of the bid, except for unamended printed literature.
c. The complete bid shall be without alterations, interlineations or erasures,

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except as may be necessary to correct errors made by the Bidder, in which case such corrections shall be rewritten & initialed by the person or persons signing the bid.

d. All the pages of the price bid shall be signed by the authorized signatory. In case all the pages of the price bid are not signed, the bid shall be rejected.

36. OPENING OF BIDS

Bids will be opened by Owner at DAFFPL Office, New Delhi, in the presence of bidders/bidders authorized representatives available on the opening date and time (duly authorized by a competent person and having the letter of authority).

a. **BID SECURITY / EMD (SECTION-I) AND TECHNICAL BID (SECTION-II):**
   I. On the day and time of bid opening, Bid security (Envelope 1) and Technical Bid (Envelope 2) shall be opened in presence of bidders.
   II. The Bidder's representatives, who are present, shall sign a register/attendance sheet evidencing their attendance.
   III. The Bidder(s) names, presence or absence of requisite bid security will be announced at the opening.
   IV. Bidder (s), whose bids are not opened for any reason, including non receipt of original bid security, will not be allowed to be present during bid opening.

b. **PRICE BID OPENING (SECTION -III):**
   I. Only those bidders whose bids meet the qualification criteria and are technically/commercially acceptable shall be called for opening of Price bid (Envelope 3) at a later date, informed in advance.
   II. The Bidder's representatives, who are present, shall sign a register/ attendance sheet evidencing their attendance.
   III. Bidder(s), whose bids are not opened for any reason, will not be allowed to be present during bid opening.

37. EVALUATION OF BIDS

a. Qualification of Bidder: The experience details and financial & technical capabilities of the bidder(s) shall be examined to determine whether the bidder(s) meet the Bid Qualification Criteria mentioned in the INVITATION FOR BIDS (IFB).
b. The Owner will examine the bids to determine whether they are complete, any computational errors have been made, whether the documents have been properly signed and whether the bids are generally in order.
c. The bids without requisite Bid Security and/or not in the prescribed proforma will not be considered and bids of such bidder Bidder(s) shall be rejected.
d. To assist in the examination, evaluation and comparison of technical bids,

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the owner/ may, at its discretion, ask the Bidder clarifications on the bid. The request for such clarifications and the response thereto shall be in writing.

e. Prior to the evaluation and comparison of the bid, the owner will determine the substantial responsiveness of each bid to the bidding documents. For the purpose of this Article, a substantially responsive bid is one, which conforms to all the terms and conditions of the bidding document without material deviations or reservations. A material deviation or reservation is one which affects in any substantial way the scope, quality, or performance of the works or which limits in any substantial way, inconsistent with the bidding document, the DAFFPL's rights or Bidder's obligation under the contract and retention of which deviation or reservation would affect unfairly the competitive position of other bidders presenting substantially responsive bids. The owner's determination of bid responsiveness is to be based on the contents of the bid itself without recourse to the extrinsic evidence.

f. A bid determined as substantially non-responsive will be rejected by the Owner and shall not subsequently be allowed by the Owner to be made responsive by the Bidder by correction of the non-conformity.

Note:

1) **The Bid Shall be submitted in English Language Only**
2) **For any Document submitted in any language other than English, the translation copy in English language shall be submitted.**

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CHAPTER 3: BID-QUALIFICATION CRITERIA:

Bidders need to meet following pre-qualification criteria to qualify for short-listing as a successful vendor, who would be considered for tendering process for the job of "***Construction of Fire Water Pump House at DAFFPL"***

- ***Technical Criteria:-***

  - **Past Experience**: Vendor should have executed successfully at-least 3 similar civil jobs at Petroleum oil terminals / depots / refineries / LPG plants / TOPs handling Petroleum products viz. ATF, MS, HSD, SKO, LPG in the preceding past 5 years reckoned from date of this notice.
  - Bidder shall have experience of having successfully completed similar civil works during last 5 years ending last day of month previous to the one in which applications are invited for either of the following:

    - ✓ **Three completed similar civil works of total value not less than 35 Lakhs**

    Or

    - ✓ **Two completed civil works of total value not less than 45 lakhs**

    Or

    - ✓ **One completed civil works of value not less than 65 Lakhs**

  - Bidder shall submit the following documents in support of full filling the above criteria:
    - ✓ PO copy for the civil works done in the past, indicating value of work.
    - ✓ Completion Certificate indicating P.O No & Date from User.

- ***Financial criteria for job :-***
  - Bidder shall have minimum average annual turnover of Rs.2 Crores as per audited financial results in the preceding three financial/calendar years. "Turnover shall mean Consolidated Turnover in case of a Bidder having wholly owned subsidiaries"

OTHER INFORMATION OF PQC

1. Parties who are affiliates of one another can decide which affiliate will make a bid. Only one affiliate may submit a bid. Two or more affiliates are not permitted to make separate bids directly or indirectly. If 2 or more affiliates submit a bid, then any one or all of them are liable for disqualification. However up to 3 affiliates may make a joint bid as a consortium, and in which case the conditions applicable to a consortium shall apply to them. "Affiliate" of a Party shall mean any company or legal entity which:

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a. Controls either directly or indirectly a Party, or
b. Which is controlled directly or indirectly by a Party; or
c. Is directly or indirectly controlled by a company, legal entity or Partnership which directly or indirectly controls a Party. "Control" means actual control or ownership of at least a 50% voting or other controlling interest that gives the power to direct, or cause the direction of, the management and material business decisions of the controlled entity.

2. Bids may be submitted by:
   a. A single person/ entity (called sole bidder);
   b. A newly formed incorporated joint venture (JV) which has not completed 3 financial years from the date of commencement of business;
   c. A consortium (including an unincorporated JV) having a maximum of 3 (three) members;
   d. An Indian arm of a foreign company.
3. Fulfillment of Eligibility criteria and certain additional conditions in respect of each of the above 4 types of bidders are stated below, respectively:
   a. The sole bidder (including an incorporated JV which has completed 3 financial years after date of commencement of business) shall fulfill each eligibility criteria.
   b. In case the bidder is a newly formed and incorporated joint venture and which has not completed three financial years from the date of commencement of business, then either the said JV shall fulfill each eligibility criteria or any one constituent member/ promoter of such a JV shall fulfill each eligibility criteria. If the bid is received with the proposal that one constituent member/ promoter fulfils each eligibility criteria, then this member/promoter shall be clearly identified and he/it shall assume all obligations under the contract and provide such comfort letter/guarantees as may be required by Owner. The guarantees shall cover inter alia the commitment of the member/ promoter to complete the entire work in all respects and in a timely fashion, being bound by all the obligations under the contract, an undertaking to provide all necessary technical and financial support to the JV to ensure completion of the contract when awarded, an undertaking not to withdraw from the JV till completion of the work, etc.
   c. In case the bidder(s) is/are a consortium (including an unincorporated JV), then the following conditions shall apply:
      I. Each member in a consortium may only be a legal entity and not an individual person;
      II. The Bid shall specifically identify and describe each member of the consortium;
      III. the consortium member descriptions shall indicate what type of legal entity the member is and its jurisdiction of incorporation (or of establishment as a legal entity other than as a corporation) and provide evidence by a copy of the articles of incorporation (or equivalent documents);

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IV. One participant member of the consortium shall be identified as the "Prime member" and contracting entity for the consortium;
V. This prime member shall be solely responsible for all aspects of the Bid/ Proposal including the execution of all tasks and performance of all consortium obligations;
VI. The prime member shall fulfill each eligibility criteria;
VII. a commitment shall be given from each of the consortium members in the form of a letter signed by a duly authorized officer clearly identifying the role of the member in the Bid and the member's commitment to perform all relevant tasks and obligations in support of the
VIII. Prime/lead member of the Consortium and a commitment not to withdraw from the consortium;
IX. No change shall be permitted in the number, nature or share holding pattern of the Consortium members after pre-qualification, without the prior written permission of the Owner.
X. No change in project plans, timetables or pricing will be permitted as a consequence of any withdrawal or failure to perform by a consortium member;
XI. No consortium member shall hold less than 25% stake in a consortium;
XII. Entities which are affiliates of one another are allowed to bid either as a sole bidder or as a consortium only;
XIII. Any person or entity can bid either singly or as a member of only one consortium.

d. In case the bidder is an Indian arm (subsidiary, authorized agent, branch office or affiliate) of a foreign bidder, then the foreign bidder shall have to full fill each eligibility criteria. If such foreign company desires that the contract be entered into with the Indian arm, then a proper back to back continuing (parent company) guarantee shall be provided by the foreign company clearly stating that in case of any failure of any supply or performance of the equipment, machinery, material or plant or completion of the work in all respects and as per the warranties/ guarantees that may have been given, then the foreign company shall assume all obligations under the contract. Towards this purpose, it shall provide such comfort letter/guarantees as may be required by Owner. The guarantees shall cover inter alia the commitment of the foreign company to complete the entire work in all respects and in a timely fashion, being bound by all the obligations under the contract, an undertaking to provide all necessary technical and financial support to the Indian arm or to render the same themselves so as to ensure completion of the contract when awarded, an undertaking not to withdraw from the contract till completion of the work, etc.

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CHAPTER 4: PERFORMANCE OF WORK

1. EXECUTION OF WORKS:
    a. All the works shall be executed in strict conformity with the provisions of the contract documents and with such explanatory detailed drawings, specifications, and instructions as may be furnished from time to time to the contractor by the Engineer-in-Charge whether mentioned in the contract or not. The contractor shall be responsible for ensuring that works throughout are executed in the most substantial, proper and workman like manner with the quality of material and workmanship in strict accordance with the specifications following all safety requirements of DAFFPL and as stipulated in work permits as per the directions and to the entire satisfaction of the Engineer-in-Charge.
    b. Wherever it is mentioned in the specifications that the Contractor shall perform certain work or provide certain facilities/materials, it is understood that the contractor shall do, so at his cost unless otherwise specified.
    c. The materials, design and workmanship shall satisfy the relevant Indian Standards, the Job specification contained herein and codes referred to. Where the job specification stipulate requirements in addition to those contained in the standards codes and specifications, these additional requirements shall also be satisfied.

2. COORDINATION AND INSPECTION OF WORK:
    The coordination and inspection of the day-to-day work under the contract shall be the responsibility of the Engineer-in-Charge. The written instructions regarding any particular job will be normally be passed by the Engineer-in-Charge or his authorized representative. A work order book / logbook will be maintained by the Contractor for each job in which the aforesaid written instructions will be entered. These will be signed by the contractor or his authorized representative by way of acknowledgment within 12 hours. The non-maintaining of the order book or non-signing by the contractor shall not preclude the contractor from complying with the instructions.

3. WORK IN MONSOON AND DEWATERING:
    a. The completion of the work may entail working in the monsoon also. The contractor must maintain a minimum labour force as may be required for the job and plan and execute the construction and erection according to the prescribed schedule. No extra rate will be considered for such work in monsoon.
    b. During monsoon and other period, it shall be the responsibility of the contractor to keep the construction work site free from water at his own cost.

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4. WORK ON SUNDAYS AND HOLIDAYS:
   For carrying out work on Sundays and Holidays if needed, the contractor will approach the Engineer-in-Charge or his representative at least two days in advance and obtain permission in writing. No special compensation on this account will be payable.

5. GENERAL CONDITIONS FOR CONSTRUCTION AND ERECTION WORK:
   a. Place of Work: The work has to be executed at specified premises as per the tender. Contractor should apprise himself of all the conditions prevailing in such location and the restrictions placed on movement of personnel and equipment, types of equipment and tools permitted, working methods allowed etc. in the light of security and safety regulations operative in the area. The safety regulations to be complied with, by the contractor will also be provided along with the tender. No idle time wages or compensation for temporary stoppage of work or restrictions would be paid, and the rate quoted for the various items of work should cover the cost of all such contingencies and eventualities. Substantial structures and utilities exist both above ground and underground, adjacent to the work site. (The construction activity gets restrained by the existence of such structures and utilities). Special care is necessary in transportation, storage, working on equipment's and other construction activities to protect the existing features and prevent damage to any facility. Necessary protective structures barricades etc. have to be erected at various places as directed by Engineer-in-Charge. No extra payment of such protective works will be made unless specially provided in the tender.
   b. The working time or the time of work is 48 hours per week normally. Overtime work is permitted in cases of need and the Owner will not compensate the same. Shift working at 2 or 3 shifts per day may become necessary and the contractor should take this aspect into consideration for formulating his rates for quotation. No extra claims will be entertained by the Owner on this account.
   c. The contractor must arrange for the placement of workers in such a way that the delayed completing of the work or any part thereof for any reasons whatsoever will not affect their proper employment. The Owner will not entertain any claim for idle time payment whatsoever.
   d. The contractor shall submit to the Owner reports at regular intervals regarding the state and progress of work. The details and preforma of the report will mutually be agreed after the award of contract.

6. DRAWINGS TO BE SUPPLIED BY THE OWNER:
   a. Where drawings are attached with tender, these shall be for the general guidance of the contractor to enable him to visualize the type of work contemplated and scope of work involved. The contractor will be deemed to have studied the drawings and formed an idea about the work involved.

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b. Detailed working drawings on the basis of which actual execution of the work is to proceed will be furnished from time to time during the progress of the work. The contractor shall be deemed to have gone through the drawings supplied to him thoroughly and carefully and in conjunction with all other connected drawings and bring to the notice of the Engineer-in-Charge, discrepancies, if any, therein before actually carrying out the work.
c. Copies of all detailed working drawings relating to the works shall be kept at the contractor's office of the site and shall be made available to the Engineer-in-Charge at any time during the contract. The drawings and other documents issued by the Owner shall be returned to the Owner on completion of the works.

7. SETTING OUT WORKS:
   a. The Engineer-in-Charge shall furnish the contractor with only the four corners of the work site and a level bench mark and the contractor shall set out the works and shall provide efficient staff for the purpose and shall be solely responsible for the accuracy of such setting out.
   b. The contractor shall provide, fix and be responsible for the maintenance of all stacks, templates, level marks, profiles and other similar things and shall take all necessary precaution to prevent their removal or disturbance and shall be responsible for the consequence of such removal or disturbance should the same take place and for their efficient and timely reinstatement. The contractor shall also be responsible for the maintenance of all existing survey marks, boundary marks, distance marks and centre line marks, either existing or supplied and fixed by the contractor. The, work shall be set out to the satisfaction of the Engineer-in-Charge. The approval thereof or joining in setting out the work shall not relieve the contractor of any of his responsibilities.
   c. Before beginning the works, the contractor shall at his own cost, provide all necessary reference and level posts, pegs, bamboos, flags, ranging rods, strings and other materials for proper layout of the work in accordance with the scheme, for bearing marks acceptable to the Engineer-in-Charge. The centre, longitudinal or face lines and cross lines shall be marked by means of small masonry pillars. Each pillar shall have distinct marks at the centre to enable theodolite to be set over it. No work shall be started until all these points are checked and approved by the Engineer-in-Charge in writing but such approval shall not relieve the contractor of any of his responsibilities. The contractor shall also provide all labour, material and other facilities, as necessary, for the proper checking of layout and inspection of the points during construction.
   d. Pillars bearing geodetic marks located at the site of work under construction should be protected and fenced by the contractor.
   e. On completion of works, the contractor must submit the geodetic documents according to which the work was carried out.

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8. RESPONSIBILITY FOR LEVEL AND ALIGNMENT:
   The contractor shall be entirely and exclusively responsible for the horizontal and vertical alignment, the levels and correctness of every part of the work and shall rectify effectually any errors or imperfections therein. Such rectifications shall be carried out by the contractor, at his own cost, when instructions are issued to that effect by the Engineer-in-Charge.

9. MATERIALS TO BE SUPPLIED BY CONTRACTOR:
   a. The contractor shall procure and provide the whole of the materials required for construction including tools, tackles, construction plant and equipment for the completion and maintenance of the works except the materials which will be issued by Owner and shall make his own arrangement for procuring such materials and for the transport thereof. The materials procured by the contractor shall be DAFFPL approved/specified quality.
   b. All materials procured should meet the specifications given in the tender document. The Engineer-in-Charge may, at his discretion, ask for samples and test certificates for any batch of any material procured. Before procuring, the contractor should get the approval of Engineer-in-Charge for any material to be used for the works.
   c. Manufacturer's certificate shall be submitted for all materials supplied by the contractor. If, however, in the opinion of the Engineer-in-Charge any tests are required to be conducted on the materials supplied by the contractor, these will be arranged by the contractor promptly at his own cost.

10. MATERIALS SUPPLIED BY OWNER:
    a. If the specifications of the work provides for the use of any materials of special description to be supplied from the Owner's stores, price for such material to be charged therefore as herein after mentioned being so far as practicable for the convenience of the contractor but not so as in any way to control the meaning or effect of the contract. The contractor shall be bound to purchase and shall be supplied such materials as are from time to time required to be used by him for the purpose of the contract only. The sums due from the contractor for the value of the actual materials supplied by the Owner will be recovered from the running account bill on the basis of the actual consumption of materials in the work covered and for which the running account bill has been prepared. After the completion of the works, however, the contractor has to account for the full quantity of materials supplied to him as per relevant clauses in this document.
    b. The value of the materials as may be supplied to the contractor by the Owner will be debited to the contractor's account at the rates shown in the schedule of chargeable materials and if they are not entered in the schedule, they will be debited at cost price, which for the purpose of the contract shall include the cost of carriage and all other expenses whatsoever such as normal storage

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supervision charges which shall have been incurred in obtaining the same at the Owner's stores. All materials so supplied to the contractor shall remain the absolute property of the Owner and shall not be removed on any account from the site of the work, and shall be at all times open for inspection to the Engineer-in-Charge. Any such materials remaining unused at the time of completion or termination of the contract shall be returned to the Owner's stores or at a place as directed by the Engineer-in- Charge in perfectly good condition, at contractor's cost.

11. CONDITIONS FOR ISSUE OF MATERIALS:

a. Materials specified to be issued by the Owner will be supplied to the contractor by the Owner from his stores/location. It shall be the responsibility of the contractor to take delivery of the materials and arrange for its loading, transport and unloading at the site of work at his own cost. The materials shall be issued between the working hours and as per the rules of the Owner framed from time to time.
b. The contractor shall bear all incidental charges for the storage and safe custody of materials at site after these have been issued to him.
c. Materials specified to be issued by the Owner shall be issued in standard sizes as obtained from the manufacturer.
d. The contractor shall construct suitable godown at the site of work for storing the materials safe against damage by rain, dampness, fire, theft etc. He shall also employ necessary watch and ward establishment for the purpose.
e. It shall be duty of the contractor to inspect the material supplied to him at the time of taking delivery and satisfy himself that they are in good condition. After the materials have been delivered by the Owner, it shall be the responsibility of the contractor to keep them in good condition and if the materials are damaged or lost, at any time, they shall be repaired and/ or replaced by him at his own cost, according to the directions of the Engineer-in-Charge.
f. The Owner shall not be liable for delay in supply or non-supply of any materials which the Owner has undertaken to supply where such failure or delay is due to natural calamities, act of enemies, transport and procurement difficulties and any circumstances beyond the control of the Owner. In no case, the contractor shall be entitled to claim any compensation or loss suffered by him on this account.
g. It shall be the responsibility of the contractor to arrange in time all materials required for the works other than those to be supplied by the Owner. If, however, in the opinion of the Engineer-in-Charge the execution of the work is likely to be delayed due to the contractor's inability to make arrangements for supply of materials which normally he has to arrange for, the Engineer-in-Charge shall have the right, at his own discretion, to Issue such materials If available with the Owner or procure the materials from the market or elsewhere and the contractor will be bound to take such materials at the

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rates decided by the Engineer-in-Charge. This, however, does not in any way absolve the contractor from responsibility of making arrangements for the supply of such materials in part or in full, should such a situation occur, nor shall this, constitute a reason for the delay in the execution of the work.

h. None of the materials supplied to the contractor will be utilized by the contractor for manufacturing item, which can be obtained from standard manufacturer in finished form.
i. The contractor shall, if desired by the Engineer-in-Charge, be required to execute an indemnity bond for safe custody and accounting of all materials issued by the Owner.
j. The contractor shall furnish to the Engineer-in-Charge sufficiently in advance a statement showing his requirements of the quantities of the materials to be supplied by the Owner and the time when the same will be required by him for the works, so as to enable the Engineer-in-Charge to make necessary arrangement for procurement and supply of the material.
k. A daily account of the materials issued by the Owner shall be maintained by the contractor indicating the daily receipt, consumption and balance in hand. This account shall be maintained in a manner prescribed by the Engineer-in-Charge along with all connected papers viz. requisition, issues etc. and shall be always available for inspection in the contractor's office at site.
l. The contractor should see that only the required quantities of materials are got issued. The contractor shall not be entitled to cartage and incidental charges for returning the surplus materials, if any, to the stores/location where from they were issued or to the place as directed by the Engineer-in-Charge.
m. Materials/ Equipment supplied by Owner shall not be utilized for any other purpose(s) than issued for.

12. MATERIALS PROCURED WITH ASSISTANCE OF OWNER:

Notwithstanding anything contained to the contrary in any or all the clause of this document where any materials for the execution of the contract are procured with the assistance of Owner either by issue from Owner's stock or purchase made under orders or permits or licences issued by Government, the contractor shall hold the said materials as trustee for the Owner and use such materials economically and solely for the purpose of the contract and not dispose them off without the permission of the owner and return, if required by the Engineer-in-Charge, all surplus or unserviceable materials that may be left with him after the completion of the contract or at its termination for any reason, whatsoever on his being paid or credited such prices as the Engineer in-Charge shall determine having due regard to the condition of the materials. The price allowed to the contractor however, shall not exceed the amount charged to him excluding the storage charges if any. The decision of the Engineer-in- Charge shall be final and conclusive in such matters. In the event of breach of the aforesaid condition, the contractor shall in terms of the licenses or permits, and/or for criminal breach of trust, be liable to compensate the Owner a

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double rate or high rate, in the event of those materials at that time having higher rate or not being available in the market, then any other rate to be determined by the Engineer-in-Charge and his decision shall be final and conclusive.

13. MATERIALS OBTAINED FROM DISMANTLING:
    If the contractor in the course of execution of the work is called upon to dismantle any part for reasons other than those stipulated in clauses 64 & 68 hereunder, the materials obtained in the work of dismantling etc. will be considered as the Owner's property and will be disposed off to the best advantage of the Owner.

14. ARTICLES OF VALUE FOUND:
    All gold, silver and other materials, of any description and all precious stones, coins, treasure relies, antiquities and other similar things which shall be found in, under or upon the site, shall be property of the Owner and the contractor shall duly preserve the same to the satisfaction of the Engineer-in-Charge and shall from time to time deliver the same to such person or person indicated by the Owner.

15. DISCREPANCIES BETWEEN INSTRUCTIONS:
    Should any discrepancy occur between the various instructions furnished to the contractor, his agents or staff or any doubt, arise as to the meaning of any such instructions or should there be any misunderstanding between the contractor's staff and the Engineer-in-Charge's staff, the contractor shall refer the matter immediately in writing to the Engineer-in-Charge whose decision thereon shall be final and conclusive and no claim for losses alleged to have been caused by such discrepancies between instructions, or doubts, or misunderstanding shall in any event be admissible.

16. ALTERATIONS IN SPECIFICATIONS AND DESIGNS AND EXTRA WORK:
    a. The Engineer-in-Charge shall have power to make any alterations in, omissions from, additions to of substitutions for, the schedule of rates, the original specifications, drawings, designs and instructions 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 such altered / extra / new items of work in accordance with any instructions which may be given to him in writing signed by the Engineer-in-Charge and such alterations, omissions, additions or substitutions shall not invalidate the contract 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 conditions in all respect on which he agree to do the main work. The time for completion of work may be extended for the part of the particular job at the discretions of the Engineer-in-Charge, for only such alteration, additions or substitutions of the work, as he may consider as just and reasonable. The rates for such additional, altered or substituted work

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under this clause shall be worked out in accordance with the following provisions:

- If the rates for the additional, altered or substituted work are specified in the contract for the work, the contractor is bound to carry out the additional, altered or substituted work at the same rates as are specified in the contract.
- If the rates for the additional, altered or substituted work are not specifically provided in the contract for the work, the rates will be derived from the rates for similar class of works as specified in the contract for the work. The opinion of the Engineer-in-Charge as to whether the rates can be reasonably so derived from items in the contracts will be final and binding on the contractor.
- If the rates for the altered, additional or substituted work cannot be determined in the manner specified in sub-clause (a) and (b) above, then the contractor shall inform the Engineer-in-Charge of the rate which is his intension to charge for such class of work supported by analysis of the rate or rates claimed, and the Engineer-in-Charge shall determine the rates on the basis of the prevailing market rates of materials, labour cost at schedule of labour plus 10% to cover contractor's supervision, overheads and profit and pay the contractor accordingly. The opinion of the Engineer-in-Charge as to the current market rates of materials and the quantum of labour involved per unit of measurement will be final and binding on the contractor.
- Provisions, contained in sub-clause mentioned above shall not, however, apply: Where the value of alterations / additions / deletions or substitutions exceeds beyond plus or minus 25% of the estimated contract value (i.e. quoted item rates of contractor shall hold good for variations etc. within plus or minus 25% of estimated contract value)

b. In the event and as a result of such alternatives / additions / substitutions / deletion, the scope of contract work exceed the value stipulated in the contract by more than the limits given in clause above, the Contractor shall claim revision of the rates supported by the proper analysis in respect of such items for quantities in excess of the above limits, notwithstanding the fact that the rates for such items exist in the tender for the main work or can be derived in accordance with the provision of sub-clause (b) of Clause 61 A, and the Engineer-in-Charge may revise their rates having regard to the prevailing market rates, and the contractor shall be paid in accordance with the rates so fixed. But, under no circumstances the contractor shall suspend / stop / slowdown the work on the plea of non-settlement of rates of items falling under this clause.

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17. ACTION WHERE NO SPECIFICATIONS ISSUED:
    In case of any class of work for which there is no such specification given by the Owner in the tender documents, such work shall be carried out in accordance with Indian Standard Specifications and if the Indian Standard Specifications do not cover the same the work should be carried out as per standard Engineering Practice subject to the approval of the Engineer-in-Charge.

18. ABNORMAL RATES:
    The contractor is expected to quote rate for each item after analysis of cost involved for the completion of item/work, considering all specifications and conditions of contract. This will avoid loss of profit or gain, in case of curtailment or change of specification for any item. In case it is noticed that the rates for any item, quoted by the tenderer unusually are high or unusually low it will be sufficient cause for the rejection of the tender unless the Owner is convinced about the reasonableness of the rates on scrutiny of the analysis for such rate to be furnished by the tenderer on demand.

19. INSPECTION OF WORK:
    a. The Engineer-in-Charge will have full power and authority to inspect the works at any time wherever in progress either on the Site or at the contractor's premises / workshop where situated premises /workshops of any person, firm or corporation where work in connect with the contract may be in hand or where materials are being or are to be supplied, and the contractor shall afford or procure for the Engineer-in-Charge every facility and assistance to carry out such Inspection. The contractor shall at all time during the usual working hours and at all other time for which reasonable notice of the intention of the Engineer in-Charge or his representative to visit the works have been given to the contractor, either himself be present to receive order and instructions or post a responsible agent duly accredited in writing for the purpose. Orders given to the contractor's agent shall be considered to have the same force as if they had been given to the contractor himself. The contractor shall give not less than seven days, notice in writing to the Engineer-in-Charge before covering up or placing any work beyond reach of inspection and measurement any work in order that the same may be inspected and measured. In the event of breach of above the same shall be uncovered at contractor's expense carrying out such measurement or inspection.
    b. No materials shall be dispatched by the contractor before obtaining the approval of Engineer-in-Charge in writing. The contractor is to provide at all times during the progress of the work and the maintenance period, proper means of access with ladders, gangways, etc. and the necessary attendance to move and adopt as directed for inspection or measurement of the works by the Engine in-Charge.

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20. ASSISTANCE TO THE ENGINEERS:

The contractor shall make available to the Engineer-in-Charge, free of cost necessary instruments and assistance in checking of setting out of works and taking measurement of work.

21. TESTS FOR QUALITY OF WORKS:

a. All workmanship shall be of the respective kinds described in the contract documents and in accordance with the instructions of the Engineer-in-Charge and shall be subjected from time to time to such test at contractor's cost as the Engineer-in-Charge may direct at place of manufacture or fabrication or on the site or at all or any such places. The contractor shall provide assistance, instruments, labour and materials as are normally required for examining, measuring and testing any workmanship as may be selected and required the Engineer-in-Charge.
b. All the tests necessary in connection with the execution of the work as decided by Engineer-in-Charge shall be carried out at the field testing laboratory of the Owner by paying the charges as decided by the Owner from time to time. In case of non-availability of test facility with the Owner, the required test shall be carried out at the cost of contractor at government or any other testing laboratory as directed by Engineer-in-Charge.
c. If any tests are required to be carried out in connection with the work or materials workmanship not supplied by the contractor, such tests shall be carried out by the contractor as per the instructions of Engineer-in-Charge and cost of such tests shall be reimbursed by the Owner.

22. SAMPLES:

The contractor shall furnish to the Engineer-in-Charge for approval when requested or if required by the specifications, adequate samples of all materials and finishes to be used in the work. Such samples shall be submitted before the work is commenced and in ample time to permit tests and examinations thereof. All materials furnished and finishing applied in actual work shall be fully identical to the approval samples.

23. ACTION AND COMPENSATION IN CASE OF BAD WORK:

If it shall appear to the Engineer-in-Charge that any work has been executed with unsound, imperfect or unskilled workmanship or with materials of any inferior description, or that any materials or articles provided by the contractor for the execution of the work are unsound or of a quality inferior to that contracted for, or otherwise not in accordance with the contract, the contractor shall on demand in writing from the Engineer-in-Charge or his authorized representative, specifying the work, materials or articles complained of, notwithstanding that the same have been inadvertently passed, certified and paid for forthwith shall rectify or remove and reconstruct the works specified and provide other proper and suitable materials or articles at his own charge and cost, and in the event of failure to do so within a period to be specified by the Engineer-in-Charge in his demand aforesaid, the

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contractor shall be liable to pay compensation at the rate of 0.5% of the estimated cost of the whole work, for every week limited to a maximum of 10% of the estimated cost of the whole work, while his failure to do so shall continue and in the case of any such failure the Engineer-in-Charge may on expiry of notice period rectify or remove and re-execute the work or remove and replace with others, the materials or articles complained of as the case may be at the risk and expenses of the contractors in all respects. The decision of the Engineer-in-Charge as to any question arising under this clause shall be final and conclusive.

24. SUSPENSION OF WORKS:
The contractor shall, if ordered in writing by the Engineer-in-Charge or his representative, temporarily suspend the works or any part thereof for such period and such time as so ordered and shall not, after receiving such written order, proceed with the work therein ordered to be suspended, until he shall have received a written order to proceed therewith. The contractor shall not be entitled to claim/ compensation for any loss or damage sustained by him by reason of temporary suspension of the works aforesaid. An extension of time for completion, corresponding with the delay caused by any such suspension of the works as aforesaid will be granted to the contractor, should he apply for the same, provided that suspension was not consequent to any default or failure on the part of the contractor.

25. OWNER MAY DO PART OF WORK:
Upon failure of the contractor to comply with any instructions given in accordance with the provisions of the contract, the owner has the alternative right, instead of assuming charge for entire work to place additional labour force, tools, equipments and materials on such parts of the work, as the owner may designate or also engage another contractor to carry out the work. In such cases, the owner shall deduct from the amount which otherwise might become due to the contractor, the cost of such work and materials with ten percent added to cover all departmental charges and should the total amount thereof exceed the amount due to the contractor, the contractor shall pay the difference to the owner.

26. POSSESSION PRIOR TO COMPLETION:
The Engineer-in-Charge shall have the right to take possession of or use any completed or partially completed work or part of the work. Such possessions or use shall not be deemed to be an acceptance of any work completed in accordance with the contract agreement. If such prior possession or use by the Engineer-in-Charge delays the progress of work, suitable adjustment in the time of completion will made and contract agreement shall be deemed to be modified accordingly.

27. PERIOD OF LIABILITY FROM THE DATE OF COMPLETION OF WORK:
    a. The contractor shall guarantee the installation/site work for a period of 12 (twelve) Months from the date of completion of work, unless otherwise

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specified. Any damage that may lie undiscovered at the time of issue of completion certificate, connected in any way with the equipment or materials supplied by him or in the workmanship shall be rectified or replaced by the contractor at his own expense as deemed necessary by the Engineer-in-Charge or in default, the Engineer-in-Charge may cause the same made good by other workmen and deduct expenses (for which the certificate of Engineer-in-Charge shall be final) from any sums that may be then or at any time thereafter, become due to the contractor or from his security deposit.

b. If the contractor feels that any variation in work or in quality of materials or proportions would be beneficial or necessary to fulfill the guarantee called for, he shall bring this to the notice of the Engineer-in-Charge in writing. The work will not be considered as complete and taken over by the Owner until all the temporary works etc., constructed by the contractor is removed and work site cleaned to the satisfaction of Engineer-in-Charge.

c. Care of Works:
From the commencement to completion of works, the contractor shall take full responsibility for the care of all works including all temporary works, and in case any damage, loss or injury happens to the works or to any part thereof or to any temporary work, from any cause whatsoever, he shall at own cost repair and make good the same, so that at completion, the work shall be in good order and in conformity in every respect with the requirements of the contract and the Engineer-in-Charge's instructions.

d. Effects prior to taking over: If at any time, before the work is taken over, the Engineer-in-Charge shall
   - Decide that any work done or materials used by the contractor or any sub-contractor is defective or not in accordance with the contract or that the works or any portion thereof are defective or do not fulfill the requirements of contract (all such matters being herein after called 'Defects' in this clause) and
   - As soon as reasonably practicable, notice given to the contractor in writing of the said decisions specifying particulars of the defects alleged to exist or to have occurred, then the contractor shall at his own expenses and with all speed make good the defects so specified. In the case contractor shall fail to do so, the Owner may take, at the cost of the contractor, such steps as may in all circumstances, be reasonable to make good such defects. The expenditure, so incurred by the Owner shall be recovered from the amount due to the contractor. The decision of the Engineer-in-Charge with regard to the amount be recovered from the contractor will be final and binding on the contractor. As soon as the works have been completed in accordance with the contract and have passed the tests on completion, the Engineer-in-Charge shall issue a certificate (hereinafter called completion certificate) in which he shall certify the date on which the work have been so completed and have passed the said tests and the

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Owner shall be deemed to have taken over the works on the date so certified. If the works have been divided into various groups in the contract, the Owner shall be entitled to take over any group or groups before the other or others and thereupon the Engineer-in-Charge shall issue a completion certificate which will however, be for such group or groups as taken over only.

e. Defects after taking over: In order that the contractor could obtain a completion certificate, he shall make good with all possible speed, any defect arising from the defective materials supplied by the Contractor or workmanship or any act of omission of the contract that may have been noticed or developed after the works or group of the works has been taken over. The period allowed for carrying out such work will be normally one month. If any defect be not remedied within a reasonable time, the Owner may proceed to do the work at the contractor's risk and expense and deduct from the final bill such amount as may be decided by the Owner. If by reason of any default on the part of the contractor a completion certificate has not been issued in respect of every portion of the work within one month after the date fixed by the contract for the completion of the works, the Owner shall be at his liberty to use the works or any portion thereof in respect of which a completion certificate has been issued provided that the works or the portion thereof so used as aforesaid shall be afforded reasonable opportunity for completing these works for the issue of completion certificate.

f. The Security Deposit/retention money deducted / furnished shall be retained for the period of liability as given in clause above. This Retention amount or Bank Guarantee furnished against Security Deposit/retention money shall be released only on expiry of the period of liability and also based on the certification of the Engineer-in-charge that no defect/damage has been reported / observed during the stipulated period of liability for the contract.

g. Performance of contractor shall be evaluated on each job by Engineer-in-Charge and recorded. Review of performance will be carried out at appropriate intervals by DAFFPL.

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CHAPTER 5: GENERAL TERMS & CONDITIONS:

1. General:
   The materials and workmanship shall satisfy the relevant Indian Standards, the job specifications contained herein & codes referred to. Where the job specifications stipulate requirements in addition to those contained in the standard codes and specifications, these additional requirements shall also be satisfied.

   In the absence of any standard / specification / codes of practice for detailed specifications covering any part of the work covered in this tender document, the instruction / direction of consultant engineer will be binding on the contractor.

   Wherever it is stated in this tender document that a particular supply is to be effected or that a particular work is to be carried out, it shall be understood that the same shall be affected / carried out by the contractor at his cost, unless a different intention is specifically and expressly stated herein or otherwise explicit from the context.

2. Construction Program:
   A detailed bar chart showing various activities shall be prepared by the tenderers. The work shall be executed strictly as per the agreed time schedule. The period of completion shall include, the time required for mobilization and testing as well as rectification, if any, testing & completion in all respects to the entire satisfaction of the consultant.

   A joint programme of execution programme shall be prepared by the contractor.

   Monthly / weekly construction programme shall be made by the contractor. The contractor shall scrupulously adhere to these targets / programme by deploying adequate personal and construction tools and tackles. He shall also supply all materials in his scope of supply in time to achieve the targets set out in the weekly and the monthly programme.

   The contractor shall give every day, a report on labour and equipment deployed along with the progress of the work done on previous day, for each category of work.

3. Construction Water and Electricity:
   - Electricity will be provided by DAFFPL @ Rs. 14.50 per unit. Bidder has to make own arrangement for sub meter.
   - Water for construction will not be provided by DAFFPL.

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4. Safety Rules and Regulations:
   All Safety rules and regulations of the terminal operator have to be followed by the contractor without fail. If any damage occurs due to negligence of safety, contractor will be held responsible for the same.

5. Tests and Inspection:
   The contractor shall carry out the various tests as enumerated in the technical specifications of this tender document and the technical documents that will be furnished to him during the performance of the work. No separate payment shall be made.

   The contractor shall carry out at his cost, all the tests either on the field or through external institutions / laboratories, concerning the execution of the work and supply of materials by the contractor.

   Any work not conforming to the execution drawings, specifications or codes shall be rejected forthwith and the contractor shall carry out the rectification at this own cost. Results of all inspection & tests shall be recorded in the inspection reports, test reports, etc., which will be approved by the Engineer-in-charge. These reports shall form part of the completion documents.

   Inspection & Acceptance of works shall not relieve the contractor from any of his responsibilities under this contract.

6. Site Cleaning:
   The contractor shall take care to clean the working site from time to time for easy access to work site and for safety. Working site should be always kept cleared to the entire satisfaction of DAFFPL.

   Before handing over any work to the owner, the contractor in addition to other formalities to be observed as detailed in the document shall clear the site to the entire satisfaction of DAFFPL.

7. Coordination with other Agencies:
   Work shall be carried out in such a manner that the work of other agencies operating at the site is not hampered due to any action of the contractor. Proper coordination with other agencies will be the responsibility of the contractor. In case of any dispute, the decision of Engineer-in-charge shall be final and binding on the contractor.

8. DAFFPL reserves the right to accept any tender in whole and reject any or all tenders without assigning any reason. DAFFPL also reserves the right to allow public enterprises (Central/State) Price / purchase /contract / service preference as admissible under the Indian Government Policy.

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9. BID PRICES:
    a) Prices shall be furnished strictly in the Price Bid format of the tender document.
    b) Bidder should quote their lowest and best offered price. Prices so quoted will remain firm till satisfactory completion of order. The price will not be subjected to escalation for any reason whatsoever.
    c) Bidders quoted prices shall be deemed to include entire Specification of item and all obligations and responsibilities to be carried out / executed by the Bidder as per terms of tender document. It is clearly understood by the Vendor that it is for the Vendor to ascertain and assess the applicable Acts/ Regulations/ Laws etc., entirely of their own. It is also for the Vendor to ascertain and assess the applicability of taxes, duties, levies etc. In case of any difference of opinion between Vendors proposal and interpretation by any tax/assessing (or similar) authorities, on the rate or terms and conditions related to taxes and duties etc., owners liability shall be strictly as per terms/provisions of the contract based on tender document and Vendors offer.
    d) No other charges accept those mentioned in the tender document will be payable to vendor.

10. The materials should be properly packed so as to withstand all transit hazards. Materials are required to be dispatched by the vendor to the locations, on freight paid DOOR- DELIVERY CONSIGNEE COPY ATTACHED basis along with copies of Inspection release note & internal test certificates & other documents as mentioned elsewhere in this tender document.

11. All shipment shall be under deck unless carriage on deck is unavoidable.

12. Bidder to note that Special Packaging Requirement as in technical specifications of this tender. The materials should be properly packed so as to withstand all transit hazards (both ocean & inland transit).

13. Indian agent Commission will not be paid by the owner.

14. TAXES & DUTIES:
    a) Bidder(s) quoted prices shall be inclusive of all taxes, duties, cess, levies etc.,
    b) The invoice should clearly mentioned that applicable Excise Duty, Education Cess or any other taxes charged and paid / payable on quoted item to enable the owner to claim MODVAT / Input credit.
    c) The statutory variation in Excise duty, Education Cess and Sales tax / VAT on finished goods and introduction of new tax, from bid due date till the contractual completion period shall be to owner account against submission of the documentary evidence. However, any increase in the rate of these

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taxes and duties beyond the contractual delivery period shall be to Seller account. Any decrease in the rate of these taxes and duties shall be passed on to the owner. Any additional excise duty due to increase in turn-over would be to seller account.

d) It is for the Bidder to assess and ascertain the rate of excise duty, education Cess and sales tax/VAT applicable on quoted items. It is clearly understood that Owner will not have any additional liability towards payment of Excise Duty, Education Cess and Sales Tax/VAT which is based on Bidders wrong assessment / interpretation of applicability of such Excise Duty and/or education cess and / or Sales Tax/VAT.
e) Successful bidder shall carry out its obligations towards services at site as mentioned in technical specifications without any extra charges.
f) Octroi/Entry tax, if any, in the any state of India shall be directly paid by the vendor, if applicable.
g) DAFFPL shall not be liable, in case the tax authorities assess the tax elements in a different way on account of any reason, whatsoever.
h) Taxes and duties other than those specified in this document, if any, shall be included in the quoted prices and no separate reimbursement shall be made by DAFFPL.

15. Income Tax / Corporate Tax :
    a) As regards Income Tax, Surcharge on Income Tax or any other Corporate Tax payable by the Bidder for reason of the contract awarded, and / or on their expatriate personal, the Owner shall not bear any Tax liability whatsoever, irrespective of the mode of construction of contract / order. The Bidder shall be liable and responsible for payment of such tax, if attracted under the provision of Indian Income Tax Act.
    b) Bidder may note that if any tax is deductible at source as per Indian Income Tax Law, the same will be so deducted before releasing any payment to the Bidder and a TDS (Tax deducted at source) certificate will be furnished to the Bidder.
    c) Accordingly, Bidder shall have the responsibility to check and include such provision of taxes in the prices.
    d) In case of delay in delivery due to reasons attributable to Bidder, any new or additional taxes or duties levied by Statutory authorities during this period shall be borne by the Bidder.

16. EMD / BID SECURITY
    a) The bidder shall furnish, as part of his bid, a bid security in original for the amount specified in the tender document by way of pay order, bank guarantee on Rs.100/-value non-judicial stamp paper or demand draft.
    b) The bid security is required to protect the Owner against the risk of Bidders conduct, which would warrant the security forfeiture.
    c) If bid Security / EMD is in the form of bank guarantee, it shall be in the form

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of irrevocable bank guarantee (in the format attached) issued by any Indian Scheduled Bank (other than Co-operative Bank) will be accepted.

d) Bid Security / EMD shall be issued in favour of M/s Delhi Aviation Fuel Facility (P) Limited, New Delhi. .

e) Unsuccessful bidders bid security without any interest will be discharged/ returned as promptly as possible, but not later than 60 days after the expiry of the period of bid validity prescribed by the Owner.

f) The successful bidder bid security without any interest will be discharged, upon the Bidder accepting the Contract/ Purchase Order and furnishing the Contract performance bank guarantee to DAFFPL.

g) The bid security may be forfeited:
   i. If a bidder withdraws his bid during the period of bid validity or
   ii. In the case of a successful bidder, if the bidder fails or refuses to:
      - Accept the Purchase Order in accordance with agreed terms and conditions.
      - Furnish Contract performance bank guarantee as per bid document/ Purchase Order.
   iii. Detection of submission of false / forged documents and fraud.

h) Bid Security / EMD should be in favour of "Delhi Aviation Fuel Facility Private Limited", payable at New Delhi and submitted to the relevant office of DAFFPL as mentioned in covering note of the tender document. Covering letter to bid Security / EMD must indicate the tender number. This is essential to have proper co-relation at a later date. The bid security / EMD shall be strictly in the form provided in the bid document before the due date & time of bid submission.

i) Central Public Sector Undertaking of Govt. Of India are exempted from furnishing the bid security. Firms registered with NSIC/ MSME are also exempted from furnishing bid security, provided they are registered for the tendered items and up to the monetary limit they intend to quote. Provided further that they submit a copy of the current and valid registration certificate for the quoted item and monetary value along with their bid(s). Owner reserves right to verify the registration certificate provided, with relevant authorities.

17. CONTRACT PERFORMANCE BANK GUARANTEE [CPBG]

a) As a Performance security, the successful Bidder, to whom the work is awarded by, shall be required to furnish within 30 days of notification of award of contract (Letter/ Fax/e-mail of Intent) a Performance Bank Guarantee on RS.100/- VALUE non-judicial stamp paper in favour of the Owner (M/S DAFFPL).

b) The Bank Guarantee amount shall be equal to TEN PERCENT (10%) of the

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Total Order Value and it shall guarantee the faithful performance of the Order in accordance with the Terms and conditions specified in the documents and specifications.

c) CPBG shall be in the form of an irrevocable Bank Guarantee (in the format attached) issued by any Indian Scheduled Bank (other than Co-operative Bank).
d) The Bank Guarantee shall be valid for the entire period of the Contract, namely, till the end of the guarantee / warranty period. The guarantee amount shall be payable on demand to the Owner.
e) In case, the Contract Performance Bank Guarantee stated above gets reduced/ deducted for reasons of non-fulfillment of any Contractual obligations upto the completion of guarantee period, the bidder shall immediately take action to increase the value of Bank Guarantee to TEN PERCENT (10%) of the Contract price, to cover his guarantee/warranty obligations.
f) The Performance Guarantee will be returned to the bidder without any interest at the end of the warranty / guarantee period subject to fulfillment of all contractual obligations by the Bidder. The bank guarantee shall have a claim period of 3 months beyond the contractual guarantee period.
g) The proceeds of performance security shall be appropriated by the owner as compensation for any loss resulting from vendor's failure to complete his obligations under the contract to the prejudice to any of the rights or remedies the owner may be entitled to as per terms and conditions of contract. The proceeds of this performance security shall also govern the successful performance of goods and services and vendors all obligations during the entire period of contractual warrantee / guarantee.

18. PRICE REDUCTION FOR DELAY IN DELIVERY:

a) The completion period quoted must be realistic & specific. The inability of successful bidder to execute orders in accordance with the agreed completion schedule will entitle DAFFPL, at its options, to:
b) Accept delayed delivery at prices reduced by a sum equivalent to half percent (0.5%) of the value of any goods not delivered for every week of delay or part thereof, limited to a maximum of 10% of the total order value. Date of completion of work shall be considered for calculation of price reduction
c) The price reduction clause shall become applicable for works done beyond the schedule completion period of six months.

19. INSURANCE

Supplier shall carry and maintain any and all statutory insurance(s) required under Indian Laws and Regulations, including Workmen compensation Act/ESI/Third party liabilities etc. and insurances for their personnel engaged in performance of the work at their own cost.

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20. INSPECTION:

a) Material / construction shall be inspected by owner or its representative. Charges other than third party inspection, is entirely vendor responsibility and in no way should affect the completion schedule.
b) OWNER may, at its own expense, witness any test or inspection. In order to enable OWNER to witness the tests/inspections OWNER will advise the bidder in advance whether it intends to be present at any of the inspections.
c) Even if the inspection and tests are fully carried out, the Vendor shall not be absolved from its responsibilities to ensure that the Material(s), raw materials, components and other inputs are supplied strictly to conform and comply with all the requirements of the Contract at all stages, whether during manufacture and fabrication, or at the time of Delivery as on arrival at site and after its erection or start up or consumption, and during the defect liability period. The inspections and tests are merely intended to prima-facie satisfy OWNER that the Material(s) and the parts and components comply with the requirements of the Contract. The Vendor s responsibility shall also not be anywise reduced or discharged because OWNER or OWNER s representative(s) or Inspector(s) shall have examined, commented on the Vendor s drawings or specifications or shall have witnessed the tests or required any chemical or physical or other tests or shall have stamped or approved or certified any Material(s).
d) Although material approved by the Inspector(s), if on testing and inspection after receipt of the Material(s) at the location, any Material(s) are found not to be in strict conformity with the contractual requirements or specifications, OWNER shall have the right to reject the same and hold the Vendor liable for non-performance of the Contract.

21. GUARANTEE/WARRANTY:

a) Materials shall be guaranteed against manufacturing defects, materials, workmanship and design for a period of 12 months from the date of commissioning. Warranty for replacement of material / accessories should be provided free of charges at our premises. The above guarantee/warranty will be without prejudice to the certificate of inspection or material receipt note issued by us in respect of the materials.
b) All the materials including components and sub contracted items should be guaranteed by the vendor within the warranty period mentioned above. In the event of any defect in the material, the vendor will replace / repair the material at DAFFPL concerned location at vendor risk and cost on due notice.
c) Alternatively, DAFFPL reserves the right to have the material repaired / replaced at the locations concerned, at the vendors risk, cost and responsibility, in case, vendor does not replace / repair the material.
d) The Vendor shall provide similar warrantee on the parts, components, fittings, accessories etc. so repaired and / or replaced.
e) Vendor shall guarantee that the performance of the EQUIPMENT supplied

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under the CONTRACT shall be strictly in conformity with the specifications and shall perform the duties specified under the CONTRACT.

f) RISK PURCHASE CLAUSE: We reserve the right to curtail or cancel the order either in full or part thereof if bidder fails to comply with delivery schedule and other terms & conditions of the order. DAFFPL also reserves the right to procure same or similar materials/equipment through other sources at vendor's entire risk, cost and consequences.

22. TEST & PERFORMANCE CERTIFICATES: Bidder shall furnish Material test and Performance Certificates for the materials along with the challans and invoice.

23. PAYMENT TERMS: The payment terms given below are subjected to the following conditions:

- Monthly progressive payments shall be made towards the work completed as per the payment terms and as per agreed rates, against running account bills submitted by the contractors.
- Payment will be released within 30 Days from the date of receipt of Invoice.
- There will be a deduction of 10% towards retention amount from every running account bill which may be released against equivalent performance bank guarantee on completion of jobs.

➢ **CIVIL**
- **90% on completed individual item of work.**
- **10% on completion of all and final acceptance by site-in-charge**

➢ **Electrical**
- **100% after supply, installation and acceptance by site-in-charge**

➢ **Mechanical**
- **Structural Steel Works**
  - ✓ **60% after supply, inspection, acceptance of material and fabrication**
  - ✓ **20% after erection and welding**
  - ✓ **20% on completion of all works and final acceptance by site-in-charge**
- **Fittings**
  - ✓ **100% after supply, installation and acceptance by site-in-charge**
- **Painting Works**
  - ✓ **30% after surface preparation and application of one coat of primer**
  - ✓ **30% after second coat of primer**

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- ✓ **40% after application of finish paint, completion of all works and acceptance of site-in-charge**

- **Piping**
  - ✓ **50% after completion of fabrication**
  - ✓ **30% on completion of erection including provision of supports, vents, drains etc., alignment and welding including completion of radiography and other examinations as specified.**
  - ✓ **20% after lines are pressure tested and finally accepted in all respects by site-in-charge**

24. Only in the event of causes of Force Majeure occurring within the contractual delivery period and if they impede the performance of contract, the delivery dates shall be extended on receipt of application from the bidder / Owner without imposition of penalty. Only those causes which depend on natural calamities, civil wars, fire and national strikes which have duration of more than seven consecutive calendar days are considered the causes of force Majeure. The decision of Owner shall be final and binding on vendor.

25. The Vendor must advise the Owner by a registered letter duly certified by Local Chamber of Commerce or statutory authorities and Owner must advise the Vendor by a letter, the beginning and the end of the delay immediately, but in no case later than within 10 days of the beginning and end of such causes of Force Majeure condition as defined above. Provided further that if the performance in whole or part of any obligation under this contract is prevented or delayed by reason of any such event for period exceeding 60 days either party may at its option terminate the contract.

26. Repeat Order: DAFFPL reserves the right to place repeat order up to the order quantity within SIX MONTHS from the date of original order on mutual agreement basis.

27. Any reference to the Govt. Acts /Regulations etc. in the Bid Document is only indicative, and it is entirely for the bidder to ascertain the applicable Acts/Regulations.

28. Rejected material lying in Owner premises must be replaced within 60 days from date of final report on rejection of material.

29. RECOVERY OF SUMS DUE: Whenever, any claim against bidder for payment of a sum of money arises out of or under the contract or in any other form, the owner shall be entitled to recover such sums from any sum then due or when at any time thereafter may become due from the vendor under this or any other form and should this sum be not sufficient to cover the recoverable amount of claim(s), the vendor shall pay to DAFFPL on demand the balance remaining due.

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30. PATENTS & ROYALTIES: The vendor shall fully indemnify owner and users of materials specified herein/supplied at all times, against any action, claim or demand, costs and expenses, arising from or incurred by reasons of any infringement or alleged infringement of any patent, registered design, trademark or name, copy right or any other protected rights in respect of any materials supplied or any arrangement, system or method of using, fixing or working used by the vendor. In the event of any claim or demand being made or action sought against Owner in respect of any of the aforesaid matter, the vendor shall be notified thereof immediately and the vendor shall at his/its own expense with (if necessary) the assistance of Owner (whose all expense shall be reimbursed by the vendor) conduct all negotiations for the settlement of the same and/or litigation which may arise thereof.

31. LIABILITY CLAUSE: In case where it is necessary for employees or representatives of the Vendor to go upon the premises of owner, vendor agrees to assume the responsibility for the proper conduct of such employees/representatives while on said premises and to comply with all applicable Workmen s Compensation Law and other applicable Government Regulations and Ordinances and all plant rules and regulations particularly in regard to safety precautions and fire hazards. If this order requires vendor to furnish labour at site, such vendors workmen or employees shall under NO circumstances be deemed to be in owner s employment and vendor shall hold himself responsible for any claim or claims which they or their heirs, dependent or personal representatives, may have or make, for damages or compensation for anything done or committed to be done, in the course of carrying out the work covered by the purchase order, whether arising at owner s premises or elsewhere and agrees to indemnify the owner against any such claims, if made against the owner and all costs of proceedings, suit or actions which owner may incur or sustain in respect of the same.

32. COMPLIANCE OF REGULATIONS: Vendor warrants that all goods/Materials covered by this order have been produced, sold, dispatched, delivered and furnished in strict compliance with all applicable laws, regulations, labour agreement, working condition and technical codes and statutory requirements as applicable from time to time. The vendor shall ensure compliance with the above and shall indemnify owner against any actions, damages, costs and expenses of any failure to comply as aforesaid.

33. REJECTION, REMOVAL OF REJECTED GOODS AND REPLACEMENT: In case the testing and inspection at any stage by inspectors reveal that the equipment, materials and workmanship do not comply with specification and requirements, the same shall be removed by the vendor at his/its own expense and risk, within the time allowed by the owner. The owner shall be at liberty to dispose off such rejected goods in such manner as he may think appropriate. In the event the vendor fails to remove the rejected goods within the period as aforesaid, all expenses incurred by the owner for

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such disposal shall be to the account of the vendor. The freight paid by the owner, if any, on the inward journey of the rejected materials shall be reimbursed by the vendor to the owner before the rejected materials are removed by the vendor. The vendor will have to proceed with the replacement of the equipment or part of equipment without claiming any extra payment if so required by the owner. The time taken for replacement in such event will not be added to the contractual delivery period.

34. NON-WAIVER : Failure of the Owner to insist upon any of the terms or conditions incorporated in the Purchase Order or failure or delay to exercise any rights or remedies herein, or by law or failure to properly notify Vendor in the event of breach, or the acceptance of or payment of any goods hereunder or approval of design shall not release the Vendor and shall not be deemed a waiver of any right of the Owner to insist upon the strict performance thereof or of any of its or their rights or remedies as to any such goods regardless of when such goods are shipped, received or accepted nor shall any purported oral modification or revision of the order by DAFFPL act as waiver of the terms hereof. Any waiver to be effective must be in writing. Any lone incident of waiver of the any condition of this agreement by DAFFPL shall not be considered as a continuous waiver or waiver for other condition by DAFFPL.

35. NEW & UNUSED MATERIAL: All the material supplied by the vendor shall be branded new, unused and of recent manufacture.

36. CANCELLATION:
    a) DAFFPL reserves the right to cancel the contract/purchase order or any part thereof through a written notice to the vendor if –
        i. The vendor fails to comply with the terms of this purchase order/contract.
        ii. The vendor becomes bankrupt or goes into liquidation.
        iii. The vendor fails to deliver the goods on time and/or replace the rejected goods promptly.
        iv. The vendor makes a general assignment for the benefit of creditors.
        v. A receiver is appointed for any of the property owned by the vendor.
        vi. Any other conditions where owners commercial interest get affected.
    b) Upon receipt of the said cancellation notice, the vendor shall discontinue all work on the purchase order matters connected with it. DAFFPL in that event will be entitled to procure the requirement in the open market and recover excess payment over the vendor s agreed price if any, from the vendor and also reserving to itself the right to forfeit the security deposit if any, made by the vendor against the contract. The vendor is aware that the said goods are required by DAFFPL for the ultimate purpose of materials production and that non-delivery may cause loss of production and consequently loss of profit to the DAFFPL. In this-event of DAFFPL exercising the option to claim damages for non delivery other than by way of difference between the market price and the

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contract price, the vendor shall pay to DAFFPL, fair compensation to be agreed upon between DAFFPL and the vendor. The provision of this clause shall not prejudice the right of DAFFPL from invoking the provisions of price reduction clause mentioned aforesaid.

37. ANTI –COMPETITIVE AGREEMENTS/ABUSE OF DOMINANT POSITION : The Competition Act, 2002 as amended by the Competition (Amendment) Act, 2007 (the Act), prohibits anti- competitive laws and aims at fostering competition and at protecting Indian markets against anti- competitive practices by enterprises. The Act prohibits anti- competitive agreements, abuse of dominant position by enterprises, and regulates combinations (consisting of acquisition, acquiring of control and M&A) wherever such agreements, abuse or combination causes, or is likely to cause, appreciable adverse effect on competition in markets in India. DAFFPL reserves the right to approach the Competition Commission established under the Act of Parliament and file information relating to anti-competitive agreements and abuse of dominant position. If such a situation arises, then Vendors are bound by the decision of the Competitive Commission and also subject to penalty and other provisions of the Competition Act.

38. ASSIGNMENT: The Vendor can / does not have any right to assign his rights and obligations under these general purchase conditions without the prior written approval of DAFFPL.

39. GOVERNING LAW: These General Purchase Conditions shall be governed by the Laws of India.

40. AMENDMENT: Any amendment to these General Purchase Conditions can be made only in writing and with the mutual consent of the parties to these conditions.

41. The following expressions used in these terms and conditions and in the purchase order shall have the meaning indicated against each of these:
    a) **OWNER,** Client, Purchaser, buyer **:** means DAFFPL
    b) **VENDOR**, tenderer, Bidder, Contractor, Seller, Supplier, manufacturer stated anywhere in the tender document carry the same meaning: It means the person, firm or the Company / Corporation to bidding and shall include its successors and assigns.
    c) **INSPECTOR/ TPIA:** Person/agency deputed by Owner for carrying out inspection, checking/testing of items ordered and for certifying the items conforming to the purchase order specifications..
    d) **GOODS / MATERIALS:** means any of the articles, materials, machinery, equipments, supplies, drawing, data and other property and all services including but not limited to design, delivery, installation, inspection, testing and commissioning specified or required to complete the order.
    e) **SITE / LOCATION:** means any Site where DAFFPL desires to receive materials

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anywhere in India as mentioned in tender

f) **CONTRACT**, Order or Purchase Order/CALL-OFF means the agreement for supply of goods/ materials for required quantity between Owner and Vendor, for a fixed period of time on mutually agreed terms and conditions.

g) The term MR means Material Requisition containing technical requirements and scope of work (technical), GPC means General Purchase Conditions containing commercial terms & conditions, PO means Purchase order issued after award of contract incorporating agreed deviations in MR, ATC means Agreed Terms & Conditions , RFQ means Request For Quotation.

h) For the purpose of contract, the trade terms FOB, CFR and CIF, DAP shall have the meanings as assigned to them by INCOTERMS 2010 published by ICC, Paris.

42. REFERENCE FOR DOCUMENTATION :

The number and date of Collective Request for Quotation (CRFQ) must appear on all correspondence before finalization of Contract / Purchase Order.

After finalization of Contract / Purchase Order: The number and date of Contract /Purchase Order must appear on all correspondence, drawings, invoices, dispatch advices, (including shipping documents if applicable) packing list and on any documents or papers connected with this order.

43. ARBITRATION

a) Any 'dispute or difference of any nature whatsoever, any claim, cross-claim, counterclaim or set off of the Owner against the Consultant or regarding any right, liability, act, omission or account of any of the parties hereto arising out of or in relation to this agreement shall be referred to the Sole Arbitration of the nominated Director of the Owner or of some Officer of the Owner who may be nominated by the nominated Director. The consultant will not be entitled to raise any objection to any such arbitrator on the ground that the arbitrator is an officer of the Owner or that he has dealt with the matters to which the contract relates or that in the course of his duties as an Officer of the Owner, he had expressed view on all or any other matters in dispute or difference. In the event of the arbitrator to whom the matter is originally referred being transferred or vacating his office or being unable to act for any reason, the nominated Director as aforesaid at the time of such transfer, vacation of office or inability to act may in the discretion of the nominated Director designate another person to act as arbitrator in accordance with the terms of the agreement to the end and intent that the original Arbitrator shall be entitled to continue the arbitration proceedings notwithstanding his transfer or vacation of office as an officer of the Owner if the nominated Director does not designate another person to act as arbitrator on such

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transfer, vacation of office or inability of original arbitrator. Such person shall be entitled to proceed with the reference from the point at which it was left by his predecessor. It is also a term of this contract that no person other than the nominated Director of the Owner or a person nominated by such nominated Director as aforesaid shall act as arbitrator hereunder. The award of the arbitrator so appointed shall be final, conclusive and binding on all parties to the agreement subject to the provisions of the Arbitration & Conciliation Act,1996 or any statutory modification or reenactment thereof and the rules made there under for the time being in force shall apply to the arbitration proceedings under this clause.

b) The arbitrator shall have power to order and direct either of the parties to abide by, observe and perform all such directions as the arbitrator may think fit having regard to the matters in difference i.e. dispute, before him. The arbitrator shall have all summary powers and may take such evidence oral and/or documentary, as the arbitrator in his absolute discretion thinks fit and shall be entitled to exercise all powers under the Indian Arbitration & Conciliation Act 1996 including admission of any affidavit as evidence concerning the matter in difference i.e. dispute before him.

c) The parties against whom the arbitration proceedings have been initiated, that is to say, the Respondents in the proceeding, shall be entitled to prefer a cross claim, counter claim or set off before the Arbitrator in respect of any matter in issue arising out of or in relation to the Agreement without seeking a formal reference of arbitration to the nominated Director/officer for such counter-claim, or set off and the Arbitrator shall be entitled to consider and deal with the same as if the matters arising therefore has been referred to him originally and deemed to form part of the reference made by the nominated Director/officer.

d) The arbitrator shall be at liberty to appoint, if necessary any accountant or engineering or other technical person to assist him, and to act by the opinion so taken.

e) The arbitrator shall have power to make one or more awards whether interim or otherwise in respect of the dispute and difference and in particular will be entitled to make separate awards in respect of claims of cross claims of the parties.

f) The arbitrator shall be entitled to direct any one of parties to pay the costs to the other party in such manner and to such extent as the arbitrator may in his discretion determine and shall also be entitled to require one or both the parties to deposit funds in such proportion to meet the arbitrators expenses whenever called upon to do so.

g) The parties hereby agree that the courts in the city of Delhi alone shall have jurisdiction to entertain any application or other proceedings in respect of anything arising under this agreement and any award or awards made by the Sole Arbitration hereunder shall be filed (if so required) in the concerned courts in the city of Delhi only.

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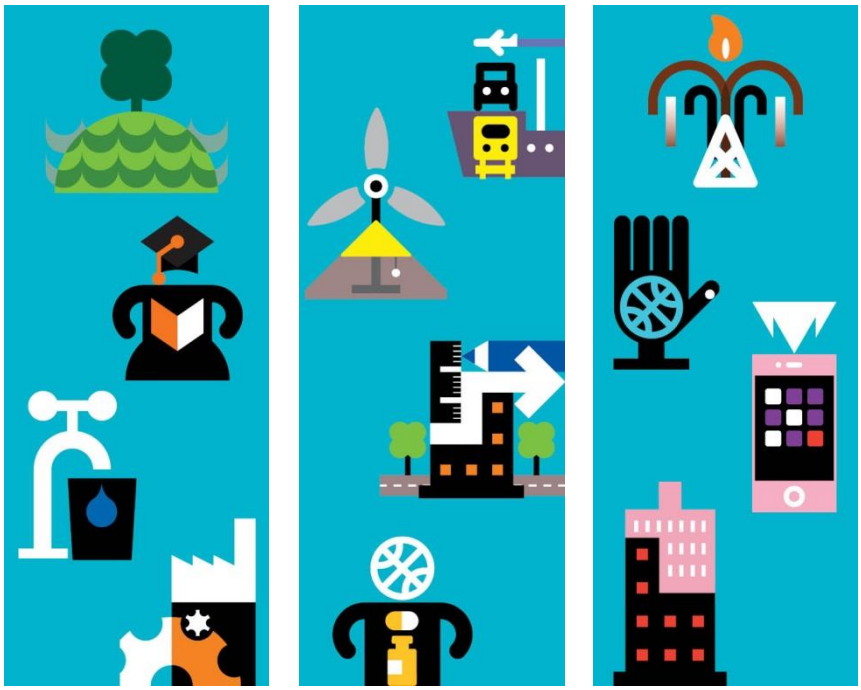

Tender for Fire Water Pump House

General Technical Specification - Civil/Structural work

December 2015

Delhi Aviation Fuel Facility Private Limited

Mott MacDonald

Tender for Fire Water Pump House

General Technical Specification -
Civil/Structural work

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Delhi Aviation Fuel Facility Private Limited

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Issue and revision record

Revision	Date	Originator	Checker	Approver	Description
P1	12/10/2015	M M Patel	A S Patel	VST / GDS	Issued for Approval

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Contents

1 Scope of Work

1.1 Location of the Site

The Site is located at Modernisation of Fuel Farm - IGI Airport, Shahbad Mohammadpur, New Delhi-110037.

1.2 Works Description

Delhi Airport Fuel Farm Private Limited (DAFFPL) is modernisation of existing tank farm of his fuelling set up. The scope of works covers General Civil Works for Fire water pump house building, foam tank foundations, pump foundations, drain, drain sump, structural valve operation platforms, pipe supports for new additional route to tank farms and Monorail at this proposed pump house location etc.,

The Work covered under this Contract shall generally be as above & given in the Tender Documents, tender drawings and specifications, but not limited to it. The EPC Contractor shall be responsible to complete the work in all respects and provide / supply all facilities which may not be covered in the Tender Documents but are nevertheless required to complete the Works, with the only exception of such items as they have been specifically excluded from the Contractor's scope.

1.3 BID Qualification Criteria

Bidders need to meet following pre-qualification criteria to qualify for short-listing as a successful vendor, who would be considered for tendering process for the job of "***Civil Jobs for construction of fire water Pump House at DAFFPL"***

Technical Criteria:-

- Past Experience: Vendor should have executed successfully at-least 3 similar civil jobs at Petroleum oil terminals / depots / refineries / LPG plants / TOPs handling Petroleum products viz. ATF, MS, HSD, SKO, LPG in the preceding past 5 years reckoned from date of this notice.

- Bidder shall submit the following documents in support of full filling the above criteria:

✓ PO copy for the civil works done in the past, indicating value of work.
✓ Completion Certificate indicating P.O No & Date from User.

2 Excavation & Filing Work

2.1 Scope

This section covers the works specification of earthwork in excavation in all kinds of soils including Murrum, hard Murrum, soft rock (without blasting), hard rock (without blasting), rock (with blasting), filling excavated earth in plinths, sand filling in plinth, rubble soling, and brick on edge soling.

2.2 Applicable Codes

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

IS - 4081 Safety code for blasting and related drilling operations
IS - 1200 Method of measurement of building works.
IS - 3764 Safety code for excavation work.
IS - 3385 Code of practice for measurement of Civil Engineering works.
IS - 2720 Part II Determination of moisture content.

Part VIII Determination of moisture content dry density relation using light compaction.

Part XXVIII Determination of dry density of soils, in-place by the sand replacement method.

Part XXIX Determination of dry density of soils, in-place, by the core cutter method.

2.3 Drawings

Engineer will furnish all necessary drawings showing the areas to be excavated, filled, sequence of priorities etc. Contractor shall follow strictly such drawings.

2.4 General

Contractor shall provide all tools, plants, instruments, qualified supervisory personnel, labour, materials, and temporary works, consumables, any and everything necessary, whether or not such items are specifically stated herein, for completion of the Work. Contractor shall carry out the survey of the site before excavation and set properly all lines and establish levels for various works such as earthwork in excavation for levelling, basement, foundations, plinth filling, roads, drains, cable trenches, pipelines etc. Such survey shall be carried out by taking accurate cross sections of the area perpendicular to establish reference/grid lines at 5 M intervals or nearer as determined by Engineer based on ground profile. These shall be checked by Engineer and thereafter properly recorded.

The area to be excavated / filled shall be cleared of fences, trees, plants, logs, slumps, bush, vegetation's, rubbish slush etc. and other objectionable matter. If any roots or stumps of trees are found during excavation, they shall also be removed. The material so removed shall be burnt or disposed off as directed by Engineer. Where earth fill is intended, the area shall be stripped of all loose/soft patches, topsoil containing deleterious matter/materials before fill commences. Matter/materials before fill commences. Final cleaning shall be done with removal of all rubbish upto the distance of 50.0 M, all around outside the periphery of building.

Relics, Objects of Antiquity, etc.

All gold, silver, oil, minerals, archaeological and other findings of importance, all precious stones, coins, treasures, relics, antiquities and other similar things which may be found in or upon the site shall be the property of owner and Contractor shall dully preserve the same to the satisfaction of Owner and from time to time deliver the same to such person or persons as Owner may from time to time authorise or appoint to receive the same.

2.5 Earth Work in Excavation

2.5.1 Classification

Any earthwork will be classified under any of the following categories:-

2.5.1.1 All kinds of soils

These shall include all kinds containing kankar, sand, silt, Murrum and/or shingle, gravel, clay, loam peat, ash, shale etc. which can generally be excavated by spade, pick-axe and shovel and which is not classified under soft and decomposed rock, and hard rock defined below. This shall also include embedded rock boulders not bigger than 1metre in any dimension and not more than 200 mm in any one of the other two dimensions.

2.5.1.2 Soft Rock

This shall include rock, boulders, slag, chalk, slate, hard mica schist, laterite etc. which are to be excavated with or without blasting or could be excavated with picks, hammer, crow bars, wedges. This shall also include excavation in macadam and tarred roads and pavements. This shall also include rock boulders not bigger than 1 metre in any dimension and not more than 500 mm in any one of the other two dimensions Rubble masonry to be dismantled will also be measured under this item.

2.5.1.3 Hard Rock

This shall include rock which cannot be easily excavated with pick-axes, hammer, crow bars and wedges but has to be either heated where blasting is prohibited or has to be blasted. They shall be stacked separately for measurement.

The earth work in excavation shall be done as per the Architect and structural consultant's drawings upto required depths and levels and alignments in all sorts of soils. The depth of the foundation will be as per the Engineer's instructions. The contractor should do the lining work. Roots or trees met with during the excavation shall be cut and smeared with coal tar. Excavated earth shall be stacked at least 3 m away from the trenches or as per the Engineer's instructions, so that it may not damage the sides of the excavated trenches. The sides of the excavated trenches shall be vertical and in straight line and bottom uniformly levelled watered, consolidated and ready for termite treatment. The maximum lead for stacking the earth shall be 50 M, unless otherwise categorically specified in the item description.

In firm soil if the excavation is deeper than 2 M the sides of the trenches shall be made bigger by allowing steps of 30 cm on either side so as to keep the slope 0.25: 1. In loose soft or slushy soil the width of the step shall be suitably increased or the sides sloped or shoring and strutting may be done as per the Engineer's instructions.

For excavation for drain work, the sides and the bottoms should be to the required slope, shape and gradient. The cutting shall be done from top to bottom. Under no circumstances shall undermining or under cutting be allowed. The final surface shall be neatly levelled and well compacted. The earth from the cutting shall be directly used for filling either in plinth or on grounds.

For excavation in trenches for pipes nothing extra shall be payable for the lift irrespective of the depth unless specifically mentioned otherwise in the Schedule of Quantities.

If the trenches are made deeper than specified level due to oversight or negligence of the Contractor the extra depth shall be filled up by lean concrete of mix 1:5:10 (1 cement; 5 coarse sand and 10 coarse aggregate of nominal size 40mm) and if the trench is made wider than shown in the drawings the Contractor has to make good at his own cost. The foundation trenches shall be free from water and muck, while the foundation work is in progress.

The trenches which are ready for concreting shall be got approved by the Engineer.

The excavated stacked earth shall be refilled in the trenches and sides of foundation in 250 mm layers and the balance surplus shall be first filled in layers in plinth and the remaining surplus shall be disposed off by uniform spreading within the site/ outside the site as directed by the Engineer.

Adequate protective measures shall be taken by the Contractor to see that the excavation for the building foundation does not affect the adjoining structure's stability and safety. Contractor will be responsible if he has not taken precaution for the safety of the people, property or neighbour's property caused by his negligence during the constructional operations.

To the extent available, selected surplus spoils from excavated materials shall be used as backfill. Fill material shall be free from clods, salts, sulphates, organic & other foreign material. All clods of earth shall be broken or removed. Where excavated material is mostly rock, the boulders shall be broken into pieces not larger than 150 mm size, mixed with properly graded fine material consisting of Murrum or earth to fill up the voids and the mixture used for filling.

As soon as the work in foundations has been accepted and measured, the spaces around the foundations, structures, pits, trenches etc. shall be cleared of all debris and filled with earth in layers 20 cm to 25 cm, each layer being watered, rammed and properly consolidated before the succeeding one is laid. Each layer shall be consolidated to the satisfaction of Engineer.

2.5.1.4 Mode of measurement for Earth work in excavation including back filling

Lead for deposition/disposal of excavated material, shall be as specified in the respective item of work. If the lead is not specified in the respective item, a basic lead of 50 M shall be considered for quoting rates. Only leads beyond 50 m shall be considered as extra lead and the Contractor shall be compensated for the same. For the purpose of measurement of lead the area to be excavated or filled or area on which excavated material is to be deposited/disposed off shall be divided into suitable blocks and for each of the blocks, the distance between centrelines shall be taken as the lead which shall be measured, as far as practically possible, by the shortest straight line route on the plan and not the actual route taken by Contractor. No extra compensation is admissible on the grounds that the lead including that for borrowed materials had to be transported over marshy or katcha land/route.

All excavation shall be measured net. Dimensions for purpose of payment shall be reckoned on the horizontal area of the excavation at the base for foundations of the walls, columns, footings, tanks, rafts or other foundations structure to be built, multiplied by the mean depth from the surface of the ground in

accordance with the drawings. Excavation inside slopes shall not be paid for. Contractor may make such allowances in his rates to provide for excavation in side slopes keeping in mind the nature of the soil and safety of excavation. In soft/slushy soil or in firm soil if the excavation is deeper than 2m the sides of the trenches shall be made bigger by allowing steps of 50cm on either side so as to keep slope 0.25: 1. This shall be paid as per original tender rate. However, if concreting is proposed against the additional/extra excavation made by the Contractor shall be made good by the Contractor with concrete of the same class as in the foundations at his own cost.

Back filling as per specification the side of foundations of columns, footings, structures, and walls, tanks rafts, trenches etc. with excavated materials will not be paid for separately. It shall be clearly understood that the rate quoted for excavation including back filling shall include stacking of excavated material as directed, excavation/stacking of selected stacked material, conveying it to the place of final backfill, compaction etc., as specified. As a rule material to be back filled shall be stacked temporarily within the basic lead of 30 metres unless otherwise specified in the item.

The rates quoted shall also include for dumping of excavated materials in regular heaps, bunds, prepare with regular slopes as directed by Engineer within the lead specified and levelling the same so as to provide natural drainage. Rock/soil excavated shall be stacked properly as directed by Engineer. As a rule, all softer material shall be laid along the centre of the heaps, the harder and more weather resisting materials forming the casing on the sides and the top. Excavated soft rock or hard rock shall be stacked separately.

The bailing out of water shall also be executed by the Contractor at his own cost.

2.6 Filling In Plinth with Selected Excavated Earth

Plinth above in layers 150-200mm, watered and compacted with mechanical compaction machines. When filling reaches the finished level, the surface shall be flooded with water, if directed by the Engineer, for at least 24 hours, allowed to dry and then the surface again compacted as specified above to avoid settlements at a later stage. The finished level of the filling shall be trimmed to the level/slope specified.

Where specified in the item description given in the Schedule of Quantities that the compaction of the plinth fill shall be carried out by means of 10/12 tonnes roller smooth wheeled, sheep-foot or wobble wheeled rollers. As rolling proceeds water sprinkling shall be done to assist consolidation. Water shall not be sprinkled in case of sandy fill.

2.6.1 Mode of Measurement

Payment for filling in plinth and land development with selected excavated material will be made as specified/directed. Payment for this work will be made, based on measurement of actual plinth/dimensions filled. The plinth/ground levels shall be surveyed beforehand for this purpose. The lead shall be above 30mt and up to 100 M. It shall be measured in Cu.M.

2.7 Filling in Plinth/ground with selected earth/Murrum brought from Outside

2.7.1 Scope

Supply and filling selected earth / murrum brought from outside of site including transportation, all government duties, filling, compaction, tests etc.

2.7.2 Code, Standards and Rules

Relevant code lists in specification of Earthwork.

2.7.3 Material Specification

Only materials which will be considered suitable by the EIC will be permitted to use for filling and that considered unsuitable shall be disposed off by the Contractor at his own cost as directed by EIC.

The Contractor shall give the samples of earth proposed to use for filling along with the following characteristics of the sample to EIC, prior to collection and use, for approval:

Mechanical analysis or grain size analysis as per IS: 2720 part IV.

Liquid Limit as per IS: 2720 part V

Plastic Limit as per IS: 2720 part V

Moisture density relationship as per IS: 2720 part VIII.

The material used for filling shall be free from boulders, lumps, tree roots, rubbish or any organic deleterious matter.

Material having plasticity index less than 20 shall be used for filling purposes.

Material having laboratory maximum dry density of less than 95 lbs. per cubic ft. (1600 Kg/m3) shall not be used.

Care shall be taken to see that unsuitable waste material is disposed off in such a manner that there is no likelihood of its getting mixed with the materials proposed to be used for filling.

The work shall be so planned and executed so that the best available material (soil) is reserved for the top portion of embankments.

Compacted backfill covers two types of materials and compacting operations. The first is compacting of clayey and silty materials of low permeability. These soils are used for backfilling around or under pipelines and structures when seepage is to be limited, or if drainage is not required. This type of backfill is normally compacted by tamping rollers when space is available or by hand or power tampers in confined areas. The soils are normally compacted at Proctor optimum moisture, and the percentage of proctor maximum density, “D-ratio”, is specified.

The second type of compacted backfill is related to the consolidating of cohesion less free-draining soils of high permeability. These soils are used around or under pipelines and structures when permeability is not required, when free drainage is desired, or when particularly good bedding or foundations of low compressibility are desired. Like tractor compacted fill or fills compacted by consolidating process, the materials used must be free-draining sandy and gravely soils. When high stability and low settlement are the design requirements, this type of backfill is often preferred over compacted backfill of clayey and silty soils because of the ease and economy of securing a backfill, particularly in confined area.

Consolidation of the soils is usually accomplished by pneumatic rollers, vibratory rollers, tractors, surface vibrators, or internal vibrators; after the soils have been thoroughly wetted.

Filling Material Selection

Proper selection of materials is important for successful results. Excessive amounts of fines will plug the voids between the coarser particles and will prevent drainage during the consolidating period. As a guide, table 1 and 2 below provides information for preliminary selection of suitable soils.

Table : - General suitability of soild for compacted backfill by consolidation processes (Ref:- Earth Manual, U.S Department of interior Water and Power Resources Service, second edition)

Soil Type	Limitations
GW, GP, SW, SP	All suitable (Fines in the soils are limits to 5% by definition)
Borderline GW-GM, GW-GC, GP-GM, GP-GC	Suitable if the fines are less than 8 %
Borderline SW-SM, SP-SM and SP-SC	All suitable (fines in the soils are limited to 12 %)
SM and SC	Require special consideration and testing as suitability depends upon graduation and plasticity (some SM soils with fines as high as 16% have been suitable)

- Fines are particles smaller than No.200 sieve size

Table :- Very Broad specifications for soil to be considered as CNS material (Ref.:- Foundation Design Manual, NV Nayak)

Sr. No.	Property	Very Broad Specification Range
1	Grain size analysis	
	i) Clay	15 – 25 %
	ii) Silt	35 – 50 %
	iii) Sand	30 – 40 %
	iv) Gravel	< 10 %
2	Consistency Limits	
	i) Liquid Limit	30 – 40 %
	ii) Plastic Limit	20 – 25 %
	iii) Plasticity Index	10 – 25 %
	iv) Shrinkage Limit	15 % and above
	v) CBR Value in 4 day socked condition	5 %

2.7.4 Construction Specification

2.7.4.1 Procedure for Filling

The area where filling is to be placed must be cleared of all loose material and virgin soil must be exposed. Such exposed surface must be consolidated properly to obtain 95% of maximum laboratory dry density of the soil. All soft patches must be filled back and compacted.

No separate payment for consolidation of exposed ground surface will be made. The scope includes clearing and stripping, consolidation, including watering, testing etc. of the exposed ground.

Approved fill material shall be spread in uniform un-compacted layers of 150-200mm. All clods, lumps, etc. shall be broken before compaction.

In general the soil shall be spread in uniformity over the entire width of embankment. For large embankments the spreading of soil shall be as directed by EIC.

Successive layers of filling shall not be placed until the layer under construction has been thoroughly compacted to satisfy the requirements laid down in this specification.

2.7.4.2 Compaction for Filling

Prior to rolling, the moisture content of material shall be brought to within plus or minus 2 % of the optimum moisture content as described in IS: 2720 part VIII. The moisture content shall preferably be on the wet side for potentially expansive soils.

After adjusting the moisture content as described in section above, the layers shall be thoroughly compacted by means of rollers till 95% of maximum laboratory dry density is obtained as per IS : 2720 part VIII.

Each layer shall be tested in field for density and accepted by EIC subject to achieving the required density before laying the next layer.

The type of rollers / compactors that should be employed for compaction shall be as per direction of EIC.

If the layer fails to meet the required density, it shall be reworked or the material shall be replaced and method of construction altered as directed by EIC to obtain the required density.

The filling shall be finished in conformity with the alignment, levels, cross-sections and dimensions as shown in the drawings.

Extra material shall be removed and disposed off by the Contractor at no extra cost.

2.7.5 Testing Procedure / Quality Control

The Contractor shall establish and maintain quality control for various aspects of the work, method, material and equipment used. The quality control operation shall include but not be limited to the following items of work:

- Lines, Levels and Grades
  - Periodic survey
  - Establishment of marks, boards etc.
- Filling Material and Compaction

Soil suitable for consolidation under O.M.C. conditions should preferably have the following characteristics:

- Grain Size Analysis
  - Percentage of Clay 15% to 25%
  - Percentage of Silt 35% to 50 %
  - Percentage of Sand 30% to 40 %
  - Percentage of Gravel 5 to 10%
- Atterberg Limits
  - Liquid limit 20 % to 35 %
  - Plastic Limit 20 % to 25 %
  - Plasticity index should not more than 12
  - Free swelling Index 50 % Less than
  - Peat, muck and organic soils are unsuitable

Field Testing and Compaction Methodology

The Modified proctor density test shall be done to know the Maximum Dry Density (MDD) and the Optimum Moisture Content (OMC) of the fill. If there is any change in type of filling material, the test shall be done separately. The filling shall be done in layer wise. The filling layer thickness provided is depending upon the type of filling material is used and efforts made in compacting the layer. Generally the filling layer thickness provided is around 250mm to 400mm when compacted. The compaction shall be done by using 10T capacity vibratory roller.

The Field California Bearing Ratio (CBR) tests OR Dynamic Cone penetration tests (DCPT) shall be conducted per 200m2 area for each filling layer. If the Company decides to go for CBR, then the CBR values around 6-8 are desirable. Also the core cutters shall be used to determine the density of soil obtained during compaction. The soil samples collected shall then be sent for the laboratory testing.

The Plate load test at the structure locations or 200m^2 whichever is less, shall be carried out to confirm the Safe Bearing Capacity.

The EIC, may, however relax these requirements taking into account availability of materials and other relevant factors.

Various tests required to be conducted on the borrow material with their recommended frequency are indicated below. The frequency of testing indicated refers generally to the minimum number of tests to be conducted. The frequency of testing must be stepped up as found necessary depending upon the variability of the materials and compaction methods employed.

- Gradation: At least one test for each kind of soil. Usual frequency of testing 2 tests per 8000m^3 of soil.
- Plasticity: At least one test for each kind of soil. Usual frequency of testing 2 tests per 8000m^3 of soil.
- Proctor Tests: At the rate of 1 per 800m^3 of soil.
- Deleterious Contents: As required.
- Moisture Contents: One test for every 800m^3 of soil.

EIC's directions /decisions in all aspects of quality control shall be final and binding on the Implementation Contractor. Contractor shall abide by such instructions at his own cost.

2.7.6 Tolerance

Embankment for roads, units, etc. shall be carried to within a tolerance of 15mm from final lines but shall be to required grades and slopes.

2.7.7 Method of Measurement

As measurement shall be in accordance with IS 1200.

Quantity shall be measured on cubic meter of volume calculated on the basis of cross sections plotted from the level of the ground surface prepared as described above, and from where filling is to be carried out and the levels reached after filling and the due consolidation.

Embankment or fill formation should include cost of breaking clods, watering, consolidation, providing testing apparatus and testing the degree of consolidation, providing and operating including and operator charges of necessary road rollers and other equipment, dressing and levelling of sides and top surfaces, etc.

2.8 Sand Filling

2.8.1 Scope

Supply and filling coarse sand for filling in plinth / foundation / trenches, including transportation, all government taxes, royalties, filling, compaction, testing etc.

2.8.2 Codes, Standard and Rules

IS 383 Specification for coarse and fine aggregates from natural sources for concrete.
IS 2386 (Part I to VIII): Methods of test for aggregates for concrete

2.8.3 Materials Specification

The sand shall be free from any organic and deleterious materials as detailed in IS. Sand Gradation in Zone III shall be used for filing.

Machine made sand will be acceptable, provided the constituent rock/gravel composition shall be sound, hard dense, non-organic un-coated and durable against weathering.

2.8.3.1 Screening and Washing

Sand shall be prepared for use for such screening or washing, or both, as necessary, to remove all objectionable foreign matter while separating the sand grains to the required size fractions

2.8.3.2 Foreign Material Limitations

The percentages of deleterious substances in sand delivered to the mixer shall not exceed the following:

Percentage allowable	Minimum	Maximum
Material finer than 75 micron IS sieve	3.00	15.00
Shale	1.00	-
Coal and lignite	1.00	1.00
Clay lumps	1.00	1.00
Total of all above substances including items (i) to (iv) for un crushed sand and items iii) and (iv) for crushed sand	5.00	2.00

2.8.3.3 Gradation

Unless otherwise directed or approved, the grading of sand shall be within the limits indicated here under:

IS Sieve Designation	Percentage passing for			
	Grading Zone I	Grading Zone II	Grading Zone III	Grading Zone IV
10 mm	100	100	100	100
4.75 mm	90-100	90-100	90-100	95-100
2.36 mm	60-95	75-100	85-100	95-100
1.18 mm	30-70	55-90	75-100	90-100

IS Sieve Designation				Percentage passing for
600 Microns	15-34	35-59	60-79	80-100
300 Microns	5-20	8-30	12-40	15-50
150 Microns	0-10	0-10	0-10	0-15

2.8.3.4 Fineness Modules

The sand shall have fineness Modulus of not less than 2.0.

The sand to be used for filling shall be free from salts, organic or other foreign matter.

2.8.4 Construction Specification

The sand shall be filled in layers not exceeding 150mm, below footing, grade slab etc., wherever indicated shall adequately be watered and consolidated. When filling reaches finished level, the surface shall be flooded with water for at least 24 hours and allowed to dry and then rammed and consolidated.

The finished level of filling shall be kept to shape and gradient, intended to receive any floor finish.

In case of large heavy duty flooring, the consolidation may be done by power rollers, where so specified or as directed. The extent of consolidation required shall also be as specified or as directed.

2.8.5 Testing procedure

Compaction test shall be carried out as per above specification of filling work.

2.8.6 Method of Measurements

The quantity shall be measured for filling in plinth and below foundations as per IS 1200.

No deductions shall be made for shrinkage or voids. Only consolidated measurements shall be considered.

2.9 Rubble Soling

2.9.1 Materials

Rubble used for packing under floors, foundations etc. shall be hard, durable rock, free from veins, black trap, flaws and other defects. The size of the rubble shall be 150 mm - 200mm unless otherwise specified in the item description in the Schedule of Quantities and the quality shall be got approved by the Engineer.

2.9.2 Workmanship

Rubble shall be laid closely in position on the sub-grade. All interstices between the stones shall be wedged in with smaller stones of suitable size well driven to ensure tight packing and complete filling of interstices. Such filling shall be carried out simultaneously with the placing in position of rubble stone and shall not lag behind.

Small interstices shall be filled with Murrum, well-watered and rammed.

2.9.3 Mode of Measurement

The unit of measurement shall be Cu.M. of the work done as per the drawings and/or as specified in the Schedule of Quantities.

2.9.4 Mode of Measurement

This item shall be measured in Cubic meter of work done as per the drawings / directed by the Engineer. No deduction shall be made for any opening up to 0.1 Sq.M. required and instructed by the Engineer / Owner. No separate payments shall be made to Contractor on this account.

3 Concrete & Allied Work

3.1 Applicable Codes

The following codes and standards are made a part of the Specifications. All standards, codes of practice referred to herein shall be the latest edition including all applicable official amendments and revisions.

In case of discrepancy between this specification and those referred to herein, this specification shall prevail.

3.1.1 Materials

IS 269 1989	Specification for 33 grade ordinary Portland cement
IS 8112 1989	Specification for 43 grade ordinary Portland cement
IS 122691987	Specification for 53 grade ordinary Portland cement
IS 1489 Part-I	Specification for Portland pozzolona cement - Fly ash based (third revision)
IS 1489 Part-II	Specification for Portland pozzolona cement – Calcined clay based (third revision)
IS 3812	Fly ash
IS 3812(Part I)	Fly ash for use as Pozzolona for concrete
IS 3812(Part II)	Fly ash for use as admixture for concrete
IS 3812(Part III)	Fly ash for use as fine aggregate for mortar and concrete
IS 650	Specification for standard sand for testing of cement
IS 383	Specification for coarse and fine aggregates from natural sources for concrete.
IS 2386 (pt I to VIII)	Methods of test for aggregates for concrete
IS 515	Specifications for natural and manufactured aggregate for use in mass concrete
IS 516	Methods of test for strength of concrete.
IS 1199	Methods of sampling and analysis of concrete.
IS 5640	Flakiness Index of aggregates
IS 3025	Methods of sampling and test (physical and chemical water used in industry)
IS 432 (Part I & II):	Specification for mild steel and medium tensile steel bars and hard drawn steel wire for concrete reinforcement.
IS 1139	Specification for hot rolled mild steel and medium tensile steel deformed bars For Concrete reinforcement
IS 2645	Specification for integral cement water-proofing compound
7861 (Part I)	Hot weather concreting
7861 (Part II)	Cold weather concreting
IS 9103	Admixture for concrete
IS:2751	Recommended practice for welding of mild steel plain & deformed bars for reinforced construction.
IS:5525	Recommendation for detailing of reinforcement in reinforced concrete works.
SP:34	Handbook on concrete reinforcement detailing.

3.1.2 Equipment

IS 1791 Specification for batch type concrete mixers

IS 2438 Specification for roller pan mixer
IS 2505 Specification for concrete vibrators immersion type
IS 2506 Specification for screed board concrete vibrators
IS 2514 Specification for concrete vibrating tables.
IS 3366 Specification for pan vibrators
IS 4656 Specification for form vibrators for concrete.
IS 2722 Specification for portable swing weigh-batchers for concrete (single and double bucket type)
IS 2750 Specification for steel scaffoldings

3.1.3 Codes of Practice

IS 456 Code of practice for plain and reinforced concrete.
IS 1343 Code of practice for prestressed concrete
IS 457 Code of practice for general construction of plain and reinforced concrete for dams and other massive structures
IS 3370 Code of practice for concrete structures for storage of liquids (Part I to IV)
IS 3935 Code of practice for composite construction
IS 3201 Criteria for design and construction of precast concrete trusses.
IS 2204 Code of practice for construction of reinforced concrete shell roof
IS 2210 Criteria for the design of RC shell structures and folded plates.
IS 2751 Code of practice for welding of mild steel bars used for reinforced concrete construction.
IS 2502 Code of practice for bending and fixing of bars for concrete reinforcement.
IS 3558 Code of practice for use of immersion vibrators for consolidating concrete.
IS 3414 Code of practice for design and installation of joints in buildings
IS 4014 Code of practice for steel tubular, scaffolding.(Part I&II)
IS 2571 Code of practice for laying in-situ cement concrete flooring.

3.1.4 Construction Safety

IS 3696 Safety code for scaffolds and Ladders.

3.1.5 Measurement

IS 1200 Methods of measurement of building and civil engineering works

The above mode of measurements shall be applicable only if it is not given specifically in the tender document.

3.2 General

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

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

3.3 Materials

The ingredients to be used in the manufacture of standard concrete shall consist solely of standard type Portland cement, clean sand, natural coarse aggregate, clean water and admixtures.

3.3.1 Cement

If the Contractor is instructed to supply cement, then the following points shall be applicable:

Cement material shall be Portland Pozzolona Cement supply in 50 kg bags or loose bulk materials conforming to IS 1489 Part-1 Fly ash based, as per concrete mix design requirements and as directed by EIC.

Cement supply in bags or bulks shall be allowed for any work consuming cement, only with the specific written approval of EIC.

A certified report attesting to the conformance of the cement to IS specifications by the cement manufacturer's chemist shall be furnished to EIC.

For Bulk Loose Cement supply the contractor will be required to construct proper storage facility / silos. Cement held in storage for a period of ninety (90) days or longer shall be tested. Should at any time EIC have reasons to consider that any cement is defective, and then irrespective of its origin, and/or manufacturers test certificate, such cement shall be tested immediately a Contractor's cost at a National Test Laboratory/approved laboratory and until the results of such tests are found satisfactory, it shall not be used in any work. Contractor shall not be entitled to any claim of any nature on this account.

Contractor will have to make his own arrangements to store bulk Cement, which will provide complete protection from dampness contamination and minimise caking and false set.

If the cement is supplied by the Owner

Contractor will have to make his own arrangements for the storage of minimum 60 MT of cement. If supplies are arranged by Owner, cement will be issued in quantities to cover work requirements of one month or more, as deemed fit by Engineer and it will be the responsibility of contractor to ensure adequate and proper storage.

Cement in bulk may be stored in bins or silos which will provide complete protection from dampness contamination and minimise caking and false set.

Cement bags shall be stored in a dry enclosed shed (storage under tarpaulins will not be permitted), well away from the outer walls and insulated from the floor to avoid contract with moisture from ground and so arranged as to provide ready access damaged or reclaimed or partly set cement will not be permitted to be used and shall be removed from the site.

The storage bins and storage arrangements shall be such that there is no dead storage. Not more than 12 bags shall be stacked in any tier.

The storage arrangement shall be approved by Engineer. Consignments of cement shall be stored as received and shall be consumed in the order of their delivery.

3.3.2 Aggregates

Aggregate in general designates both fine and coarse inert materials used in the manufacture of concrete. Fine aggregate is aggregate all of which passes through 4.75mm IS sieve. Coarse aggregate is aggregate most of which is retained on 4.75 mm sieve. All fine and coarse aggregates proposed for use in the work shall be subject to Engineer's approval and after specific materials have been accepted the source of supply of such materials should not be changed without prior approval of Engineer. Fine aggregate should be of good quality of locally available from river sand. Coarse aggregate should be of special quality of locally available.

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

3.3.2.1 Sampling and testing

Samples of the aggregates for mix designed determination of suitability shall be taken under the supervision of Engineer and delivered to the laboratory, well in advance of the scheduled placing of concrete. Records of tests which have been made on proposed aggregates and on concrete made from this source of aggregates shall be furnished to Engineer in advance of the work for use in determining aggregate suitability. The costs of all such tests, sampling etc. shall be borne by contractor.

3.3.2.2 Storage of Aggregates

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

3.3.2.3 Specific Gravity

Aggregate except as noted above, and for other than lightweight concrete shall consist of natural or crushed sand and shall conform to IS 383. The sand shall be clean sharp, hard, strong and durable and shall be free from dust, vegetable substances, adherent coating, clay, alkali, organic matter, mica, salt or other deleterious substances, which can be injurious to the setting qualities / strength / durability of concrete.

3.3.3 Machine made Sand

Machine made sand will be acceptable, provided the constituent rock/gravel composition shall be sound, hard dense, non-organic un-coated and durable against weathering.

3.3.3.1 Screening and Washing

Sand shall be prepared for use for such screening or washing, or both, as necessary, to remove all objectionable foreign matter while separating the sand grains to the required size fractions

3.3.3.2 Foreign Material Limitations

The percentages of deleterious substances in sand delivered to the mixer shall not exceed the following:

1. Material finer than 75 micron IS sieve 3.00 15.00
2. Shale 1.00 -
3. Coal and lignite 1.00 1.00
4. Clay lumps 1.00 1.00
5. Total of all above substances including items (i) to (iv) for un crushed sand and items iii) and (iv) for crushed sand 5.00 2.00

3.3.3.3 Gradation

Unless otherwise directed or approved, the grading of sand shall be within the limits indicated here under:

Table 3.1: Gradation

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

Where the grading falls outside the limits of any particular grading zone of sieves other than 600 micron IS sieve, by total amount not exceeding 5 percent, it shall be regarded as falling within that grading zone. This tolerance shall not be applied to percentage passing the 600 micron IS sieve or to percentage passing any other sieve on the coarser limit of grading zone I or the finer limit of grading zone IV.

3.3.3.4 Fineness Modules

The sand shall have fineness Modules of not less than 2.2 or more than 3.2. The fineness Modules is determined by adding the cumulative percentages retained on the following IS sieves sizes 4.75mm, 2.36 mm, 1.18 mm, 600 micron, 300 micron and 150 micron and dividing the sum by 100.

3.3.4 Coarse Aggregate

Coarse aggregate for concrete, except as noted above and for other than light weight concrete shall conform to IS 383. This shall consist of natural or crushed stone and gravel and shall be clean and free from elongated, flaky or laminated pieces adhering coatings, clay lumps, coal residue, clinkers slag, alkali, mica, organic matter or other deleterious matter.

3.3.4.1 Screening and Washing

Natural gravel and crushed rock shall be screened and / or washed for the removal of dirt or dust coating, if so demanded by Engineer.

3.3.4.2 Grading

Coarse aggregate shall be graded in both cases the grading shall be within the following limits.

Table 3.2: Coarse aggregate Gradations

IS Sieve Designation	% passing for single sized aggregate of nominal size in mm					% passing for graded aggregate of nominal size in mm			
	40	20	16	12.5	10	40	20	16	12.5
63 mm	100	-	-	-	-	100	-	-	-
40 mm	85-100	100	-	-	-	95-100	100	-	-
20 mm	0-20	85-100	100	-	-	30-70	95-100	100	-
16 mm	-	-	85-100	100	-	-	-	90-100	-
12.5 mm	-	-	-	85-100	100	-	-	-	90-100
10 mm	0.5	0-20	0-30	0-45	85-100	10-35	25-55	30-70	40-85
4.75 mm	-	0-5	0-5	0-10	0-20	0-5	0-10	0-10	0-10
2.36 mm	-	-	-	-	0-5	-	-	-	-

The pieces shall be angular in shape and shall have granular or crystalline surfaces, Friable, flaky and laminated pieces, mica and shale, if present, shall be only in such quantities that will not, is the opinion of Engineer affect adversely the strength and /or durability of concrete. The maximum size of coarse aggregate shall be 75 mm for class A concrete 40mm for class B concrete and 20mm for class C concrete. The maximum size of coarse aggregate shall be the maximum size specified above, but in no case greater than 1/4 of the minimum thickness of the member, provided that the concrete can be placed without difficulty so as to surround all reinforcement thoroughly and fill the corners of the form. Plums above 150 mm and upto any reasonable size can be used in plain mass concrete work of large dimensions upto a maximum limit of 20% of volume of concrete when specifically approved by Engineer. For heavily reinforced concrete members the nominal maximum size of the aggregate shall be 5 mm less than the minimum clear distance between the reinforcing main bars or 5mm less than the minimum cover to the reinforcement whichever is smaller. The amount of fine particles occurring in the free state or as loose adherent shall not exceed 1% when determined by laboratory sedimentation tests as per IS 2386. After 24 hours immersion in water, a previously dried sample shall not have gained more than 10% of its oven dry weight in air, as determined by IS 2386.

3.3.4.3 Foreign Materials Limitations

The percentages of deleterious substance in the coarse aggregate delivered to the mixer shall not exceed the following:

Table 3.3: Material limitations

Sr. No.	Materials	Percent by weight	
		Uncrushed	Crushed
i)	Material finer than 75 micron IS sieve	3.00	3.00

Sr. No.	Materials	Percent by weight	
ii)	Coal and lignite	1.00	1.00
iii)	Clay lumps	1.00	1.00
iv)	Soft fragments	3.00	-
v)	Total of all the above substances	5.00	5.00

3.3.5 Water

Water used for both mixing and curing shall be free from injurious amounts of deleterious materials. Potable waters are generally satisfactory for mixing and curing concrete.

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

Average 28 days compressive strength of at least three 15 cm concrete cubes prepared with water proposed to be used shall not be less than 90% of the average strength of three similar concrete cubes prepared with distilled water.

The initial setting time or test block made with the appropriate set cement and the water proposed to be used shall not be less than 30 minutes and shall not differ by more than plus minus 30 seconds form the initial setting time of control test block prepared with the appropriate test cement and distilled water. The test blocks shall be prepared and tested in accordance with the requirements of IS 4031.

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

a. To neutralise 200 ml sample of water, using phenolphthalein as indicator, it should not require more than 2 ml of 0.1 normal NaOH. The details of test shall be as given in IS 3025.
b. To neutralise 900 ml sample of water using methyl arrange as an indicator, it should not require more than 10 ml of 0.1 normal HCl. The details of test shall be given in IS 3025.
c. Percentage of solids when tested in accordance with the method indicated below shall not exceed the following:

Table 3.4: Percentage of solids

	Percent	Method of Test (Reference to clause no. in IS 3025-1964.
Organic	0.02	10 and 11(organic solids = Total solids minus ignited residue)
Inorganic	0.30	11 (Ignited residue)
Sulphate (as SO4)	0.05	20
Alkali Chlorides (as Cl)	0.10	24

3.3.6 Reinforcement Steel

Reinforcement bars, if supplies are arranged by contractor, shall be either plain round mild steel bars grade I as per IS 432 (part I) or medium tensile steel bar as per IS 432 (Part I) or hot rolled mild steel and

medium tensile steel deformed bars as per IS 1139 or cold twisted steel bars as per IS 1786, as shown and specified on the drawings. Wire mesh or fabric shall be in accordance with IS 1566. Substitution of reinforcement will not be permitted except upon written approval from Engineer.

Plain round mild steel bars grade II as per IS:432 (part I) may be used with prior approval of Engineer in writing and with 10% increase in the reinforcement area but its use shall not be permitted in structures located in earthquake zones subjected to severe damage (as per IS:1895) and for structures subject to dynamic loading (other than wind loading), such as frames supporting rotary or reciprocating machinery etc.

All reinforcement shall be clean, free from grease, oil, paint, loose mill scale, loose rust, dust, bituminous material or any other substances that will destroy or reduce the bond. All rods shall be thoroughly cleaned before being fabricated. Pitted and defective rods shall not be used.

3.3.7 Binding Wire

The mild steel wire shall be of 1.63 mm. or 1.22 mm. (16 or 18 gauge) diameter and shall conform to IS : 280-1972.

The use of black wire will be permitted for binding reinforcements bars. It shall be free from rust, oil paint, grease, loose mill scale or any other undesirable coating which may prevent adhesion of cement mortar.

3.4 Plain Cement Concrete (PCC) Including Shuttering

3.4.1 Materials

Water, Sand, Cement, Stone aggregate 40 mm nominal size shall conform to above material list, and foam work to in item of foam work.

3.4.2 Workmanship

3.4.2.1 General

Before commencing concreting, the bed of foundation trenches shall be cleared off of all loose materials, levelled, watered and rammed, as directed.

3.4.2.2 Proportion of mix

The proportion of cement, sand and coarse aggregate shall be one part of cement, 4 parts of sand, 8 parts of stone aggregates and shall be so measured by volume or Control concrete grade as mentioned in BOQ.

3.4.2.3 Mixing

The concrete shall be mixed in a mechanical mixer at the site of work. Hand mixing, may however be allowed for smaller quantity of work, if approved by the Architect and Engineer-in-charge. When hand mixing is permitted by the Architect and Engineer in-charge, in case of breakdown of machineries and in the interest of the work, it shall be carried out on a water tight platform and care shall be taken to ensure that the mixing is continued until the mass is uniform in colour and consistency. However in such cases, 10% more cement than otherwise required, shall have to be used without any extra cost. The mixing in

mechanical mixer shall be done for a period 1.5 to 2 minutes. The quantity of water shall be just sufficient to produce a dense concrete of required workability for the purpose.

3.4.2.4 Transporting & placing the concrete

The concrete shall be handled from the place of mixing to the final position within 15 minutes by the method, as directed and shall be placed into its final position, compacted and finished within 30 minutes of mixing with water i.e. before the setting commences.

The concrete shall be laid in layers of 15 cm. to 20 cm.

3.4.2.5 Compacting

The concrete shall be rammed with heavy iron rammers and rapidly to get the required compaction and to allow all the interstices to be filled with mortar.

3.4.2.6 Curing

After the final set, the concrete shall be kept continuously wet, if required by ponding, for a period of not less than 7 days from the date of placement.

3.4.3 Mode of Measurements and Payment

The concrete shall be measured for its length, breadth and depth, limiting dimensions to those specified on plan or as directed.

The rate shall be for a unit of one m^3 including cost of Shuttering work.

3.5 M20 / M25 / M30 Controlled Grade Concrete

3.5.1 Mix Design

All concrete in the works shall be of design mix as defined in IS 456, unless it is a nominal mix concrete such as 1:3:6, 1:4:8 or 1:5:10. Whether reinforced or otherwise, all design mix concrete works to be carried out under this specification.

All reinforced concrete in the works shall be “Design Mix Concrete” as defined in I.S. 456-2000.

This is to investigate the grading of aggregates, water cement ratio, workability and the quantity of cement required to give works cubes of the characteristic strength specified. The proportions of the mix shall be determined by weight. Adjustment of aggregate proportions due to moisture present in the aggregate shall be made.

Mix proportioning shall be carried out according to the ACI standard designation ACI- 613 or Design of concrete mixes - Road research Note No.4, Department of Scientific and Industrial Research U.K. or I.S. 10262 - 1982.

After award of the work, if so desired by the contractor, he/they may be allowed by the Engineer-in-Charge, till the designed mix is obtained, to carry out the reinforced concrete work in foundation and plinth as per equivalent nominal mix against the specified design mix concrete as per I.S. Codes. However, all other specification for design mix shall govern for nominal mix also and nothing extra shall be paid for use of

extra cement or else on this account whether the cement is supplied by the Department or procured by the contractor. Where the quantity of RCC is very small, under such circumstance equivalent nominal mix can also be permitted by the Engineer-in-Charge. The concrete shall be in grades designated as below.

Table 3.5: Concrete Grade designation

Group	Grade Designation	Specified Characteristic compressive strength of 150 mm cube at 28 days (N/mm2)
Ordinary concrete	M10	10
	M15	15
	M20	20
Standard Concrete	M25	25
	M30	30
	M35	35
	M40	40
	M45	45
	M50	50
	M55	55
High strength concrete	M60	60
	M65	65
	M70	70
	M75	75
	M80	80

NOTE:

The characteristic strength is defined as the strength of material below which not more than 5% of the test results are expected to fall.

6. In the designation of a concrete mix, letter "M" refers to the mix and the number to the specified characteristic compressive strength of 150 mm. size cubes at 28 days expressed in N / mm2.
7. Minimum Cement Content, Maximum Water Cement Ratio and Minimum Grade of Concrete for Different Exposures with Normal Weight Aggregates of 20 mm Nominal Maximum size.

Table 3.6: Different Exposures

		Plain concrete			Reinforced concrete		
Sl. No.	Exposure	Minimum cement content Kg/m3	Maximum Free Water Cement Ratio	Minimum grade of concrete	Minimum Cement Content Kg/m3	Maximum Free Water Cement Ratio	Minimum Grade of concrete
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
i)	Mild	220	0.60	-	300	0.55	M - 20
ii)	Moderate	240	0.60	M-15	300	0.50	M - 25
iii)	Severe	250	0.50	M-20	320	0.45	M -30
iv)	Very severe	260	0.45	M-20	340	0.45	M -35
v)	Extreme	280	0.40	M25	360	0.40	M- 40

Note:

Cement content prescribed in this table is irrespective of the grades of cement and it is inclusive of additions mentioned in mineral admixtures. The additions such as fly ash or ground granulated blast furnace slag may be taken into account in the concrete composition with respect to the cement content and water-cement ratio if the suitability is established and as long as the maximum amounts taken into account do not exceed the limit of pozzolona and slag specified in IS 1489 (Part 1) and IS 455 respectively.

Minimum grade for plain concrete under mild exposure condition is not specified.

Table 3.7: Nominal cover to meet Durability Requirements

Exposure	Nominal concrete cover in mm not less than
Mild	20
Moderate	30
Severe	45
Very severe	50
Extreme	75

NOTES

For main reinforcement up to 12 mm diameter bar for mild exposure the nominal cover may be reduced by 5mm.

Unless specified otherwise, actual concrete cover should not deviate from the required nominal cover by + 10 mm

For exposure conditions ‘severe’ and ‘ very severe’, reduction of 5 mm may be made, where concrete grade is M 35 and above.

Table 3.8: Nominal cover to meet specified period of fire resistance

Fire Resistance	Nominal cover						
	BEAMS		SLABS		RIBS		COLUMNS
	Simply Supported	Continuous	Simply Supported	Continuous	Simply Supported	Continuous	
H	mm	mm	mm	Mm	mm	mm	mm
0.5	20	20	20	20	20	20	40
1	20	20	20	20	20	20	40
1.5	20	20	25	20	35	20	40
2	40	30	35	25	45	35	40
3	60	40	45	35	55	45	40
4	70	50	55	45	65	55	40

NOTES

The nominal covers given relate specifically to the minimum member dimensions as per drawing

Cases that lie below the bold line require attention to the additional measures necessary to reduce the risks of spilling.

Adjustments to Minimum cement contents for Aggregates other than 20 mm Nominal Maximum size:

Sr No	Nominal maximum Aggregate size mm	Adjustments to minimum cement content kg/ m3
(1)	(2)	(3)
i)	10	+40
ii)	20	0
iii)	40	-30

For concrete of compressive strength greater than M55 design parameters given in the standard may not be applicable and the values may be obtained from specialized Literatures and experimental results.

The mix shall be designed to produce the grade of concrete having the required workability and characteristic strength not less than appropriate values given in the table above.

It shall be very clearly understood that whenever the class of concrete such as M 20 is specified it shall be the Contractor's responsibility to ensure that minimum crushing strength stipulated for the respective class of concrete is obtained at works. The maximum total quantity of aggregate by weight per 50 kg of cement shall not exceed 450 kg except when otherwise specifically permitted by Engineer-In-Charge.

To fix the grading of aggregates, water cement ratio, workability and the quantity of cement required giving preliminary and works cubes of the minimum strength specified, the proportions of the mix shall be determined by weight. Adjustment of aggregate proportions due to moisture present in the aggregate shall be made. Mix proportioning shall be carried out according to Indian Standard Specifications.

Whenever there is a change either in required strength of concrete or water cement ratio or workability or the source of aggregates and/or cement, preliminary tests shall be repeated to determine the revised proportions, of the mix to suit the altered conditions.

While fixing the value for water cement ratio for preliminary mixes, assistance may be derived from the graph (appendix IS 456 showing the relationship between the 28 day compressive strengths of concrete mixes with different water cement ratios and the 7 days compressive strength of cement tested in accordance with IS 269.

3.5.2 Preliminary Test

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

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

Mixing shall be done by a mixer machine as per IS 516 in such a manner as to avoid loss of water. The cement and fine aggregate shall first be mixed dry until the mixture is uniform in colour. The coarse aggregate shall then be added,. mixed and water added and mixed thoroughly for a period of not less than

3 minutes until the resulting concrete is uniform in appearance. Each mix of concrete shall be of such a quantity as to leave about 10% excess concrete after moulding the desired number of test specimens.

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

Compression tests of concrete cubes shall be made as per IS 516 on 15 cm cubes. Each mould shall be provided with a metal base having a plane surface so as to support the mould during filling without leakage. The base plate shall be preferably attached to the mould by springs or screws. The parts of the mould when assembled shall be positively and rigidly held together. Before placing concrete the mould and base plate shall be cleaned and oiled. The dimensions and internal faces of the mould shall be accurate within the following limits.

Height and distance between the opposite faces of the mould shall be of specified size ± 0.2mm. The angle between the adjacent internal faces and between internal faces and top and bottom planes of mould shall be 90 Deg. ± 5 Deg. The interior faces of the mould shall be plane surfaces with a permissible variation of 0.03mm.

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

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

3.5.3 Testing of specimens

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

3.5.4 Proportioning Consistency, Batching and Mixing of Concrete

3.5.4.1 Aggregate

The proportions which shall be decided by conducting preliminary test shall be by volume. These proportions of cement, fine and coarse aggregates shall be maintained during subsequent concrete mixing. The supply of properly graded aggregate of uniform quality shall be maintained over the period of work, the grading of aggregates shall be controlled by obtaining the coarse aggregate in different sizes and blending them in the right proportions. The different sizes shall be stocked in separate stock piles. The grading of

coarse and fine aggregate shall be checked as frequently as possible as determined by Engineer, to ensure maintaining of grading in accordance with the samples used in preliminary mix design. The material shall be stock piled well in advance of use.

3.5.4.2 Cement

The cement shall be measured by volume in normal cases. However in case of central weight batching plants. Cement may be weighed for each batch if so desired by engineer in charge.

3.5.4.3 Water

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

The water cement (W/C) ratio is defined as the volume of water in the mix (including the surface moisture of the aggregates) divided by the volume of cement in the mix. The actual water cement ratio to be adopted shall be determined in each instance by the Contractor and approved by the Engineer.

3.5.4.4 Proportioning by water/Cement ratio

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

3.5.4.5 Consistency and slump

Concrete shall be of a consistency and workability suitable for the conditions of the job. After the amount of water required is determined, the consistency of the mix shall be maintained throughout the progress of the corresponding parts of the work and approved tests e.g. slump tests, compacting factor tests, in accordance with IS 1199 shall be conducted from time to time to ensure the maintenance of such consistency.

The following tabulation gives a range of slumps which shall generally be used for various types of construction unless otherwise instructed by the Engineer.

3.5.5 Slumps for Various Types of Construction

Only sufficient quantity of water shall be added to concrete during mixing to produce a mix of sufficient workability to enable it to be well consolidated, to be worked in to the corners of the shuttering and around the reinforcement, to give the specified surface finish, and to have the specified surface strength. The following slumps shall be adopted for different kinds of works:-

Table 3.9: Slump Requirements

Name of Work	When vibrator used	When vibrator not used
Mass Concrete In Foundations, footings retaining walls and pavements.	10mm to 25mm	50mm to 75mm

Name of Work	When vibrator used	When vibrator not used
Thin sections of floors of less than 75mm thick	25mm to 40mm	75mm to 100mm
For Reinforced cement concrete work:		
Mass concreting in foundations, footings retaining walls and pavements	10mm to 25mm	80mm
Beams, slabs, columns	25mm to 40mm	100mm to 125mm
Thin shells, folded plates etc.	40mm to 50mm	125mm to 150m

3.5.6 Sampling and Testing Concrete in the Field

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

a. One concrete cube testing machine suitable for 15 cm cubes of 100 tonnes capacity with proving calibration ring.
b. Twelve cast iron cube moulds of 15 cm size.
c. One Lab. balance to weigh up to 10 kg with sensitive of 10gm.
d. One set of sieves for coarse and fine aggregates.
e. One set of slump cone complete with tamping rod.
f. A set of measures from 0.1 litres to 5 litres.
g. One electric oven with thermostat up to 120 Deg. Cent.
h. One flakiness gauge.
i. One elongation index gauge.
j. One sedimentation pipette.
k. One Pyconometer.
l. Two calibrated glass jar of 1 litre capacity.

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

At least 6 test cubes of each class of concrete shall be made for every 15.0 Cu.M. of concrete or part thereof. Such samples shall be drawn on each day for each type of concrete of each set of 6 cubes; three shall be tested at 7 days age and three at 28 days age. The laboratory test results shall be tabulated and furnished to Engineer. Engineer will pass the concrete if average strength of the specimens tested is not less than the strength specified, subject to the condition that only one out of three consecutive tests may give a value less than the specified strength but this shall not be less than 90% of the specified strength. The cubes shall be tested on 7th and 28th day from the day of casting of the cubes.

3.5.7 Admixtures

Admixtures may be used in concrete only with the approval of Engineer based upon evidence that, with the passage of time, neither the compressive strength nor its durability reduced. Calcium chloride shall not be used for accelerating setting of the cement for any concrete containing reinforcement, or embedded steel parts. When calcium chloride is permitted to be used, such as in mass concrete works, it shall be dissolved in water and added to the mixing water in an amount not to exceed 1.5% of the volume of the cement in concrete. When admixtures are used, the designed concrete mix shall be corrected accordingly. Admixtures shall be used as per manufacturer's instructions and in the manner and with the control specified by Engineer.

3.5.7.1 Air entraining agents

Where specified and approved by Engineer, neutralised vinyl resin or any other approved air-entraining agent may be used to produce the specified amount of air in the concrete mix and these agents shall conform to the requirements of ASTM standard 6260 air entraining admixtures for concrete. The recommended total air content of the concrete is 4% plus minus 1%. The method of measuring air content shall be a per IS 1199.

3.5.7.2 Water reducing admixtures

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

3.5.7.3 Retarding admixtures

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

3.5.7.4 Water proofing agent

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

3.5.8 Optional tests

Engineer may order tests to be carried out on cement, sand, coarse aggregate and water in accordance with the relevant Indian Standards.

Tests on cement shall include

- Fineness test
- Test for normal consistency
- Test for setting time
- Test for soundness
- Test for tensile strength
- Test for compressive strength
- Test for heat of hydration by experiment and by calculations in accordance with IS: 269.

Tests on sand shall include

- Sieve test
- Test for organic impurities
- Decantation test for determining clay and silt content
- Specific gravity test (v) test for unit weight and bulkage factor .

Tests on coarse aggregate shall include

- Test for sieve analysis
- Specific gravity and unit weight of dry loose and rodded aggregate
- Soundness and alkali aggregate reactivity
- Petrography examination
- Deleterious materials and organic impurities
- Test for aggregate crushing value.

Any or all these tests would normally be ordered to be carried out only if Engineer feels the materials are not in accordance with the specifications or if the specified concrete strengths are not obtained and shall be performed by contractor at site or at an approved test laboratory. If the tests are successful, Owner shall pay for all such optional tests otherwise the Contractor shall have to pay for them.

If the works cubes do not give the stipulated strengths Engineer reserves the right to ask contractor to dismantle such portions of the work, which in his opinion are unacceptable and re-do the work to the standard stipulated at contractor's cost in the manner and schedule approved by Engineer.

Load test on members or any other tests

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

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

o. If within 24 hours of the removal of the load, the structure dose not show a recovery of at least 75 percent of the maximum deflection shown drying the 24 hours under load the test loading shall be repeated after a lapse of at least 72 hours. The structure shall be considered to have failed to pass the test if the recovery after the second test is not at least 75 percent of the maximum deflection shown during the second test. If the structure is certified as failed by Engineer, the cost of the load test shall be borne by the contractor.

p. Any other tests e.g. taking out in approved manner concrete cores, examination and tests on such cores removed from such parts of the structure as directed by Engineer, sonic testing etc. shall be carried out by contractor if so directed.

q. Should the results of any test prove unsatisfactory, or the structure shows signs of weakness, undue deflection or faulty construction the contractor shall remove and re build the member or members involved or carry out such other remedial measures as may be required by Owner. The Contractor shall bear the cost of so doing, unless the failure of the member or members to fulfil the test Conditions is proved to be solely due to faulty design.

3.5.9 Concrete in alkali soils and alkaline water

Where concrete is liable to attack from alkali salts or alkaline water, special cements containing low amount of tri-calcium aluminates shall be used, if so specified in the drawings. Such concrete shall have a minimum 28 days compressive strength of 250 kg per sq. cm and shall contain not less than 370 kg of cement per cubic metre of concrete in place. If specified, additional protection shall be obtained by the use of a chemically resistant stone facing or a layer of plaster of Paris covered with suitable fabric, such as jute thoroughly impregnated with tar.

3.5.10 Preparation prior to concrete placement

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

s. The various agencies shall be permitted sample time to install drainage and plumbing lines in floor and trench drains, conduits, hangers, anchors, inserts, sleeves, bolts, frames and other miscellaneous embedment’s to be cast in the concrete as indicated on the drawings or as is

necessary for the proper execution of the work. Contractor shall co-operate fully with all such agencies and shall permit the use of scaffolding form work etc. by other agencies at no extra cost.

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

u. Anchor bolts shall be positioned and kept in place with the help of proper manufactured templates. The use of all such templates, fixture etc.. shall be deemed to be included in the rates. No extra payment will be made for making or providing templates.

v. Slots, openings, holes, pockets etc. shall be provided in the concrete work in the positions indicated in the drawings or as directed by Engineer.

w. Prior to concrete placement all work shall be inspected and approved by Engineer and if found unsatisfactory, concrete shall not be poured until after all defects have been corrected at Contractor's cost. Cat ladders shall be provided on the reinforcement to facilitate labour movement.

x. Approval by Engineer for all materials and work as required herein shall not relieve contractor from his obligation to produce finished concrete in accordance with the drawings and specifications.

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

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

3.5.11 Transportation

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

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

All equipment’s used for mixing; transporting and placing of concrete shall be maintained in clean condition. All pans, buckets, hoppers, chutes, pipelines and other equipment shall be thoroughly cleaned after each period of placement.

3.5.12 Procedure for Placing of Concrete

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

Concrete shall replace in its final position before the cement shall normally be compacted in its final position within thirty minutes of leaving the mixer and once compacted it shall not be disturbed.

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

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

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

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

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

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

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

Concrete may be conveyed and placed by mechanically operated equipment e.g. pumps or pneumatic placers only with the written permission of Engineer. The slump shall be held to the minimum necessary for conveying concrete by this method.

When pumping is adopted, before pumping of concrete is started, the pipeline shall be lubricated with one or two batches of mortar composed of one part cement and two parts sand. The concrete mix shall be specially designed to suit pumping. Care shall be taken to avoid stoppages in work once pumping has started.

When pneumatic placer is used, the manufacturer's advice on layout of pipeline shall be followed to avoid blockages and excessive wear. Restraint shall be provided at the discharge box to cater for the reaction at this end. Manufacturer's advice shall be followed regarding concrete quality and all other related matters when pumping or pneumatic placing equipment's are used.

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

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

3.5.13 Compaction

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

Vibrators shall conform to IS specifications. Type of vibrator to be used shall depend on the structure where concrete is to be placed. Shutter vibrators, to be effective, shall be firmly secured to the formwork which must be sufficiently rigid to transmit the vibration and strong enough not to be damaged by it. Immersion vibrators shall have no load frequency, amplitude and acceleration as per IS 2505 depending on the size of vibrator. Immersion vibrators in sufficient numbers and each of adequate size shall be used to properly consolidate all concrete. Tapping or external vibrating of forms by hand tools or immersion vibrators will not be permitted.

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

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

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

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

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

The surface vibrators will not be permitted under normal conditions. However for thin slabs vibration by specially designed vibrators may be permitted upon approval of Engineer.

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

3.5.14 Placement interval

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

3.5.15 Special provision in placing

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

3.5.16 Placing concrete through reinforcement steel

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

3.5.17 Bleeding

Bleeding of free water, on top of concrete , being deposited in to the forms , contractor shall be asked to stop the concrete pour. The conditions causing this defect are corrected before any further concreting is resumed.

3.5.18 Curing, Protecting, Repairing and Finishing

3.5.18.1 Curing

All concrete shall be cured by keeping it continuously damp for the period of time required for complete hydration and hardening to take place. Preference shall be given to the use of continuous sprays or pounded water continuously saturated covering of sacks, canvas, Hessian or other absorbent materials, or approved effective curing compounds applied with spraying equipment capable of producing a smooth, even textured coat. Extra precautions shall be exercised in curing concrete during cold and hot water as outlined hereinafter. The quality of curing water shall be the same as that used for mixing concrete.

Certain types of finish or preparation for overlaying concrete must be done at certain stage of the curing process and special treatment may be required for specific concrete surface finish.

Curing of concrete made of high alumina cement and super sulphated cement shall be carried out as directed by Engineer.

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

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

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

For curing of concrete in pavements, side-walks floors, flat roofs or other levelled surfaces, the ponding method of curing is preferred. The method of containing the ponded water shall be approved by Engineer. Special attention shall be given to edges and corners of the slabs to ensure proper protection to these areas. The pounded area shall be kept continuously filled with water during the curing period.
Surface coating type compounds shall be used only by special permission of Engineer. Curing compound shall be liquid type white pigmented. Other curing compound shall be used on surfaces where future blending with concrete, water or acid proof membrane or painting is specified.

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

3.5.18.2 Protecting fresh concrete

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

3.5.18.3 Repair and replacement of unsatisfactory concrete

Immediately after the shuttering is removed, the surface of concrete shall be very carefully inspected and all defective areas called to the attention of Engineer who may permit patching of the defective areas or also reject the concrete unit either partially or entirely. Rejected concrete shall be removed and replaced by contractor at no additional expense to owner. Holes left from bolts etc. shall be filled up and made good with mortar composed of one part of cement to one and half parts of sand passing 2.36 mm IS sieve after removing any loose stones adhering to the concrete and shall be finished as described under the particular items of work.

Superficial honey combed surfaces and rough patches shall be similarly made good immediately after removal of shuttering in the presence of Engineer and superficial water and air holes shall be filled in. The mortar shall be well worked into the surface with a wooden float. Excess water shall be avoided. Unless instructed otherwise by Engineer, the surface of the exposed concrete placed against shuttering shall be rubbed down immediately on removal of shuttering to remove fine or other irregularities and necessary care being taken to avoid damage to the surface. Surface irregularities shall be removed by grinding.

If reinforcement is exposed or the honeycombing occurs at vulnerable positions e.g. ends of beams or columns it may be necessary to cut out the member completely or in part and reconstruct. The decision of Engineer shall be final in this regard. If only patching is necessary, the defective concrete shall be cut out till solid concrete is reached (or to a minimum depth of 25mm), the edges being cut perpendicular to the affected surface or with small undercut if possible. Anchors, tees or dovetail slots shall be provided whenever necessary to attach the new concrete securely in place an area extending several centimetres beyond the edges and the surfaces of the prepared voids shall be saturated with water for 24 hours immediately before the patching material is placed.

The use of epoxy for bonding fresh concrete used for repairs will be permitted upon written approval of Engineer. Epoxy shall be applied in strict accordance with the instructions of the manufacturer.

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

aa. The hole to be patched shall be roughened and thoroughly soaked with clean water until absorption stops. A 5mm thick layer of grout of equal parts of cement and sand shall be well brushed into the surface to be patched, followed immediately by the patching concrete which shall be well consolidated with a wooden float. The concrete patch shall be built up in 10 mm thick layers. After an hour or more, depending upon weather conditions, it shall be worked off flush with a wooden float and smooth finish obtained by wiping with Hessian. A steel trowel shall be used for this purpose. The mix for patching shall be of same material and in the same proportions as that used in the concrete being repaired, although some reduction in the maximum size of the coarse aggregates may be necessary and the mix shall be kept as dry as possible.

bb. Mortar filling by air pressure (grunting) shall be used for repairing of areas too large and/or too shallow for patching with mortar. Patched surfaces shall be given a final treatment to match the colour and texture of the surrounding concrete. White cement shall be substituted for ordinary cement, if so directed by Engineer, to match the shade of the patch with original concrete.

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

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

3.5.18.4 Finishing

The type of finish for formed concrete surface shall be as follows, unless, otherwise specified by the Engineer:

cc. For surfaces against which backfill or concrete is to be placed, no treatment is required except repairing of defective areas.

dd. For surface below grade which will receive waterproofing treatment the concrete shall be free of surface irregularities which would interfere with proper application of the waterproofing material which is specified for use.

ee. Unless specified, surfaces which will be exposed when the structure is in service shall receive no special finish, except repairing of damage or defective concrete removal of fins and abrupt irregularities, fillings of holes left by form ties and rods and clean-up of loose or adhering debris.

Surfaces which will be exposed to the weather and which would normally be level, shall be sloped for drainage. Unless the drawing specifies such as stair treads, walls shall be sloped across the width approximately 1 in 30 broader surface such as walkways., roads, parking areas and platforms shall be sloped about 1 in 50. Surfaces that will be covered by backfill or concrete sub floors to be covered either concrete topping, terrazzo or quarry tile and similar surfaces shall be smooth screened and levelled to produce even surfaces. Surface irregularities shall not exceed 6mm. Surfaces which will not be covered by backfill, concrete or tile toppings such as outside decks, floors of galleries and sumps, parapets, gutters, sidewalks floors and slabs shall be consolidated, screened and floated. Excess water and Latinate shall be removed before finishing. Floating may be done with hand or power tools and started as the screened surface has attained a stiffness to permit finishing operation and these shall be the minimum required to produce a surface uniform in texture and free from screed marks or other imperfections. Joints edges panels and forms linings shall be of uniform size and be as large as practicable and installed with closed joints. Upon removal of forms the joint marks shall be smoothed off and all blemishes, projections etc., removed leaving the surfaces reasonably smooth and unmarred.

3.5.18.5 Integral cement concrete finish

When specified on the drawings and integral cement concrete finish of specified thickness for floors and slabs shall be applied either monolithic or bonded as specified on the drawing as per IS 2571. The surface shall be compacted and then floated with a wood float or power floating machine . The surface shall be checked with a straight edge and any high and low spots eliminated. Floating or trowelling of finish shall be permitted only after all surface water has evaporated. Dry cement or a mixture of dry cement and sand shall not be sprinkled directly on the surface of the cement finish to absorb moisture or to stiffen the mix.

3.5.18.6 Exposed Concrete finish/Rendering

A rubbed finish shall be provided only on exposed concrete surfaces as specified on the drawings. Upon removal of forms, all fins and other projections on the surfaces shall be carefully removed, off-sets levelled and voids and damaged sections be immediately saturated with water and repaired by filling with a concrete or mortar of the same composition as was used in the surface. Then surface shall be thoroughly wetted and rubbed with carborundum or other abrasive. Cement mortar may be used in the rubbing, but the finished surface shall be brush coated with either cement grout after rubbing. The finished surfaces shall present a uniform and smooth appearance.

3.5.19 Mode of Measurement

The unit rate for concrete work under various categories shall be all inclusive and no claims for extra payment on account of such items as leaving holes, embedding inserts, bolts etc. shall be entertained unless separately provided for in the schedule of quantities. No extra claim shall also be entertained due to change in the number, position end/or dimensions of holes slots or openings sleeves, inserts or on account of any increased lift or scaffolding etc. All these factors should be taken into consideration while quoting the unit rates.

Payments of concrete will be made on the basis of unit quoted for the respective items in the Schedule of Quantities. No deduction in the concrete quantity will be made for reinforcements, inserts, Sleeves etc. and openings less than 0.05 Cu.M. where concrete is measured in cum. Where no such deduction for concrete is made, payment for shuttering work provided for such holes, pockets etc. Will not be made. .

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

3.6 Formwork

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

3.6.1 Codes, Standard and Rules

IS 4014-1967(Part I &II): Code of practice for steel tubular scaffolding (I: Definition / Material: II: Safety Regulations) 4990-1981 Specifications for plywood for concrete shuttering work
IS 1200: Method of Measurement

3.6.2 Material specification

3.6.2.1 Steel props, Acrow H frames wooden planking:

The shuttering shall be of ply wood of 12mm minimum thickness. The shuttering shall be supported on battens and beams and props of vertical steel pipe columns / props, frames, Acrow spans shall be of MS pipe materials as per IS 1161, structural grade.

3.6.2.2 Concrete Shuttering Plywood:

It shall be made from strong and selected hard-woods. It shall be bonded with high quality Phenol Formaldehyde synthetic resin adhesive, hot pressed and then shall be further treated with a permanent type of preservative by vacuum-cum-pressure impregnation.

Due to the bonding with Phenol Formaldehyde, it shall be moisture and weather proof. The use of selected hard-woods renders hard and wear-resistant faces and thereby it shall be reusable several times. It shall be highly resistant to rot, termites and other wood inhabiting insects. Due to complete penetration of the preservative, it shall be exceedingly durable.

It shall have high impact strength and therefore shall be used successfully in place of timber planks and steel sheets. It shall protect the concrete from rapid temperature changes and shall provide optimum conditions for setting of the concrete. As it shall possess remarkable design flexibility, it shall be ideal for curved formwork.

For the concrete with fair finish (form finish with no other enclose like plaster, cladding etc.) especial type of plywood with plastic coating shall be used.

For plywood of all shuttering maximum six repetitions shall be allowed provided the EIC is fully satisfied about the surface condition of the shuttering ply.

All Formwork shall be supported with pipe adjustable props, acrow spans, steel staging and top and side of concrete shall be of good quality ply wood of appropriate thickness. Sliding forms and slip forms may be used with the approval of EIC.

3.6.3 Design of formwork

The design of the formwork as well as its construction shall be the responsibility of Contractor. If so instructed, the drawings and/or calculation for the design for the formwork shall be submitted to Engineer for approval before proceeding with work, at no extra cost. Engineer's approval shall not however relieve Contractor of the full responsibility for the design and construction of the formwork. The design shall take into account the entire load vertical and lateral that the forms will be carrying live and vibration loading.

3.6.4 Form work requirements

Forms shall conform to the shapes, lines, grades and dimensions including camber of the concrete as called for on the drawings. Ample studs, braces, ties, straps, etc. shall be used to hold the forms in proper position without any distortion whatsoever until the concrete is set sufficiently to permit removal of forms. Forms shall be strong enough to permit the use of immersion vibrators. In special cases form vibrators may also be used. The shuttering shall be close boarded. Timber shall be well seasoned, free from sap,. shakes, loose knots, worm holes, warps or other surface defects in contact with concrete. Faces coming in contact with the concrete shall be free from adhering grout, plaster, paint, projecting nails, splits or other defects. Joints shall be sufficiently tight to prevent loss of water or any fine material from concrete.

Plywood shall be used for exposed concrete surfaces, where called for. Swan and wrought timber may be used for unexposed surfaces. Inside faces of forms for concrete surfaces which are to be rubbed finished shall be planned to remove irregularities or unevenness in the face. Formwork with linings shall be permitted.

All new and used form timber shall be maintained in a good condition with respect to shape, strength, rigidity, water tightness, smoothness and cleanliness of surfaces. Form timber unsatisfactory in any respect shall not be used and if rejected by Engineer shall be removed from the site.

Shores supporting successive members shall be placed directly over those below or be so designed and placed that the load will be transmitted directly to them. Trussed supports shall be provided for shores that cannot be secured on adequate foundations.

Formwork, during any stage of construction showing signs of distortion or distorted to such a degree that the intended concrete work will not conform to the exact contours indicated on the drawings, shall be repositioned and strengthened. Poured concrete affected by the faulty formwork, shall be removed completely and the formwork be corrected prior to placing of new concrete at contractors own cost.

Excessive construction camber to compensate for shrinkage, settlement may impair the structural strength of members and shall not be permitted.

Forms shall be so designed that their removal will not damage the concrete. Face formwork shall provide true vertical and horizontal joints, conform to the architectural features of the structure as to location of joints and be as directed by engineer.

Where exposed smooth or rendered concrete finishes are required the forms shall be constructed with special care so that the resulting concrete surfaces require a minimum finish.

3.6.5 Formwork for Slope Surfaces

Forms for sloped surfaces shall be built so that the formwork can be placed board-by-board immediately ahead of concrete placement so as to enable ready access for placement, vibration inspection and repair of the concrete.

The formwork shall also be built so that the boards can be removed one by one from the bottom up as soon as the concrete has attained sufficient stiffness to prevent sagging. Surfaces of construction joints and finished surfaces with slopes steeper than 4 horizontal: 1 vertical shall be formed as required herein.

3.6.6 Formwork for Curved Surfaces

The contractor shall interpolate intermediate sections as necessary and shall construct the forms so that the curvature will be continuous between sections. Where necessary to meet requirements for curvature, the form timber shall be built up of laminated splines cut to make tight, smooth form surfaces.

After the forms have been constructed, all surface imperfections shall be corrected and all surface irregularities at matching faces of form material shall be dressed to the specified curvature.

3.6.7 Formwork for Exposed Concrete Surfaces

Where it is desired, directed or shown on the drawings to have original fair face finish of concrete surface without any rendering or plastering, formwork shall be carried out by using wood planks, plywood or steel plates of approved quality size and pattern as per direction of the Engineer.

The contractor shall use one type of material for all such exposed concrete faces and the forms shall be constructed so as to produce uniform and consistent texture and pattern on the face of the concrete. Patches or forms for these surfaces will not be permitted. The formwork shall be placed so that all horizontal formworks are continuous across the entire surface.

To achieve a finish which shall be free of board marks, the formwork shall be faced with plywood or equivalent material in large sheets. The sheets shall be arranged in an approved pattern. Wherever possible, joints between sheets shall be arranged to coincide with architectural features, cills, window heads or change in direction of the surface. All joints between shuttering plates or panels shall be vertical or horizontal unless otherwise directed. Suitable joints shall be provided between sheets. The joints shall be arranged and fitted so that no blemish or mark is imparted to the finished surfaces.

To achieve a finish which shall give the rough appearance of concrete cast against sawn boards, formwork boards unless otherwise stated shall be of 150 mm wide, securely jointed with tongue and grooved joints if required to prevent grout loss with tie rod positions and direction of boards carefully controlled. Sawn boards shall be set horizontally, vertically or at an inclination shown in the drawings. All bolt holes shall be accurately aligned horizontal and vertical and shall be filled with matching mortar recessed 5mm back from the surrounding concrete face.

Forms for exposed concrete surfaces shall be constructed with grade strips (the underside of which indicate top of pour) at horizontal construction joints, unless the use of groove strips is specified on the drawings. Such forms shall be removed and reset from lift to lift, they shall not be continuous from lift to lift.

Sheeting of reset forms shall be tightened against the concrete so that the forms will not be spread and permit abruption irregularities or loss of mortar. Supplementary form ties shall be used as necessary to hold the reset forms tight against the concrete.

For fair faced concrete, the position of through bolts will be restricted and generally indicated on the drawings.

Chamfer strips shall be placed in the corners of forms for exposed exterior corners so as to produce 20 mm bevelled edges except where otherwise shown in the drawings. Interior corners and edges at formed joints shall not be bevelled unless shown on the drawings for grooves, drip courses and bands shall be made in the form itself.

The wood planks, plywood and steel plates used in formwork for obtaining exposed surfaces shall not be used for more than 3 times in case of wood planks, 6 times for plywood and 10 times for steel plates respectively. However, no forms will be allowed for reuse, if in the opinion of the Engineer it is doubtful to produce desired texture of exposed concrete.

In order to obtain exposed concrete work of uniform colour it shall be necessary to ensure that the sand used for all exposed concrete work shall be of approved uniform colour. Moreover the cement used in the concrete for any complete element shall be from single consignment.

No exposed concrete surface shall be rendered or painted with cement or otherwise. Plastering of defective concrete as a means of achieving the required finish shall not be permitted, except in the case of minor porosity on the surface, the Engineer may allow a surface treatment by rubbing down with cement and sand mortar of the same richness and colour as for the concrete. This treatment shall be made immediately after removing the formwork.

The contractor shall also take all precautionary measures to prevent breaking and chipping of corners and edges of completed work until the building is handed over.

3.6.8 Bracings struts and props

Shuttering shall be braced, strutted, propped and so supported that it shall not deform underweight and pressure of the concrete and also due to the movement of men and other materials. Bamboo’s shall not be used as props or cross bearers.

The shuttering for beams and slabs shall be so erected that the shuttering on the sides of the beams and under the soffits of slabs can be removed without disturbing the beam bottoms. Re propping of beams shall not be done except when props have to be reinstated to take care of construction loads anticipated to be in excess of the design load. Vertical props shall be supported on wedges or other measures shall be taken whereby the props can be gently lowered vertically while striking the shuttering. If the shuttering for a column, is erected for the full height of the column, one side shall be left open and built up in sections as placing of concrete from the sides to limit the drop of concrete to 3M or as directed by engineer.

3.6.9 Mould Oil

Care shall be taken to see that the faces of form wok coming in contact with concrete are perfectly cleared and two coats of mould oil or any other approved material applied before fixing reinforcement and placing concrete. Such coating shall be insoluble in water, non-staining and not injurious to the concrete. It shall not become flaky or be removed by rain or wash water. Reinforcement and/or other items to be cast in the

concrete shall not be placed until coating of the forms is complete; adjoining concrete surface shall also be protected against contamination from the coating material.

3.6.10 Chamfers and fillets

All corners and angles exposed in the finished structure shall be formed with moulding to form chamfers or fillets on the finished concrete. The standard dimension of chamfers and fillers, unless otherwise specified shall be 20 mmx20 mm. Care shall be exercised to ensure accurate mouldings. The diagonal face of the mouldings shall be planned or surfaced to the same texture as the forms to which it is attached.

3.6.11 Wall ties

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

3.6.12 Reuse of forms

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

3.6.13 Removal of forms

Contractor shall record on the drawings and in a special register the date upon which the concrete is placed in each part of the work and the date on which the shuttering is removed there from. The Contractor shall remove the shuttering after obtaining the approval of the Engineer.

In no circumstances shall forms be struck until the concrete reaches strength of at least twice the stress due to self-weight and any construction/erection loading to which the concrete may be subjected at the time of striking formwork.

In normal circumstances (generally where temperatures are above 20 Deg. Cent.) forms may be removed after expiry of the following periods:-

Table 3.10: Removal of Form

Sr. No.	Description	Ordinary Portland cement concrete	Rapid hardening Portland cement concrete
a)	Walls columns and vertical sides of beams	24 to 48 hrs as directed by the Engineer	24 hrs.
b)	Slabs left under	3 days	2 days
c)	Beam soffits props left under	7 days	4 days
d)	Removal of props to slabs:	7 days	4 days
	i) Spanning up to 4.5 m	14 days	8 days
	ii)Spanning over 4.5 m		
e)	Removal of props to beams & arches		
	i) Spanning up to 6 m	14 days	8 days
	ii) Spanning over 6m	21 days	12 days

Striking shall be done slowly with utmost care to avoid damage to rises and projections and without shock or vibration, by gently easing the wedges. If after removing the form work, it is found that timber has been embedded in the concrete, it shall be removed and made good as specified earlier.

Reinforced temporary openings shall be provided as directed by Engineer to facilitate removal of formwork which otherwise may be inaccessible.

Tie rods, clamps, form bolts etc. which must be entirely removed from walls or similar structures shall be loosened not sooner than neither 24 hours nor later than 40 hrs after the concrete has been deposited. Ties except those required to hold forms in place, may be removed at the same time. Ties withdrawn form wall & grade beams shall be pulled towards the inside face. Cutting ties back form the surface of wall & grade beams will not be permitted.
For liquid retaining structures no sleeves for through bolts shall be used for nor shall through bolts be removed as indicated above. The bolts in this case, shall be cut at 25 mm depth from the surface and then the hole shall be made good by sand, cement mortar of the same proportions as the concrete just after striking the formwork.

3.6.14 False staging

The additional height for which it is required shall be as specified in the item specification.

The item of staging will be operated if the work is at height more than specified in item description and the contractor has erected extra staging.

3.6.15 Mode of Measurement

It shall be measured in Sq.M. The actually shuttered area shall be measured and paid for. The rate shall include providing and erecting formwork in position as per drawings, applying oil, removal of form after the specified period.

False staging shall be measured and paid for in Sq.M. The plan area of the structure shall be measured for payment.

3.7 TMT Reinforcement Steel Bar

3.7.1 Material

The contractor **(if material not supply by Client)** shall make his own arrangement for procurement of Reinforcement steel bars and wires for use in Reinforced Cement Concrete works. Unless otherwise specified in drawings / Schedule of quantities, the steel bars shall be of “High strength deformed steel bars and wires” conforming to the IS 1786 (latest revision), in the following strength grades:

a) Fe 415, Fe 415D;
b) Fe 500, Fe 500D;
c) Fe 550, Fe 550D; and
d) Fe 600.

Where **“Fe”** stands for specified minimum 0.2% proof / yield stress in N/mm2 and **“D”** stands for same specified minimum 0.2% proof / yield stress but with enhanced specified minimum percentage elongation.

3.7.2 Terminology

Elongation: The increase in length of a tensile test piece under stress, expressed as a percentage of the original gauge of a standard piece.

Longitudinal Rib -A uniform continuous protrusion, parallel to the axis of the bar/wire (before cold-working, if any).

Nominal Diameter or Size- The diameter of a plain round bar/wire having the same mass per meter length as the deformed bar/wire.

Nominal Mass -The mass of the bar/wire of nominal diameter and of density 0.00785 kg/cum per meter.

Nominal Perimeter - 3.14 times the nominal diameter of a deformed bar/Wire.

Percent Proof Stress -The stress at which a non-proportional elongation equal to 0.2% of the original gauge length takes place.

Uniform elongation - The elongation corresponding to the maximum load reached in a tensile test (also termed as percentage total elongation at maximum force).

Tensile Strength - The maximum load reached in a tensile test divided by the effective cross-sectional area of the gauge length portion of the test piece (also termed as ultimate tensile stress).

Transverse Rib - Any rib on the surface of a bar/wire other than a longitudinal rib.

Yield Stress - Stress (that is, load per unit cross sectional area) at which elongation first occurs in the test piece without increasing the load during the tensile test. In the case of steels with no such definite yield point, proof stress shall be applicable.

The high strength deformed steel bars and wires for concrete reinforcement shall be hot rolled steel without subsequent treatment or hot rolled steel with controlled cooling and tempering and cold worked steel, and reinforcing bars and wires which may be subsequently coated.

Steel bars shall be supplied from M/s. Steel Authority of India Ltd. (SAIL) or M/s. TATA Steel (TISCO) or M/s. Rashtriya Ispat Nigam Ltd (RINL) or M/s. Indian Iron & Steel Co. (IISCO) Ltd., from their own plants rolled from virgin material, and shall be procured directly or from their authorized dealers and not from re-rollers or conversion agents.

The contractor shall supply copy of Documentary evidence of purchase of steel from the specified manufacturers.

3.7.3 Tests

The contractor shall submit the test certificate of manufacturer. Regular tests on steel supplied by the contractor shall be performed by the contractor at the approved lab, in presence of the Departmental Engineers as per relevant Indian Standards. Engineer-in-charge may require Contractor to perform necessary tests of samples at random as per relevant B.I.S. All cost of such tests and incidentals to such tests shall be borne by the Contractor. The quality, grade, colour coding embossing marks etc. all shall be to the entire satisfaction of the Engineer-in-Charge. Steel not conforming to above test criteria shall be rejected.

The Chemical, Physical & Mechanical properties of the steel reinforcement bars shall be as per IS 1786. Unless otherwise specified, Selection and Preparation of Test Sample shall be as per the requirements of IS 2062

All test pieces shall be selected either from the cuttings of bars / wires; or from any bar/wire after it has been cut to the required or specified size and the test piece taken from any part of it. In neither case, the test piece shall be detached from the bar/wire except in the presence of the EIC or his authorized representative.

The test pieces shall be full sections of the bars/wires and shall be subjected to physical tests without any further modifications. No reduction in size by machining or otherwise shall be permissible, except in case of bars of size 28 mm and above. No test piece shall be annealed or otherwise subjected to heat treatment. Any straightening which a test piece may require shall be done cold.

For the purpose of carrying out tests for tensile strength, proof stress, percentage elongation and percentage elongation at maximum force for bars 28 mm in diameter and above, deformations of the bars only may be machined. For such bars, the physical properties shall be calculated using the actual area obtained after machining. The following IS codes shall be referred for test methods:

Table 3.11: Test Method

SN	Title	IS No	ISO No.
I	Mechanical testing of metals -Tensile testing	1608	6892
Ii	Methods for bend test	1599 7438 & 1786	15630-1
Iii	Method for re-bend test for metallic wires & bars	1786	15630-1

The Properties as Per IS 1786 – 2008 Are Reproduced Below:

Table 3.12: Chemical Composition of the bars shall conform to the following requirement:

Constituents	Maximum Permissible Percent							Permissible max. Variation
	Fe 415	Fe 415D	Fe 500	Fe 500D	Fe 550	Fe 550D	Fe 600	
Carbon	0.300	0.250	0.300	0.250	0.300	0.250	0.300	0.020%
Sulphur	0.060	0.045	0.055	0.040	0.055	0.040	0.040	0.005%
Phosphorus	0.060	0.045	0.055	0.040	0.050	0.040	0.040	0.005%
Sulphur & Phosphorus	0.110	0.085	0.105	0.075	0.100	0.075	0.075	0.010%

Notes:

i) For welding of deformed bars, the recommendations of IS 9417 shall be followed.

ii) In case of deviations from the specified maximum, two additional test samples shall be taken from the same batch and subjected to the test or tests in which the original sample failed. Should both additional test samples pass the test, the batch from which they were taken shall be deemed to comply with this standard. Should either of them fail, the batch shall be deemed not to comply with this standard

Table 3.13: Mechanical Properties of High Strength Deformed Bars and Wires

Sl. No.	Property	Maximum Permissible Percent						
		Fe 415	Fe 415D	Fe 500	Fe 500D	Fe 550	Fe 550D	Fe 600

Sl. No.	Property	Maximum Permissible Percent						
1	2	3	4	5	6	7	8	9
I	0.2 percent proof stress / yield stress, Min, N/mm2	415.0	415.0		500.0	550.0	550.0	600.0
Ii	Elongation, percent, Min. on gauge length 5.65 ;A, where A is the Cross – sectional area of the test piece	14.5	18.0	12.0	16.0	10.0	14.5	10.0
Iii	Tensile strength, Min	10% more than the actual 0.2% proof stress / yield stress but not less than 485.0 N/mm2	12% more than the actual 0.2% proof stress/yield stress but not less than 500.0 N/mm2	8% more than the actual 0.2% proof stress/ yield stress but not less than 545.0 N/mm2	10% more than the actual 0.2% proof stress/yield stress but not less than 565.0 N/mm2	6% more than the actual 0.2% proof stress/ yield stress but not less than 585.0 N/mm2	8% more than the actual 0.2% proof Stress / yield stress but not less than 600.0 N/mm2	6% more than the actual 0.2% proof stress/ yield stress but not less than 660.0 N/mm2
Iv	Total elongation at maximum force, percent, Min of gauge length 5.65 ;A, where A is the cross sectional area of the test piece	-	5	-	5	-	5	-

Note: To satisfy Clause 26 of IS 456 -2000, no mixing of different types of grades of bars shall be allowed in the same structural members as main reinforcement, without prior written approval of the Engineer-in-Charge.

3.7.4 Storage

Steel for reinforcement shall be stored in such a way as to prevent distorting and corrosion. The steel for reinforcement shall not be kept in direct contact with ground. Fresh / Fabricated reinforcement shall be carefully stored to prevent damage, distortion, corrosion and deteriorations. Care shall be taken to protect steel from exposure to saline atmosphere during storage, fabrication and use. It may be achieved by treating the surface of reinforcement with cement wash or by suitable methods. Bars of different classifications, sizes and lengths shall be stored separately to facilitate issue in such sizes and lengths to cause minimum wastage in cutting from standard length.

3.7.5 Quality

Steel not conforming to specifications 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 rods shall be thoroughly cleaned before being fabricated. Pitted and defective rods 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-in-Charge. If welding is approved, the work shall be carried as per I.S. 2751, according to best modern practices and as directed

by the Engineer-in-Charge. In all cases of important connections, tests shall be made to prove that the joints are of the full strength of bars welded. Substitution of reinforcement will not be permitted except upon written approval from Engineer-in-charge.

3.7.6 Nominal Sizes

The nominal sizes of bars/wires shall be 4mrn, 5mrn, 6mrn, 8mrn, 10mrn, 12mrn, 16mrn, 20mrn, 25 mm, 28mrn, 32mrn, 36mrn, 40 mm. (Other sizes viz. 7mrn, 18mrn, 22 mm, 45 mm and 50 mm may be procured on specific stipulations).

3.7.7 Nominal Mass

For the purpose of checking the nominal mass, the density of steel shall be taken as 0.00785 kg/mm3 of the cross sectional area per metre. Unless otherwise specified, the tolerances on nominal mass shall be as per following Table.

Table 3.14: Tolerances on Nominal Mass

SN	Nominal Size in mm	Tolerance on the nominal mass in Percent		
		Batch	Individual sample	Individual sample for coils only
1	2	3	4	5
i)	Up to and including 10	± 7	- 8	± 8
ii)	Over 10 up to and including 16	± 5	- 6	± 6
iii)	Over 16	± 3	- 4	± 4

3.7.8 Laps

Laps and splices for reinforcement shall be 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-in-Charge. The bars shall not be lapped unless the length required exceeds the maximum available lengths of bars at site. Not more than 25% to 50% bars shall be lapped at one section.

3.7.9 Bending

All bars shall be accurately bent according to the sizes and shapes shown on the detailed working drawing / bar bending schedules. They shall be bent gradually by machine or other approved means. Reinforcing bars shall not be straightened and re-bent in a manner that will injure the materials. Bars containing cracks or splits shall be rejected. They shall be bent cold, except bars of over 25 mm. in diameter which may be bent hot if specifically approved by the Engineer-in-Charge. Bars that depend for their strength on cold working shall not be bent hot. Bars bent hot shall not be heated beyond cherry red colour (not exceeding 6450C) and after bending shall be allowed to cool slowly without quenching. Bars incorrectly bent shall be used only after straightening and re-bending be such as shall not, in the opinion of the Engineer-in-Charge, injure the material. No reinforcement bar 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.

Bending At Construction Joints

Where reinforcement bars are bent aside at construction joints and afterwards bent back into their original position, care should be taken to ensure that at no time the radius of the bend is less than 4 bar diameters for plain mild steel or 6 bar diameters for deformed bars. Care shall also be taken when bending back bars to ensure that the concrete around the bar is not damaged.

3.7.10 Fixing / Placing and Tolerance on Placing

Before cutting, bending and placing, all reinforcement shall be clean and free from pitting, loose mill scales, dust, loose rust and coats of paints, oil or other coatings which may destroy or reduce the bond. Any defective or damaged reinforcement shall be brought to the notice of the Engineer and replaced with good quality bars.

General construction details and workmanship related to reinforcement including bar bends, lap splices and installation shall be in accordance with IS: 2502 and IS: 456.

Contractor responsibility for preparation of “bar bending schedules” based on structural design drawings. Shown in schedule bars numbers, lengths, and bending details for relevant to the particular drawing. The bar bending schedule shall be approved form Engineer In Charge / Client representative before any cutting or bending of bars.

No reinforcement shall be bent when already in position in the work, without approval of the Engineer, whether or not it is partially embedded in concrete. Bars shall not be straightened in a manner that will injure the material. Re-bending can be done only if approved by the Engineer. Reinforcing bars shall be bent by machine or other approved means producing a gradual and even motion. All the bars shall be cold bent unless otherwise approved. Bending hot at a cherry-red heat (not exceeding 845 °.C) may be allowed under very exceptional circumstances except for bars whose strength depends on cold working. Bars bent hot shall not be cooled by quenching. However, such bending will be allowable only with the approval of the Engineer.

The number, sizes, shape and position of all the reinforcement shall unless otherwise directed or authorised by the Engineer, be strictly in accordance with the drgs. The reinforcement shall be adequately secured and held in position by metal wires, chairs and spacers. Tees at inter-sections shall be made with 16 SWG soft black annealed binding wire (IS: 10632, part II). Whenever conduit, piping inserts, sleeves etc. Interface with placing of reinforcement, proper adjustment in the spacing of bars shall be made as approved by the Engineer. No bars shall be made rest on or against forms nor on or against the earth in excavation.

All the reinforcing bars shall be so tied as to form a rigid cage to prevent displacement before or during concreting. Necessary wooden planks supported independently of the reinforcement shall be provided for the labourers to move. The vertical distance required between successive layers of bars in beams or similar members shall be maintained by the provision of mild steel spacer bars inserted at such interval that the main bars do not perceptibly sag between adjacent spacer bars.

Tack welding may be permitted by the Engineer under certain conditions for fixing reinforcement. Welding shall be done by skilled and qualified welders only. Suitable safeguards shall be taken by the contractor for welding.

Reinforcement shall be accurately fixed by any approved means maintained in the correct position as 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 number 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 spacer bars at such intervals that the main bars do not perceptibly sag between adjacent spacer bars.

Tolerance on Placing of Reinforcement

Unless otherwise specified, reinforcement shall be placed within the following tolerances :

Tolerance in spacing

a) For effective depth, 200 mm or less + /- 10 mm

b) For effective depth, more than 200 mm + /- 15 mm

3.7.11 Cover to Reinforcement

Nominal cover is the design depth of concrete cover to all steel reinforcements, including links. It is the dimension used in design and indicated in the drawings. It shall be not less than the diameter of the bar. Unless otherwise specified, cover to reinforcement shall be provided generally as per guidelines of IS 456.

Concrete / PVC spacer blocks of same strength as of parent concrete shall be used to ensure correct cover to the reinforcement. The clear cover shall be as shown on the drawings or as per instructions of the Engineer.

Nominal cover to meet durability requirement:

Minimum values for the nominal cover of normal weight aggregate concrete which should be provided to all reinforcement, including links depending on the condition of exposure described in 4.4 above and as per (nominal cover to meet durability requirements).

However for a longitudinal reinforcing bar in a column nominal cover shall in any case not be less than 40 mm or less than the diameter of such bar. In the case of columns of minimum dimension of 200mm or under, whose reinforcing bar do not exceed 12mm , a nominal cover of 25 mm may be used.

For footings minimum cover shall be 50 mm.

Nominal cover to meet specified period of fire resistance

Minimum values of nominal cover of normal-weight aggregate concrete to be provided to all reinforcement including links to meet specified period of the resistance as per the tables given under clause 4.4.1 of this specifications.

The cover shall in no case be reduced by more than one third of specified cover or 5 mm whichever is less. Unless indicated otherwise on the drawings, clear concrete cover for reinforcement (exclusive of plaster or other decorative finish shall be as follows:

a) At each end of reinforcing bar not less than 25mm., nor less than twice the diameter of such, bar.

b) For a longitudinal reinforcing bar not less than 25 mm., nor more than 40 mm., nor less than the diameter of such bar. In the case of column of maximum dimensions of 200 mm. or under, whose reinforcing bars do not exceed 12 mm., a cover of 25 mm. may be used.

c) For longitudinal reinforcing bar in a beam, not less than 25mm., nor less than diameter of such bar.

d) For tensile, compressive, shear, or other reinforcement in a slab, not less than 25 mm, nor less than the diameter of such bar, and

e) For any other reinforcement not less than 15 mm, nor less than the diameter of such bar.

f) Increased cover thickness may be provided when surfaces of concrete members are exposed to the action of harmful chemicals (as in the case of concrete in contact with earth faces contaminated with such chemicals), acid, vapour, saline atmosphere, sulphurous smoke (as in the case of steam-operated railways) etc. and such increase of cover may be between 15 mm. and 50 mm. beyond the figures given in (a to e) above as may be specified by the Engineer-in-Charge.

g) For reinforced concrete members, totally immersed in sea water, the cover shall be 40 mm. more than specified (a to e) above.

h) For reinforced concrete members, periodically immersed in sea water or subject to sea spray, the cover of concrete shall be 50 mm. more than that specified (a to e) above.

i) For concrete of grade M 25 and above, the additional thickness of cover specified in (f), (g) and (h) above may be reduced to half. In all such cases the cover should not exceed 75 mm.

j) Protection to reinforcement in case of concrete exposed to harmful surroundings may also be given by providing dense impermeable concrete with approved protective coating, as specified on the drawings. In such case the extra cover, mentioned in (h) and (i) above, may be reduced by the Engineer-in-Charge, to those shown on the drawing.

k) The correct cover shall be maintained by cement mortar briquettes or other approved means. Reinforcement for footings, grade beams and slabs on sub grade shall be supported on precast concrete blocks as approved by the Engineer-in-Charge. The use of pebbles or stones shall not be permitted.

l) The minimum clear distance between reinforcing bars shall be in accordance with I.S. 456 or as shown in drawing.

3.7.12 The Bars Shall be kept in Correct Position by the Following Methods

a) In case of beam and slab construction precast cover blocks in cement mortar 1:2 (1 cement: 2 coarse sand) about 4 x 4 cm section and of thickness equal to the specified cover shall be placed between the bars and shuttering, so as to secure and maintain the requisite cover of concrete over reinforcement.

b) In case of cantilevered and doubly reinforced beams or slabs, the vertical distance between the horizontal bars shall be maintained by introducing chairs, spacers or support bars of steel at 1.0 metre or at shorter spacing to avoid sagging.

c) In case of columns and walls, the vertical bars shall be kept in position by means of timber templates with slots accurately cut in them; or with block of cement mortar 1:2 (1 cement : 2 coarse sand) of required size suitably tied to the reinforcement to ensure that they are in correct position during concreting.

d) In case of other R.C.C. structure such as arches, domes, shells, storage tanks etc. a combination of cover blocks, spacers and templates shall be used as directed by Engineer-in-Charge.

3.7.13 Inspection

The contractor must obtain the approval of the Engineer for the reinforcement laid, before any concrete is placed in the forms. The reinforcement at this time shall be free from loose rust or scale or other coatings that may destroy or reduce bond.

3.7.14 Mode of Measurement for Reinforcement for R.C.C. Works

Reinforcement as detailed in schedule of quantities shall be measured for payment lineally as per the cutting length nearest to a centimetre shown in bar bending schedule submitted by the contractor and approved by the Engineer-in-Charge and weight calculated based on the standard weights as per I.S.1786, as indicated in the following table:

Table 3.15: Standard weight

Nominal size in mm	6	7	8	10	12	16	18	20
Cross Sectional area in mm2	28.30	38.50	50.30	78.60	113.10	201.20	254. 60	314.30
Mass / Weight in Kg / RM	0.222	0.302	0.395	0.617	0.888	1.580	2 .000	2 .47

Nominal size in mm	22	25	28	32	36	40	45	50
cross Sectional area in mm2	380.30	491.10	614.00	804.60	1018.30	1257.20	1591.10	1964.30
Mass / Weight in Kg / RM	2 .980	3.850	4.830	6.310	7.990	9.850	12.500	15.420

No allowance shall be made/ be measured in the weight for rolling margin. If weight of bar(s) found to be more than the standard weights, the measurement / payment shall be restricted to the standard weights as above. However, if weight of bar(s) found to be less than the standard weights (but within the permissible limit), the measurements / payment for the same shall be as per standard weights.

Only authorized laps shall be measured. The cost of steel used by the contractor in the reinforcement of beams, slabs and columns etc. will be paid as per the rate of reinforcement only up to the extent shown in the drawings. As far as possible laps in bars shall be avoided. Any laps and hooks provided by the contractor other than authorized as per approved bar bending schedule will be considered to have been provided by the contractor for his own convenience and shall not be measured for payment. Pins, chairs, spacers shall be provided by the contractor wherever required as per drawing and bar bending schedule and as directed by the Engineer-in-Charge and shall be measured for payment. Fan hooks as required shall be provided by the contractor under this item and shall be measured for payment The rate shall include the cost of all materials and labour required for all above operations including transport, wastage, straightening, cutting, bending, binding and the binding wire required.

The wastage as specified in clause of condition of contract shall be recovered at issue rate from the Contractor.

The rate quoted for reinforcement should include cost of receiving, storing, cleaning, cutting, bending, placing, binding, with contractor's own binding wire, including providing, cutting allowance, rolling margin and preparation of bar bending schedules etc. complete including transporting, handling, taxes and levies.

3.8 Plasticizer

3.8.1 Material

The plasticizer to be used shall be of approved make like Conplast of Fosroc, BASF or equivalent as per I.S. The material will be used as per manufacturer's specification.

3.8.2 Mode of Measurement

The payment will be paid in unit of Litre basis of actual material used as per manufacturer's specification.

3.9 Ready Mix Concrete

3.9.1 Scope

Ready mix concrete shall be allowed during pre-construction stage till installation of Batching plant on site. Concrete shall conform to latest revision of IS: 4926 following are the requirement for supply and laying of R.M.C

Concrete delivered at site shall be in a plastic condition and requiring no further treatment before being placed in the position in which it is to set and harden. It should be ensured by the Contractor that any Ready Mix Concrete should be placed in position within a maximum period of two hours from its batching time.

The process of continuing the mixing of concrete at a reduced speed during transportation to prevent segregation should be ensured on truck mounted equipment designed to agitate concrete during transportation to the site of delivery.

Concrete produced by completely mixing cement, aggregates, admixtures if any and water at a stationary central mixing plant and delivered in containers fitted with agitating devices. The concrete may also be transported without being agitated as a special case and as requested.

Concrete produced by placing cement, aggregates and admixtures, if any other than those to be added with mixing water, in a truck mixer at the batching plant , the addition of water and admixtures to be added along with mixing water, and the mixing being carried out entirely in the truck mixer either during the journey or on arrival at the site of delivery. No water shall be added to the aggregate and cement until the mixing of concrete commences.

3.9.2 IS Codes

IS : 4926 – Ready mix concrete

Other Code shall be as per concrete Work Specification.

3.9.3 Material Specification

3.9.3.1 Cement

Cement used shall be of specified grade ordinary Portland cement or low heat Portland cement conforming to IS: 269 ordinary Portland cement shall be used.

3.9.3.2 Fly Ash

Fly ash when used for partial replacement of cement, shall conform to the requirements of IS-3812 (Part I) and as specified by the users.

3.9.3.3 Aggregate

It shall conform to IS: 383. Fly ash when used as fine aggregate shall conform to the requirements of IS 3812 – (Part - II).

3.9.3.4 Water

Water used for concrete shall conform to the requirement of IS 456.

3.9.3.5 The admixtures

It shall conform to the requirements of IS:456 and their nature, quantities and methods of use shall also be specified. Fly ash when used as an admixture for concrete shall conform to IS : 3812 (Part II). However, partial replacement of cement by fly ash shall not be more than 15% of designed requirement. In case if fly ash is used more than 15%, the same shall be guided under table of the IS, and in which case specific care shall be taken in terms of curing, protecting, repairing, finishing, de-shuttering etc. as detailed in the Chapter “Fly Ash Concrete”, here in after.

3.9.4 Supply

The ready-mixed concrete shall be manufactured and supplied on either of the following basis:

- Specified strength based on 28-day compressive strength of 15 -cm cubes tested in accordance with IS : 456.
- Specified mix proportion.

NOTE : Under special circumstances and as specified the strength of concrete in (a) above may be based on 28-day or 7-day flexural strength of concrete instead of compressive strength of 15-cm cube tested in accordance with IS : 456.

When the concrete is manufactured and supplied on the basis of specified strength, the responsibility for the design of mix shall be that of the Contractor and the concrete shall conform to the requirements specified.

When the concrete is manufactured and supplied on the basis of specified mix proportions, the responsibility for the design of the mix shall be that of the Contractor and the concrete shall conform to the requirements specified.

1.1.1 Construction Specification

When a truck mixer or agitator is used for mixing or transportation concrete, no water from the truck-water system or from elsewhere shall added after the initial introduction of the mixing water for the batch, when on arrival at the site of the work, the slump of the concrete is less that specified, such additional water to bring the slump within limits shall be injected into the mixer under such pressure and direct flow that the requirements for uniformity specified.

Unless otherwise specified when a truck or agitator is used for transporting concrete, the concrete shall be delivered to the site of the work and discharge shall be complete within 1 ½ hour (when the prevailing atmospheric temperature above 20^0C) and within 2 hours (when the prevailing atmosphere temperature is at or below 20^0C) of adding the mixing water to the mix of cement and aggregate or adding the cement to the aggregate whichever is earlier.

Adequate facilities shall be provided by the manufacturer/supplier to inspect the materials used the process of manufacture and methods of delivery of concrete. He shall also provide adequate facilities to take samples of the materials used.

The tests for consistency or workable shall be carried out in accordance with requirements of IS 1199 by such other method as may be agreed to between the purchaser and manufacturer.

The sampling and testing of concrete shall be done in accordance with the relevant requirements of IS 456, IS 1199 and IS 516.

The compressive strength and flexural strength tests shall be carried out in accordance with the requirement of IS: 516 and the acceptance criteria for concrete whether supplied on the basis of specified strength or on the basis of mix proportion, shall conform to the requirements and other related requirements of IS 456.

The testing shall be carried out in accordance with the requirements and the cost shall be borne by the Implementation Contractor.

The manufacturer shall keep batch records of the quantities by mass all the solid materials, of the total amount of water used in mixing and of the results of all tests. If required insisted, the manufacturer shall furnish certificates, at agreed intervals, giving this information.

3.9.5 Method of Measurement

Ready mixed concrete (RMC) is the same as mode of measurement for concrete work already mentioned.

However, consumption of RMC shall be maintained at site. Wastage, spill over, wastage due to pump blockage etc. shall not be considered for payment.

3.10 CAPCELL-HD-100 joint filler sheet

3.10.1 Material

The Capcell-HD-100 Joint filler sheet shall be as per BS-5628-(part 3),

3.10.2 Workmanship

Boards shall be placed in locations before concreting as instructed by the Engineer. The work shall be done at all levels without any extra cost. The thickness of the board shall be as specified in the item specification.

3.10.3 Mode of Measurement

This shall be measured in Sq. M for actual measured quantities. Payment shall be in Sq.M basis for different thickness as per item description.

3.11 Poly urethane / Silicon sealant

3.11.1 Material

Polyurethane/silicon sealing compound of BASF, Fosroc or equivalent make confirming to ASTM C920:08, Standard Specifications for Elastomeric Joint Sealant as filler material as per manufacturer's specification

3.11.2 Workmanship:

This shall be filled in the expansion joints as directed by the Engineer / shown in the drawings. The joints shall be of uniform width and care shall be taken for proper bonding of the joints.

3.11.3 Mode of Measurement

This shall be measured in RMT for specified width and depth as per the item in the Schedule of Quantities.

3.12 Grouting Cement mortar / GP2

3.12.1 General

The grouting material shall solidly fill the spaces to be grouted and permanently retain its original volume so that the base plate will be held firmly in set position. The amount of water used in mixing shall be kept to a minimum.

All grouting shown on the drawing must be carried out with a pre packed cement based product which is chloride free. It shall be mixed with clean water to the required consistency. The grout must not bleed or segregate. A positive volumetric expansion shall occur while the grout is plastic by means of gaseous hydrogen free system. The grout must also be compensated for shrinkage in the hardened state as per ASTM C 1107-91.

The compressive strength of the grout must exceed 55 N/mm_2 at 7 days and 65 N/mm_2 at 28 days. The flexural strength of grout must exceed $9N/mm_2$ @ 28 days. The fresh wet density of the mixed grout must exceed 2200 kg/m^3. The storage, handling and placement of the grout must be in strict accordance with the manufacturer's instructions.

3.12.2 Shims

Removal or retaining of the shims or wedges shall be done as per instruction of Engineer-in-Charge. The width of the shims shall be 50 mm less than the space between two adjacent anchor bolts or 75 mm whichever is less. The length of shim shall be same as base plate width and the thickness shall be kept as required, however minimum number of shims in each pocket should be used as far as possible. If wedges are used, they shall preferably be put in between base plate and shims.

For column having erection weight more than 20 tonnes, shims will be provided in every alternate bolt pocket and retained under the grout. Voids formed on removing the shims shall be grouted with the similar grout mixture.

If these are to be removed after the grout has hardened, they should be treated with a thin layer of grease.

3.12.3 Preparation of Foundation

The substrate surface must be free from oil, grease or any loosely adherent material. If the concrete surface is defective or has laitance, it must be cut back to a sound base. Bolt holes and fixing pockets must be blown clean of any dirt or debris.

Several hours prior to placing, the concrete substrates should be saturated with fresh water. Immediately before grouting takes place any free water should be removed with particular care being taken to blow out all bolt holes and pockets.

It is essential that this is clean and free from oil, grease or scale. Air pressure relief holes should be provided to allow venting of any isolated high spots.

3.12.4 Form Construction

In order to obtain a solid layer of grout under the structure the grout shall be held firmly in place by strong, well braced form held tightly around the foundation and all joints shall be tight to prevent leakage. It is preferable to use 40 to 50 mm thick finished lumber, if possible. The form should be at least 100 mm higher than the bottom of the structure to provide a fluid head which will help to force the grout completely under the structure and inside any hollow spaces in its base.

The formwork should be constructed to be leak-proof. This can be achieved by using foam rubber strip or mastic sealant beneath the constructed formwork and between joints. In some cases it is practical to use a sacrificial semi dry sand and cement formwork. The formwork should include outlets for pre-soaking.

This must be kept to a minimum. Generally the gap width between the perimeter formwork and the plate edge should not exceed 150mm on the pouring side and 50mm on the opposite side. It is advisable, where practical, to have no gap at the flank sides.

3.12.5 Cleaning Foundation Top

In addition to the preparation of the foundation top as described herein above, it is also required to clean the Foundation immediately preceding grouting. Also, to promote better bonding, the foundation top shall be wet. After the structure is installed and the form constructed, using compressed air, all dust and foreign matters shall be blown off the foundation top. The foundation top shall be wetted thoroughly, and a slight stream of water shall be kept running on it for a period of two to four hours prior to starting the placing of grout. When ready to grout, again using compressed air all excess water on foundation top and in foundation bolt holes shall be blown off.

3.12.6 Preparation of Grouting Mixture

Grouting of anchor bolts, holes, pockets and under base plates of structure, have been broadly classified into two categories, e.g. non-shrinking grout and ordinary grout.

Non shrinking grout shall consist of 1 part of ordinary Portland cement: 1 part of clean, dry well graded sand: 1 part of Ferro grout or similar additive (as approved by the Engineer-in-Charge). Water should be kept at minimum to make the mix place able/workable.

Non shrinking grout shall be used for all structure frame supports or platform having height more than 6 m.

For best results a mechanically powered grout mixer should be used. When quantities up to 50kg are used, a heavy duty slow speed drill (400-500 rpm) fitted with a paddle is suitable. Larger quantities will require a heavy duty mixer to enable the grouting operation to be carried out continuously, it is essential that sufficient mixing capacity and labour are available. The use of a grout holding tank with provision to gently agitate the grout may be required.

The Mortar mix for ordinary grout shall consist of 1 part of ordinary Portland cement parts of clean dry well graded sand and mixed to the minimum consistency required. Water shall be kept enough to make the mix place able. The mix shall be poured under a suitable head and tamped until the space has been completely filled.

Ordinary grout shall be used for grouting purposes in:
- All structural frames or platforms having height less than 6.0 m.
- All other miscellaneous foundations on piles or paving.

3.12.7 Placing the grout mixtures

Consistency of grout mix GP2

The quantity of clean water required to be added to a 30kg bag to achieve the desired consistency is given below:

Pourable (@ w/p=0.13) : 3.9 litres
Flowable (@ w/p=0.14) : 4.2 litres

The selected water content should be accurately measured into the mixer. The total content of the Conbextra GP3 bag should be slowly added and continuous mixing should take place for 5 minutes. This will ensure that the grout has a smooth even consistency.

At 30 deg. C place the grout within 20 minutes of mixing to gain full benefit of the expansion process. Conbextra GP3 can be placed in thicknesses up to 100mm in a single pour when used as an under plate grout. For thicker sections it is necessary to fill out Conbextra GP3 with well graded silt free aggregate to minimise heat build-up. Typically a 10mm aggregate is suitable. 50 - 100% aggregate weight of Conbextra GP3 can be added.

Pouring should be from one side of the void to eliminate any air or pre-soaked water becoming trapped under the base plate. It is advisable to pour the grout across the shortest distance of travel. The grout head must be maintained at all times so that a continuous grout front is achieved. Where large volumes have to be placed Conbextra GP3 may be pumped. A heavy duty diaphragm pump is recommended for this purpose. Screw feed and piston pumps may also be suitable.

Any bolt pockets must be grouted prior to grouting between the substrate and the base plate. Continuous grout flow is essential. Sufficient grout must be prepared before starting. The time taken to pour a batch must be regulated to the time to prepare the next one.

When the air or contact surface temperatures are 10_0C or below on a falling thermometer, warm water (30 – 40 deg. C) is recommended to accelerate strength development. For ambient temperature below 10 deg. C. the formwork should be kept in place for at least 36 hours. Normal precautions for winter working with cementitious materials should then be adopted.

At ambient temperatures above 40 deg. C, cool water (below 20 deg. C) should be used for mixing the grout prior to placement.

Sufficient equipment, paddles, and rods to force the grout under the base plates, flexible steel strips of 1.5 mm x 12 mm or steel cable of 5 to 10 mm diameter long enough to pass under the base plate structure sufficiently on each side to allow holding at each end while the grout is being poured, the strips shall be dragged back and forth continuously, this will aid to uniform grout distribution. Supply of compressed air, hose and a nozzle with a piece of pipe long enough to reach under the base plate to blow all the dirt and excess water just before grouting.

The grout should be poured into the form on one side of the base plate only. Continuous moving of the steel strips and ramming with rods will carry the grout under the equipment base and through to the other side. After grout has appeared all round the equipment base, and has reached the level of the bottom of the base, it is permissible to pour grout into the form at all points around the equipment. Pouring and agitation of the grout should be continued, until a level is reached about 100mm higher than the bottom of the base. All the steel strips or wires are to be removed and the grout thoroughly packed to fill the voids left by the strips. When the grout has taken an initial set, and further flow is impossible the grout is to be cut from around the outside of the base, down to a level even with the base.

On completion of the grouting operation, exposed areas should be thoroughly cured. This should be done by the use of Concure WB curing membrane, continuous application of water and/or wet hessian.

3.12.8 Removal of shims and wedges and final alignment checking

After completion of grouting as described above the grouting mixture shall be allowed to harden for a period of 5 days. At the end of this period, the wedges or shims may be removed. The anchor bolts are tightened uniformly. The alignment of the structure should now be re-checked. If serious misalignment is indicated, it shows that grouting has not been done properly, and it may be necessary to tear out the grout, realign and grout again. If the alignment is correct, the voids left by the removal of shims (if it is removed) must be filled up with the similar mixture of grout.

Note : Clean-up

- Upon the completion of concrete work, all forms, equipment, construction tools protective coverings and any
- Debris resulting from the work shall be removed from the premises.
- All debris, i.e. empty containers, wooden pieces etc. shall be removed.
- The finished concrete surfaces shall be left in a clean condition satisfactory to EIC.

4 Masonry Work

4.1 Concrete Block Masonry

4.1.1 Hollow and solid concrete blocks

These shall conform to the requirements of IS:2185 - Specification for hollow and solid concrete blocks except with regard to the mix of cement concrete and sizes of aggregates which shall be as indicated. Hollow blocks shall be sound, free from cracks, broken edges, honey combing and other defects that would interfere with the proper placing of block.

The concrete mix used for blocks shall not be richer than 1 part by volume of cement to 6 parts by volume of combined aggregate before mixing.

4.1.2 Dimensions and Tolerances

Concrete masonry building units shall be made in sizes and shapes to fit different construction needs. They include stretcher, corner, double corner or pier, jamb, header, bull noise, and partition block.

Concrete Block-hollow (open or closed cavity) or solid shall be referred to by its nominal dimensions.

The nominal dimensions of concrete block shall be as follows:
1. Length : 400, 500 or 600 mm
2. Height : 200 or 100 mm
3. Width : 50, 75, 100, 150, 200, 250 or 300 mm

In addition, block shall be manufactured in half lengths of 200, 250 or 300 mm to correspond to the full lengths.

The maximum variation in the length of the units shall be not more than 5 mm and maximum variation in height and width of unit, not more than 3 mm.

4.1.3 Classification

Hollow (open and closed cavity) Concrete Blocks:

The hollow (open and closed cavity) concrete blocks shall conform to the following three grades:
Grade ‘A’ – These are used as load bearing units and shall have a minimum block-density of 1500 kg/Cu.M. These shall be manufactured for minimum average compressive strengths of 3.5, 4.5, 5.5 and 7.0 N/mm2 respectively at 28 days (See Table below).

Grade ‘B’ – These are also used as load bearing units and shall have a block density less than 1500 kg/Cu.M but not less than 1000 kg/Cu.M. These shall be manufactured for minimum average compressive strengths of 2.0, 3.0 and 5.0 N/mm2 respectively at 28 days (See Table below).

Grade ‘C’ – These are used as non-load bearing units and shall have a block density less than 1500 kg/Cu.M. But not less than 1000 kg/Cu.M. These shall be manufactured for minimum average compressive strength of 1.5 N/mm2 at 28 days (see Table below).

Solid Concrete blocks shall conform to:

Grade 'D' – The solid concrete blocks are used as load bearing units and shall have a block density not less than 1800 kg/Cu.M. These shall be manufactured for minimum average compressive strengths of 4.0 and 5.0 N/mm2 respectively (See Table below).

4.1.4 Physical Requirements

Compressive Strength

The average crushing strength of eight blocks, when determined in accordance with IS:2185 shall be not less than as specified in table given below.

Table 4.1: Compressive strength of concrete block

Type	Grade	Density of Block Kg/mm3	Min. Average Compressive Strength of Units N/mm2	Min. Strength of Individual Units N/mm2
(1)	(2)	(3)	(4)	(5)
Hollow (open & closed cavity) Load bearing unit	A(3.5	Not less than 1500	3.5	2.8
	A(4.5)		4.5	3.6
	A(5.5)		5.5	4.4
	A(7.0)		7.0	5.6
	B(2.0)	Less than 1500 but not less than 1000	2.0	1.6
	B(3.0)		3.0	2.4
	B(5.0)		5.0	4.0
Hollow (open and Closed cavity) non-load bearing units	C(1.5)	Less than 1500 but not Less than 1000	1.5	1.2
Solid load bearing units	D(5.0)	Not less than1800	5.0	4.0
	D(4.0)		4.0	3.2

Drying Shrinkage

The drying shrinkage of the blocks (average of three blocks), when unrestrained, shall be determined in accordance with IS:2185 and shall not exceed 0.1 Percent.

Moisture Movement

The moisture movement (average of three blocks), when determined in the manner described in IS:2185, shall not exceed 0.09 Percent.

Water Absorption

The water absorption (average of three blocks), when determined in the manner described in IS-2185 shall not be more than 10 Percent by mass.

Face shells and webs

Face shells and webs shall increase in thickness from the bottom to the top of the unit. Depending upon the core moulds used, the face shells and webs shall be flared and tapered or straight tapered, the former providing a wider surface for mortar. The thickness of the face shell and web shell be not less than the values given in Table below.

Table 4.2: Cement concrete block properties

Nominal Block Width	Face shell Thickness;	Minimum Thickness of Web. Min.	Total Web Thickness per Course in any 200 mm length of Walling Min
(1)	(2)	(3)	(4)
100 or less	25	25	25
Over 100 to 150	25	25	30
Over 150 to 200	30	25	30
Over 200	35	30	38

4.1.5 Curing and Drying

The blocks shall be cured in an immersion tank or in a curing yard and shall be kept continuously moist for at least 14 days. When the blocks are cured in an immersion tank, the water of tank shall be changed at least every four days. After curing, the blocks shall be dried in shade before being used on the work. They shall be stacked with voids horizontal to facilitate through passage of air. The blocks shall be allowed to complete their initial shrinkage, before they are laid in wall.

4.1.6 Construction of Masonry

If hollow blocks are used, their hollows shall be filled up with cement concrete 1:3:6 using 12.5 mm nominal size aggregates, where required by Engineer.

4.1.7 Wetting of Blocks

Blocks need not be wetted before or during laying in the walls. In case the climate conditions so require, the top and the sides of the blocks may only be slightly moistened so as to prevent absorption of water from the mortar and ensure the development of the required bond with the mortar.

4.1.8 Laying

Blocks shall be laid in mortar, as indicated and thoroughly bedded in mortar, spread over the entire top surface of the previous course of blocks to a uniform layer of not more than 10 mm thickness.

All courses shall be laid truly horizontal and all vertical joints made truly vertical. Blocks, shall break joints with those above and below for not less than quarter of their length. Precast half-length closers (and not cut from full size blocks) shall be used. Wherever required, only machine cutting of block shall be permitted. for battered faces, bedding shall be at right angles to the face unless otherwise directed. Care shall be taken during construction to see that edges of blocks are not damaged.

4.1.9 Provision for Door and Window Frames

A course of solid concrete block masonry shall be provided under door and window openings (or a 100mmm thick precast concrete sill block under windows). The solid course shall extend for at least

200mm beyond the opening on either side. For jambs of very large doors and windows either solid unit are used, or the hollows shall be filled in with concrete of mix 1:3:6 using 12.5 mm nominal size aggregates.

4.1.10 Provisions for Roof

The course immediately below the roof slab shall be built with solid blocks. The top of the roof course shall be finished smooth with a layer of cement and coarse sand mortar 1:3, 10mm thick and covered with a thick coat of white wash or crude oil, to ensure free movement of slab.

4.1.11 Intersecting Walls

When two walls meet or intersect and the course is to be laid up at the same time, a true masonry bond between at least 50% of the units at the intersection is necessary. When such intersecting walls are laid up separately, pockets with 20 mm maximum vertical spacing shall be left in the first wall laid. The corresponding course of the second wall shall be built into these pockets.

4.1.12 Fixtures, fittings, etc.,

Fixtures, fittings, etc. shall be built into the masonry in cement and coarse sand mortar 1:3 while laying the blocks where possible. Hold fasts shall be built into the joints of the masonry during laying. Holes, chases, sleeves, openings etc. of the required size and shape shall be formed in the masonry with special blocks while laying, for fixing pipes, service lines, passage of water etc. After service lines, pipes etc. are fixed, voids, left, if any, shall be filled up with cement concrete 1:3:6 (1 cement : 3 coarse sand : 6 stone aggregate 20 mm nominal size) and neatly finished.

4.1.13 Finishes

Rendering shall not be done to the walls when walls are wet. Joints for plastering or pointing as specified shall be raked to a depth of 12 mm.

4.1.14 Mode of Measurement

Block work of thickness one block i.e. 190 / 200 mm and above shall be paid in units of cum.

In all cases, the quantities measured shall be executed after making necessary deductions for openings etc. as given below:-

a) No deductions shall be done for openings up to 1000 Sq.cm , ends of dissimilar materials, drainage holes, window/door holdfasts, concrete lintel bearings, landing slab bearing, beam bearing, chimney flues, cut-outs, iron fixtures, pipes up to 300mm dia.
b) It shall be clearly understood that the rates quoted by the Contractor include leaving openings, cutting chases in brickwork as per drawings/ instructions of the Engineer.

The rate includes necessary single or double scaffolding, centring, soaking of blocks, raking out joints and curing the work all complete.

The block partition wall shall be measured in Sqm. The deductions shall be as specified in the item above. Rate shall be includes for providing and placing of 2 nos. of 8 mm dia MS bars or 25mm x 1.2 mm deep iron band, raking out joints and curing the work all complete.

5 Doors and Windows

5.1 Scope

The work in general shall consist of supplying assembling and/or erecting and installing of all doors, windows, ventilators, louvers, rolling shutters, glazed partitions, etc. as shown on drawings with all materials complete including supply and fixing of glass and glazing.

Supply, deliver, fabricate, install and warrant the works in strict compliance with the materials and workmanship requirements of the Technical Specification as per site conditions.

Where required to prepare drawings these shall be limited to final detailing of components and systems indicated on the Design Drawings, necessary to demonstrate their safe installation.

Where alternative products are offered by the Contractor for acceptance by the Client, provide full supporting documentation in respect of the complete system or installation, including its value engineering proposals.

5.2 Applicable Codes and Specifications

The following codes, standards and specifications are a part of this specification. All standards, tentative specification, specifications, codes of practices referred to herein shall be the latest edition including all applicable official amendments and revisions.

In case of discrepancy between this specification and those mentioned elsewhere, this specification shall prevail.

IS:1948 -	Aluminium doors, windows and ventilators
IS:1949 -	Aluminium windows for industrial buildings
IS:6248 -	Metal Rolling Shutters and Rolling grills
I.S. 208	Specification for door handles
I.S. 723	Specification for steel countersunk head wire nails.
I.S. 2209 (Part — I)	Specification for mortice lock of timber.
I.S. 3564	Specification for door closers.
I.S. 4992	Specification for door handles for mortice lock.
I.S. 1081	Code of practice for fixing and glazing of steel and aluminium doors, windows and ventilators.
I.S. 1200 (Part XXI)	Method of measurement of building and civil engineering works. (Wood work and joinery)

5.2.1 Special Requirements

Architectural and Functional

All door sets shall be certified to achieve the performance criteria purpose for which they are designed.

The components of the entire assembly shall be covered by a single source warranty. Therefore, approval shall be obtained from the manufacturer for all materials to be used.

The works shall be securely fixed and sealed in accordance with the manufacturer's recommendations, not compromising the performance and certification of the door set.

Fittings and Fixtures / Ironmongery /operating mechanisms:

- Fittings and Fixtures / Ironmongery shall be as specified. The door set manufacturer shall ensure that the ironmongery does not compromise the certification of the works.
- For sliding door the sliding gear shall be integrated as indicated on the Design Drawings.
- Refer to the Door Schedule, Services EIC's documentation and the Fire Strategy Report with regard to door operations, security and additional devices, etc.

Concealed wire ways shall be allowed for connection to equipment within the framing system, back to the building power supply and Building Management System (BMS), etc. Co-ordinate provisions for electrical services and sensing devices and final connections. Connect all parts of equipment with insulated wiring as required for operation.

- Locations/ positioning of services shall be agreed with the Client where not indicated on the Design Drawings.
- Provide all necessary seals, gaskets and support framing etc. where services penetrate or interface with the other works.

Where glazing is specified, the glass thickness, type, make-up, risk of breakage and containment in the various locations shall be determined, taking full regard for the safety requirements.

All door sets shall be checked with regards to security and the relevant security symbols.

Fixing of signage shall be undertaken by methods that do not compromise with the performance and integrity of the door sets.

Door sets shall be factory pre-machined, and reinforced as necessary, for all specified ironmongery, prior to the application of factory finishes. Ensure that the door set manufacturer is in receipt of specimen furniture at the earliest opportunity after order placement to enable configurations of machinery.

The Implementation Contractor, in liaison with the manufacturer, shall ensure that the works as specified incorporate all necessary seals, sealants; fixings, accessories and ancillary items are supplied as required in accordance with and to achieve the requirements of the Technical Specification.

Door frames shall include integral or planted door stops that are within the frame profile, as accepted by the EIC.

The method of installation of door frames to sub-frames, partitions or block work shall provide for seals and components to meet all performance requirements.

Fixings:

- Fixings shall be concealed unless accepted otherwise by the EIC.
- Provide and install all fixing devices, including framing, bearing brackets and movement fixings and carry out all necessary preparation work such as drilling, plugging, screwing, bolting, cutting for anchor bolts or sockets to be cast-in, making good, including grouting-in of anchor bolts and fixing in order to secure the works to supporting walls.

Pack any gaps between door frame and wall with suitable material to meet performance requirements.

Shadow gap detail between wall and frame shall be as indicated on the Design Drawings, where required.

Ensure that door leaf (ves) and associated panels arrive on site with adequate surface protection. Material used for surface protection shall be of low flammability.

Doors shall be mortised, reinforced, drilled and tapped in shop for hinges, hooks and bolts. They shall also be reinforced for closers, push plates and other surface hardware where necessary. Drilling and tapping required for surface hardware shall be done at site. Where shown in drawing, provision shall be made for fixing glazing, vision panels, louvers etc.

Performance Requirements

Performance, as indicated on the associated Door Schedule, of the door set/ assembly type shall vary dependent on location. The Contractor shall use the applicable manufacturer's details of the required visual range to achieve the stated performance.

- Intumescent fire and brush smoke seals to suit fire and smoke ratings, as scheduled, shall be included.
- Acoustic seals to suit acoustic ratings, as scheduled, shall be included.

Industry recognised independent third party certification is required indicating compliance of individual door sets with the specified performance.

Ensure that all door sets are clearly marked on the hinge edge, with their door number and performance, enabling them to be reconciled with their intended location.

Door set components shall receive fire retardant treatments as required to satisfy the fire rating requirements.

Vision panels shall maintain the performance requirements of the door sets and shall be factory fitted.

Fire rated glass and associated beads, where required, shall be bedded in intumescent mastic in compliance with the manufacturer's performance certification.

Metal Finishes

All metal components shall be corrosion protected.

Visual Requirements

Door and door set T-sheet references shall be common to doors of equivalent visual appearance. Variations in performance requirements, dimensions, configurations (i.e. single leaf, leaf and a half, double leaf) and structural opening dimensions shall be as stated on the Door Schedule and as indicated on the Design Drawings.

Arrangement and configuration of door sets and the inclusion of any additional requirements, such as but not limited to, vision panels, louvers, door protection, in excess of the standard door blank, shall be as stated on the Door Schedule and/ or the Design Drawings.

Finishes shall be as indicated on the Door Schedule and/ or the Design Drawings, preparation for which shall be in accordance with the door set and finishes product/ material manufacturer's recommendations and, where applicable, the Technical Specification.

Dimensions and profiles of doors and frames indicated on the Door Schedule and/ or Design Drawings are nominal and indicative of the design intent. The Contractor shall maintain these dimensions and clearly state them on the fabrication / soap Drawings. Any deviations to the indicated dimensions shall be stated with the return of RFP Document.

Vision panels shall be, unless otherwise stated, clear, unwired, Kite marked (BSI Kite marks and / or Manufacturer ID marks shall be included on each glass pane in accordance with BS EN 1279.) safety glass in accordance with relevant standards and regulations

Where fire resisting glass is required, comply with the specified fire ratings and ensure that framing, beadings and gaskets are suitable for the fire rating to be achieved.

Beading, for vision panels, shall be a species of hardwood to match the facing of the door set and shall be accepted by the Client through sampling

5.2.2 Materials specifications

5.2.2.1 Aluminium Doors and Windows

Aluminium sections for fabricating doors, windows, partitions etc. shall be extruded sections conforming to IS: 1948 and 1949 or as manufactured by approved manufacturer. The alloy used shall conform to IS Designation HE 9-WP of IS: 733.

The mastic for caulking shall be of best quality from a manufacturer approved by the Client. In general, the mastic for fixing of metal frames shall be as per IS: 1081 and/or as approved by the Client.

- Manufacturer
  - Reference(s) as required to suit the scheduled performance criteria:
- Frames:
  - Galvanised steel as recommended by the door set manufacturer, of suitable thickness, to achieve the requirements of the Technical Specification.
  - Frames shall be profiled as indicated on the Design Drawings.
  - Frames shall be supplied with mitred and welded corners providing a clean smooth finish.
  - All mullions shall be minimum 50mm wide.
- Leaves:
  - Core from the manufacturer's range to achieve the requirements of the Technical Specification.
  - Facings shall be formed from two skins of galvanised sheet steel of suitable thickness, and with no face seams. Face skins shall be connected by a continuous interlocking edge lock seam associated with the specified product.
  - Door edges shall be bevelled.
- Finishes, refer to the Door Schedule:
  - Paint finished, colour to the acceptance of the Client through sampling.
  - Finishes shall be undertaken in accordance with the manufacturer's recommendations and subject to acceptance by the EIC through sampling.

5.2.3 Construction Specifications

5.2.3.1 Fabrication of Aluminium Doors

All work shall be fitted and shop assembled to a first class job, and ready for erection. Shop joints shall be made to hair lines and then welded or braced by such method as will produce a uniform colour throughout the work. Work on the above, other than described, shall be carefully fitted and assembled with neat joints with concealed fasteners. Whenever possible, joints shall be made in concealed locations and on edges of doors. Field connections of all work may be made with concealed screws or other approved type of fasteners. Glazing beads shall be snap fit type without visible screws and shall be of sizes to accommodate 6mm thick glazing. All work shall be adequately braced and reinforced as necessary for strength and rigidity

Extruded sections shall have a minimum 3mm wall thickness. All sections shall be approved by the Client before fabrication is taken up. Doors, frames mullions, transoms etc. shall be anodized in bath of sulphuric acid to provide a clear coating. The anodized materials shall then be sealed by immersing in boiling water for 15 minutes. A protective transparent coating shall be applied to the sections before shipment from the factory.

All work shall be fitted and shop assembled to a first class job, and ready for erection. Shop joints shall be made to hair lines and then welded or braced by such method as will produce a uniform colour throughout the work. Work on the above, other than described, shall be carefully fitted and assembled with neat joints with concealed fasteners. Whenever possible, joints shall be made in concealed locations and on edges of doors. Field connections of all work may be made with concealed screws or other approved type of fasteners. Glazing beads shall be snap fit type without visible screws and shall be of sizes to accommodate 6mm thick glazing. All work shall be adequately braced and reinforced as necessary for strength and rigidity.

5.3 Rolling Shutters

5.3.1 Scope

Scope of this specification covers the basic minimum requirement for the material, workmanship & Submittals.

The work also for requirements of providing and fixing in position Electro-mechanically operated, 2 Hr. Fire rated interlocking rolling shutters of approved make as shown in the drawings

5.3.2 Material specification

The Contractor before manufacturing the rolling shutter shall supply the detailed working drawing and got approved by EIC. They shall also obtain the approval of the door materials, all hardware, lifting arrangement, fixtures, etc. to be provided.

Rolling shutters shall conform to IS:6248.

Rolling shutter shall be of the size to suit the openings and shall be positioned as shown on the drawing and/or as directed by the EIC.

The shutter shall be fabricated from 18 gauge, 75mm wide Galvanised Lathe interlocked sections of effective bridge depth 12mm at 75mm rolling centres, interlocked with each other and ends locked with malleable cast iron or mild clips. The guide shall either be rolled or pressed deep channel sections, fitted

with necessary fittings and fixtures. The width of the channel shall be 25mm and the depth 75mm up to 8 M wide shutter. The depth shall be 100 mm for shutters above 8 M width.

The hood covers shall be made of 18 gauge G.I sheets with necessary stiffeners and frame work to prevent sag. The bottom lock plate shall be made of 3mm thick M.S. plate and 95 mm wide reinforced with angle iron of suitable section with 6mm dia. M.S rivets interlocked with stride of curtain. Where grills are specified in the drawings , shall be fabricated from 8 mm dia round / square bars with supporting frames , clips etic to allow free vertical movement of the shutter .

Unless otherwise specified for overall area of rolling shutters up to 8 m^2 pull and push type hand operated shutters shall be used shutters shall be provided with ball bearings.

For area larger than 10m^2 mechanical gear types or electrically operated from inside & outside, shutters shall be used. Operation of shutters shall be by means of worm and worm wheel and shaft arrangement and it shall be possible to operate the door either from inside or from outside. The shutter shall be capable of withstanding horizontal forces up to 100 kg/m^2 without any appreciable deflection.

5.3.3 Handling & Storage of Fabricated Materials

All doors windows, etc. shall be packed and crated properly before despatch, to ensure that there will be no damage to the fabricated materials. Loading into wagons and trucks shall be done with all care to ensure safe arrival of materials at site in undamaged condition.

When taking delivery of items supplied by Owner, the Contractor shall satisfy himself that the items supplied are up to the specified standard. Any defect detected shall promptly be brought to the notice of the EIC. All doors, widows etc. shall be stored under cover in a way to prevent damage or distortion. Special care shall be taken to prevent staining of aluminium products by rust, mortar etc.

5.3.4 Assembly & Erection at Site

In general, the fixing of steel doors, windows, ventilators, louvers, etc. shall conform to IS: 1081 and as shown on drawings. The Contractor shall assemble and install all steel doors, windows, sashes, fixed metal louvers, etc. including transoms and millions for composite units in respective places as shown on drawings, keeping proper lines and levels, and in approved workmanship manner, to give trouble free and leak-proof installations. The installation shall be done according to the instructions of the manufacturer, and/or as approved by the EIC. If required by the EIC, the installation shall have to be carried out under the supervision of the manufacturer's staff. The Contractor shall take every precaution against damage of the components during installation. Necessary holes, chases, etc. required for fixing shall be made by the Contractor and made good again as per original, after installation, without any extra charge.

After installation of steel doors, windows, etc. all abrasions to shop-coat of paint shall be retouched and made good with the same quality of paint used in shop coat.

All coupling mullions, transoms, frames etc. in contact with adjacent steel and other members, shall be well bedded in mastic. The Contractor shall bring to the site the mastic cement in original sealed containers of manufacturer and shall apply it as per the instructions. For all frames mastic shall be supplied by the Contractor and caulking done properly as per drawings, specifications and as per instructions of the EIC. Door shutters partitions hardware fixtures etc. shall be fixed only after major equipment’s have been installed in rooms.

Wherever required, nylon cords of approved quality shall be supplied along with pivoted sashes and shall be of adequate length to terminate one meter from the floor. Loose ends of cords shall end in metal or plastic pull as approved by the EIC.

5.4 Acceptance Criteria

For fabricated Items

- Overall dimensions shall be within ± 1.5mm of the size shown on drawings.
- Mullions, transoms etc. shall be in one length and permissible deviations from straightness shall be limited to ± 1.5 mm from the axis of the member.
- Door and windows shutters shall open without jamming. The clearance at head and jamb for door shutters shall not exceed 1.5 mm. For double leaf doors, the gap at the meeting stiles shall not be more than 1.5 mm.
- Door leaves shall be undercut where shown on drawings.
- Doors, windows, frames, etc. shall be on a true plane, free from warp of buckle.
- All welds shall be dressed flush on exposed and contact surfaces.
- Correctness of location and smoothness of operation of all shop installed hardware and fixtures.
- Provision for hardware and fixtures to be installed at site.
- Glazing beads shall be cut with mitered corners.
- Glazing clips, fixing devices etc. shall be supplied in adequate numbers.
- Shop coats shall be properly applied.
- Exposed aluminium surfaces shall be free from scratches, stains and discolouration. Anodised surfaces shall present a uniform and pleasing look.

For Installed Items

- Installations shall be at correct location, elevation and in general on a true vertical plane.
- Fixing details shall be strictly as shown on drawings.
- Assembly of composite units shall be strictly as per drawings, with mastic caulking at transoms and mullions, gaskets, weather strips etc. complete.
- All frames on external walls shall be mastic caulked to prevent leakage through joint between frames and masonry.
- All open able sections shall operate smoothly without jamming.
- Locks, fasteners etc. shall engage positively, Keys shall be non-interchangeable.
- Cutting to concrete or masonry shall be made good and all abrasions to shop paint shall be touched up with paint of same quality as shop paint.
- Aluminium doors, windows etc. shall be free from scratches, stain or discolouration.

5.4.1 Testing Procedures

- Provide certification to demonstrate that doors and frames/ door set assemblies have been previously tested to meet the requirements of the Technical Specification and to confirm successful achievement of test criteria stipulated within BS 476: Parts 22 and 31, or BS EN 1634: Parts 1 and 3 and IS 6248. Such certification must cover door and frame materials, glass and glazing materials and their installation, essential and ancillary ironmongery, hinges and seals.
- Provide independently certified test data and Agreement certificates that demonstrate that the proposed systems meet the requirements of the Technical Specification. Such tests shall demonstrate compliance in respect of the following performance criteria:
- Acoustic integrity.
- Structural stability.

- Testing procedures shall be undertaken to internal doorsets as appropriate and agreed with the EIC.
- Include for all off-site testing specified herein, which shall be carried out by an independent testing body accredited by the Indian.
- Test certificates shall not relieve the Contractor of his responsibilities regarding the performance and service life requirements of the doors and frames.
- Provide independently certified evidence that all specified variants of components comply with specified performance requirements.

5.4.2 Off-Site Testing

Impact Testing

- A soft body impact test to glazed elements shall be carried out in accordance with BS 6206 and BS EN 12600, conforming to the category requirements specified.
- A manual attack test shall be carried out in accordance with LPCB LPS 1175, conforming to the category requirements specified.
- The extent of any damage determined through testing shall be recorded and, where possible, quantified. Samples shall also be submitted to the EIC.

Acoustic Testing

The works shall achieve the specified requirements when tested in accordance with BS EN ISO 140: Part: 3 Samples of flush door shutters shall be subjected to following tests in accordance with I.S. 2202 (Part - I & II): End immersion test.

Knife test

Glue adhesion test.

All the sample shutters when tested shall satisfy the requirements of the tests as laid down in I.S. 2202 (Part -I & II) if the number of samples found unsatisfactory or a test is two or more the entire lot shall be considered unsatisfactory.

Fittings shall be provided to the Contractor free of cost by the Department as decided by EIC. Screws for fixing these fittings shall be provided by the Contractor and nothing extra shall be paid for the same.

5.4.3 Performance Requirements

- Comply with the general performance requirements and the following specific performance requirement.
- Door sets shall maintain the performance requirements of the walls/ systems that they are set in.

Acoustics

Test reports shall be provided demonstrating that all doors installed requiring to be sound rated meet the performance criteria as specified, and that values achieved in laboratory conditions are exceeded by a minimum of 2dB to correct the diminution anticipated once installed on Site.

Where no specific value is stated, the door set/ door assembly shall achieve as a minimum, the level of acoustic performance demanded by Approved Document E of the Building Regulations.

Frames of sound-rated doors shall be sealed such that there is no noise leakage around the frame.

Sound-rated doors shall be supplied complete with perimeter (including threshold, where indicated on the Door Schedule) seals and ironmongery to ensure that the seals operate effectively. No light shall be visible on either side of the door set when viewed in darkness with a light source on the other side.

Open keyholes and other openings shall not occur in sound-rated doorsets.

Doors shall close quietly without 'slamming noise'. The maximum sound level caused by door operation shall be 68dB (audible), as measured at 1m from both faces of the door with a sound level meter set to 'F' (fast) in response.

Fire and Smoke

General

Fire and smoke performance requirements shall be as indicated in the Design Drawings, the Fire Strategy Report and Section 2.1.

Reaction to Fire

Materials shall be either non-combustible or not easily ignitable with low flame spread characteristics and shall not produce excessive quantities of smoke or toxic gases under combustion, confirmed by testing in accordance with the appropriate IS code of Practice.

Fire Resistance

Fire door sets/ fire door assemblies, including glazing, ironmongery and seals, shall comply with the following fire performance requirements, including the installation method within door openings:

- Achieve the fire performance requirements indicated within the project Door
- Schedule, read in conjunction with the Fire Strategy Report.
- Fire door sets/ fire door assemblies shall be marked with a label or plug to confirm conformance to the requirements of one of the following third party certifying bodies:
- Fire Doors and Door sets Quality Assurance Scheme - TRADA.
- Certifier F i r e D o o r a n d Door set Scheme - BWF (British Woodworking Federation).
- Fire doors and frames including fire seals and all associated materials and installation shall comply with the requirements of BS 8214.
- Fire safety signs shall comply with BS 5499: Part 1 and shall be, unless otherwise stated, stainless steel discs of 75mm diameter. Signage shall be as indicated on the Door Schedule and/ or Section of the Technical Specification.

Where a floor or wall in the building is a fire-resisting separation, the junction between the works and the floor or wall shall maintain the integrity and insulation of the fire compartment, to prevent fire spread. Materials used to complete the junction shall accommodate movement between the works and other elements and their fire resisting performance shall not be affected by water from sprinkler discharge.

Horizontal/ vertical cavity barriers and fire/ smoke stopping shall be provided within the works, including at the junction of the works with all other fire resisting elements of the building.

All fire/ smoke barriers/ stops shall be positively fixed in position, in accordance with manufacturers' recommendations, in such a manner that they shall not become dislodged in the event of a fire. The fixing

shall secure the barrier/ stop in position for a period at least equal to that required for the compartment wall or floor against which the works abut.

Durability

The performance criteria shall be satisfied for the full service life of the works, as stated in the Technical Specification, provided always that the maintenance has been carried out as specified.

Selected materials shall be durable and satisfy the requirements of the Technical Specification for the service life of the works.

Exposure to sunlight during the lifetime of the works shall not reduce the performance or visual appearance of any element/ component. Take into consideration expected solar performance under varying conditions of solar radiation and external/ internal air velocity.

The works shall perform throughout the service life without failure resulting from defects in design, materials or workmanship. Failure shall be defined as breakage, disengagement of components, deflection beyond stated values, reduction in performance or unacceptable change in appearance including breakage.

The works shall comply with the Building Regulations, with regard to accidental damage/ robustness.

Abrasion Resistance

The works shall resist abrasion from agreed cleaning methods and maintenance systems without any noticeable change in surface appearance.

Demountability

Elements of the works shall be individually and independently removable, ensuring access for maintenance and/ or replacement of glazed/ solid infill units and other components in the event of breakage/ damage.

The removal of glazed/ solid infill units shall not affect the performance or safety of adjacent or any other part of the works. Provide a method statement for removal and replacement for acceptance.

Services

Where applicable, framing sections shall be capable of containing electrical cables serving security/ access equipment to activators and other components, as indicated on the Design Drawings.

Openings for the installation of cables shall be provided by the Implementation Contractor, after discussion and agreement with the EIC.

5.5 Workmanship

During construction, exposed components shall be protected after fitting and care taken to avoid fitting any components whilst 'wet' trades are still in progress. Protect from abrasives, acids and other corrosive materials.

Installation of Fire Door sets shall be carried out by sub-contractors who are members of a nationally recognised quality assurance scheme, and ideally the same scheme to which the door manufacturer subscribes.

Installation of Fire Door sets shall be in accordance with the recommendations of the Architectural and Specialist Door Manufacturer's Association Installation Guide.

Protection of Components

Do not deliver to site components, which cannot be put immediately into suitable dry, covered storage with a dry floor. Stack on bearers, separated with spacers to prevent damage by and to projecting ironmongery, beads, etc.

Protection of Components after Installation

Ensure that all exposed components have protective coverings during storage and after installation to protect factory applied finishes. Door leaves shall also be protected during onsite operations.

Moisture Content

All timber shall be subjected to controlled drying to ensure that the moisture content, if not otherwise specified, is suitable for the situation of the finished joinery. When fixed it shall remain stable and free from expansion, contraction or other movements detracting from the required performance or appearance.

During delivery, storage, fixing and thereafter till handing over, maintain conditions of temperature and humidity to suit the specified moisture content(s) of timber components. When instructed by the EIC, test components with an accepted electrical moisture meter used in accordance with the manufacturer's recommendations.

On-Site Dimensions

Implantation Contractor to take responsibility for all dimensions and for checking dimensions on site prior to manufacture.

Ensure that the Detailed Design accommodates any given tolerances and differences between actual site dimensions and dimensions shown on the Design Drawings.

Tolerances

Tolerances shall be measured against the relevant Base Reference Datum; Location Reference Point; Location Reference Plane; Location Reference Surface or Reference Element as defined.

All elements shall be set out to their correct position as indicated on the Design Drawings and/ or Working Drawings, within ±2mm or 0.1% of the length, whichever is the lesser.

Vertical elements shall be plumb, within ±2mm or 0.1% of the height, whichever is the lesser.

Horizontal elements shall be level, within ±2mm or 0.1% of the length, whichever is the lesser.

The maximum variation in gap from a straightedge applied to a flat vertical plane shall be 2mm for a 3000mm straightedge and 1mm for a 1000mm straightedge.

The maximum variation in gap from a straightedge applied to a flat horizontal plane shall be 2mm for a 3000mm straightedge and 1mm for a 1000mm straightedge.

The maximum variation in gap from a straightedge applied to a flat inclined plane shall be 2mm for a 3000mm straightedge and 1mm for a 1000mm straightedge. Drainage requirements of inclined planes shall be maintained.

The maximum offset in plane, level or section between any two adjacent sections shall be ±1mm.

The average width of any panel to panel joint shall be within ±1mm of the nominal joint. Any variation shall be equally distributed with no sudden changes or steps.

The maximum deviation between adjacent tile/ panel surfaces either side of an expressed joint shall be 1mm.

The bow of any flat surface shall not exceed more than ±2mm from a 2000mm straightedge placed against it in any direction.

The straightness of any surface of an edge shall not deviate by more than ±2mm from a 2000mm straightedge placed against it in any direction parallel to the long axis of the element.

The centre section of any lineal element shall not bow by more than the lesser of ±2mm or 0.075% of the length of the element measured from a straight line between the ends of the element.

The cross-section of any element shall not be twisted by more than 1° from the intended alignment.

Dimensional and location tolerances of cut-outs for interfacing works shall be ±1mm the dimensions indicated on the Design Drawings. The Contractor shall verify, with the appropriate supplier/ trade Implementation Contractor, that such dimensions and locations are correct. Any deviation shall be agreed with the EIC.

Account shall be taken of the installation tolerance requirements such that repetitive elements are accurately located, relative to gridlines.

Tolerances shall not be cumulative. The most onerous tolerance shall apply.

The physical fitting together of any assembly of sub-elements shall be properly allowed for in the Detailed Design of the corresponding sub-elements.

The following tolerances apply to each individual component:

Length/ Width: Maximum allowed deviation is the lesser of 1.5mm up to 2000mm and 2.0mm above 2000mm of design dimension.

Thickness/ Depth (extrusion tolerances nominally): Maximum allowed deviation is ±0.5mm.

Installation Tolerances

The Working Drawings shall provide for sufficient tolerance in manufacture of the works in order to accommodate manufacturing tolerances of interfacing elements.

Full details shall be submitted to the EIC for review of the proposed methods for achieving and constantly monitoring the tolerances during all stages of the work. Detailed records of the constant control and tolerances achieved shall be submitted to the EIC.

Gaps to head and jambs of doors to frames shall be consistent, of minimal dimensions and shall maintain the performance and functional requirements of the door(s).

The gap at the threshold of a door shall provide a nominal 3mm clearance above the finished floor level.

The maximum variation from plumb shall be ± 1.5mm.

Cut-outs for interfacing works shall be to the dimensions shown on the Working Drawings ±1mm.

Horizontal Plan Position: For any element at any level whose position is defined in relation to a primary reference grid, the maximum allowed deviation from the Design Dimension to that reference grid is ±2mm.

Where a series of doors is arranged in an array of two or more, the maximum allowed deviation of the horizontal distance between any two adjacent elements is ±2mm from the corresponding Design Dimension.

Planarity: Any door whose position is defined from a reference plane shall not deviate from the Design Dimension of the reference plane by more than ±2mm measuring perpendicular to the defined plane.

The width of any joint shall not deviate from the nominal width by more than ±1mm of the joint width. Any variation shall be equally distributed with no sudden changes. The misalignment between joints shall not exceed 1mm.

Line and level shall be within ±2mm of the specified level.

The works shall be erected such that no point on any part is more than 1mm from its theoretical plane.

The dimensional and detailed provisions intended to accommodate the construction tolerances of surrounding elements in order to ensure that all aspects of the works relate satisfactorily to the works as a whole shall be stated and shown on the Working Drawings.

All tolerances stated shall be measured and monitored at a mean temperature to be agreed with the EIC.

Before work begins on site the proposed method of dimensional setting-out and cross-checking with adjacent trades and elements, to satisfy the accuracy requirements, shall be submitted to the EIC.

The checking of any setting-out or of any line or level by the EIC, or his representative, shall not in any way relieve the Contractor of his responsibility for the correctness thereof.

Alternative tolerances to those specified may be permitted at the EIC's discretion, provided they are agreed in advance of the manufacture of components.

Tolerances shall not be cumulative.

5.6 Submittals

Before bulk supply of material

Names of manufacturers for doors, windows etc.

Manufacturer's catalogue for all hardware and fixtures proposed to be used.

Before starting fabrication of all metal doors, windows, etc. the Contractor shall submit detailed fabrication drawings to the EIC for approval. The fabrication shall be started only after approval of drawings.

Before bulk supply. The Implantation Contractor shall submit for the approval of the EIC samples of all bought out items and samples of each type of fabricated item. The samples shall be retained by the EIC for comparison of bulk supply and returned to the Contractor towards the end for the final incorporation in the job.

Post contract award samples of the following shall be provided:

- 300mm x 200mm samples of all doors, including lipped edge detail with associated ironmongery, forming the acceptable control samples for the project.
- Door frame minimum 300mm of each type with associated ironmongery.
- Samples of fire and smoke seals.
- Samples of acoustic seals.
- Samples of glazing materials.

A sample of each type of door set shall be provided by the Implementation Contractor. After approval of all the samples by EIC / Company, the Contractor shall prepare the full size mock up for each type of door set showing fixing arrangements, routing of service cables and colour of the approved shade

5.7 Fittings and Fixtures

5.7.1 Scope

The work covered under these specifications consists of supplying different types of fittings and fixtures required for doors, windows, ventilators etc. The supply shall be in accordance with the specification, drawings / approved samples. Samples of various fittings and fixtures proposed to be incorporated in the work shall be submitted by the Contractor for approval of the EIC before order for bulk supply is placed.

The scope shall cover to assemble and fix carefully and accurately using fastenings with a matching finish supplied by the ironmongery manufacturer. To prevent damage to ironmongery and adjacent surfaces. At completion check, adjust and lubricate as necessary to ensure correct functioning

5.7.2 Codes, Standards and Rules

- IS: 1868
- IS 1341 (M.S.)
- IS : 205 IS : 362
- IS : 453
- IS : 3818
- IS 204 (Part II & I).
- IS : 2681
- I.S.281
- IS : 208.
- I.S. 2209.
- IS 4992
- IS : 3564

- IS: 3847
- IS: 1823
- IS 1868

5.7.3 Special Requirements

Hardware and fixtures shall be as specified in "Schedule of Fixtures" and the best quality from approved manufacturers (Refer to recommended vendor / brand information) shall only be used. The Contractor shall specifically state the particular manufacturer's material he proposes to use. "Schedule of Fixtures" is for the purpose of stating the minimum requirement and improper alignment or faulty operation due to inadequate strength of hardware or fixture shall entirely be the Implementation Contractor's responsibility. All hardware and fixtures shall be able to withstand repeated use. Door closers shall conform to IS: 3564 and shall be suitable for doors weighing 61-80 kg. Unless otherwise stated in schedule.

Each closer shall be guaranteed against manufacturing defect for one year and any defect found within this period shall be rectified or the closer replaced free of charge. Concealed door closers shall be either floor mounted or transom mounted, and suitable for installation with metal doors. It shall conform to the performance requirements and endurance test stated in IS : 3564 - Appendix A. The Contractor shall submit samples of each type of hardware to the EIC. The approved samples shall be retained by the EIC for comparison of bulk supply. The samples shall be returned to the Contractor towards the end for incorporation in the job.

5.7.4 System Description

All fittings and fixtures shall conform to relevant IS code and made of Stainless Steel or as specified. These shall be well made reasonably smooth and free from sharp edges, corners, flaws and other defects. Screw holes shall be counter sunk to suit the heads of the specified screws. All hinges pins shall be of aluminum alloy NR-6 or steel pins for aluminum hinges with nylon washers or as specified. All riveted heads pertaining to hinge pins shall be well formed. Screws supplied for fittings shall be of the same metal and finish as the fittings. However brass cadmium plated/chromium plated screws shall be supplied with aluminum fittings. Samples of each fixture/fitting shall be furnished by the Contractor for approval of the EIC. Order for procurement of fittings and fixtures in bulk shall be placed only after approval by the EIC.

The fittings and fixtures to be incorporated in the work shall be strictly according to the approved sample. Fittings shall be fixed in proper position as shown in the drawing and as directed by the EIC. These shall be truly vertical or horizontal as the case may be. Screws shall be driven home with a screwdriver and not hammered in. Recess shall be cut to the exact size and depth for the counter sinking of hinges. The fittings and fixtures shall be fixed in a workman like manner and any damages done either to fittings and fixtures or to the shutter frames etc. should be rectified by the Contractor at his own cost.

Fittings shall be of Stainless steel or as specified. The fittings shall be well made, smooth, and free from sharp edges and corners, flaws and other defects.

Stainless steel fittings shall be non-magnetic, rust & moisture proof, strong & sturdy. Pin of hinges shall also be of stainless steel.

5.7.5 Material Specifications

All fixtures and fittings for doors, windows, louvers, ventilators etc. shall be of stainless steel only.

Butt Hinges

Aluminum hinges shall be manufactured from the extruded sections and shall be free from cracks and other defects. S.S. butt hinges shall be cranked and manufactured from S.S. sheets. All butt hinges shall conform to latest I.S. specifications butt hinges shall generally conform to relevant I.S codes. The size of butt hinges shall be taken as the length of the hinge. Width of the hinge shall be measured from the center line of hinge pin to end of flange.

The Butt Hinges shall be in Pair of size 1.5 S/S hinge BS Class 8 BS476 part22 fire test BS7352.

Wherever specified S/S Pivot hinges shall be provided.

Tower Bolts

These shall generally conform to IS 204 (Part II & I). They shall be well made and shall be free from defects.

The tower bolts shall be of the following types:
SS semi barrel tower bolt with SS sheet pressed barrel and SS bolt or with SS barrel and SS Sheet bolt.

The knobs of SS tower bolts shall be cast and the bolt fixed into the knob firmly as per 1.S. specifications. The tower bolt shall be finished to correct shape and pattern so as to have a smooth action.

Knobs shall be properly screwed to the bolt and riveted at the back. The size of the tower bolt shall be taken as the length of barrel without top socket.

Deadlock

Where ever specified Top concealed flush bolt and Bottom concealed flush bolt shall be provided.

700mm bolt through pull handle

Door Latch

This shall be of SS, cast or as specified shall have smooth sliding action. SS Latch shall be satin finish or as specified. Where ever specified Single cylinder or Face fixed cylinder pull shall be provided.

Aldrops

These shall be oxidized brass or anodized aluminum, iron oxidized or as specified and shall be capable of smooth sliding action and shall be as per relevant I.S. code. Brass sliding door bolt (aldrop) shall be made from rolled brass generally confirming to IS : 2681. M.S. sliding door bolt shall generally conform to I.S.281. The hasp shall be of cast brass and screwed to the bolt in a workman like manner. Alternatively the hasp and the bolt may be in one piece. Bolts shall be finished to shape and threaded with worth standard and provided with round brass washers and nuts of square or hexagonal shape. All components shall be smooth and polished. The leading dimensions of aldrop shall be as the length of the bolt and specified diameter. Where ever specified 700mm bolt through pull handle shall be provided.

Door Handles- Bow/Plate Handles

These should generally conform to IS : 208. Unless otherwise specified door handles shall be of 100 mm size & windows handles of 75 mm size. These shall be of cast brass of specified size, shape and pattern as approved by the EIC. All edges and corners shall be finished smooth and correct to shape and

dimensions. Brass handles shall be finished bright, chromium plated or oxidized as specified. Anodized aluminum or iron oxidized (MS) handles shall be of specified size, shape and pattern. The size of the handle is taken as the inside grip of the handle. In case of iron oxidized handles, the same shall be manufactured from MS sheet pressed into oval section as per I.S. Where ever specified 2 nos. Straight lever handles (suitable for disabled use) on roses and/or Straight Lever handles on roses shall be provided.

Mortise Lock & Latch

This should generally conform to I.S. 2209. Handles shall conform to IS 4992. Mortise sash lock Euro profile and 5 pin Euro profile Cylinder / 3 key with turn 1 Euro profile Escutcheon, Thumb Turn Escutcheon on inside shall be provided or as specified body of approved quality, and shall be right or left handed as specified. The pair of handles shall be SS of approved shape and pattern. It shall be of the best Indian make of approved quality. The size of the lock shall be determined by its length. The lock for single leaf door shall have plain face and that for double leaf door a rebated face. Level handles with springs shall be mounted on plates and shall be of approved quality, anodized aluminum or as specified.

All bathroom doors shall be fitted with Mortise bathroom lock and Indicator Bolt (suitable for disabled use) with emergency release.

All glass doors shall be fitted with Glass Lock unless specified otherwise in the drawings.

Hydraulic Door Closer

This shall be generally conform to IS : 3564. Hydraulic door closer shall be of approved quality and make. The operation of the Hydraulic door closer shall be very smooth.

All overhead door closer shall be Slim line with delayed action.

Where ever specified floor spring shall be provided.

It shall be dual Speed of the Hydraulic door closer shall be adjustable and latch closing also shall be adjustable type. Suspension and lubrication of door closer shall be in perfect line and level.

The Contractor shall provide for all the incidentals required for fixing these fixtures and fittings such as cadmium plated screws etc. Fittings and fixtures shall be fixed securely in a workman like manner all as directed by the EIC. Any of the fixtures damaged during the fixing shall be removed and new one fixed in their place and the surface of joinery made good where affected, at his own expense. Mortise plates shall be used over holes where the bolts enter in the wood work. Metal sockets shall be provided to all bolts where the shoot enter brick, stone, concrete etc. The incidental Fixtures like mortise plates, metal sockets, screws etc. shall not be paid for separately.

Mortise Night Latch

This is a mortise lock having a single spring bolt withdrawn from the outside by using the key and from inside by turning the knob and with an arrangement whereby the lock can be prevented from being opened by its key from outside while the night latch is used from inside the room.

This should generally conform to IS: 3847. It shall be SS or as specified and of approved make. These shall be satin finished as specified. Normal size of the latch shall be denoted by the length of the face over the body in millimeters.

Floor Door Stopper

The floor door stopper shall conform to IS: 1823. This shall be made of cast brass of overall size as specified and shall have rubber cushion. The shape and pattern of stopper shall be approved by the EIC. It shall be of brass finished bright, chromium plated or oxidized or as specified. The size of door stopper shall be determined by the length of its plate. The body of the door stopper shall be cast in one piece. All parts of the door stopper shall be of good workmanship and finish and free from surface and casting defects. Aluminum stopper shall have anodic coating of not less than grade AC-b of IS 1868.

All bathroom doors shall be fitted with SS Clothes hooks as specified in the drawings. Where ever specified Kick plate square corners drilled & countersunk with screws (95 mm x 1.5 mm, width to suit) and/or Push plate square end radius corners (1025 x 100 x 1.5mm) drilled & countersunk with screws shall be provided. All Fire Check Doors shall be fitted with Panic Bar Handle as specified.

Testing Procedure

The testing shall confirm to the relevant Standard code of Practice.

5.8 Method of Measurement

All the fittings with all the necessary accessories shall be measured in numbers and it shall include the cost of all materials including taxes, excise duty, if any, loading, unloading, transporting, cost of screws, bolts and other accessories complete, if the same are not to be paid for separately as per schedule of quantities.

5.8.1 Submittals

A sample of each type of fitting and fixture shall be provided and agreed with the Company/EIC. After approval of all the samples by EIC / Client, the Contractor shall prepare the full size mock up for each type of doorset showing fixing arrangements, routing of service cables and colour of the approved shade.

5.8.2 Guarantee

A minimum guarantee of 24 months shall be provided from the date of handover of the project.

5.8.3 Safety

The Contractor shall consider all safety measures and precautions during the execution of the said work.

6 Plaster Finishing work

6.1 Cement Finish Plaster

6.1.1 Materials - Cement Mortar

Water, Cement and Sand shall conform to section of concrete work.

6.1.1.1 Proportion of Mix

Cement and sand shall be mixed to specified proportion, sand being measured by measuring boxes. The proportion of cement will be by volume on the basis of 50Kg/Bag of cement being equal to 0.0342 m^3. The mortar may be hand mixed or machine mixed as directed.

6.1.1.2 Proportion of Mortar

In hand mixed mortar. Cement and sand in the specified proportions shall be thoroughly mixed dry on a clean impervious platform by turning over at least 3 times or more till a homogeneous mixture of uniform colour is obtained. Mixing platform shall be so arranged that no deleterious extraneous material shall get mixed with mortar or mortar shall flow out. While mixing, the water shall be gradually added and thoroughly mixed to form a stiff plastic mass of uniform colour so that each particle of sand shall be completely covered with a film of wet cement. The water cement ratio shall be adopted as directed.

The mortar so prepared shall be used within 30 minutes of adding water. Only such quantity of mortar shall be prepared as can be used within 30 minutes.

6.1.2 Workmanship

6.1.2.1 Scaffolding

Wooden ballies, bamboos, planks, trestles and other scaffolding shall be sound. These shall be properly examined before erection and use. Stage scaffolding shall be provided for ceiling plaster which shall be independent of the walls.

6.1.2.2 Preparation of background

The surface shall be cleaned of all dust, loose mortar droppings, traces of algae, efflorescence and other foreign matter by water or by brushing. Smooth surface shall be roughened by wire brushing if it is not hard and by racking if it is hard. In case of concrete surface, if a chemical retarded has been applied to the form work, the surface shall be roughened by wire brushing and all the resulting dust and loose particles shall be cleaned off and care shall be taken that none of the retarded is left on the surface. Trimming of projections on brick/concrete surface wherever necessary shall be carried out to get an even surface.

Raking of joints in case of masonry wherever necessary shall be allowed to dry out for sufficient period before carrying out the plaster work.

Scaffolding for carrying out plastering work shall be double scaffolding having two sets of vertical supports so that the scaffolding is independent of the walls.

6.1.3 Preparation of Surface:

All putlog holes in brickwork and junction between concrete and brickwork shall be properly filled in advance. Joints in brick work shall be raked about 10 mm. and concrete surface shall be hacked to provide grip to the plaster. Projecting burrs of mortars formed due to gaps at joints in shuttering shall be removed. The surface shall be scrubbed clean with wire brush/coir brush to remove dirt, dust etc., and the surface thoroughly washed with clean water to remove efflorescence, grease and oil etc., and shall be kept wet for a minimum of two hours before application of plaster.

For external plaster, the plastering operation shall be started from the top floor and carried downwards. For internal plaster, the plastering operations may be started wherever the building frame and cladding work are ready and the temporary supporting ceiling resting on the wall of the floor have been removed. Ceiling plaster shall be completed before starting plaster to walls.

6.1.4 Applications of Plaster

The plaster about 15cm x 15cm shall be first applied horizontally and vertically at not more than 2 M intervals over the entire surface to serve as gauge. The surfaces of these gauges shall be truly in plane of the finished plastered surface. The mortar shall then be applied in uniform surface slightly more than the specified thickness, then brought to a true surface by working a wooden straight edge reaching across the gauges with small upwards and sideways movements at a time. Finally, the surface shall be finished off true with a trowel or wooden float according to the texture, smooth or sandy granular, as may be required. Excessive trowelling or over working the float shall be avoided. All corners, arises, angles and junctions etc. shall be carried out with proper templates to the size required.

Cement plaster shall be used within half an hour after addition of water. Any mortar or plaster which is partially set shall be rejected and removed from the site.

In suspending the work at the end of the day, the plaster shall be left out, clean to line both horizontally and vertically. While recommencing the plaster, the edges of the old work shall be scrapped clean and wetted with cement putty before plaster is applied to the adjacent areas to enable the two to properly join together. Plastering work shall be closed at the end of the day on the body of the wall and shall not be nearer than 15cm. to any corners or arises. Horizontal joints in plaster work shall not also occur on parapet tops and copings as these invariably lead to leakage. No portion of the surface shall be left out initially to be packed up later on.

Each coat shall be kept damp continuously till the next coat is applied or for a minimum period of 7 days. Moistening shall commence as soon as plaster is hardened sufficiently. Soaking of walls shall be avoided and only as much water as can be readily absorbed shall be used, excessive evaporation on the sunny or windward side of building in hot air or dry weather shall be prevented by hanging mats or gunny bags on the outside of the plaster and by keeping them wet.

The surface shall be finished smooth using cement and lime (60-70% lime and 40-30% cement) slurry at the ratio of 2.2 kg/m^2. The plastered surface shall be rubbed with iron plate as specified.

6.1.5 Mode of Measurements & Payment

The rates shall include for work at any height, position, and floor and for all necessary scaffolding, etc. as may be required. The rates shall also include for hacking and/or bush hammering to form key for plaster and for spatter dash treatment, as specified, as and where necessary.

- The rates shall also include for all work in narrow width, arises, rounded angles, chamfered external angles, drip moulds, grooves and for making good after all trades.
- The rate shall also include for groove with cement finish up to 12 mm x 6mm to be formed in plaster at junction of slab and beam and slab and brick without any extra charge. The rate shall also include for similar grooves in plaster at the junction of masonry and wood or steel
- Door/window/ventilator frame or at bottom of beam/lintels as drip moulds without extra charge.

  Sand used shall be 50% fine and 50% coarse for plaster unless otherwise specified.

All plastering shall be measured in Sqm, unless otherwise specified. Length, breadth or height shall be measured correct to a centimetre.

Thickness of the plaster shall be exclusive of the thickness of the key i.e. grooved or open joints in brick work, stone work, etc. or space between laths. Thickness of plaster shall be average thickness with minimum specified in item at any point on the surface.

The measurement of wall plastering shall be taken between the walls or partitions (dimensions before plastering being taken) for length and from the top of floor or skirting to ceiling for height. Depth of cover of cornices if any shall be deducted.

Soffits of stairs shall be measured as plastering on ceilings. Flowing/folding soffits shall be measured separately.

For jambs, soffits, sills, etc., openings exceeding 0.5 Sq.M., and not exceeding 3.0 Sq.M area deductions and additions shall be made in the following manner :-

- No deductions shall be made for ends joints, beams, posts, etc. for openings not exceeding 0.5Sq.m. each and no addition shall be made for reels, jambs, soffits, sills, etc. of these opening for finish to plaster around ends of joints, beams, posts, etc.
- Deduction for openings exceeding 0.5 m^2 but not exceeding 3.0 m^2 each shall be made as follows and no addition shall be made for reveals, jambs, soffits, sills, etc. of these openings.
- When both faces of any wall are plastered with same plaster, deduction shall be made for one face only.
- When two faces of any wall are plastered with different types of plasters or if one faces is plastered and the other pointed, deductions shall be made from the plaster or pointing on the side of frame for door, windows, etc. on which width of reveals is less than that on the other side but no deductions shall be made on the other side. Where width of reveals on both faces of all is equal, deductions of 50% of area of opening on each face shall be made from area of plaster and/or pointing as the case may be.

For openings having door frames equal to projection beyond the thickness of wall, full deduction for opening shall be made from each plastered face of the wall.

In case of openings having area above 3.0 m^2 each, deduction shall be made for the opening but jambs, soffits, and sills shall be measured additionally.

The rate shall be for an unit of one Square meter.

6.2 Mala finish plaster

6.2.1 Material

Cement, Sand, Water specified in item of cement finish plaster

6.2.2 Surface Preparation

Same as per Item no 5.1 Cement finishes plaster

6.2.3 Proportion

The proportion of the mortar shall be as specified under the respective items of work. Cement shall be mixed thoroughly in dry condition and then just enough water added to obtain a workable consistency. The quality of water, sand and cement shall be as mentioned in the Specifications for Concrete & allied works. The mortar thus mixed shall be used immediately and in no case shall the mortar be allowed to stand for more than 30 minutes after mixing with water.

6.2.4 Workmanship

The plaster shall be laid in a single coat. The mortar shall be splashed on the prepared surface with a **steel trowel and finished smooth by trawling**. The plastered surface shall be rubbed with iron plate till the surface shows cement paste. The work shall be in line and level. Curing of plaster shall be started as soon as the applied plaster has hardened enough so as not to be damaged. Curing shall be done by continuously applying water in a fine spray and shall be carried out for at least 7 days.

The plaster shall be carried out on jambs, lintel and still faces top and undersides, etc. as shown in the drawing or as directed by the engineer.

6.2.5 Mode of Measurement

The quantity of work to be paid for under this item shall be calculated in M^2. by taking the projected surface of the area plastered after making necessary deductions for openings, doors, windows etc. as given below :-

No deductions shall be made for opening or end steel joints, beams, post girders etc. upto 0.5 M^2 area. No addition shall be made for joints, softies and sills of such openings. This is applicable to both the sides of the wall.

Where opening exceeds 0.5 M^2. but does not exceed 3 M^2 and also when only one side of the wall is treated and other side is not treated, deduction shall be made if the width of the reveal on the treated sides is less than that on the untreated side but if the width of the reveal is more than no deduction nor addition shall be made for reveals for jambs, softies, sills etc.

For openings more than 0.5 M^2 but not exceeding 3 M^2 and also when both the sides of the wall is plastered with the similar plaster, deduction shall be made for one face only. But when both the sides are treated with different plaster, then deduction shall be made from the side on which the reveal is less and no deduction on the other side.

For openings whose respective areas exceed 3 M^2 deduction shall be made for the full opening of the wall treatment on both faces while at the same time jambs, sills and softies shall be measured in M^2 for payment. In measuring the jambs deduction shall not be made for the area in contact with the frames of doors, windows etc.

If the average thickness of the plaster is more than the specified thickness due to any account nothing extra shall be paid for the same.

Nothing extra shall be paid for double scaffolding and the rate is applicable for work at all levels.

6.3 Double Coat 20mm Sand face Plaster

6.3.1 Scope

The work under this section consists of providing and applying double coat of all external plastering work on masonry wall and RCC surfaces (wherever it is not coming in contact with the rain) in true to lines & levels as shown on the drawings and as specified herein. Architecture Groove, Pattas, Drip moulds,. Chicken mesh for joint in RCC / Masonry work, shall be carried out by Contractor including supply of materials, labour, plant, tools, scaffolding, complete in all respect as required for the work.

Sand face finished plaster by using “wooden gutka” finish only on top coat of plaster surfaces.

Machine mixed Cement mortar shall be used for plastering work.

6.3.2 Materials specification

Material specification for cement mortar shall conform to IS code.

6.3.3 Construction Specification

The work shall be carried out in two coats. The backing coat (base coat) shall be in C.M. 1:4 and the relevant specifications of item no. 5.03 shall be followed except that the thickness of the back coat shall be 12 mm. averages. Before the first coat hardens its surface shall be beaten up by edges of wooden tappers and close dents shall be made on the surface. The subsequent coat shall be applied after this coat has been allowed to set for 3 to 5 days depending upon the weather conditions. The surface shall not be allowed to dry during this period.

The second coat shall be completed to 8mm. thickness in C.M. 1:2 as described above. The surface shall then be tapped to uniform grained texture by using Gutka only, as specified. The sample of sand face shall be got approved before the work is started. The whole work shall be carried out uniformly as per the sample approved.

Curing

The curing shall be start overnight after finishing of the plaster work. The plaster shall be kept wet for a period of 7 days. During this period, it shall be protected from all damages.

Tolerances

Tolerances shall be measured against the relevant Base Reference Datum; Location Reference Point; Location Reference Plane; Location Reference Surface or Reference Element.

- All elements shall be set out to their correct position as indicated on the Design Drawings and/ or Working Drawings, within ±2mm or 0.1% of the length, whichever is the lesser.
- Vertical elements shall be plumb, within ±2mm or 0.1% of the height, whichever is the lesser.
- The maximum variation in gap from a straightedge applied to a flat vertical plane shall be 2mm for a 3000mm straightedge and 1mm for a 1000mm straightedge.
- The maximum variation in gap from a straightedge applied to a flat inclined plane shall be 2mm for a 3000mm straightedge and 1mm for a 1000mm straightedge. Drainage requirements of inclined planes shall be maintained.
- The maximum offset in plane, level or section between any two adjacent sections shall be ±1mm.
- The average width of any panel to panel joint shall be within ±1mm of the nominal joint.
- Any variation shall be equally distributed with no sudden changes or steps.
- The bow of any flat surface shall not exceed more than ±2mm from a 2000mm straightedge placed against it in any direction.
- The straightness of any surface of an edge shall not deviate by more than ±2mm from a 2000mm straightedge placed against it in any direction parallel to the long axis of the element.
- The centre section of any lineal element shall not bow by more than the lesser of ±2mm or 0.075% of the length of the element measured from a straight line between the ends of the element.
- The cross-section of any element shall not be twisted by more than 1° from the intended alignment.
- Dimensional and location tolerances of cut-outs for interfacing works shall be ±1mm the dimensions indicated on the Design Drawings. The Contractor shall verify, with the appropriate supplier/ trade Implementation Contractor, that such dimensions and locations are correct. Any deviation shall be agreed with the EIC.
- Account shall be taken of the installation tolerance requirements such that repetitive elements are accurately located, relative to gridlines.
- Tolerances shall not be cumulative. The most onerous tolerance shall apply.

6.3.4 Method of Measurements

The method of Measurement shall paid as per IS 1200. The relevant specifications for plastering work shall be followed

The rate shall be for a unit of one Square meter.

6.4 Waterproof Cement Plaster

6.4.1 Scope

The work under this section consists of providing and applying double coat water proof of all plastering work on masonry wall and RCC surfaces in true to lines & levels as shown on the drawings and as specified herein. Including supply and mixing of water proofing materials, labour, tools, scaffolding, curing etc. complete in all respect as required for the work.

Plaster shall be included for water proofing agent, and top surface shall be smooth finished plaster by using Cement slurry.

Machine mixed Cement mortar shall be used for plastering work.

6.4.2 Code, Standard and Rule

As per applicable for plastering work.

6.4.3 Materials specification

The relevant specifications of item of plastering work shall be followed except that the water proofing materials of approved make, conforming to item of water proofing shall be added to the cement at the rate specified by manufacturer or as directed by the EIC. The proportion of water proofing materials shall be mixed by using weigh batcher.

Water proofing material shall be as recommended by the manufacturer specification.

6.4.4 Construction specification

Same specification applies for relevant item of plastering work. Plaster shall be in double coat and thickness shall be 25mm or specified in Item description.

The plaster shall be of specified thickness and of mortar proportions. The Contractor shall use approved waterproofing admixture made by reputed manufacturer in the mortar for plaster work. The quantity to be used shall be in accordance with the manufacturer's instructions, however subject to the approval of the EIC. The use of calcium chloride shall be prohibited unless specifically allowed by EIC and shall conform to IS: 2645. The plaster shall be cured at least for 7 days.

Tolerances

Tolerances shall be measured against the relevant Base Reference Datum; Location Reference Point; Location Reference Plane; Location Reference Surface or Reference Element as per above item specification of plaster work.

6.4.5 Method of Measurements

The Measurement shall be as per IS 1200.

The payment shall be made for 25mm thick water proof plaster work, as per the relevant specifications

The rate shall be for a unit of one Square meter, for plaster work using water proofing material per bag of cement weighing 50 kg.

7 Painting work

7.1 General

7.1.1 Scope

Supply, deliver, install and warrant the works in strict compliance with the materials and workmanship requirements of the Technical Specification.

7.1.2 Architectural and Functional Requirements

General

- Surfaces to receive finishes shall be indicated on the Design Drawings/ Finishes Schedule.
- Surfaces shall be prepared in accordance with the manufacturer's recommendations.
- Where not specified, primers, base coats and under coats shall be in accordance with the manufacturer's recommendations to suit substrates, finish and performance requirements.
- Application shall be in accordance with the manufacturer's recommendations. Agree application method with the EIC where method affects finished surface texture.
- Refer to the Design Drawings/ Finishes Schedule for colours.
- Products/ materials applied as floor finishes shall include manufacturer's data stating the PTV and Rz values to demonstrate compliance with the performance requirements.

7.1.3 Samples and Testing

Sample shall be 300mm x 200mm samples of accepted coating system on substrates representative of those to be used in the works, in specified colour(s) and gloss levels.

Testing shall be Include for all testing and inspections specified herein, which shall be carried out by an independent testing body accredited or certified.

Evidence of Performance

Provide technical information/ test certificates to demonstrate that coatings meet the requirements of the Technical Specification.

Testing and provision of data does not relieve the Contractor of his responsibilities regarding the performance requirements, service life and warranties given.

7.1.3.1 On-Site Testing/ Inspections

Inspection

Together with the applicator alert the coating manufacturer seven days prior to the start of the application programme and permit the manufacturer to inspect the work in progress and prepare inspection reports in accordance with the standard conditions of Contract. Notify the EIC of projected dates for the commencement of surface preparation and coating.

- The proprietary manufacturer shall dispatch personnel to inspect the work in progress and all quality control records, take dry film thicknesses and other measurements, and take samples of their products if deemed necessary.
- Do not comply with any directions or requests (other than those pertaining to health and safety matters), which vary the Technical Specification unless and until confirmed in writing by the EIC.

The coating manufacturer shall forward a copy of the inspection report direct to the EIC without delay.

Technical support from the coating manufacturer shall not relieve the Contractor of his contractual responsibility to ensure that the coatings are applied in accordance with the Technical Specification.

Where the coating manufacturer does not have an inspection/ quality control support system, employ an independent testing body to verify compliance of the coating systems with the Technical Specification.

7.1.3.2 Coatings Thickness Testing

Perform the following tests and inspections using qualified personnel and equipment unless directed otherwise:

Wet film thickness measurements shall be taken as necessary during application, using a wet comb or similar, to ensure that the required thickness of the various coatings is achieved.

Dry film thickness (DFT) measurement shall be taken as required in accordance with the methods as per relevant code of Practice to ensure that the work has achieved the required thickness.

Slip Resistance Testing

Assessing the slip resistance of flooring' by The Health and Safety Executive (latest published version).

Testing shall be carried out by an independent testing body accredited or certified body.

Pendulum Test:

Flooring shall be evaluated in both dry and wet conditions using the TRL Pendulum Tester in accordance with relevant IS code or BS 7976.

7.1.3.3 Roughness Test:

Flooring shall be evaluated using a surface roughness meter as per relevant standard code of Practice.

Flooring materials provided with manufacturer's data referring to slipperiness (R) values in accordance with DIN 51130 or relevant IS code of Practice, will not be acceptable unless PTV and Rz values are also provided.

Samples shall be tested at the following stages of the project:

- Approval.
- Production.
- Post-installation (in situ).

Submit test results to the EIC for acceptance in due time, prior to each of the project stages or as agreed with the EIC.

Test samples must include any surface sealer or treatment to be applied to the finished flooring.

7.1.4 Application and Workmanship

7.1.4.1 Workmanship

Workmanship shall generally comply with relevant IS codes.

The works shall be carried out in accordance with the manufacturer's recommendations.

Make due allowance for the sequencing of the whole works and all interfaces. The sequence of working shall be such as to ensure that surfaces inaccessible after assembly receive the full specified treatment and coating system.

Operatives shall be trained, experienced and appropriately skilled in the application of the works and, where applicable, be recommended by the system/ product manufacturer.

Undertake the works under cover and in properly lit, ventilated and heated conditions where appropriate.

The EIC shall be informed of any discrepancy in the suitability of specified coatings and surfaces. Instructions shall be obtained before proceeding with the application.

Refer to the paint manufacturer's recommended working procedures to be read in conjunction with the technical data sheets and material safety data sheets.

7.1.4.2 Storage

Do not deliver materials to site until required or until there is suitable dry storage space.

All materials shall be stored on site in accordance with the manufacturer's recommendations.

All paints and other products shall be marked or labelled and stored in such a way that identification of product and batch numbers is possible at all times. Ensure, whenever possible, that coating materials are from one manufacturing batch. Where more than one batch is to be used, keep separate, allocate to distinct parts or areas of the work, and inform the EIC accordingly.

7.1.4.3 Preparation

Suitability of Substrate

Before commencing application, survey the substrates checking suitability and report immediately to the EIC if the existing structure is unsuitable to receive the works.

If the substrate is unsuitable, propose remedial action to make the substrate suitable.

All substrates shall be dry, sound, smooth, clean, free from dust, dirt, grease and other contaminants before systems/ products are applied.

Substrates shall be sound, with no loose material or significant cracks or gaps.

Concrete structures may have inherent cracks measuring up to 0.3mm in width, due to the loading of the structure. Decoration and preparation of the concrete surfaces shall therefore not take place until the structure and roof are complete. The cracks within the structure shall be filled as specified.

All fabrication and other necessary procedures required that cannot/ should not be undertaken after the application of the works specified herein, shall be completed.

Application of coatings shall not occur until the surfaces and conditions within any given area to receive the specified coatings are correct.

Where surfaces have received pre-fabrication primers or other initial coating systems, the layer coating materials shall be compatible with these applications and shall not inhibit its performance.

All steelwork shall have received corrosion protection treatment and the finishing coats shall be compatible and shall maintain the integrity of the protective system. Report any steel surfaces that have no corrosion protection to the EIC.

7.1.4.4 Dampness

Where systems/ products are to be installed on new wet-laid backgrounds/ bases, ensure that:

Drying aids shall have been turned off for not less than four days.

Tests for moisture content shall be taken, using an accurately calibrated hygrometer or probe in accordance with BS 5325 or BS 8203 or other relevant standard as agreed with the EIC.

Readings are taken in all corners, along edges and at various points over the area being tested.

7.1.4.5 Interfacing Components

Prior to commencing work, and where applicable,

Remove fixtures and fittings (not to be coated), protect, safely set aside and later replace on completion.

Protect adjacent elements.

7.1.4.6 Existing Coatings

When removing or partially removing coatings, the methods used shall not damage the substrate or adjacent surfaces nor adversely affect subsequent coatings.

The primer and corrosion protection coats of any metalwork shall be touched up after removing, or partially removing, existing coatings.

7.1.4.7 Methods, Generally

Surfaces shall be fully prepared.

The methods used shall not unduly damage the substrate or adjacent surfaces, nor adversely affect subsequent coatings.

Materials and processes used in preparation shall be of the types recommended by their manufacturers and by the coating manufacturer for the situation and surfaces being prepared.

Where stopping/ filling is required, products and methods shall be compatible with the substrate(s) and coatings, and be as recommended by the coating manufacturer.

7.1.4.8 Blast Cleaning

Removal of existing coatings by blasting shall be carried out by specialists.

Oil and grease shall be removed by washing with white spirit or steam.

Steel shall be blast cleaned at suitable pressures in dry atmospheric conditions using abrasive of suitable type and size, free from contamination by fines, moisture and oil, removing any existing coatings in the process and taking all necessary precautions to minimise dust and residues.

Blast pressures shall be appropriate to the substrate.

Blasting shall be continued until the finish complies with BS EN ISO 8501: Part 1, preparation grade Sa 2.5, and control quality in accordance with BS 5493, BS EN ISO 12944: Parts 1-8 and BS EN ISO 14713 or alternate relevant IS code of practice.

Abrasive residues shall be removed.

All flash rust shall be removed, where applicable. Surfaces shall be primed as soon as possible after blast cleaning and in any case within four hours.

7.1.4.9 Preparation for Site Welding of Shop Painted Steelwork

Blast clean and mask weld areas before coating surrounding areas. If more than one coat is applied to surrounding areas, step each coat 30mm back from the edge of the preceding coat. Remove masking immediately before welding.

Alternatively prepare and shop paint welded areas as specified, then grind off to bare steel immediately before welding.

7.1.4.10 Treatment of Site Welded Joints in Painted Steelwork

After welding, and without delay, remove all scale and weld spatter from the weld areas by grinding or chipping, abrade to remove all traces of rust to achieve the specified preparation grade. Wash clean with water and allow to dry.

Prime without delay and apply further coatings to the weld areas to match the surrounding painted areas.

7.1.5 Application

Unless specified otherwise, do not commence internal applications of the works before the building is weather tight, wet trades have been completed and the building is dried out.

Only use materials/ components from the same production batch in the same area to prevent banding, patchiness or other visual variations.

Apply coatings to clean, dust free, suitably dry surfaces in dry atmospheric conditions and after any previous coats have cured adequately.

Apply coatings evenly to give a smooth finish of uniform thickness and colour, free from brush marks, nibs, sags, runs and other defects.

Where required, brush apply an additional stripe coat to the edges, welds, corners of flanges, bolt heads, nuts and any areas difficult to coat.

Keep all surfaces clean and free from dust during coating and drying. Adequately protect completed work from damage.

There shall be an interval of at least the period recommended by the manufacturer between successive coats of paint. Ensure that an adequate drying/ curing period for each coat has elapsed before handling.

Multiple coats of the same material shall be of a different tint to ensure that each coat provides complete coverage. Consideration shall be given to the correct choice of colour for the undercoat such that it complements the finished topcoat colour and avoids any colour variation showing through the topcoat.

7.1.6 Suitability of Conditions

Unless stated otherwise by the manufacturer, do not apply coatings:

- To surfaces affected by moisture or frost.
- Unless the substrate temperature is at least 3°C above the dew point with conditions stable or improving, or as otherwise recommended by the coating manufacturer.
- Unless the relative humidity is below 85% or as otherwise recommended by the coating manufacturer.
- When heat is likely to cause blistering or wrinkling.

Take all necessary precautions including restrictions on working hours, providing temporary protection and allowing extra drying time, to ensure that coatings are not adversely affected by atmospheric and environmental conditions before, during and after application.

Initial Coats

The preparatory coatings used shall be of the types recommended by the coating manufacturer for the situation and surfaces being prepared to receive new finishes.

7.1.7 Undercoat and Finishing Coats

Once applied the finish shall not in any way slump, flow, crack, flake, split, sag, pit, bubble, blister, float, effloresce, craze, shrink, break, wrinkle, crinkle, yellow, chalk, fade, discolour, powder, stain, bleed or lose its finish or gloss in any way. Full account of the extremes of all atmospheric and environmental conditions shall be taken.

There shall be no variation of final surface finish after application.

All unsatisfactory paintwork shall be made good with additional coats of material at the Implementation Contractor's own expense, to the acceptance of the EIC.

7.1.8 Film Thickness

Check the thickness of each coat during application using a wet film thickness wheel or comb gauge in accordance with BS EN ISO 2808 or relevant IS code of practice.

After each coat has dried, measure the total accumulated dry film thickness in accordance with the methods described in BS EN ISO 2808 or relevant IS code of practice, the number and position of measurements to be as directed by the EIC. Carry out all measurements in the presence of the EIC, unless otherwise directed.

If at any stage the accumulated dry film thickness is deficient, the EIC may require application of additional coats, at no extra cost.

The dry film thickness of the topcoat shall be sufficient to give an even, solid, opaque appearance, irrespective of the number of applied topcoats necessary to achieve cosmetic obliteration of the undercoat. The full specified topcoat dry film thickness shall be maintained, notwithstanding any greater than specified undercoat dry film thickness.

7.1.9 Making Good

Splashes resulting from work carried out on site shall be cleared from all surfaces.

Any painted area of metalwork mechanically damaged in transit or at site shall be hand or power tool cleaned. Touch up bare areas to meet the specified requirements. Adhere to the recommendations of the manufacturer of the paint system regarding appropriate method of application.

Any remedial work shall be in accordance with the manufacturer's recommendations, matching the original finish in every respect. Samples of remedial work shall be submitted to the EIC for review prior to commencement of work.

Early degradation of coatings by blistering, peeling, flaking, cracking or lack of adhesion shall be made good by complete removal, re-preparation and reapplication of all coats, as instructed.

Inadequate dry film thickness or surface defects due to adverse weather shall, depending on the type of paint, be remedied by rubbing down and applying further coat(s), as instructed.

Mechanical damage to coatings shall be made good by local cutting back of coatings, re-preparation and reapplication of all coats to leave a neat, continuous and flat finish.

Where damage to coatings or subsequent surface preparation has exposed bare metal, it shall be thoroughly cleaned and primed within two hours.

7.1.10 Protection

Temporary Protection

Partially finished and finished areas shall be adequately protected from damage by subsequent building operations and other factors until Practical Completion.

Adequate protection shall be provided to adjacent surfaces during application of the paint systems/ products.

Exhibit 'Wet Paint' signs and provide protective barriers where necessary.

7.1.11 Cleaning

At Practical Completion of the works, or when otherwise agreed with the EIC, clean all exposed areas/ surfaces of the works using agreed cleaning methods and materials.

Materials and methods shall be recommended/ accepted by the system/ product manufacturer, where applicable.

Do not use materials or methods that could alter the character of the exposed finishes.

Protect adjacent surfaces from damage due to cleaning operations.

7.1.12 Completion

Installed works shall be left clean.

Defects shall be repaired without delay, to minimise damage and nuisance.

On Practical Completion, the works shall be checked for damage and defects. Operable systems shall be tested for satisfactory operation.

7.1.13 Adverse Conditions

Working in Adverse Conditions

If unavoidable wetting of the works does occur, take prompt action to minimise and make good any damage.

Provide temporary covers as required to keep unfinished areas dry.

Suspend work in severe or continuously wet weather unless an effective temporary enclosure is provided over the working areas, or if the performance of the system/ product will not be impaired.

7.2 Acrylic / Plastic Emulsion Paint

7.2.1 Scope

This specification covers painting of Wall & RCC surfaces etc. of both interior & exterior surfaces of painting of masonry, concrete, plaster surfaces, structural and other miscellaneous steel items, rain water down comer, floor & roof drains, soil waste & service water pipes and other ferrous & nonferrous metal item as shown on drawings or as directed by the EIC.

7.2.2 Codes, Standard and Rules

IS: 101 Methods of test for ready mixed paints and enamels.

IS:158	Specification for ready mixed paint, brushing, bituminous black, lead free, Acid alkali and heat resisting.
IS:2074	Specification for Ready mixed paint, air drying, red oxide – zinc chrome, priming.
IS:2338(I&II)	Code of practice for finishing of wood & wood based materials.
IS:2345	Code of practice for painting concrete, masonry & Plaster surface.
IS:2932	Specification for enamel, synthetic, exterior, type-1
IS:5411	Specification for Plastic emulsion Paint : Part I – for interior use.

7.2.3 Materials specification

Paint

Paint shall be of approved quality and shades.

This shall be polyvinyl based Acrylic/plastic emulsion paint of approved manufacture of the required shade, conforming to IS.5411.

Primer

The primer to be used for the painting with acrylic emulsion on cement concrete surfaces, plastered surfaces, sheets, timber and metal surfaces, if necessary, shall be of approved base and as per recommendations of the manufacturers.

Putty

Plaster filler to be used for filling up (putting) uneven surfaces, small cracks and holes etc. shall be of approved compound and as per recommendations of the manufacturers. No oil based putty shall be used. The putty should be made from a mixture of whiting and plastic emulsion paint or as per manufacturers recommendations.

7.2.4 Construction specification

Finishing coats

All the finishing coats shall be of matt finish or any other finish as required by the EIC. The number of finishing coats shall be as specified in the item.

Surface Preparation

This includes scraping uneven surface, damaged plaster, etc. with carborundum papers of suitable number till hard, clean surface is obtained. This is to be repeated till the work is approved by the EIC. Putty shall be used to cover holes and unevenness on the surface.

Preparation and application of Putty

Putty will be prepared as under. It shall be prepared from English whiting chalk, linseed oil, white zinc and plaster of Paris in the prop. of 7:1:2:1. However, exact proportion shall be decided as per site condition. Water, if required, can be added as per the instructions and requirements to have proper consistency and stickiness. Putty should be smooth and free from any coarse ingredient, etc. Application of putty should be started only after approval of surface by the EIC. It should be applied on the whole surface to make the

surface smooth. No lumps should be allowed to dry completely. After drying, the surface should be scraped with sand/emery paper till smooth surface is obtained.

If no proper smoothness is obtained again apply primer, putty, etc. and repeat the process as mentioned above, till the surface is perfect smooth as per instructions.

After application of first coat of putty, the surface shall be allowed to dry for 24 hours. sand papering shall then be done to give smooth surface. Subsequent applications of putty and sand papering shall be done till the EIC is satisfied about final surface, which should be absolutely even, levelled and smooth.

The Putty Shall be used Readymade of approved make or as approved by EIC for wall & ceiling surface.

Primer application

Primer should be a cement primer, or as per manufacturer's specification (manufacturer same as that of Acrylic / Plastic Emulsion Paint). These tins should be opened in presence of the EIC. Before applying primer on the surface, its consistency must be approved by the EIC and shall be same as specified by the manufacturer. Primer should be applied with smooth brushes on surface to cover entire surface properly. There should be no brush marks, stripes, etc. when applied on the surface. This surface should be allowed to dry at least for 24 hours before next application.

Paint application

On the surface so prepared, two coats of Acrylic / Plastic Emulsion Paint of selected shade and approved make shall be applied only after inspection by the EIC. A horizontal and vertical travel of brush together will be considered as one coat of paint. Each coat of paint shall be applied only after inspection of EIC. No brush marks shall be visible on the surface at the end of final coat. Final surface shall be smooth, even or roller finish and uniform in colour and texture.

For Acrylic / Plastic Emulsion Paint, an average thickness in dry condition shall be 25-38 μm per coat of paint applied. However it is recommended to establish a coverage trial with EIC's approval before finalising the parameters. Method of measurement

Measurement shall be as per IS 1200

All the measurements for payment shall be taken on net surface area actually painted, unless otherwise specified. Deduction will be made from the areas for fixtures, grills, ventilation, outlets, electrical boxes and such obstructions not painted, if they are individually more than 0.05m^2.

7.3 Cement Paint

7.3.1 Materials: Cement Paints

It shall be from Berger, ICI, Asian Paints "Super Snowcem" or equivalent, as approved by the Architect and Engineer-in-charge. It shall conform to IS: 5410-1969

It shall be manufactured from selected range of raw materials and special cement, so that it shall be suitable for both indoors and outdoors. It shall be suitably used on concrete renderings, cement/sand renderings, cement/lime/sand renderings, asbestos sheets, fibber boards, brickwork, etc. It shall offer matt finish. It shall require no primer and shall be water thinnable. It shall offer a covering capacity of 6-8 m^2 per

Kg., depending on the surface and shade used. It shall preferably not be applied under direct sunlight to avoid patchy effect.

7.3.2 Workmanship

7.3.2.1 Scaffolding

The relevant specifications of item No. 6.4 shall be followed.

7.3.2.2 Preparation of surface

The relevant specifications of item no. 6.4 shall be followed except that the work white washes, colour wash shall be substituted with water proofing cement paint. The surface shall be thoroughly wetted with clean water before cement water proofing paint is applied.

7.3.2.3 Preparation of paint:

Portland cement paint shall be prepared by adding paint powder to water and stirring to obtain a thick paste, which shall then be diluted to a brushable consistency. Generally, equal volumes of paint powder and water make a satisfactory paint. In all cases, the manufacturer's instructions shall be followed. The paint shall be mixed in such quantities as can be used up within an hour of mixing as otherwise the mixture will set and thicken, affecting flowing and finish. The lids of cement paint drums shall be kept tightly shut when not in use.

7.3.2.4 Application of Paint:

No painting shall be done when the paint is likely to be exposed to a temperature of below 7°C within 48 hours after application.

When weather conditions are such as to cause damage, the work shall be carried out in shadow as far as possible. This helps the proper hardening of the paint film by keeping the surface moist for a longer period.

To maintain the uniform mixture and to prevent segregation, the paint shall be stirred frequently in the bucket.

For undecorated surfaces, the surface shall be treated with minimum two coats of water proof cement paint. Not less than 24 hours shall be allowed between two consecutive coats. Next coat shall not be started until the preceding coat has become sufficiently hard to resist marking by the brush being used. In hot dry weather, the preceding coat shall be slightly moistened before applying the subsequent coat.

The finished surface shall be even and uniform in shade, without patches, brush marks, paint drops etc.

The cement paint shall be applied with a brush with relatively short stiff hog or fibre bristles. The paint shall be brushed in uniform thickness and shall be free from excessively heavy brush marks. The lumps shall be well brushed out.

Water proof cement paint shall not be applied on surfaces already treated with white wash, colour wash, distemper dry or oil bound varnishes, paint etc. It shall not be applied on gypsum, wood and metal surfaces.

7.3.2.5 Curing

Painted surfaces shall be sprinkled with water two or three times a day. This shall be done between coats and for at least two days following the final coat. The curing shall be started as soon as the paint has hardened so as not to be damaged by the sprinkling of water say about 12 hours after the application.

Protection measures shall be taken as per above item of painting work.

7.3.3 Mode of Measurements and Payment

The measurement shall be as per IS 1200.

Measurement shall be in square meter.

The rate shall be for a unit of one m².

8 Flooring Work

8.1 Indian Patent Stone (IPS) Flooring

8.1.1 Scope

The above specification shall cover for flooring work inside and out sides of buildings area.

All flooring work shall done as per specified in the drawings or as directed by the EIC.

8.1.2 Applicable codes

IS:1443 -	Code of practice for laying and finishing of cement concrete flooring tiles
IS: 2114 -	Code of practice for laying in situ terrazzo floor finish
I.S.1200 (Part-XI)	Method of measurement building and civil engineering works

8.1.3 Material specifications

Water, cement, sand, aggregate 20mm nominal size shall conform in concrete section.

Cement concrete shall be M15 Grade of concrete proportion measured by volume shall conform to relevant specification of grade concrete.

8.1.4 Construction Specification

8.1.4.1 Preparation of Surface

Before the operation for laying the topping is started, the surface of the base concrete shall be thoroughly cleaned of all dirt, loose particles, caked mortar droppings and laitance, if any, by scrubbing with coir or steel wire brush. Where the concrete has hardened so much that roughening of surface by wire brush is not possible, the surface shall be roughened by chipping or hacking at close intervals. The surface shall then be cleaned with water and kept wet for 12 hours and surplus water shall be removed by mopping before the topping is laid.

8.1.4.2 Laying

The screed strips shall be fixed over the base concrete dividing it into suitable panels. Before placing the concrete for topping, neat cement slurry shall be thoroughly brushed into the prepared surface of the base concrete just ahead of the finish. Concrete of specified grade and thickness shall be laid in alternate panels to required level and slope and tamped thoroughly to achieve an uniform homogenous surface.

The cement concrete flooring of 50mm. thick (Average) is to be laid as per the site condition. The concrete shall be mixed in a mechanical mixer at the work. It shall carry out on a water tight platform and care shall be taken to ensure that mixing is continued until the mass is uniform in color and consistency. However, in such cases 10% more cement than otherwise required shall have to be used without any extra cost.

The mechanical mixing shall be done for a period of 1.5 to 2 minutes. The quantity of water shall be just sufficient to produce a dense concrete of required workability for the purpose.

The castings of the finish layer shall be done in rectangular or square panels not exceeding 2 M on any side, using glass strips of height equal to the specified thickness of the floor finish. Required slope in the floor shall be given in the base course concrete without reduction in thickness.

Flooring of specified thickness shall be laid in accordance with approved pattern or as directed. Finishing operation shall start shortly after the cessation of beating and shall be spread over a period of one to six hours depending upon the temperature and atmospheric conditions.

The surface shall be left for some time till moisture disappears from it. Fresh quantity of cement shall be mixed with water to form a thick slurry and spread over the surface while the concrete is still green. Use of dry cement or cement and sand mixture sprinkled on this surface to stiffen the concrete or absorb excessive moisture shall not be permitted.

The cement slurry shall then be properly pressed twice by means of iron floats, once, when the slurry is applied and the second time when cement starts setting and is to be finished smooth.

The surface shall be marked with string or B.R.C. fabric Jali to make the surface non-slippery as and when directed. The junction of floors with wall plaster, dado or skirting shall be rounded off where so required up to 25 mm radiuses. Flooring in lavatories and bath rooms shall be laid after fixing of water closet and squatting pans and floor traps which shall be plugged while laying the floors and opened after the floors are completed. Any damage, done to water supply, sanitary fittings or to any item during execution of work shall be made good by the Implementation Contractor.

After the final set, the concrete shall be kept continuously wet, if required by ponding, for a period of not less than 7 days from the date of placement.

The form work shall be provided if necessary as directed by EIC. Concreting shall be done as per alternate bay method with necessary centering either by mastic or cement mortar as directed.

8.1.4.3 Finishing the Surface

After the concrete has been fully compacted it shall be finished by trowelling or floating with neat cement rendering. Finishing operations shall start shortly after the compaction of concrete and the surface shall be trowelled three times at intervals so as to produce an uniform and hard surface. The satisfactory resistance of floor to wear and tear, depends largely upon the care with which trowelling is carried out. The time interval allowed between successive trowelling is very important. Immediately after placing cement rendering, only just sufficient trowelling shall be done to give a level surface. Excessive trowelling in the earlier stages shall be avoided as this tends to bring a layer in cement to the surface. Sometime, after the first trowelling, the duration depending upon the temperature and atmospheric conditions and the rate of setting of the cement used, the surface shall be re-toweled to close any pores in the surface and to bring to surface and to scrape off any excess water in concrete or any laitance. No dry cement shall be used directly on the surface to absorb moisture or to stiffen the mix. 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.

If directed by the EIC, approved mineral pigment shall be added to the rendering to give desired color and shade to the flooring at no extra cost.

When 1:2:4 mix is specified the topping shall be rendered with 1:1:2, (1 part cement mortar with a suitable mineral pigment (if directed), 1 part sand and 2 parts grit - 6 mm. and down size), instead of cement only. If specified in the schedule of quantities, the flooring shall be machine polished as per EIC's instructions.

Wherever the patent flooring is used as a finishing on roof, the joints shall be filled with approved bitumastic filler in a workman-like manner.

8.1.5 Method of Measurements

Method of Measurement shall be as per IS 1200

The rate shall include the cost of all materials and labour involved in all the operations described above.

No deduction shall be made or extra paid for any opening up to 0.1 Sqm. in area, in the floor, nothing extra shall be paid for laying the floor at different levels in the same room or the courtyard.

8.2 50mm thick Screed in Drain

8.2.1 Scope

The above specification shall cover for flooring work inside the drain.

All flooring work shall done as per specified in the drawings or as directed by the EIC.

8.2.2 Applicable codes

IS:1443 - Code of practice for laying and finishing of cement concrete flooring

8.2.3 Material specifications

Water, cement, sand, aggregate 20mm nominal size shall conform in concrete section.

Cement concrete shall be M15 Grade of concrete proportion measured by volume shall conform to relevant specification of grade concrete.

8.2.4 Construction Specification

8.2.4.1 Preparation of Surface

Before the operation for laying the topping is started, the surface of the base concrete shall be thoroughly cleaned of all dirt, loose particles, caked mortar droppings and laitance, if any, by scrubbing with coir or steel wire brush. Where the concrete has hardened so much that roughening of surface by wire brush is not possible, the surface shall be roughened by chipping or hacking at close intervals. The surface shall then be cleaned with water and kept wet for 12 hours and surplus water shall be removed by mopping before the topping is laid.

8.2.4.2 Laying

The cement concrete flooring of 50mm. thick (Average) is to be laid as per the site condition. The concrete shall be mixed in a mechanical mixer at the work. It shall carry out on a water tight platform and care shall be taken to ensure that mixing is continued until the mass is uniform in color and consistency. However, in such cases 10% more cement than otherwise required shall have to be used without any extra cost.

The mechanical mixing shall be done for a period of 1.5 to 2 minutes. The quantity of water shall be just sufficient to produce a dense concrete of required workability for the purpose.

The surface shall be left for some time till moisture disappears from it. Fresh quantity of cement shall be mixed with water to form thick slurry and spread over the surface while the concrete is still green. Use of dry cement or cement and sand mixture sprinkled on this surface to stiffen the concrete or absorb excessive moisture shall not be permitted.

The cement slurry shall then be properly pressed twice by means of iron floats, once, when the slurry is applied and the second time when cement starts setting and is to be finished smooth.

After the final set, the concrete shall be kept continuously wet, if required by ponding, for a period of not less than 7 days from the date of placement.

The form work shall be provided if necessary as directed by EIC. Concreting shall be done as per alternate bay method with necessary centering either by mastic or cement mortar as directed.

8.2.5 Method of Measurements

Method of Measurement shall be as per IS 1200

The rate shall include the cost of all materials and labour involved in all the operations described above.

8.3 Terrace water proofing India type, average 115mm thick

8.3.1 Materials: Water & Weather Proof Compound

The water & weather proof integral cement admixture shall be of best quality and from manufacturer like Fosroc, BASF, Dr. Fixit or equivalent as approved by the Engineer-in-charge. The prior approval for the source shall be taken from the consultant. It shall conform to the relevant I.S. Code.

It shall be used as an excellent cement admixture in all types of concrete/plaster mortars, pointing mortars, masonry works and pressure grouting works. It shall improve resistance of concrete surfaces to weathering and chemical attack. It shall be non-toxic so as to use for waterproofing water tanks, reservoirs, bio-gas tank, leaking ceiling, basements, tunnels, lift wells etc.

It shall be mixed to concrete or plaster mortar, while mixing. First, water is added and then the admixture, at the rate instructed by the manufacturer. For use of the admixture, precaution shall be taken to use clean materials for preparation of mortar.

Water, Cement, Sand, Stone grit and Brickbats shall conform to concrete section. Cement mortar shall conform to section of plastering work.

8.3.2 Workmanship

Unless otherwise specified proprietary waterproofing treatment shall be executed through M/s. India Waterproofing Co. or approved equivalent, who should give a guarantee of 10 years on stamp paper to the employer directly and the tender rate shall be inclusive of the same.

A guarantee bond on fifty rupees stamp paper shall be given by the contractor to the client in the manner form prescribed below:

FORM OF GUARANTEE BOND

"I/We .....(Contractor) hereby guarantee that work will remain unaffected and will not be in any way damaged by water or any other form of humid condition, for a period of 10 years after completion of the work of water-proofing as per the terms and conditions of the contract and the Contractor hereby indemnifies and agrees to save the Client from any loss and or damage that might be caused on account of water and or other similar form of humid conditions and hereby guarantees to make good any loss or damage suffered by the Client and further guarantees to redo the affected work without claiming any extra cost."

This guarantee shall remain in force for a period of 10 years from the completion of the work under the contract and it shall remain binding to the Contractor for period of 10 years.

While tendering the contractors should clearly stipulate the type of treatment proposed to be provided by them and the name and particulars of firm through whom they propose to carry out the treatment.

The surface to be treated shall have a minimum slope of 1 in 120. The grading shall be carried out prior to the application of water proofing treatment by cement mortar. The brickbats of varying size as per requirement shall be arranged in proper gradient using cement mortar 1:5 according to the desired slope. Suitable waterproofing chemical shall be added to make the C.M. water tight and then cement mortar 1:4 shall again be provided on top of the brickbats, including the waterproofing compound which shall be added in the C.M. and finishing on top with neat cement @ 2.75 kg/m². The top surface shall be finished rough surface as per the direction so as to receive the next finishing item.

The testing shall be done by ponding for at least 48 hours.

Well defined cracks other than hair cracks in the treated structure shall be cut to `V' section, cleaned and then filled up flush with cement sand slurry or with bitumen conforming to IS : 702-1961.

The surface under treatment, part of parapet (in case of balcony or terrace) and gutters, drain mouths etc. over which the water proofing treatment is to be applied, shall be cleaned of all foreign matter such as fungus, moss and dust by wire brushing and dusting.

Drain outlet shall be suitably placed with respect to the surface gradient to ensure rapid drainage and prevention of local accumulation of water on the treated surface. Masonry drain mouth shall be widened sufficiently and rounded with cement mortar.

For cast iron drain outlets, a groove shall be cut all around to touch the treatment.

When a pipe passes through a roof on which water proofing treatment is to be laid, a cement concrete angle fillet shall be built round it and the water proofing treatment shall be taken over the fillet.

In case of parapet wall over 450mm. in height, for tucking in the water proofing treatment, a horizontal groove 75 mm. wide and 65 mm. deep at minimum height of 150 mm. above roof level shall be left in the vertical face at the time of construction, the horizontal face of the groove shall be shaped with cement mortar 1:4.

In case of low parapet where the height does not exceed 450 mm. no groove shall be provided and the water proofing treatment shall be carried right over the top.

In case of existing R.C.C. and stone wall cutting the chase for tacking in the water proofing treatment is not recommended.

At the junction between the roof and vertical face of the parapet wall, a fillet 75mm. in radius shall be constructed.

At the drain mouths the fillet shall be suitably cut back and rounded off for each application of water proofing treatment and easy flow of water.

Outlet at every low dividing wall about less than 300 mm. in height shall be rounded smooth and corners rounded off for easy application of water proofing treatment.

8.3.3 Mode of Measurements and Payment

The rate shall include providing water proof cement concrete terracing of adequate thickness to give desired slope for drainage of rain water from terraces.

The measurements for this item shall be taken as under:

a. Water proofing of roof shall be measured in Sqm, length and breadth shall be measured correct to a centimeter.

b. Measurement shall be taken for the superficial area of roofing and flashing treatment including flashing over the parapet wall, low dividing walls and expansion joints and at the pipe projections etc. Overlapping and tucking into flashing grooves shall not be measured extra.

c. Sloping and vertical surface of water proofing treatment shall be measured under this only and no extra payment shall be given.

d. In measurements, no deduction shall be made for either openings or recess for chimney stacks, roof lights etc. having areas up to 0.4 m². Deduction shall be made in measurements for full opening but nothing extra shall be paid for extra Labour and materials in forming such openings.

The rate includes cost of all materials and Labor required carrying out the works as per the above specifications. The rate also includes cleaning of surface and treating the cracks shall not be paid separately. Cutting of horizontal grooves in parapet walls for tucking in water proofing treatment shall not be measured or paid separately.

Measurements shall be based on the drawings or as executed on site, the lesser of the two shall be given. No extra payment shall be made for rounding and vata at the junction of two different materials. A deposit at the rate of 50% of the cost of this item from the running and final bills shall be recovered and retained for the first one year after completion of the work and 10% of the same shall be retained for the balance of the guarantee period and shall be refunded only after the completion of the guarantee period.

9 Structural Steel

9.1 Scope

This specification covers the requirements for materials fabrication, assembly, testing, transportation, erection, grouting under bases, of all types of structural steelworks consisting of columns, beams, trusses, lattice girders, pipe racks, trestles, galleries, monorails, space frame, platforms, stairs, ladders, handrails, purlins, side runners, Grill, fencing post, equipment supporting structures, guide structure, etc. for general construction work.

9.2 General Specifications

The requirements set forth in IS 800 and relevant latest BIS for the design, fabrication and erection of structural steel for buildings shall govern this work, except as otherwise noted on the drawings or as otherwise specified.

In cases of conflict between clauses of this specification and those in the Indian Standards, this specification shall govern.

Substitutions of sections or modifications of details or both shall be made only when approved in writing by the Owner / Consultant. The Contractor shall be responsible for all errors of fabrication and for the correct fittings of the structural members shown on the drawings.

9.3 Materials

The contractor may use equivalent materials in some very special cases but only with the written approval of the Owner / Consultant.

The Structural steel shall conform to latest revision of IS 2062 (Wieldable quality & Incorporates IS 226 in this code), IS 816 unless specified otherwise

Whenever welded construction is specified plates of more than 20mm thick shall conform to IS: 2062 Grade B. Dimensions and masses for hot Rolled steel beams, columns, channels and angle sections shall conform to IS 808, superseding those given in SP6(1).

Carbon steel pipes shall conform to IS 1161 of Grade YST-25 or higher.

Covered electrodes for metal are welding of structural steel shall conform to IS 815.

Welding electrodes shall conform to IS:814.

Approval of welding procedures shall be as per IS:9595.

Bare wire electrodes for submerged are welding of structural steel shall conform to IS 7280. The combination of wire and flux shall comply with IS 3613.

Filler rods and wires for gas welding shall conform to IS 1278. Filler rods and bare electrodes for gas shielded are welding of structural steel shall conform to IS 6419.

Bolts and nuts (including lock nuts) shall conform to IS 1364, IS 1367, IS 3460, IS 3757, IS 6623 and IS 6639 as applicable. Washers shall conform to IS 5370, IS 5372, IS 5374, IS 6610 and IS 6649 as applicable.

Materials for which Test Certificate is not available or for which test results do not conform to relevant standard specifications, shall not be used.

Receipt and Storing of Materials

Each section shall be checked on receipt to ensure that they are free from surface defects such as pitting, twists, cracks and laminations. They shall be arranged by grade and quality and by lot. Every section shall be marked to aid identification and the manufacturer's certificate for every lot giving details of chemical analysis and mechanical characteristics shall be kept in record.

Welding wires and electrodes shall be segregated by quality and lots and stored inside a dry, enclosed room as per recommendations of IS:9595. All care shall be taken to keep the electrodes in perfectly dry condition to ensure weld metal soundness and satisfactory operations. Manufacturers' certificates for electrodes shall also be logged into the records.

Bolts, nuts and washers shall be sorted out by grade, type and diameter and the manufacturers' quality / test certificates shall be maintained for record purpose.

The contractor is required to provide manufacturers quality certificate for every item of material supplied by him. In case such certificates are not available, the contractor shall at his own cost carry out all such tests as are required by Owners / Consultants at an established Test House and submit the test results for approval. The approval of such material shall however be entirely at the discretion of the Owner / Consultant.

9.4 Storage and Preparation

The storage yard for fabricated steel parts shall be prepared in advance and got approved by the Owner / Consultant before the steel structures start arriving from the shop.

All materials shall be set at least 150mm clear from ground on wooden or steel blocks for protection against direct contact with the ground and to permit drainage of water.

Steps shall be taken to prevent warping of items during handling at all stages.

9.5 Fabrication Drawings

Following fabrication and erection drawings shall be prepared by the client/consultant before commencement of work.

- Details of joints, shop / field splices.
- Location, size, type and dimensions of welds and bolts.

Rest Of fabrication and erection drawings shall be prepared by the contractor based on the AFC (Approved For Construction) drawings of the Owner / Consultant. These drawings shall be thoroughly checked and stamped "Good for Construction" and signed by the contractor's authorised representative.

The contractor shall directly issue his site the fabrication and erection drawing in the correct order. Simultaneously submitting three copies of contractor prepared drg to Owner / Consultant for their review. The Owner / Consultant shall at his sole discretion review part or whole of all, some or none of the drawings.

The review of fabrication drawings shall be limited to the layout, orientation and elevation of structures and members, the section of members and the adequacy of connections. The review shall NOT include marking of members, erection clearances, cut length, matching of joints and holes. Consultant shall review the bill of materials.

Preparation of drawing by Owner / Consultant shall in no way relieve the contractor of his responsibility for correctness in the execution of the work, and the contractor shall be required to modify / rectify the structure at any stage of the work in case owner / consultant bring to his attention any mistake / omission in the fabrication drawing and the fabrication based on this drawing or that the work does not conform to good engineering practice. All such modifications / rectifications shall be made at no extra cost to the owner.

The fabrication drawings shall include but not be limited to the following:-

- Marketing plan / elevation / layouts.
- Erection assemblies.
- Method of erection and special precautions to be taken during erection.

The Contractor shall also supply two prints of as built drawings, along with their transparencies at no extra cost.

9.6 Fabrication

9.6.1 General

All fabrication shall be done as per specifications, IS:800, IS:9595 and the relevant IS codes on the basis of stamped and signed “Good for Construction” fabrication drawings.

Fabrication shall also be understood to include building up and element either by welding plates to a rolled section, a combination of rolled sections, and a combination of rolled sections with plates or a section built up entirely with plates.

The contractor shall prior to starting any fabrication ensure that the fabrication yard is levelled and firm enough to take weight of structures and equipment.

Any defective fabrication of material pointed out at any stage shall be replaced by the contractor free of cost.

Tolerances for fabrication shall be as per IS:7215

9.6.2 Fabrication Procedure

9.6.2.1 Straightening

All materials shall be clean and straight. If straightening or flattening is necessary, it shall be done by a process approved by the Owner / Consultant, and in a manner that will not damage the material. Sharp kinks or bends shall be a cause for rejection. The specified camber wherever necessary shall be provided.

9.6.2.2 Clearance

The erection clearance for members having end cleats or plates shall not be more than 2mm at each end, whereas for other types of end connections it shall not be more than 3mm at each end. If for any reason a greater end clearance is required, suitable seating, approved by Owner / Consultant shall be provided.

9.6.2.3 Cutting

The use of a hand cutting torch is permissible only if the metal being cut is not subject to substantial stress during the operation. Gas cut edges subject to substantial tensile stress, shall be cut by mechanically controlled torch, or if hand cut, shall be carefully examined and any nicks removed by Grinding, Shearing, Cropping by gas cutting shall be clean, square, and free from any distortion and should the inspector find it necessary, the edges be subsequently ground at no extra cost. Owner to make them straight and uniform.

Cutting tolerances shall be as follows:

a. For members connected at both ends : $\pm$ 1mm.

b. Elsewhere : $\pm$ 3mm.

9.6.2.4 Holing

Holes for compound section passing through more than one thickness shall preferably be drilled after the members are assembled and tightly clamped or bolted together. In case the thickness of metal for each component is less than 16mm, the holes may be punched prior to assembly provided the holes are punched 3mm smaller in diameter than the required size and reamed after assembly to the required diameter. Dynamically loaded structures shall not be holed by punching. In case the material is not more than 12mm thick and the connection is not a splice, the hole may be punched full size except in holes for close tolerance bolts or barrel bolts.

Holes may be drilled in one operation through two or more parts and the burrs removed from each part after drilling. Holes not drilled through all the thickness in one operation shall be drilled to a smaller size and reamed out after assembly.

Holes for close tolerance bolts and barrel bolts shall be drilled through all the thickness in one operation and subsequently reamed to size after firmly holding the parts together with the aid of tacking bolts or clamps.

Finished holes for black bolts high strength friction grip bolts shall not have a diameter more than 2mm the diameter of the bolt passing through them or as specified in fabrication drawing.

Holes for bolts shall not be formed by gas cutting.

9.6.2.5 Bending

Bending of plates, flats and sections shall be carried out on bending rolls or in presses.

Cold bending may be accepted when bending radius is equal to or more than :

- 25 times member thickness for plates and flats.
- 25h or 25b for rolled steel beams and channels according to the bending plane.
- 45b for angle.

Where, h = section height, b = flange width

When bending radius is less than that as indicated above, bending shall be done on hot metal by heating the member up to 850^{o}C light red radiance. Bending shall be discontinued when temperature drops below 500^{o}C.

Accuracy of bending operations shall be checked by means of templates and the clearance between member and template shall not be more than $\pm$ 1 mm.

Bent member shall not have cracks or deep indentations from bending equipment.

Assembly

The component part shall be aligned and assembled in such a fashion that they are not twisted or damaged in any way and have the prescribed camber. The clamps, jigs and other fixtures shall be placed so as to cause no imbalance which would result in twisting / incorrect positioning of members. Due attention shall be paid to welding shrinkage and distortion.

Bolting

All turned and fitted bolts shall be parallel throughout the barrel within the tolerance of 0.125mm, unless otherwise specified and faces of heads and nuts bearing on steel work shall be machined.

All such bolts shall be provided with wrappers not less than 3mm thick, so that when the nut is tightened, it shall not bear the unthreaded body of the bolt and the threaded portion of the bolt should not be within the thickness of the parts bolted together. The threaded portion of each bolt shall project through the nut by at least one thread. Square tapered washers shall be provided for all heads and nuts bearing on bevelled surface. flat washers shall be circular in shape. The bolts, nuts and washers, etc. shall be thoroughly cleaned and dipped in linseed oil.

The bolts shall be of GKW Class I make or equal conforming to the above specifications.

9.6.3 Welding

9.6.3.1 General

Welding of steel shall be in accordance with IS:816, IS:819, IS:1024, IS:1261, IS:1323 and IS:9595 as applicable. Welds shall be made only by Operators who have been previously qualified by tests by the Owner / Consultant. A welder shall product satisfactory evidence of his ability to do a given type of work and shall prove his ability to product a connection of the strength required. Evidence of welder's qualification tests shall be produced if required by the Owner / Consultant. Owner / Consultant may reject any welder found not suitable during actual work.

Welding wire and electrode shall be sorted separately by quantities and lots inside a dry and enclosed room, and as per instruction given by the Owner / Consultant. Electrodes shall be perfectly dry and drawn from an electrode oven, if required.

Both the structural members and the welding operators shall be adequately protected from rain, strong winds or snow during welding. The Contractor shall provide necessary supervision to ensure that all welding is carried out in conformity with the specification and relevant IS codes. The contractor shall make

all necessary infrastructure available such ass requisite number of welding sets, cutting and grinding equipment, test equipment and all consumables required.

9.6.3.2 Preparation of Members for Welding

Edge preparation of fusion faces for welding shall be carried out as per details given in IS:9595 or as shown on drawings. All tolerances for such work shall be ass per IS:9595. The bevelling of such faces shall be checked by the Owner / Consultant.

Surfaces to be welded shall be cleared to ensure that they are free from loose scales, slag, rust, grease, paint and other foreign matter, and shall be maintained.

Preheating of members shall be necessary when the base metal temperature (based on ambient temperature) is less than the temperature required for that welding procedure. The preheating shall be done in such a manner that the part on which weld metal is to be deposited is above the specified temperature for a distance of 75mm on either wide of the weld line. The temperature shall be measured on the face opposite to the face being heated. In case access is limited to only the face being heated, the source of heat shall be removed and sufficient time allowed elapsing for heat equalisation prior to measurement. (1 minute per 25mm of plate thickness).

Column splices and butt joints of compression member shall be accurately ground and close butted over the entire section to ensure full contact for load transmission. The tolerance for such work shall be maximum 0.2mm. In the case of column bases and caps the ends of the section along with connected gusset, stiffeners, angles, channels, etc. shall be ground so ass to ensure a minimum contact area of 90%. The fitting of angles and channels should be sufficiently accurate to limit the reduction in thickness on account of grinding to 2mm. The ends of bearing stiffeners shall be ground so as to fit tightly at both top and bottom. Slab bases and cap plates shall be accurately ground over bearing surfaces to ensure minimum 90% contact area with columns.

9.6.3.3 Welding Processes

Any one or more of the following welding processes may be used :

i) Manual Metal Arc Welding Process.

ii) Gas Metal Arc Welding Process.

The Contractor shall submit the welding procedure and the consumables proposed to be used to the Owner / Consultant for approval. Combination of process or electrodes may be permitted only with the specific approval of the Owner / Consultant.

9.6.3.4 Approval and Testing of Welding Procedure

The contractor shall carry out weld procedure test as per IS:7307. The test weld shall be as per weld details required for the actual work and should simulate the worst conditions likely to be encountered in the actual work in terms or fit-up, electrode conditions, etc. The test weld shall be held at ambient temperature for a minimum period of 72 hours prior to testing to IS:7307. The welding procedure once established shall be submitted in the standard format prescribed by ISS:99595 to the Owner / Consultant for approval.

9.6.3.5 Sequence of Welding

a) The direction of welding shall be from points relatively fixed with respect to each other towards points having more flexibility.

b) Welding shall be carried out continuously to completion with the required number of runs.

c) For compound section splices, each component part shall be spliced prior to welding with other component parts.

d) Welds shall progress in a sequence that will balance the applied heat so as to reduce distortion.

e) Joints having more shrinkage shall be welded prior to joints having less shrinkage.

f) The sequence causing minimum distortion of shrinkage shall be chosen.

9.6.3.6 Welding Technique

The fusion faces shall be properly aligned and the gap set to the distance specified. The root pass of butt joint shall be done such that full penetration is achieved as also complete fusion of root edges.

On completing each run the weld and parent metal shall be cleared by wire brushing and light chipping to remove all stag and splatters. Visible defects if any such as cracks, cavities, etc. shall be removed to sound metal prior to depositing subsequent run of weld.

All full penetration butt welds shall be completed by gouging / chipping the back of the joint and depositing a seal run of weld metal. Alternatively a backing strip shall be provided.

All care shall be taken to prevent any kind of movement, shock or vibration of components during welding to prevent weld cracks.

9.6.3.7 Inspection and Testing of Welds

All testing shall be as per IS:822 and the extent of inspection and testing shall be in conformity with the relevant standard or as directed by Owner / Consultant. The contractor shall extend to Owner / Consultant all facility required to inspect all stages if fabrication and erection including welding procedure qualification and welders procedure qualification. No painting of welds shall be undertaken prior to inspection and approval.

The various types of tests shall be :

i) Visual Inspection

100% welds shall be visually inspected to ascertain absence of the following defects :

a) Surface cracks in weld or parent metal, or undercut, burning, overheating of parent metal.
b) Blow holes, exposed porosity in the weld or unused welds.
c) Defects in the profile such as excessive convexity of concavity, unequal leg lengths incompletely filled grooves, excessive penetration beds, root grooves, etc.
d) Distortion due to welding and misalignment.

ii. Mechanical Tests

Tensile load tests, bend tests, impact tests, etc. shall be carried out as per the standard.

iii. Radiographic Testing

Such testing shall be carried out only in very special cases when so directed by the Owner / Consultant. The tests shall be carried out as per IS:822. The contractor shall full fill all necessary statutory safety requirements while handling X-ray and game ray equipment and provide the Owner / Consultant viewing facilities.

9.6.3.8 Magnetic Particle / Dye Penetrator / Ultrasonic Tests

Such tests shall be carried out only when directed by Owner / Consultant. These shall be carried out to the procedure specified in IS: 822.

9.6.3.9 Repair of Welds

Welds not meeting the requirements of the specification and IS codes shall be removed and replaced. Repairs to defective welds shall be carried out only after the repair procedure submitted is approved by the Owner / Consultant.

9.6.3.10 Splicing

In compound sections, splicing of components shall be staggered with respect to each other by a minimum of 500mm. When the two parts of a component are not butt welded to each other, the opposing ends at a joint shall be ground flush for bearing and suitable flange and web splice plates shall be designed to cater for the full strength of the flange / web of the sections.

In case full strength butt weld is used to connect opposing ends at a joint, additional flange and web splice plates shall be provided capable of carrying 20% strength of the flange and well.

9.7 Shop Section

The steel work shall be temporarily erected in the shop to determine the accuracy of the fit. The extent of erection shall be either complete as directed by Owner / Consultant.

9.8 Inspection and Testing of Structures

Materials and workmanship at all times shall be subject to inspection by the Owner/ Consultant. All inspection as far as possible shall be made at the place of fabrication and the contractor shall cooperate with the Owner / Consultant's inspector and permit access for inspection to all places where work is being done. The contractor shall supply free to the Owner / Consultant all necessary gauges and templates necessary for inspection. However, such inspection shall not relieve the contractor of his responsibility to furnish satisfactory work.

Materials of workmanship, not conforming to provisions of the specifications, may be rejected at any time when defects are found during the progress of work.

The contractor shall obtain approval from the Owner / Consultant of all fabricated items prior to commencement of their erection. However, any such approval shall not absolve the Contractor from his responsibility of correctness and workmanship of the entire work.

9.9 Shop Painting

All steel work shall be provided one coat of appropriate primer (depending upon the type of final painting). Surfaces which are inaccessible after erection shall be provided the full number of coats prior to assembly. The steel work shall be cleared of all rust, scale and grease prior to the application of the primer. When specifically called for the structural steel shall be cleaned by sand blasting to SA2 as per SIS-5900. All care shall be taken to cover all crevices, comers, edges, etc.

Application of primer shall not be done near edges which are to be welded thereafter. Similarly, welds which are yet to be approved by Owner / Consultant shall not receive the primer coat. Parts which are to be encased in concrete shall not be painted.

Machine finished surfaces shall be protected against corrosion by a rust inhibiting coating that can be removed prior to erection.

9.10 Packing and Transportation

Loading and transportation shall be done in accordance with transport rules prevailing at that location. Items shall be packed to protect them from damage/distortion. Small parts shall be securely wired to their main members.

Loose items such as Bolts, nuts and washers shall be packed in crates.

9.11 Field Erection

The contractor shall submit to the Owner / Consultant the planned mobilisation of plant and equipment for approval.

Prior to setting out of the steelwork the contractor shall satisfy himself regarding the accuracy of the main axes of the structure and the correctness of the levels, alignment and location of concrete pedestals, columns, pockets and holding down bolts. In case there are any deviations regarding positions of foundations or anchor bolts which would lead to erection deviations, the Owner / Consultant shall be intimated. Minor rectification such as chipping, cutting and making good, adjusting the anchor bolt, etc. shall be carried out by the Contractor at his own expense.

Tolerances for erection of steel work shall be in accordance with Annexure I & IS:7215 whichever is more stringent.

9.12 Safety and Security

The contractor shall take necessary safety measures to comply with IS:7205 and shall ensure that hazardous or unsafe working conditions do not exist during any stage of erection.

During erection the contractor shall ensure that all loads due to wind, erection equipment etc. is catered for either by introducing temporary bracings or guy wires. The guy wires shall not be anchored from other adjoining permanent structures.

Contractors shall provide at no extra cost proper access, platforms and safety arrangements at no extra cost.

Permanent bolting and welding shall be done only after ensuring proper alignments.

9.13 Field Connections

9.13.1 Field Bolting

This shall be carried out with the same care as shop bolting.

9.13.2 Field Welding

Field welding after field assembly shall follow the same requirements as laid down for shop assembly and shop welding.

9.14 Grouting

Prior to erecting the steel work over concrete pedestals, columns or brackets, the top of concrete shall be cleared with wire brushes, chipping and compressed air to remove all substance and loose material and made thoroughly wet. The structural member shall then be erected aligned and plumbed with the base plates as shoe plates maintained at specified levels using shims / pack plates or wedges.

After the structure is erected, formwork shall be done all around and the joints sealed to be water tight. The grout under the base plates, including in pockets and sleeves shall be ordinary grout or non-shrink grout as specified on drawings. Non shrink grout shall be of premix type and shall be prepared as per manufacturer's instructions. Non shrink grout shall be of quality and type approved by Owner / Consultants.

The grout shall be poured in by grout pumps continuously from one side till the intervening space are filled completely and the grout is carried to the far side of base plate. The grout shall be spread with flexible steel strips and rammed with rods to ensure the gap is filled completely.

After the grout has sufficiently hardened the shims / pack plates / wedges which are accessible may be removed and anchor bolts tightened. The alignment of the structure shall be rechecked and the voids left by removal of the shims / pack plates / wedges shall be filled with a similar mix of grout. In case the structure is not properly aligned, the grout shall be removed, the structure realigned and grouting operation repeated.

9.15 Payment for Structural Steel

Payment for structural steel shall be paid on the basis of admissible weight (in metric tons) of the structure accepted by Owner / Consultant. The rate shall include supply, fabrication, erecting in position (at all locations and levels as mentioned in Schedule of Items), testing and examining (excluding all types of built up and compound sections made up from rolled sections and plates including all transporting, preheating, welding or bolting of joints, including continuously seal welding of box sections, grinding, fixing in line and level with temporary staging, bracing or guying and the removal of the same after erection, grouting with ordinary or non-shrink grout (payment for grout being made separately) including preparation of fabrication drawings and erection drawings, erection schedules including all necessary submissions for review, preparing the surface for painting, surface cleaning, wire brushing, removal of mill scale, dust, rust, oil or

grease and applying one coat of red oxide zinc chromate primer or appropriate primer shall be made for rolling tolerance.

The weight as determined from the fabricator drawings and bill of material prepared by the contractor shall be the admissible weight for payment mentioned as per above. The weights shall be calculated on the basis of IS: 808, latest revision in sectional dimensions and unit weight, wherever applicable and from manufacturer's handbook for other cases. No allowance in weight shall be made for rolling tolerance.

The bill of materials shall be checked and approved by the Owner / Consultant prior to making payment.

Bolts, nuts, washers, pack plates, shims, wedges and welds shall not be measured. The quoted rate shall be deemed to include the same.

Grout shall be paid on Cu.M / Sq.M basis based on volume area calculated to fill the pockets and the gap between top of pedestal and underside of base plate.

9.16 Painting after Erection

9.16.1 General

Painting work after erection shall be carried out with the best quality of approved material. Workmanship in line with good engineering practice shall be ensured. As far as possible the application instructions of paint manufacturers shall be followed.

Painting shall not be done during foggy or frosty weather or if humidity is high causing condensation on the surface to be painted.

Paints shall be stored in such a manner so as to avoid extremes of temperature. Primers and finish coats shall be from the same manufacturer so as to ensure compatibility.

Shop coated surfaces shall be cleared of all dirt, dust, grease, rust etc. using energy / abrasive paper or warm fresh water and air dried. Areas where the shop primer has got damaged shall be touched up. A primer coat of red oxide zinc chromate primer conforming to IS:2074 or other appropriate primer shall be brushed/sprayed on to form a continuous film throughout. The primer coat shall have a minimum film thickness of 25 microns $\pm$ 10 percent after drying. The primer coat shall be air dried.

After the primer is hard and dry, the surfaces shall be dusted off and the first coat of synthetic enamel paint or other appropriate paint, of approved shade and colour shall be applied by brushing or spraying. The first coat shade shall be slightly lighter than that of second coat to aid identification. The second coat of paint shall be applied after the first coat is hard and dry. The minimum thickness of each coat shall be 20 microns $\pm$ 10 percent tolerance (Dry Film thickness).

A data sheet of painting requirements specifying the location/type of structure, type of paint, surface preparation, primer type and DFT, number of final coats and the DFT of each of the final coats, shall be as given by consultant.

9.16.2 Inspection and Testing of Paint

All painting material shall be procured from reputed manufacturers only and manufacturer's quality / test certificates must accompany the supply.

Owner / Consultant at his discretion may require additional tests to satisfy him regarding the quality of paint including batch wise test of wet paints for physical and chemical analysis. The costs of all such testing shall be borne by the contractor.

The various stage wise inspections shall be at the following stages:

i) Surface preparation

ii) Primer application

iii) Each final coat

The contractor shall make available all facility and equipment such as Elko meter necessary for inspection free of cost. Measurement / tests shall be performed at as many locations as desired by Owner / Consultant. The contractor shall make good / rectify any defects pointed out prior to proceeding with next stage of work. Irrespective of any intermediate inspections and approval the contractor shall be responsible for rectifying any defect found during final inspection, guarantee period or defect liability period.

9.16.3 Payments

The rate shall include storage, surface preparation, degreasing, cleaning, drying, touching up of shop primer, providing temporary staging, testing and supplying of all types / shapes at all locations and positions etc. all complete, as specified.

9.17 Annexure 1 - Erection Tolerances

Tolerances allowed in the erection of Structural Steel Buildings frames shall be as follows :

Component	Description	Variation allowed
Main Columns and Roof Posts	Shifting of column axis at foundation level with respect to true axes.	
	- in Longitudinal direction	± 5 mm
	- in Lateral direction	± 5 mm
	Out of plumpness of column axis from true vertical as measured at the top.	
	For a column up to and including 30M ht.	+ 25mm or + H/1000 (whichever is less)
	- For a column greater than 30 M height.	+ 35mm or + H/1200 (whichever is less)
	Deviation in straightness in longitudinal and transverse planes of column at any point along the height.	+ 10 mm or + H/1000 (whichever is less)
	For any individual column deviation of any bearing or resisting level from levels shown on the drawings.	± 5 mm
	Difference in the erected positions of adjacent pairs of columns across the width of the building prior to placing of truss/beams with respect of true distance.	± 5 mm
	For adjacent pairs of columns either across the width of building or longitudinally, level difference allowed between bearing and	± 5 mm

	seating level supposed to be at the same level.	
Trusses	Deviation at centre of span of upper chord member from vertical plane running through centre of bottom chord. Lateral displacement of top chord at centre of span from vertical place running through centre of supports. c) Lateral shift in location of purlin from its true vertical position. Lateral shift in location of purlin from true position. Deviation in difference of bearing levels of truss from the true difference.	1/250 of the height of truss in mm at centres of plan of ± 15 mm whichever is less. 1/50 of span of truss in mm or ± 10 mm (whichever is less). ± 10 mm ± 5 mm ± 1/250 of span of truss in mm or ± 20 mm (whichever is less).
Crane, Gantry, Girders and Rails	Shift in the centre line of crane rail with respect to centre line of web of gantry girder. Shift of alignment of crane rail w.r.t. true axis of crane rail. Deviation in crane track gauge with respect to true gauge. I) For gauge upto 15 M ii) For gauge more than 15 M Deviation in the crane rail level at any point from true level. Difference in levels between crane track rails (across the bay) at I) Supports ii) Mid span Relative shift of crane rail surface (at a joining in plan and elevation)	± (half web thickness plus 2mm) ± 5 mm ± 5 mm ± 10 mm ± 10 mm 15 mm 20 mm 2 mm

9.18 Anchor Bolts

All materials used by the Contractor shall be of tested quality as per specifications below and test certifications of raw materials shall be provided by the Contractor.

Bolts shall be turned from M.S conforming to IS 2062 grade A and IS 432.

Nuts shall be hexagonal type conforming to IS 1363-3138.

Plain washers shall be of mild steel conforming to IS 2016.

Sleeves shall be M.S. Tubes (Medium) conforming to IS 1161.

9.18.1 Fabrication

Fabrication of anchor bolts shall be in compliance with the specifications. Complete anchor bolt assembly shall be as per drawings, and will include the cost of sleeve pipes, fine gussets, bottom plates, and other fixtures including all welding work if involved.

Threads shall be of coarse type conforming to IS 1367 and IS 4218.

The anchor bolt assembly to be anchored or embedded in concrete shall be placed and securely held in position strictly as per drawings before and during pouring of concrete, with necessary wooden or steel templates and other devices.

Tolerances allowed for anchor bolts positioning shall be:

8) For sleeved bolts one tenth of bolt nominal diameter.
9) For bolts without sleeves, one twentieth of the bolt nominal dia.

The surface not to be covered with concrete shall be greased and protected from damage by wrapping and tying jute cloth/polythene.

Payment

Payment for supply and fabrication of anchor bolts including sleeves and nuts shall be on weight basis of the finished product and shall include greasing etc. A sample bolt shall be got approved from Engineer-in-Charge.

Payment for fixing where separately specified, shall be on weight basis and rate shall include carting, fixing, greasing, providing and tying Hessian cloth, welding, if required etc. complete.

9.19 M.S. Metal Inserts

All metal inserts and its fabrication, bolting, riveting, welding etc. shall conform to the requirements specified under "Specification for structural Steel". The metal inserts shall be fabricated as per drawing and direction of the Engineer-in-Charge.

The placement of the metal inserts shall be in brick masonry, plain or reinforced concrete members. It shall be so securely placed in the member that its position is not disturbed while concreting. Suitable templates, spacer blocks, dummy structures and staging shall be provided. Necessary cutting in the shuttering and adjustment of reinforcement shall be effected for the placement of metal inserts if situation so requires. Where so indicated, it shall be welded to the reinforcement.

The exposed surfaces shall be given one coat of red oxide primer and where directed, protected by grease jute cloth wrapping and tying.

Payment:

Payment shall be made on the basis of actual weight of the metal inserts. Rate for metal inserts shall include supply, fabrication, fixing, tying, turning, tack welding, welding on other embedded items such as Pipe (for puddle flanges) cutting and adjusting the shuttering, and reinforcement and dry packing, if required with cement mortar 1:3, protecting with jute cloth etc. complete.

9.20 Carbon Steel Grating

9.20.1 Scope

The purpose of this standard is to define the specifications to be followed for shop fabricated Carbon Steel Grating for Steel floors, walk ways, platforms, stairs etc. Including fixing with saddle clips for 30mm

bearing bars including bolts & nuts as per manufacturers details, with hot deep galvanised coating mass of minimum 610 g/m2 total of zinc on both face.

9.20.2 Material specification

Carbon steel as per IS 2062 minimum tensile strength Fy250 grating with main bars 25mm x 5mm @ 30mm c/c and cross bars 8mm dia mild round/square @ 100mm c/c or size as per item description, etc.

9.20.3 Fabrication Drawings

Based on the arrangement of supporting structure shown on design drawings, the Contractor shall prepare shop fabrication drawings and get the same approved as per the procedure outlined for shop fabrication drawings for Grating work.

9.20.3.1 Gratings

These shall be of readymade bought out type and designed to carry specified loads with limitations on permissible deflections.

Unless otherwise mentioned in schedule of rates these shall be capable of carrying a uniformly distributed load of 5 kN/m^2 or a concentrated load of 10 kN at mid span, whichever is governing. The maximum span for the above loading condition shall be 1200mm. The deflection shall not exceed span/200 or 6mm whichever is less.

Before fabrication or procurement the Contractor shall submit the drawings and manufacturer's literature and get the same approved from Client.

The gratings for stair treads shall be provided with nosing of chequered plate of approved size and thickness.

Grating fixing with saddle clips for 30mm bearing bars including bolts & nuts as per manufacturer’s details.

Coating with Hot deep galvanised coating mass of minimum 610 g/m2 total of zinc on both faces.

9.20.4 Method of measurement

Gratings shall be paid on the basis of the area of Gratings and frame actually laid.

The rate shall include cost of preparation of fabrication drawings, cost of cutting to size, fabricating, welding, bolting, smoothing ends if necessary, hot deep galvanising, transporting and fixing in positions by clips as per the design drawings. Full deductions shall be made for all openings above 300 mm^2 sizes. The rates shall also include all incidental costs and charges such as carriage, local taxes, loading, unloading, storing, safe custody, watch and ward, returning back of surplus materials to godown of issue where applicable.

9.21 M.S. Tubes for Hand Rails

All mild steel tubes and fittings shall conform to IS 1161 & IS 1239 and shall be of medium grade. All screwed pipes shall have threads as per IS 554. All fittings shall be malleable iron fittings as approved by Engineer-in-Charge.

All pipes shall either be directly welded or joined with screwed couplings. Care shall be taken to remove burrs from the ends of the pipe and if required the vertical members should be grouted with cement mortar as specified. The pipe shall be fixed to pipe or angle uprights by means of suitable clamps or by means of

welding. After fixing, the pipe shall be painted with two coats of white paint or aluminium paint over a coat of primer as directed by Engineer-in-Charge.

9.21.1 Payment

The payment shall be made on running meter basis of the actual length of hand rail fixed and shall include the cost of pipes, clamps and fittings, if any, transportation, cutting of pipes as required, threading or welding, fixing, painting, etc. all complete as per direction of the Engineer-in-Charge.

10 Drainage Work

10.1 Scope of Work

Work under this section shall consist of furnishing all labour, materials, equipment's and appliances necessary and required to completely install all soil, waste, vent and rainwater pipes as required by the drawings, specified hereinafter and given in the schedule of quantities.

Without restricting to the generality of the foregoing, the soil, waste, vent and rainwater pipes system shall include the followings:-

- Vertical and horizontal soil, waste and vent pipes, rainwater pipes and fittings, joints, clamps and connections to fixtures.
- Testing of all pipes

10.2 General requirements

- All materials shall be new and of the best quality conforming to specifications and as per the approved samples for all the items shall be submitted to EIC for approval.
- Pipes and fittings shall be fixed truly vertical, horizontal or in slopes as required in a neat workmanlike manner.
- Pipes shall be fixed in a manner so as to provide easy accessibility for repair and maintenance and shall not cause obstruction in shafts, passages etc.
- Pipes shall be securely fixed to walls and ceilings by suitable clamps at intervals specified.
- Access doors for fittings and cleanouts shall be so located that they are easily accessible for repair and maintenance.
- All works shall be executed as directed by EIC.

Soil and wastewater from the toilets shall be collected by two pipe system with separate stack for grey waste and soil waste are connected to gully trap, which in turn is discharged to first inspection chambers and then manholes.

Minimum diameter of soil pipe is 100mm and waste pipe is 75mm in toilet portions. All the soil stacks shall be properly vented. Cross venting shall be provided for vertical stacks.

10.3 Codes and stranded

IS 458 - Precast concrete pipes (With and without reinforcement) - Specification
IS:783 - Code of practice for laying of concrete pipes.
IS:784 - Pre-stressed concrete pipes.

10.4 Non-Pressure Hume Pipe

10.4.1 Materials

For pipe materials shall be as per IS 458, for cement sand, mortar, water etc. the specifications laid down for concrete works shall apply. All pipes must be new and perfectly sound, free from cracks, cylindrical, straight, and of standard nominal diameter and length with even texture. Each pipe shall have one collar

with it. The Implementation Contractor shall submit manufacturer's test certificate to the EIC. Spun yarn for pipe joints shall be of best quality. It shall be clean and free from dust etc.

The pipe shall be with or without reinforcement as required and of the class as specified.

10.4.2 Transportation and Stacking

The transportation of materials to the work site and stacking shall be done in a manner to cause minimum inconvenience to the traffic and other construction works. The pipe shall be protected during handling against impact; shocks and free fall to avoid cracks and damage. The Implementation Contractor shall be fully responsible for the safety and security of materials transported and stacked in the field. Gradual unloading by inclined plane or by chain pulley block is recommended.

10.4.3 Lowering and Laying of Pipes

General

The laying and jointing of pipes shall conform to IS:783. The trench shall be checked for proper level, gradient and alignment before lowering the pipes. Lowering the pipes shall be lowered cautiously to prevent disturbance of the bed and sides of the trench. The heavy pipes shall be lowered by means of proper shear legs, chain pulley blocks or as directed by EIC. Great care should be taken to prevent sand etc. from entering the pipes.

All pipe sections and connections shall be inspected carefully before being laid. Broken or defective pipes or connections shall not be used. Pipes shall be lowered into the trenches carefully mechanical appliances may be used. Pipes shall be laid true to the line and grade as specified. Laying of pipe shall proceed upgrade of a slope.

Laying

Laying of pipes shall proceed upgrade of slopes. The error of grade shall not be rectified by packing up earth underneath the pipes. If required, concrete shall be used for packing.

The ends of the pipes shall be kept closed to keep out dirt, mud and foreign materials, out. Adequate provision shall be made to prevent floating of pipe in the event of flooding of trenches.

The body of the pipe for its entire length shall rest on an even bed in the trench and collar location shall be excavated to receive the collar for the purpose of jointing.

Where the pipe shall be bedded directly on soil, the bed shall be suitably rounded to fit the lower part of the pipe the cost for this operation being included in the rate for laying the pipe.

Jointing of Pipes

A few skeins of spun yarn soaked in neat cement shall be inserted in the groove at the end of the pipe and the two adjoining pipes butted against each other. Collar shall be slipped over the joint covering equally both the pipes. Spun yarn soaked in neat cement shall be passed round the pipes and inserted in the joint by means of caulking tools from both ends of the collar. More skeins of yarn shall be added & well rammed home. The object of the yarn is to centre the two ends of the pipes within the collar and to prevent pipes becoming loose.

Cement mortar 1:2 (1 cement: 2 sand) shall be slightly moistened and must on no account be soft or sloppy and shall be carefully inserted by hand into the joint. The mortar shall then be punched and caulked into the joint and more cement mortar added until the space of the joint has been filled completely with tightly caulked mortar. The joint shall be finished off neatly outside the collar on both side at an angle of 45 Deg.

Any surplus mortar projecting inside the joint is to be removed and to guard against any such projections, sack or gunny bags shall be drawn past each joint after completion.

Concrete used for the manufacture of un reinforced and reinforced concrete pipes and collars shall not be leaner than 1: 2:4 (1 cement : 2 coarse sand :4 graded stone aggregate). The maximum size of aggregate should not exceed one third of the thickness of the pipe or 20 mm whichever is smaller. The reinforcement in the reinforced concrete pipes shall extend throughout the length of the pipe. The circumferential and longitudinal reinforcements shall be adequate to withstand the specified hydrostatic pressure and further bending stresses due to the weight of water when running full across a span equal to the length of pipe plus three times its own weight.

If the pipe have spigot and socket joints, the socket ends shall face up-stream. In the case of pipes with joints to be made with loose collars, the collars shall be slipped on before the next pipe is laid. Adequate and proper expansion joints shall be provided where directed.

In cases where the natural foundation is inadequate the pipes shall be laid either in concrete or cradle supported on proper foundations or on any other suitably designed structure. If a concrete cradle bedding is used the depth of concrete below the bottom of the pipe shall be at least 1/4th of the internal dia of the pipe subject to a minimum of 10 cm and a max. of 30 cm. The concrete shall extend up the sides of the pipes at least to a distance of 1/4th of the outside diameter for pipes 300 cm and over in diameter. The pipe shall be laid in this concrete bedding before the concrete has set pipes laid in trenches in earth shall be bedded evenly and firmly and as far up the haunches of the pipes as to safely transit the load expected from, the backfill through the pipe to the bed. This shall be done either by excavating the bottom of the trench to fit the curve of the pipe or by compacting the earth under the curve of the pipe to form an even bed. Necessary provision shall be made for joint wherever required. When the pipe is laid in a trench in rock, hard clay, shale or other hard material the space below the pipe shall be excavated and replaced with an equalising bed of concrete sand or compacted earth. In no case shall pipe be laid directly on such hard material. When the pipes are laid completely above the ground the foundations shall be made even and sufficiently compacted to support the pipe line without any material settlement. Alternatively the pipe line shall be supported on rigid foundations at intervals. Suitable arrangements shall be made to retain the pipe line in the proper alignment such as by shaping the top of the supports to fit the lower part of the pipe. The distance between the supports shall in no case exceed the length of the pipe. The pole shall be supported as far as possible close to the joints. In no case shall the joint come in the centre of the span. Care shall be taken to see that superimposed loads greater than the total load equivalent to the weight of the pipe when running full shall not be permitted. Suitably designed anchor blocks at change of directions and grades for pressure lines shall be provided where required.

Collar shall be spaced symmetrically over the two pipes and the space between collar and pipe filled with cement mortar 1:1 thoroughly rammed with caulking tools. The joint shall be finished with a fillet sloping at 45°. If specified in the item specification wedge shaped groove in the end of the pipe shall be filled with a special bituminous plastic compound for bitumen soaked spun yarn. The collar shall then be slipped over the end of pipe and next pipe butters well against tee plastic compound

by suitable application so as to compress the plastic compound in the grooves, care being taken not to disturb concentricity and level of the pipes.

Curing

Joints shall be protected and cured for about 10 days.

Testing

All joints in the pipes shall be tested to a head of 1.5 metres of water above the top of the highest pipe.

Mode of measurement

- Providing and laying of pipe links, rounding off the bed to fit the lower part of the pipe, jointing of pipes all shall be paid in RM under this item.
- The concrete bed and blocks of CC 1:2:4 provided at junction shall be paid under concrete work.

10.5 UPVC Pipes & fittings

All Horizontal running Waste pipe from appliances e.g. washbasins, water closet and urinals shall be uPVC pipes of confirming to **13592 (Type-B)** in all toilets.

All pipes shall be fixed in gradient towards the connection to stack, trap or drain. Pipes inside all toilets shall be in chase unless otherwise mentioned. Joints shall be done as per the manufacturer's recommendations. The pipes and fittings must have matching dimension for perfect joints in the system. 'O' ring fittings must have sufficient gap (approx. 10 mm) for thermal expansion of pipes.

Use proper uPVC pipe adapters for connections between traps & uPVC pipes where necessary. Such joints shall be made of an approved type of 'Putty'.

10.5.1 Supports & clamps

UPVC pipes require supports at close intervals. Recommended support spacing for un-plasticised PVC pipes is 1400 mm for pipes 50mm dia and above. Pipes shall be aligned properly before fixing them on the wooden plugs with clamps. Even if the wooden plugs are fixed using a plumb line, pipe shall also be checked for its alignment before clamping, piping shall be properly supported on, or suspended from clamps, hangers as specified and as required. The Implementation Contractor shall adequately design all the brackets, saddles, anchors, clamps and hangers and be responsible for their structural sufficiency. Pipe supports shall be primer coated with rust preventive paint.

For UPVC pipes standard UPVC clamps shall be used. For other pipes M.S. clamps, supports and hangers provided shall be galvanised. Factory made Pre-fabricated clamps shall be preferred. Implementation Contactor may fabricate the clamps of special nature and galvanise them after fabrication but before installation. (Clamps shall be fabricated from mild steel sections) All nuts, bolts, washers and other fasteners shall be factory galvanised.

Clamps shall be of approved designs and fabricated from M.S. flats and other sections of thickness and sizes as per approved working drawings or shop drawings. Clamps shall be fixed in accordance to manufacturer's details/shop drawings

When required to be fixed on RCC columns, walls or beam they shall be fixed with approved type of galvanised expansion anchor fasteners (Dash fasteners) of approved design and size according to load.

Structural clamps e.g. trapeze or cluster hangers shall be fabricated by electro-welding from M.S. structural members e.g. rods, angles, channels flats as per Contractors shop drawing shall be galvanised after fabrication. All nuts, bolts and washers shall be galvanised.

10.5.2 Sleeves / cut-outs

Contractor shall utilize all cut out and sleeves provided during construction to prevent breaking. The annular space between the pipe and the sleeve shall be filled up with approved type of fire retardant sealant. When sleeves are misplaced or inaccurately located Implementation Contractor shall make the holes in the wall or structural members at his own cost but only with the prior permission of the EIC

11 Roofing & Cladding work

11.1 Scope of Work

The Contractor shall furnish all labour, materials, tools and services necessary to complete all work in Roof Sheeting, louvers, side cladding etc. in accordance with the drawings and as specified therein.

Applicable Codes & Specifications

The following codes, standards and specifications are made a part of this specification. All specifications, standards, codes of practices referred to herein shall be the latest edition including all applicable official amendments and revisions. In case of discrepancy between this specification and those referred to herein, this specification shall govern:

IS:2527 : Code of Practice for fixing rain water gutters and down pipes for roof drainage.

IS:277 : Specification for galvanised steel sheets (plain and corrugated).

11.2 Zincalume sheet roofing / cladding work

11.2.1 General

The work described herein shall cover providing and installing Trapezoidal profile metal sheet roofing and cladding including translucent sheets and all accessories such as flashings, capping, gutters, trims, supporting straps, brackets, foam fillers, sealants and the work shall be carried out in strict accordance with this specification and applicable drawings. Supplier shall prepare shop drawings for roofing, cladding, gutters etc. and shall take the approval of Client/Engineer In Charge prior to manufacturing and supply. Based on roof slope, supplier shall propose the type of profiled sheet to be used and the proposal shall be justified through proper calculations.

11.2.2 Material

Steel Base: The steel base material of sheet shall have minimum 550 MPa Yield strength made out of cold rolled steel. The steel manufacturers test certificate for the chemical and mechanical properties of steel must be concerned authority prior to installation.

Metallic Coating: The sheets shall have a hot-dipped metallic Aluminium-Zinc alloy coating of 55% Aluminium 43.5% Zinc &1.5% Si with total mass coating of 150 g/m^2 on both sides as Zincalume AZ150 as per AS 1397;2007/ IS 15961:2012

Colour Coating: Colorbond XRW steel quality paint coat with Super Durable Polyester oven-baked conforming to AS/NZS 2728 Class 4/ IS 15965:2012 class-3, the total coating thickness of 35 µm (nominal), It comprising of nominal 20 µm exterior Super Durable polyester coat on top surface and nominal 5 µm reverse polyester coat on back surface over nominal 5 µm primer coat on both surfaces of approved colour shade for the top sheet. The paint system should have stable SDP resin & inorganic pigments for colour durability or SMP coated painting system. The sheet shall have brand marking of the manufacturer giving product details on the back of the sheet at regular interval confirming genuinity of the material.

11.2.3 Profile

The external roof panel shall be trapezoidal profile, having **minimum 35mm crest height**, manufactured out of 0.45 mm BMT (Base Metal Thickness) /0.50mm TCT (total coated thickness excluding paint coating), Hi Tensile Zincalume steel pre-painted with super durable polyester paint system of approved colour shade suitable for external exposure condition. The sheet shall have subtle square fluting or shall have 2 - 3 nos. stiffening ribs in profile pan for better strength and effective water shedding. The sheet shall have special male/ female ends with full return legs on side laps for purlin support and anti-capillary groove to avoid any seepage of water through lateral overlap.

11.2.4 Trims & Gutters

Roof flashing and trims (parapet flashing, transition trims, expansion joint trims and ridge caps) are manufactured from same colour, finish and thickness as roof panels (or manufacturer's recommendation).

Wall flashing and trims (gable, corner, framed opening, wall penetrations, etc.) are manufactured from same colour, finish and thickness as wall panels (or manufacturer's recommendation).

Eave / valley gutters and downspouts are manufactured from same colour, finish and thickness as wall panels (or manufacturer's recommendation). *The shape and girths shall be as per design requirement and shall be approved by the EIC.*

11.2.5 Accessories

Fasteners: The steel sheet shall be fastened with min. 40 µm zinc coated or min. 20 µm Zinc-Tin alloy coated, Hex head, self-drilling screw as per AS 3566 Class 3 fasteners of approved make with EPDM washer on each crest of sheets for connecting with purlin (or as per design) perpendicular to the sheeting and in the centre of the corrugation or rib. The fastener size shall be calculated as per the design requirement.

In-fill strips: The infill strips are manufactured from closed cell polyethylene foam. This material should have uniform compressibility, waterproof, weather resistance, UV resistance, chemical resistance, nontoxic, odourless and environment friendly to meet installation requirement in accordance with AS 2424-4 3 A & B or equivalent and approved by engineer-in-charge.

Sealant: It should be acetic acid -free and amine- free neutral curing silicone rubber sealant of approved make. It shall be applied at all end laps as per manufacturer's recommendation and approval by engineer-in-charge.

11.2.6 Shop drawing

The Contractor shall prepare shop drawings for roof sheeting and cladding, based on the design drawings and/or fabrication drawings supplied to him. Shop drawings of sheeting and cladding work shall be such that roofing and cladding can be procured cut if required, erected, laid and fixed as shown on the design drawing and as per specifications and the direction of the Client/Consultant's Engineer-In-Charge. These drawings shall show the layout and exact lengths of the sheets, details of all sheeting accessories.

Shop drawings shall indicate layout and details of fixing arrangements including details to enable procurement of bolt assemblies and everything necessary for the complete execution of the sheeting work.

Shop drawings of sheeting shall be submitted to the Client/Consultant for his review, and approval prior to starting any work. The Client/Consultant's approval shall not absolve the Contractor of the responsibility of correctness and accuracy of his drawings.

11.2.7 Stacking and Handling

Sheets shall be handled, stacked and stored carefully so as to eliminate damage and prevent wastage. Stacking shall be on firm level dry ground. Sheets of equal size shall be stacked together. Damaged material shall not be stacked along with sound material. Stacking shall be away from roads / accesses to prevent damage by vehicular traffic. While handling, care shall be taken so that lifting hooks, clamps, cups, ropes, pallets etc. do not damage (scratch, bend or locally buckle) the sheets. Also this shall be as per manufacturer's specifications.

11.2.8 Installation -- Erection and Fixing

The installation shall be done in accordance to the standard practices as specified by the manufacturer and as approved by the concern authority. All sheets and accessories must be stored and finally erected without any damage.

Fastening sheet to support: The sheet installation has to be done by using AS 3566 class 3 fasteners with EPDM washer. In case of roof, it shall be placed at each crest of sheets connecting with Purlin (or as per design) perpendicular to the sheeting and in the centre of the corrugation or rib. For walling, you may use either crest- or valley-fixing the fastener size shall be calculated as per the design requirement. Do not place fasteners less than 25mm from ends of sheets

End Lap: All the sheet end lap (roof) shall have an overlap of 150 mm to 250 mm for a slope more than 15 degree (1 in 4) and 200 mm to 300 mm for slope less than 15 degree. The silicon sealant shall be applied at both the ends of the sheet at the overlap with stitch fasteners as per manufactures recommendations and conforming to AS 3566-2002 Class 3.

Side lap: The side edge of profile having anti-capillary groove is always the underlap. It is generally considered good practice to use fasteners alongside-laps however, when cladding is supported as indicated in maximum support spacing, side-lap fasteners are not usually needed,

Ends of Sheets: It is usual to allow roof sheets to overlap into gutters by about 50mm. If the roof pitch is less than 25° or extreme weather is expected, the valleys of sheets should be turned down at lower ends, and turned up at upper ends by about 80°

Lay sheets toward prevailing weather: It is much easier and safer to turn sheets on the ground than up on the roof. Before lifting sheets onto the roof, check that they are the correct way up and the overlapping side is towards the edge of the roof from which installation will start. Place bundles of sheets over or near firm supports, not at mid span of roof members. To align the first sheet uses a level on the gutter-end.

Sheet ends on low slopes : When trapezoidal sheet is laid on slopes of 5° or less, cut back the corner of the under-sheet, at the downhill end of the sheet, to block capillary action.

The contractor will be required to submit design calculation in support of the proposed profile of the sheet and standard loading etc. to the satisfaction of the design consultant and the concern authority. The contractor shall also submit methodology for fixing and also a maintenance manual for routine maintenance.

The contractor shall ensure that panel erector is familiarized with the erection procedure and all the supporting members are straight, level and true (according to AISC) before starting panel erection. Panels shall be erected according to approved shop drawings by the concern authorities.

The sheets shall be ordered in lengths suitable for minimising the number of end laps. Suitability for handling and transporting the sheets shall also be given due importance in deciding the sheet length. Sheet length shall be such that the end laps fall on a purlin. Roof sheets shall be laid so that corrugations are in the direction of the roof slope. Laying of roof sheets shall begin at the lowest level / eaves portion and away from the direction of the most prevalent wind direction.

When the roof slopes are less than 15 deg. or rainfall intensity is expected to be higher than 60 mm/hour, then troughs between the crests of the sheet at the ridge of the roof shall be turned up through 80 degrees and at lower edge/eaves turned down through 80 degrees by using turn-up tool.

Sequence of work shall be first the roofing, eaves gutter work and then side cladding. Wall sheeting shall be laid with corrugations vertical. Laying of wall sheeting shall be started at one end and shall be laid to have side lap away from the direction of the most prevalent wind. Also this shall be in line with manufacturer's specifications.

During sheet-work workers shall wear footwear with soft soles (non-scratch producing) and workers shall not step on crests (step only in troughs) and damage the profile of the sheets.

The use of cat ladders / planks is recommended.

Sheet laying shall be started after ensuring that all required sheeting, accessories, fixings are available at site and their shortfall will not hold up the sheet work. Notching tool shall be used for making notches in copings and flashings.

All fasteners shall confirm to AS: 3566 Class 3 or Class 4. Self-drilling & self-tapping sheet metal screws with metal and neoprene washers, which conform to American / Australian Standards Association Specifications.

All fasteners exposed directly to the weather should be fitted with sealing washer. The fastener size, type and frequency is to be decided by the consultant as per design requirement of the particular element.

11.2.9 Acceptance Criteria

The installation of sheeting work shall be accepted if the installation presents a neat appearance, if **NO** external light is visible when viewed from inside especially through the gaps at laps, joints, flashings, or no cracks are visible, and if the installation is water tight when tested.

Following aspects shall be checked for acceptance:

1. Soundness of sheets and accessories

Absence of cracks, holes, punctures, dents, scratches, consistency of colour shade, crests shall be parallel to sheet edges, consistent thickness of sheet, warping, broken/no smooth edges etc.

2. Correct laying sequence and method

Especially adequate side and end laps, direction of laying, mitring.

3. Fixings

Size of bolts, number of bolts and bolt spacing, size and number of washers, caps, method of making hole for bolts and its size, bolt material.

4. Adequate and proper installation of flashing to make installation water tight.

11.2.10 Measurement

The supply and installation measurement will be done on the actual finish surface area of the sheet separately.

No separate measurement will be made for the laps of sheet and accessories, bolts, nuts, washers, adjustable bolts and supports for gutters and other fixtures. These are assumed to be included in the Rates.

All accessories like ridge, flashing, Corner pieces and Gutter shall be measured in running meter basis if specified separately in Item Description.

12 Monorail Hoist

12.1 Scope of work

12.1.1 Vendor's Scope

Design, engineering, manufacturing, inspection, testing, packing and forwarding, supply at site, erection-commissioning, calibration and providing performance guarantee of electrically operated monorail hoist along with all necessary components, accessories, inter-connected cabling, wiring, instrumentation and controls etc.

It is not the intent to completely specify all the details, equipment, item, accessories etc. and their constructional features of the package. So, any additional work / equipment or technical requirement not mentioned hereunder but required to make the offered system complete in accordance with the specification or required for safe operation, shall be deemed to be included in the offer and provided by the bidder, without any additional payment / cost to the owner.

The Contractor/vendor (system supplier) shall be responsible for the coordination of the design and for the satisfactory functioning of the all the components which compose the whole system/ complete unit. In cases where the vendor supplies equipment that he has not manufactured, he shall be responsible for ensuring that the design of these items are compatible with each other and with his own equipment in all respects. In particular, they shall be compatible dimensionally, in performance, in control such that a fully integrated sturdy unit is provided.

Any additional item/equipment or technical requirement not mentioned hereunder but required to make the offered system complete in accordance with the specification or required for safe operation, shall be deemed to be included in the offer and provided by the bidder, without any additional payment.

All the equipment's that form part of the entire system shall conform to high standards of design, engineering and workmanship in all respects and shall meet all the requirements of relevant codes. Compliance to this specification shall not relieve the equipment manufacturer/ vendor of the responsibility of supplying the equipment's and auxiliaries of proper design, material and workmanship to meet the operating requirements specified in the datasheet / design basis. In case of requirements of additional instruments, controls, safety devices and any other auxiliaries for safe, smooth & trouble free operation of the equipment, the equipment manufacturer / vendor shall include the same in his scope of supply.

The Contractor/vendor shall arrange for his own power generation/distribution system required for scope of work at site.

12.1.2 Contractors/Vendors scope of supply

All civil – RCC or structural steel column (right up to insert plate of RC column or pad plates on steel column) works including foundations based of column as per complete loading data (static & dynamic), GA, Elevation and foundation plan.

Single point power & earthing cable's / earthing pit (at @ 10 m distance) shall be laid at specific location for electrical operated mono-rail.

All civil or structural column attached bracket Long Travel beam with hoisting pulley-block & pendent & cordless remote complete (insert plate onward), mono-rail operation & according to the approved GA, Elevation / section drawing of the successful bidder (Vendor).

Separate installation / commissioning spares & tool-kit box for each monorail hoist.

Mandatory & General for two years trouble free maintenance & operation.

All materials / equipment for monorail hoist including but not limited to all instrumentation and electrical works. For detailed scope of supply for various disciplines, refer elsewhere in the bid document.

The Vendor (successful bidder), shall submit monorail hoist GA & section after site visit. The actual site variation data shall communicated to owner in a covering letter. With the copy of the site variation data, the monorail hoist GA & section drawing/s shall be submitted for approval of client / consultant.

12.2 Exclusions

- Nil

12.3 Commissioning Spares

For each mono-rail Vendor shall also bring spares required during installation / commissioning along with special tool-kit box. The un-used installation / commissioning spares & tool-kit box shall be handed over to owner without any extra cost.

12.4 Two years Mandatory operational & maintenance spares

List of mandatory operational & maintenance spares for 2 years trouble free Operation & Maintenance (O&M) shall be specified / offered along with the bid.

12.5 Scope of services

The Vendor shall provide, during the course of engineering and execution services, which shall include, but not necessarily be limited to, the following:

- Providing specifications and details of all equipment and components within the scope of supply.
- Resolving engineering queries related to the equipment and components within the scope of supply.
- Ensuring that all the equipment and components supplied to meet the requirement of this specification and the specifications, standards and codes detailed therein.
- Performing and coordinating all aspects of design and execution.
- Providing all documentation, drawings, loads, calculations, analysis, design / production schedules, sub-vendor details etc. for Purchaser's review and approval as per the requirement.
- Providing progress reports etc.
- Providing expediting services for all sub-vendors.
- Providing quality assurance for all sub-vendors with respect to ISO 9000.
- Inspection and testing and co-coordinating with Consultant / Consultant appointed TPIA (Third party Inspection agency) for the same as per the requirement of the client.

12.5.1 Battery limits (as applicable)

12.5.1.1 Inst. Power supply

- 240 V plus minus 10 % AC, 50 Hz plus minus 5% single phase supply shall be provided by the Owner at one point at site.

12.5.1.2 Area Classification

- Non-Hazardous

12.5.1.3 Gen. Electrical

- 415 V plus minus 10 % AC, 50 Hz plus minus 5 % three phase supply shall be provided by the Owner at one point at site.

12.5.2 General Purchase Conditions

12.5.2.1 Conflicting requirements

All conflicts between the requirements of this specification, related specifications, standards, codes, requisition data sheets and data sheets shall be referred to the Company for clarification before proceeding with the manufacture of the affected parts.

12.5.2.2 Qualification Criteria

- The Vendor shall have the single point responsibility for the complete work.
- The Vendor shall be a regular manufacturer and supplier of the specified equipment/ package.
- Vendor in the last five years should have engineered, manufactured, tested, supplied and commissioned at least TEN (10) nos. of identical or similar packages in terms of capacity, rate, accuracy etc. relevant parameters and at least FIVE (5) of these packages shall have completed the continuous trouble free operations of a minimum 8000 Hrs. as on the bid due date in the last three (3) financial years. Vendor to give documentary evidence (confirmation from the purchaser and to refer name of person details).
- The vendor shall have full-fledged service support set-up in India or have appropriate arrangements for the same with the established local reputed company.
- The offered packages shall be of proven make from the existing production range of the manufacturer and must meet performance requirement as stated in the specifications.
- The vendor shall be required to submit the documentation and proof for above requirements and purchasers may at his discretion make additional checks for the same.

12.6 Applicable Industry Standards & Grades

12.6.1 Industrial Standards

ASME B30.11	:	Code of Practice for construction, installation, Operation, inspection, testing and maintenance of underhung crane and monorail systems
ASME-B30.2	:	Safety requirement of Overhead and Gantry Cranes
ANSI/NFPA 70	:	Code of Practice for the safe installation of Electric Wiring
ANSI/AWS D14.1	:	Specification for welding of industrial and mill Cranes and other material handling equipment's

- ANSI/NFPA 70 : External power supply, electrical equipment, and wiring for below-the-hook lifters
- ASTM A759-10 : Specification for crane rail sections
- ASTM A 781/A 781M – 97 : Casting, steel and alloy, common requirements for general industrial use
- ASTM A488 / A488M – 12 : Standard Practice for Steel Castings, Welding, Qualifications of Procedures and Personnel
- AWS D01.1 : Structural welding (steel)
- B18.25.1M : Square and Rectangular Keys and Keyways
- ASTM A36 / A36M : Standard Specification for Carbon Structural Steel
- IP15 : Hazardous area classification
- IEC -60034 7 : Classification of types of construction, Mounting Arrangements and terminal box position
- OSHA : Noise control
- IEC-60034 5 : Electrical protection
- ATEX 94/9/EC : Equipment and Protective Systems
- ISO 9000, ISO 9001 : Quality Management and Quality Assurance Standards
- ASME Section V : Non-Destructive Testing
- IEC60034 1 : Rotating electrical machinery
- B30.9 : Code of practice for slings
- ISO 2408 : Steel Wire Rope for General Purposes

12.6.2 General Material Grades

- BS-2573 : Specs. for permissible stresses and rules for Crane design Part-1
- DIN-120 (1936) : Basic Principles of structural details of steel parts of Cranes, crane tracks-fundamentals of construction
- AISE-Std.No.6-1969 : Specs. for Electric Overhead cranes for steel mill Service
- ASTM A27 : Steel Castings, Carbon
- ASTM A36 : Structural Steel
- ASTM A193 /A 194 : Alloy-Steel and Stainless Steel Bolting Materials for High-Temperature Service
- ASTM A322 : Steel Bars, Alloy, Standard Grades
- ASTM A536 : Ductile Iron Castings
- ASTM A775 : Epoxy Coated Reinforcing Bars
- ASTM B85 : Aluminium Alloy Die Castings
- ASTM B97 : Copper-Silicon Alloy Plate, Sheet, Strip and Rolled Bar
- ASTM B179 : Aluminium Alloys in Ingot Form
- ASTM F467 : Nonferrous Nuts for General Use
- ASTM F468 : Nonferrous Bolts, Hexagon Cap Screw, and Studs for General Use

12.7 Abbreviations

- ASA - American Standards Association
- ASME - American Society for Mechanical Engineers
- QA/QC - Quality Assurance / Quality Control

- API - American Petroleum Institute
- ASTM - American Society for Testing and Materials
- SS - Stainless Steel
- CS - Carbon Steel
- GA - General Arrangement
- NPSH - Net Positive Suction Head
- MLC - Metre of Liquid Column
- BKW - Brake Kilo Watt
- MOC - Material of Construction

12.8 Schedule of the Electrical operated monorail Hoist

Table 12.1: Details of Schedule

Sl. No.	Area	Tag No.	Capacity, MT	Type	Travel Length	Bottom of Hoist, m	Speed m / min.		Qty.	No of Falls	Duty classification	Control System	Remarks
							Hoist Speed	Long Travel					
Fire Water Pump House Area													
1	Fire water Pump House Area	EO-1	5	Electrically operated monorail Hoist	25	5	5-10	15-30	1 No.	2	M4	Pendant Push Button	Non-FLP Motors, Safe Area

- Notes:
  - Corrosion allowance : 3.0mm for CS, Nil for SS
  - LT : Long travel requirement
  - CT : Cross travel requirement
  - H : Hoisting (lifting) requirement

12.9 General Specifications (as applicable)

Following are the general specifications and the vendor may offer alternative better design subject to approval of Client/ Consultant.

- The required design life of the package including its auxiliaries is 20 years of service life. The offered package/equipment shall operate with a minimum maintenance interval of 12,000 hrs. In the loaded condition.
- The proposal and operating instructions shall specify maximum and minimum operating conditions of the unit and conditions which could shorten the life of the machine. Any required protective devices to prevent damage to the equipment shall be furnished by the Vendor.
- The offered package/equipment must be designed for continuous round the clock uninterrupted services.
- The motor nameplate rating (exclusive of the service factor) shall be at least 110% of the required power (including gear losses) for any of the specified operating conditions.
- Each coupling shall have a coupling guard that sufficiently encloses the coupling and shafts to prevent access to the danger zone by personnel, during operation. Metallic disk type couplings, or Elastomeric type couplings, shall be supplied. Lubricated couplings are not permitted. Elastomeric couplings shall utilize oil-resistant elastomers.
- Nameplates and Rotation Arrows: A nameplate shall be securely attached to an easily accessible point on the equipment frame and other major equipment. The nameplate data shall be etched, stamped or embossed into the metal surface. The nameplate shall be in the English language. Rotation arrows shall be cast in or attached to each major item of rotating equipment. Both nameplates and attached rotation arrows shall be made from stainless steel.
- Noise level of the complete package shall be limited to 85 dB at distance of one meter from the equipment (or as per statutory guidelines).

12.10 Technical requirements (as applicable)

- The factor of safety based on ultimate strength shall be as per ASME-B30.2 for the design of components on the basis of strength. Impact, fatigue, wear and stress concentration factors shall be taken into account, wherever applicable.
- Hoisting equipment shall comply with the safety and specification standards of ASME B30.11, ASME B30.16, and ASME HST-4.
- All materials shall be of tested quality conforming to specified standards and shall be new and unused. Combustible material shall not be used. No cast iron shall be used on the monorail Hoist except for electrical equipment.
- Where any portion of the structure is not free to expand or contract under variation of temperature, allowance shall be made for the resulting stresses, the co-efficient of expansion for each degree centigrade in variation of temperature above or below normal being taken as 0.000011 for carbon steel. The maximum variation of temperature may be taken as 45 ^{0}C unless specified otherwise in the data sheets.
- The monorail hoist shall be designed for minimum head room and for closest approach of the hooks to each end stop.
- Breathing holes shall be provided in completely enclosed welded box type girders. Drain holes shall be provided in all places where water or oil is likely to collect. Where practicable, means of access shall be provided for inside inspection of completely enclosed box girders. Diaphragm support plates at suitable intervals may be used to avoid deformation/ deflection of the box girder.
- Hoists and trolleys shall be specially designed, constructed and installed for the service intended. All features necessary for satisfactory operation and functioning of the hoisting equipment shall be

provided, whether or not they are described in these specifications. Hoists and trolleys shall meet the specific requirements of the Detailed Specifications.

- **The hoisting equipment manufacturer shall design, furnish, shop test and supervise the** installation of instrumentation and controls, coordinated to function as a system, providing and accepting appropriate signals to start and stop the hoisting equipment as required for safe, trouble-free operation.
- All parts of the mechanisms shall be amply designed and constructed for the maximum stresses occurring during fabrication, installation and continuous operation. All materials shall be new. All parts of duplicate equipment shall be interchangeable without modification, and all parts subject to wear shall be of standard pattern and easily replaceable without the necessity of special cutting and fitting.
- Each unit of hoisting equipment and monorail hoist shall bear an inscription, easily readable from the operating floor, showing the rated capacity of the equipment and control identification. All appurtenances, caution markers and appliances necessary to satisfy applicable safety laws and codes shall be provided.
- All hardware for mounting of motor drives and control panels shall be Type 316 stainless steel.
- **Main Features of Hoist:**
  - **Motor:** Motor shall be squirrel cage induction with high starting torque designed and built for hoist duty. Motor shall be suitable for frequent reversals as well as braking and provided with class-B insulation. Service Factor: 1.15. Motors shall be non-overloading at rated monorail hoist capacity. Provide winding thermostats for overcurrent protection. Bearings shall be Anti-friction and lifetime pre-lubricated and sealed.
  - **Brake:** Hoist motor shall be fitted with an electromagnetic brake designed and built to arrest and holds safely the full load capacity of the hoist and shall be of fail-safe design.
  - **Wire Rope Drum:** The wire rope drum shall be made from seamless pipe or fabricated from steel plates duly machined and grooved to take full lift without over winding. Drum shaft shall be supported by antifriction bearings for smooth running.
  - **Wire rope guide:** The wire rope guide shall be made of a special aluminium base alloy. The rope tightner shall be built-in in the rope guide itself. Rope guide shall prevent the rope from overriding and loosening and to ensure correct rope lay.
  - **Wire rope:** Wire Rope shall be of 6x 37 constructions with fibre core, and, pre-formed type with suitable safety factors as per class of Monorail hoist.
  - **Hooks**: It shall be drop forged as per ASME B30.10. Swivelling hook shall be mounted on thrust bearing and skirt shall be provided to enclose the bearing locking device to be provided to prevent rotation of the hook.
  - **Limit switches**: Hoist shall be provided with built-in limit switches to control the top and bottom position of the hook. Tappets shall be adjusted on limit switch rod to any position in between the range provided. Limit switches shall be actuated by the rope guide.
  - **Micro speed:** Hoist shall be fitted with a micro speed attachment to reduce the hoisting speed 1/10th of the main hoisting speed. The micro speed attachment shall work independent of the load and main hoist. There shall be separate control for the micro speed which is essential for handling of bulky, heavy and delicate loads.
- **Lubrication**
  - Grouped grease lubrication shall be provided for each mechanism (LT and Hoist). Each mechanism shall have hand grease pump for lubricating all parts of the mechanism simultaneously. All grease piping shall be securely fixed. For LT motion, two groups (one at each end) shall be provided.
- **Pendent Pushbutton**
  - A pendant push button station movable along the complete span of the monorail Hoist (on a separate track) independent of trolley movement shall be provided.
  - The pendant shall have buttons/ controls for all the movement of the monorail hoist. It shall also have a mushroom head type emergency stop button.

- As a minimum, following operations shall be possible with the help of pendent push button station.
  - Hoisting: Up/down with normal speed
  - Hoisting: Up/down with creep speed
  - LT: Forward/backward with normal speed

- **Guarding**
  - All rotating parts including revolving shafts shall be adequately guarded to meet safety requirements.
- **Monorail wheels**
  - Wheels for bridge and trolley shall be double flange type with tread and flange machined accurately to size and flanges tapered.
  - The wheels shall be mounted to facilitate removal and replacement.
  - Material for wheels shall be forged steel to ASTM A788 / A788M with minimum Brinell hardness of 400 to 450 BHN. The wheels shall be single piece type (no tire).
  - The dimension of flanges of track wheels shall be as per ASME 30.2.
  - Trolleys for hoists rated 2-ton capacity or less shall have a minimum of 4 wheels. Trolleys for hoists rated higher than 2-ton capacity shall have a minimum of 6 wheels.
- **Wire Ropes**
  - The wire rope shall conform to ISO 2408. The rope shall have 6 x 37 constructions with hemp core. However, this shall be in relation with drum diameter as per ASME 30.2. The tensile designation of the wires shall be minimum 1770 as per ISO 2408.
- **Rope Drums**
  - The drum shall be fabricated from carbon steel plates to ASTM A36. Circumferential welded joint shall not be permitted. All butt welds shall be subjected top 100% radiography. The plate material for the drum shall be accepted only after this plate has been successfully passed in ultrasonic testing. The fabricated rope drum shall be stress relieved.
  - The drum shall be sufficiently wide to accommodate in one layer the length of rope required for specified lift and in addition, not fewer than two dead turns at each anchored end and one space groove at opposite end.
  - The drum shall be flanged at both ends and flanges shall project a distance not less than two rope diameters above the rope. A spur or wheel secured to the drum may be regarded as forming one of the flanges.
  - Rope anchorage shall be acceptable. Rope anchorage shall be minimum at three places.
  - Drum strength, drum diameter and drum grooving shall comply with the requirements given in ASME 30.2.
  - The lead angle of rope shall not exceed 5O (1 in 12) on either side of helix angle of the grooving in the drum.
- **Sheaves**
  - The sheaves (pulleys) shall be carbon steel casting having chemical and mechanical properties as per ASTM A27
  - Sheaves diameter, sheaves grooving, its lead angle and equalizing sheaves shall comply with the requirement specified in ASME 30.2.
  - Sheaves shall be provided with guards to retain the ropes in the grooves.
- **Bearings**
  - The type of bearings recommended for various parts shall be as per ASME 30.2 and shall be as per specifications.
  - Provision shall be made for service lubrication of all bearings. Bearing enclosure shall be designed as far as practicable to exclude dirt and prevent leakage of oil or grease.
  - Suitable drip pans shall be provided as required to collect oil and grease which may drop from operating parts. All drip pans shall be accessible for draining and cleaning.
  - Lubrication chart shall be provided.
- **Couplings**

- Couplings shall be geared type on all power output shafts. On power input shaft pin and bush coupling may be provided.
- All couplings shall be of forged steel and shall be designed to suit the maximum torque that may be developed.
- Flexible couplings shall be fitted between motor shafts and gear box extension shafts.
- Service factor of coupling shall not be less than that of gear box.

- **Shafts**
  - Shafts shall be made from rolled/ forged steel bars of C-40 to ASTM A788 / A788M.
  - The material for axles shall be C-45 to ASTM A788 / A788M.
  - Keys, keyways, splines and serrations shall conform to B18.25.1M .
  - All forged shafts / axles shall be ultrasonically tested. Physical and chemical tests shall also be conducted.
- **Gears, Pinions and Gearboxes**
  - Gearing shall be straight of helical type; worm gears shall not be used. All gearing shall be totally enclosed in gear boxes. No open gearing shall be allowed to be used in any motion.
  - All gear shall be made of rolled/ forged Steel (As per AGMA) and all pinions shall be made as per ASTM A788 / A788M. The rating of the gear shall be as per AGMA.
  - The gear shall have tooth form and modules as recommended in AGMA and they shall be adequately designed to withstand shock load and vibration. Gear and pinion teeth shall be suitably heat treated for resistance to wear. However, case carburizing of gear teeth shall not be done.
  - Gear box shall be designed and manufactured taking into consideration the requirements given in ASME 30.2. Gear box casing fabricated out of steel plates shall be stress relieved.
  - All bearings of gears shall be antifriction type.
- **Hook blocks and Hooks**
  - The hook block will be designed to lift without twisting. It shall have load locking facility and anti-swiveling arrangement and shall be mounted on thrust bearings. The make of bearings shall be as per specifications.
  - The hooks of monorail hoist shall be of trapezoidal section as per ASME B30.10 for Safe Working Load up to 25 T. For Safe Working Load above 25 T and less than 40 T, the hooks shall be as per ASME B30.10.
  - The hooks of the monorail hoist shall be ramshorn type Safe Working Load 40 tones and above.
  - The hooks shall be magnetic particle tested before and after proof load test.
  - The hook shall be proof load tested marked and duly certified by component authority.
  - The material for the hook shall be supplied with physical and chemical test reports.
  - A safety latch shall be provided on hooks to prevent coming out of the slings.
- **Trunnion**
  - The trunnion shall be of forged steel as per relevant code and standard.
  - The material of trunnion shall be tested ultrasonically. Physical and chemical tests shall also be conducted.
- **Drive Units**
  - Drive Arrangement **:** (Geared motor will be preferred in drive arrangement)
  - Motor: Electrical motors shall be of Totally Enclosed Fan Cooled (TEFC) type with a degree of protection to meet the requirements of IP-64 or IP-55 of relevant code and standard.
  - Gear Box: Gear box shall be helical enclosed type. Gear box shall be rigid, robust and torsion resistant made from high grade cast iron.
  - Gears: Helical gears shall be manufactured from high alloy case hardening steel to impart high wear resistance and fatigue strength. Gears shall be machined to proper profile and grinding to be done for efficient transmission of power and noise free running.
  - Bearings and Shafts**:** All shafts shall be mounted on properly designed and dimensioned higher precision roller bearings. Shaft extensions shall be fitted with high quality seals to prevent oil leakage and dust entry.

- Lubrication: Lubrication shall be of splash type. Gear box shall be provided with proper facilities for oil filling, adequate breathing, draining and level indicators for minimum and maximum level of oil in gear box.
- Trolley drive shall be achieved by single motor in which the motor shall drive a common output shaft through gear box.
- The type of electric power transmission to motors of Long Travel shall be as specified in datasheets i.e. festoon cable type arrangement only and not by current carrying conductors considering safety point of view. This shall suit the area classification specified.
- Power supply (TPN) will be made available at one point by Owner, further distribution to individual drives, panels, etc. shall be done by local contractor.

- **Brakes**
  - Trolley brakes
  - 2 nos. (For twin driver or 1 no. for center drive) electro-hydraulic thruster brakes shall be provided for long travel (i.e. LT).

- **Main and auxiliary hoist brake**
  - Each of main hoist and auxiliary hoist shall be provided with 1 no. of DC electromagnetic or electro hydraulic thruster brake. The braking torque shall not be less than 200% of motor torque.
  - In case thruster brake is used for hoisting, anti-drop feature shall be provided to prevent lowering of load during application of brake by suitably connecting the hoist motor in reverse direction with the help of suitable control scheme.
  - All brakes shall be fail safe type and shall be applied automatically when, power to drive motor fails.
  - The brake shall be applied directly to the motor shaft and shall be equally effective in both directions of rotation.
  - The brake shoes shall be self-aligning type and shall have large cooling surface for low temperature rise.
  - The thruster motor shall be 3 phase, totally enclosed, class F insulated (with temperature rise limited to class B), continuously rated motor. The thruster motor shall be designed for frequent switching operation in the range of 720 switching per hour.
  - Thrusters shall have reserve of at least 30% stroke length available for necessary adjustment as well as provision for adjustment of time for upward and downward travels of the piston.
  - Emergency braking: All brakes shall, irrespective of control or position, be applied immediately on operating the emergency stop push button or switches.
  - Design and rating of brakes shall be as per ASME 30.2.
- **Limit switches**
  - Each of main and auxiliary hoists shall be provided with two limit switches for over hoisting and over lowering and these shall be of following type.
    - The first limit switch to act in case of over hoisting/ over lowering shall be screw type with self-resetting feature and included in the respective motor control circuit.
    - The second shall be gravity operated hand reset type connection in the main contactor control.
  - The backup limit switches shall be provided for switching off the power supply whereas main limit switch is for stopping the movement of individual motion.
    - Trolley shall be provided with limit switches to prevent over traveling. The limit switches shall operate the respective motor control circuits.
    - Limit switches shall be totally enclosed type with properly designed actuators and shall be readily accessible for adjustment and repair.
- **Monorail Controls**
  - Hoist motions (applicable for both, main and auxiliary hoist)
    - For hoist control in hoisting and lowering directions, suitable schemes and complete equipment to meet functional requirement shall be provided.

- The hoist control shall be designed to achieve inching speed of approximately 10% of rated speed in both hoisting and lowering directions with loads (from no load to full load) on hooks, if specified in the data sheets. To achieve inching speed, one of the following methods shall be used.
  - Pole changing motor.
  - Planetary gear box.
  - Separate motor with clutch and gear box.
  - Thyristor control.
  - D. C. Injection during lowering.
- Minimum five nos. speed steps shall be provided for each direction of hoist motion. Conventional rotor resistance shall be used in both hoisting and lowering direction to achieve the above speed steps.
- Trolley travel motions
  - Minimum four (4) nos. of speed steps shall be provided for each direction of motion. Convention rotor resistance controls shall be used to achieve the above speed steps. Step-less speed variation shall be provided wherever specified/required.
- The control system shall be designed for 110 V single phase power supply. Necessary transformers and all other equipment shall be furnished by the supplier.
- Pendant Control Station:
  - The motion control push-button actuators shall spring return to off.
  - Pendant control station shall be mechanically supported to protect the electrical conductors against strain. Provide sufficient cable to reach within 4 feet of the operating floor. The function of each push-button actuator shall be clearly marked and shall indicate the direction of resultant motion.
  - The maximum voltage in the pendant control station shall be 40 VAC.
    - Start-Stop
    - Raise-Lower
    - Forward-Reverse

12.11 Safety requirements

- The Monorail hoist shall comply with relevant safety regulation under the Local regulatory rules/ standards and other statutory regulations as applicable.
- Limit switches and brakes shall be provided in both directions i.e. longitudinal and hoisting.
- Rail clamps shall be provided to prevent motion of the monorail hoist during maintenance.
- All rotating parts shall be provided with safety guards.

12.12 Electrical

- All motors shall be Energy efficient motors. (with EF-2)
- All electrical equipment should be designed for indoor installation.
- Provide system with all necessary junction boxes, trolleys, festoon track, bends, brackets, joint kits, two arm kits, stops, supports and mounting hardware required for a complete installation.
- Provide a suitable number of conductors for power, control and grounding; sized to carry the required current to all connected motors when operated at rated conditions.
- Give special consideration to clearance, headroom and load approach requirements in designing layout of electrification. System layout shall permit full travel of the equipment.
- Power Supply System:
  - Power supply from main MCC feeder through single cable to the control panel of the monorail will be supplied by the Electrical Contractor, however, from the monorail control panel, power shall be distributed to various motors of the monorail hoist by monorail hoist supplier through trailing cables.
- Festoon System for Electrification:

- Festoon system shall consist of neoprene-jacketed, multi-conductor flat cables with separate control and power conductors. Cables shall be suspended from trolleys mounted on a heavy-duty C-track parallel to the hoist monorail. Track and trolleys shall be non-sparking construction.
- Provide cable lengths equal to 110 percent of the required length in order to avoid over-stressing.
- Provide all assembly and mounting hardware of Type 316 stainless steel.
- Loop Length: 5'-0" max.; storage: 4'-0", max.
- End Clamps: Provide fixed end clamps with outrigger arms where required.
- Provide all wire, cable, connectors, junction boxes, supports, special tooling and incidentals as required for power and control hook-ups.

12.12.1 For all HDG applications

- Hot Dip Galvanized up to 910GSM.
- All Hot Dip Galvanized (including Piping) shall be painted after coating as per approved procedure.
- All fasteners shall be Hot Dip Galvanized up to 80-100 MICRON and painted after torque tightening as per client's approved procedure.

12.12.2 Welding

- Welding
  - Welding after qualification **WPS / PQR / WPQT**
  - Welding consumables of approved makes like: **ESAB, ADOR, D&H, and HONAVAR.**

12.13 Painting

- Clean and prime coat ferrous metal surfaces of equipment in the shop in accordance with the requirements of General Specification 09900.
- Finish paint ferrous metal surfaces in the shop using the manufacturers approved standard finish system. Finish system shall be compatible with the primer specified in General Specification 09900 and the Detailed Specifications. Motors shall be painted in accordance with General Specification 16221.
- Coat machined, polished, and non-ferrous metal surfaces and similar unpainted surfaces with corrosion prevention compound which shall be maintained during storage and until equipment begins operation.
- The structural, mechanical and electrical parts of monorail hoist shall be cleaned properly of all dirt, grease, scale and rust by shot blasting or chemical cleaning methods.
- The bright exposed parts of the monorail hoist shall be given one coat of rust inhibitor. Interior of all gear boxes shall be painted with one coat of oil resisting paint.
- Painting approved make :
  - JOTUN, AKZONOBLE, HEMPEL, SIGMA.
  - Painting in presence of supplier technical rep. only.

12.14 Instrumentation & Motors Controls

- There shall not be specific instrumentation/automation requirement except for the excess load alarming hooter mounted to the monorail Hoist / Long travel beam / Lifting hook respectively through load-cell mechanism.
- There shall be also, motor/s interlock limit switch mechanisms for the monorail / hoist (as applicable).
  - Highest lift (at hook approach)
  - Long travel ends

For monorail / hoist, both ends approach of Long Travel to be safe guarded through addition angle fixing / welding on the track / girder.

12.15 Safety

12.15.1 LOTO – policy statement

- The vendor shall be responsible to establish and fulfill requirements for affixing the appropriate lockout/tag-out (LOTO) signage and locks to energy isolating devices and to otherwise disable machines, equipment or processes to prevent unexpected energizing, start-up, or the release of stored electrical, hydraulic, pneumatic, chemical, thermal, or other energy.

12.15.1.1 Procedure

1. Scope of This Policy:
   a. Client wishes to prevent injury to employees/users engaged in service or maintenance activities of machines, equipment, or processes where the release of energy may put them at serious risk. Examples of such machinery or equipment include but are not limited to vessel, pumps, motor, weigh-bridge etc. Work situations where unexpected energization or start-up can occur include new construction, I installation or set-up of equipment, and the adjustment, inspection, maintenance, repair, and service of machines and equipment. Energy types to be considered include electrical, mechanical, hydraulic, pneumatic, chemical, and thermal.
   b. This policy contains procedures for the service and maintenance of equipment and machines where the unexpected energization or start-up could cause injury to employees/users.

Caution: The following situations are not subject to the procedures outlined in this document:

   c. Work on plug and cord type electrical equipment, for which exposure to the hazards of unexpected energizing, start up, or the release of stored energy of the equipment is effectively controlled by the unplugging of the equipment from the energy sources and by the plug being under the exclusive control of the employee/user performing the servicing or maintenance;
   d. Hot tap operations involving transmission and distribution systems for substances such as gas, steam, water, or petroleum products when they are performed on pressurized pipelines provided that it is clear that continuity of service is essential, shutdown of the system is impractical, and documented procedures and special equipment are implemented which will provide proven and effective protection for employees/users.
   e. Service or maintenance that takes place during normal production operations, such as lubricating, cleaning, and making minor adjustments and simple tool changes, except when an employee/user is required to place any part of his/her body into an area on a machine or piece of equipment where work is actually performed upon the materials being processed (i.e., point of operation) or where an associated danger zone exists during a machine operating cycle.
   f. Each unit is responsible for the development of specific energy control procedures for each machine or other equipment within its respective areas of responsibility.

12.15.1.2 Terms and definition

1. Affected Employee/User : A person whose job requires him/her to operate or use a machine or equipment on which servicing or maintenance is being performed under lockout or tag-out, or whose job requires him/her to work in an area in which such servicing or maintenance is being performed. Affected area within the unit that contains machinery or equipment subject to lockout or tag-out procedures.
2. Authorized Employee/User: A person who locks out or tags out machines or equipment to perform service or maintenance on that particular item. An affected employee/user becomes an authorized employee/user when that employee's duties include performing service or maintenance on machines or equipment covered under this policy.
3. Blocking Tag - A tag-out device that indicates the use of chains, wedges, key blocks, adapter pins, or self-locking fasteners for isolating, securing or blocking of equipment from energy sources.

4. Energy Isolating Device - A mechanical device that physically prevents the transmission or release of energy, including but not limited to, the following: a manually operated electrical circuit breaker; a disconnect switch; a manually operated switch by which the conductors of a circuit can be disconnected from all ungrounded supply conductors, and, in addition, no pole can be operated independently; a line valve; a block; and any similar device used to block or isolate energy. Push buttons, selector switches and other control circuit type devices are not energy isolating devices.
5. Going Through a Tag - A procedure in which a piece of equipment or machinery is started when the lockout/tag-out procedure is in place.
6. Hot Tap - A procedure used in repair, maintenance, and service activities that involves welding a piece of equipment (pipelines, vessels or tanks) under pressure to install connections or appurtenances.
7. Lockout - The placement of a lockout device on an energy isolating device according to an established procedure; this ensures that the energy isolating device and the equipment being controlled cannot be operated until the lockout device is removed.
8. Lockout Device - A device that uses a lock, either key or combination type, to hold an energy isolating device in a safe position and prevent the energizing of a machine or other equipment. Included are blank flanges and bolted slip blinds.
9. LOTO – acronym for Lockout/Tag-out.
10. Normal Operations - The utilization of a machine or other equipment to perform its intended function
11. OSHA – Occupational Safety and Health Administration, an agency in the Department of Labor. Develops and enforces Occupational safety standards.
12. Owner's Representative - An individual who represents the Client in all aspects of:1) A project when dealing with a contractor; 2) A lease agreement when dealing with a vendor. Caution: Some leases may define these owner's representatives as "contact persons" or "program directors servicing and/or Maintenance - Work place activities such as constructing, installing, setting up, adjusting, inspecting, modifying, and maintaining and/or servicing machines or other equipment. These activities include lubrication, cleaning or unjamming of machines or other equipment and making adjustments or tool changes, where the employee/user may be exposed to the unexpected energization or startup of the equipment or release of hazardous energy.
13. Tag-out - The placement of a tag-out device on an energy isolating device, according to an established procedure, to indicate that the energy isolating device and the equipment being controlled may not be operated until the tag-out device is removed.
14. Tag-out Device - A prominent warning device, such as a tag and a means of attachment, which can be securely fastened to an energy isolating device according to an established procedure, to indicate that the energy isolating device and the equipment being controlled may not be operated until the tag-out device is removed.
15. This policy is specifically intended to prevent injuries to employees/users engaged in service or maintenance activities of machines, equipment, or processes where the release of stored energy may put them at serious risk. This policy (LOTO) ensures with OSHA 29CFR 1910.147.

12.15.2 Human factor engineering

- Vendor will considered the work around space for all equipment/s for operation and maintenance. The location of valves, instruments, push buttons etc., shall be at operating & ease for maintenance.

12.16 Inspection & Testing Requirements

12.16.1 Inspection

- The complete package and its component shall be subject to inspection by the Buyer's / Consultant's inspection representative in accordance with the Quality Assurance Plan as prepared by the vendor and approved by the Buyer/ Consultant.
- At manufacturer's shop

- Welder qualification test.
- Radiography.
- Material Test.
- Stage inspection during manufacturing and overall dimension check.
- Mechanical Run Test (MRT)

- At Purchaser's site :
  - Load test under full load 25% overload on hoisting and cross travel motion.
  - Checks for functioning of all the limit switches and brakes.
  - Basic parameters check test.
  - Deflection test.
  - MRT

12.16.2 Testing

- Testing at vendor's works and site shall be carried out in accordance with ASME B30.11 and shall include following tests as minimum.
  - Testing of electrical and mechanical equipment in accordance with appropriate standards.
  - Full load and 125% overload test for hoist and cross travel motions at works and site.
  - Hoist speed verification test at works and site.
  - Deflection test at works and site.
  - Testing of effectiveness of brakes, safety device, etc., at works and site.
- The tolerance in speeds shall not exceed the following limits
  - LT +10%. ---- 5%
  - Hoisting +10%---5%
- Any or all the tests, at Owner/PMC's option, shall be witnessed by Owner/PMC/third party inspector. However, such inspection shall be regarded as checkup and in no way absolve the Local contractor of his responsibility.
- After assembly and erection at site, the hoist shall be subjected to commissioning tests as laid down in per ASME-B30.2. The EPCC contractor shall be fully responsible for carrying out all the tests required by these standards including the overload testing of the hoist.
- For site testing, the lifting tackle, slings, test gauges and instruments shall be arranged by the vendor. The Owner/PMC shall however, provide the test load.
- A certified record of test results (works and site) shall be submitted along with the equipment. Test certificates of all bought out components shall be provided.
- All electrical equipment for hazardous areas shall be certified by BASEEFA or equivalent and necessary certificates furnished.
- The equipment shall meet the performance requirements specified in this specification.
- Operability tests and overload tests at site shall be carried out to demonstrate satisfactory operation of monorail hoist without undue friction or display of any other unfavorable characteristics.

12.17 Preparation of Shipment

12.17.1 General details of Preparation for shipment

Equipment shall be suitably prepared for the type of shipment specified. The preparation shall make the equipment suitable for 6 months of outdoor storage from the time of shipment, with no disassembly required before operation, except for inspection of bearings and seals.

Exterior surfaces, except for machined surfaces, shall be given at least one coat of the manufacturers' standard paint. Exterior machined surfaces, including shafts, shall be coated with suitable rust preventive.

12.18 Erection commissioning and handing over (As Applicable)

12.18.1 Erection

12.18.1.1 General

- This specification describes a general outline for the installation of the equipment involved. The field circumstances shall be taken into consideration and methods suitable to the site conditions shall be adopted in consultation with the Engineer-in- Charge. The vendor shall employ only such workers and supervisors who have considerable experience of similar work and with adequate technical skills.
- All bolts, anchor bolts, nuts, lock washers, other fasteners, supports and other miscellaneous items shall be supplied by the vendor.

12.18.1.2 Receiving and handling of equipment's

- All equipment received at site shall be checked by the vendor for the equipment being intact, in the presence of Engineer-in- Charge and shall be unloaded and accepted by the vendor for the storage and safe custody. The equipment shall be stored in the approved manner by Engineer-in-Charge and the vendor shall be responsible for the storage and safety of the equipment.
- Whenever the equipment is received in wooden crates, the vendor shall carefully dismantle these crates and store all timber and packing materials properly.
- It shall be the responsibility of the vendor to study the requirements of installation and instructions for commissioning of the same, by employing skilled technicians experienced in the type of services required. The vendor shall be fully responsible for the safe custody of the equipment during the period from acceptance of the equipment to commissioning and handing over of the same to the client.

12.18.1.3 Precautions to be taken by vendor

- Take adequate care and precautions to prevent loss/damage of material and equipment.
- Keep structures, materials and equipment adequately and safely braced by struts, guys, and any other approved means as required till installation work is satisfactorily completed. Design, provide and erect the struts, guys, shorting, bracing, planking support in such a way that they do not interfere with other work and shall not damage or cause distortion to other works executed by him.
- Openings for instruments shall be protected during and after erection.
- All accessories like pressure gauge, temperature indicators, safety valves, etc. shall be tagged and separately kept till erection.
- All flange connections and openings shall be kept blanked with wooden covers to prevent entry of foreign matter.
- Special care shall be taken for bearings, rotating parts etc., to prevent seizing. Generally, the packages shall not be opened until required for installation.
- Orientation of all the foundations, elevations, lengths, positions of anchor bolt and diameter of holes in base plates/supporting structure etc. shall be checked by well in advance.
- Minor rectification work like chipping of foundation shall be carried out in time.
- Rigging procedures of all major lifts above 5 MT and at maximum monorail hoist capacity shall be submitted by Vendor for approval of the Engineer-in-Charge. However, such approvals shall not relieve the vendor from the responsibility of safe rigging and lifting of the equipment, machinery, etc.
- Drilling and tapping of holes in base plates, fixing of couplings on shaft after enlarging the pilot bore to correct size with keyways etc. and doweling including provisions of dowel pins or similar arrangement for retaining the alignment shall be carried out by the Vendor with utmost care.
- All joints shall be assembled without undue stresses. Flanges must be parallel and correctly aligned.
- Wherever necessary remove the anti-corrosive coating applied on the machine/equipment by the vendor, carefully and completely with light oil/ Equivalent.

- On the chipped and prepared foundation surface, the vendor shall set up liners for installation and centering of equipment. Liners shall be so arranged that the load of equipment is uniformly and exactly distributed to the foundation. Liners shall be placed as near as possible to both sides of anchor bolts. Where distance between anchor bolts is too long additional liner shall be set up in between. The height of each liner shall be measured on the basis of standard level bench mark. The liners shall be fixed with appropriate grouting material.
- The vendor shall assemble, couple, fix, fit, install, level, align and grout the equipment/materials on foundations, structures, platforms, floors etc., as the case may be. He shall bolt, weld, cut, drill, rivet and brace all components and fix them rigidly with one another on the foundation supports, etc.
- All necessary shims scaffolding, temporary supports, staging, grouting cement, sand, etc., required for erection of the equipment shall be kept ready in advance.

12.18.1.4 Grouting

Grouting of Anchor bolts, holes, pockets and under base plates or under equipment's have been broadly classified into two categories e.g. non-shrinking grout and ordinary grout. Non-shrinking grout shall consist of 1 part of ordinary Portland cement, 1 part of clean dry well grades sand and 1 part of Ferro-grout of similar additive (approved by the Engineer-in-Charge). Water should be kept minimum so that the mix can be applied adequately. The grouting material shall solidly fill the spaces to be grouted and permanently retain its original volume so that the base plate will be held firmly in the set position. The amount of water used in mixing shall be kept to a minimum such that the grout shall have a consistency to stiff to flow. The top of foundation shall be clean and free of all laitance loose particles, oil, grease, etc. and shall be wetted thoroughly leaving no puddles prior to grouting. All trapped pockets in the steel structures shall be prepared using ordinary grout. Under no condition neat cement shall be used for grouting.

- All anchor bolts holes shall be completely filled with grout
- The finished surface shall be floated smooth and shall slope away from base plate approximately 1:25
- After the initial set is over, the grout shall be kept thoroughly wet for a minimum of 5 days.
- Care is to be taken during grouting so that the base plate level and alignment is not disturbed.
- Over and above the grouting clearance shown in foundation drawings, grouting of pockets made by base frame for machinery, equipment, steel structures etc. shall also be completely filled with grouting as per direction of Engineer-in- charge.

12.18.2 Installation

Unit shall be mounted on a suitable concrete sub-base or isolation pads separated from the main floor and isolated from it through vibration mountings. After completion of unit erection, whole system with interconnected piping and associated controls shall be pressure tested.

All controls, control wiring and necessary interlocking shall be carried out and checked prior to commissioning the system. Necessary safety Pressure switches shall be provided in all equipment's, vessels, lines as applicable and suitably interlocked with the starter of the compressor motor for initial trial startup purpose.

12.18.3 Acceptance Tests

After the entire erection/ installation work has been completed the vendor shall make necessary preparations for carrying out site acceptance tests. The site acceptance tests shall be carried out in the presence of Engineer-in-charge. The test shall be carried out as per the approved QAP and detailed testing schedule. All tools, tackles, equipment and instruments required for erection, carrying out

acceptance tests and commissioning by the vendor. Vendor shall also be responsible for clearing all debris during execution and after completion of work.

12.18.4 Commissioning

The vendor shall inspect equipment within its battery limit after erection, and arrange for pre-commissioning checks, functional tests of instrumentation and control before commissioning for 24 hours (8 x 3 days).

12.18.5 Handing over

The vendor shall run the package for 24 hours (8 x 3days) trouble-free operation in all aspects in presence of the Owner or the authorized representatives of the Owner before it is handed over to the owner.

12.18.6 Training of Owner's personnel

The vendor has to impart the training to the concerned staff of the owner at the site which shall cover minimum of following aspects.

- Familiarization with operational procedures and practices.
- Hands on experience on Operation of Equipment.
- Routine maintenance activities of the facilities.
- Accounting of product.
- Safety regulations and accident prevention.

12.19 Performance guarantee and warrantee

12.19.1 Guaranteed parameters

- Vendor to furnish the data against following guaranteed performance parameters.

Table 12.2: Guaranteed Parameters

Sr.	Parameter	Vendor's guaranteed parameters
1	Maximum Lifting capacity	
2	Operating Loaded speed	
2.1	Main	
2.2	Auxiliary	
2.3	Cross travel	
2.4	Long Travel	
3	Braking time (on load)	

12.19.2 General conditions of performance guarantee

Performance tests shall confirm to relative standard for testing without negative tolerance on capacity and temperature.

If the equipment / package supplied by the vendor fail to achieve the specified performance under the given condition, the vendor shall carry out such modifications or replacement of the equipment/ package as necessary to meet the required performance at his own cost within the time as mutually agreed upon.

The vendor shall guarantee the power consumption at rated point. The guaranteed power consumption at the fan shaft shall be verified during site testing by measurement of power input to the electric drive motor multiplied by motor test efficiency. The applicable tolerance on power consumption shall be +/- 1% with instrument tolerance.

The completion of stipulated tests and issue of test certificates shall not relieve the vendor of his ultimate responsibility of guaranteeing the equipment/ material and its performance.

The vendor shall furnish unconditional guarantee for design, materials, manufacture, construction for entire life of the package and for workmanship of the package for the 12 months from the date of commissioning or 18 months from the date of supply whichever is earlier.

All the equipment/items shall be capable of performing the duties specified in this specification without damage, distortion or failure of any component.

The vendor shall repair/replace any part of the equipment supplied by him at his own expense, in the event of failure during the guarantee period.

In the event of non-fulfilment of performance guarantees, (up to end of the defect liability period of 12 months from the date of commissioning or 18 months from the date of supply) the vendor, at his own cost, shall do modification, replacement and rectification to meet the guarantee requirement of the purchase order. If within reasonable time limit (as agreed to by both the parties), the vendor fails to make the required corrections in the equipment or its component, the Owner may at his discretion reject the equipment and can ask the vendor to supply and install new equipment of proper design and manufacturing to meet the performance guarantees, as per the Purchase Order.

12.19.3 Non-fulfillment of guarantee

In case of vendor's failure to fulfil guarantee mentioned in above clauses or failure in discharging the full responsibility assigned to him, owner reserves the right to terminate the contract of the vendor with immediate effect.

12.20 Data required from vendor

Table 12.3: Data required from Vendors

Sr. No.	Description	Data to be specified by the Vendor
A	Basic parameters	
1	Safe working Load	
2	Height of Lift	
B	Operation	
1	Monorail hoist control	
2	Location	
3	Area	
4	Class of Duty	
C	Speeds	
1	Hoisting	
2	Long Travel	
D	Motor Details	

Sr. No.	Description	Data to be specified by the Vendor
1	For Hoisting	
2	For Long Travel	
E	Type of Brakes	
F	Type of Wire Rope	
G	Hook	
H	Dead Weight of Monorail	
1	Monorail weight	
2	Wheel Load	
I	MOC of Components	
1	Monorail Main Beam	
2	Gears and Pinions	
3	Rope Drum	
4	Rope	
5	L.T. Wheels	
6	Hook	
7	Pendant Box	
8	Control panel	

12.21 Non-material requirements (Drawings & Documents)

- Bidders are advised to note that the bids will be considered incomplete if the documents requested for bid stage are not submitted along with the bid.

- All engineering and relevant documents shall be furnished in Hard as well as Soft copies like:
  - All drawings for civil construction.
  - Data book in 6 copies (hard and soft copies)

- Documents as follows:
  - Fabrication Schedule
  - Foundation Plan data (GAD with load details)
  - Maintenance Manual including Maintenance schedule
  - Operation Manual
  - Testing and commissioning Protocol

- Unless specified, **6 copies** each of following documents shall be submitted at the stages defined, except for the bid stage, wherein 2 copies are required.

- The bidder would need to specify the timeline when the documents requiring approval would be submitted in the PERT chart. Bidder also to include timeline for resubmission of final drawings incorporating all comments.

Table 12.4: Drawing and documents

Item	Description	Drawing / Document required stage		
		With Bid	For Approval	Final/As-Built
1	A specific statement that the offered package is in strict accordance with data sheet, technical specifications and applicable standards. In, case of any deviation, specific list with details and reasons for each deviation.	Yes	-	-
2	Catalogue details for individual bid items with all other Ancillaries and Auxiliaries	Yes	Yes	Yes

Item	Description	Drawing / Document required stage		
		With Bid	For Approval	Final/As-Built
3	Utility and their consumption requirement at battery limit	Yes	-	Yes
4	Itemised electrical load data	Yes	Yes	Yes
5	Itemised bill of material for all equipment being supplied along with sub-assemblies.	-	Yes	Yes
6	Design Documents			
a	Process and Instrument diagram with inter-locks	Yes	Yes	Yes
b	Calculation for selection of motor, Calculation for bridge, girder end carriage and their connections and all other major components involved in Package system, cable sizing, piping, electrical system, instrumentation and control.	-	Yes	Yes
c	Electrical wiring diagram		Yes	Yes
d	Itemised equipment list, listing all the sub-assemblies, capacities, rating and MOC	Yes	Yes	Yes
e	Lubrication schedule along with a statement on oil consumption and minimum allowable oil temp	Yes	-	Yes
f	Thermal and mechanical design calculation	-	Yes	Yes
g	Torque speed characteristic	-	Yes	Yes
h	Structural loading details with dynamic and static load cases.	-	Yes	Yes
i	Control system architecture	Yes	Yes	Yes
j	Control philosophy and Alarm and shut down list with set point	-	Yes	Yes
k	Loop diagram	-	Yes	Yes
l	Monorail hoist inspection procedure	-	Yes	Yes
j	Method statement for erection with checklist	-	Yes	Yes
7	General Arrangement Drawings			
a	Overall GA drawing	Yes	Yes	Yes
b	GA drawing with crab/trolley, Individual mechanism, bridge, End girder and their connection, Sub assembly drawing for wheels, Hook blocks and hoist drum, Reducer, Brakes couplings etc.,	-	Yes	Yes
c	Motor	Yes	Yes	Yes
d	Vessels, Tanks, Heat Exchangers/ Coolers, Receivers etc.	-	-	-
e	Electrical panels	-	Yes	Yes
f	Skid with mounting details	-	Yes	Yes
g	Foundation plan for all the items requiring civil foundation	-	Yes	Yes
h	Overall equipment layout	Yes	Yes	Yes
i	Tie-in point layout	-	Yes	Yes
8	List of Spares	Yes	-	Yes
9	Itemized price list of mandatory spares	Yes	-	Yes
10	Itemized list with price of spares for erection / commissioning	Yes	-	Yes
11	Item list of spares with price for 2 years running	Yes	-	Yes
12	Testing and Certificates	-	Yes	Yes
13	Overall as well individual assembly quality assurance plan	Yes	-	Yes
14	Drawing for testing arrangement and test procedure to be adopted	-	Yes	Yes
15	Certificate for following			

Item		Description	Drawing / Document required stage		
			With Bid	For Approval	Final/As-Built
a	Hydraulic testing (as applicable)		-	-	Yes
b	Non-destructive testing		-	-	Yes
c	Material composition and physical properties		-	-	Yes
d	Leak proof ness list of frame		-	-	Yes
16	Design / Actual assembly clearance chart		-	-	Yes
17	Test records of following:				
a	Mechanical running		-	-	Yes
b	Performance test		-	-	Yes
c	Noise level test		-	-	Yes
18	Statutory documents		-	-	Yes
19	O & M manual		-	-	Yes

Appendices

Appendix A. Approved Makes and Materials

Table A.1: Approved Makes and Materials

Sr. No	Material	Manufacturers / Brand / Make
1.	Cement OPC / PPC / SRC	Ultratec, Ambuja,
2.	White Cement	Birla Cement, J K Cement
3.	Reinforcement Steel Bars	SAIL, TATA, RINL
4.	Fine aggregates	Good Quality River Sand with approved sample by EIC
5.	Coarse aggregates , Rubble for soling	Good Quality, sample to be got approved before Use.
6.	Cement Hollow / Solid Blocks	Good Quality, sample to be got approved before Use.
7.	Structural Steel, H beam, I beam, Channel, Angle, Plate, flat, round pipe, chequered plate	SAIL, TATA, JINDAL, RINL, JINDAL
8.	Carbon Steel Grating	Indiana,
9.	Roofing / cladding fasteners	Buildex, Roofex,
10.	Nuts Bolts for structural joints	Unbrako / TVS
11.	Welding electrodes	ADVNI, ESAB, D & H
12.	Admixture, non-shrink cementitious Grout, epoxy grout, Tile fixing adhesive, floor Hardener, Bonding Agents etc.	Fosroc, BASF, BAL Endura, JBA, Dr. Fixit, Sika, Cico
13.	Water proofing compound / membrane water proofing	Fosroc, BASF, Sika, Cico
14.	Expansion joint filler board	Supreme- CAPCELL – HD 100
15.	Internal / External paint - Primer / Paint - Epoxy / polyurethane, weather proof external paint	Berger paints India ltd, Asian paints, godless Nerolac, ICI, Shalimar
16.	Cement paint	Snowcem, Indocem,
17.	Aluminium doors/ windows	Jindal, Hindalco, BHORUKA Aldowin
18.	Glass / Glazing	Saint Gobain Pilkington, Modi Guardian Float Glass, Triveni Glass, Asahi
19.	D/ W Hardware's	KITCH, OZONE, Hardwyn, Navkar, EP & PW, Diamond, Ajanta Accessories, Navbharat Brass Bombay , NCL
20.	Door locks	Godrej, Viyant, Dorset, NCL, Shakti met, Ahlada
21.	Hydraulic door closer., Floor Spring	Dorma, Ingersoll
22.	Ceramic / Glazed / Vitrified tiles / Antiskid tiles	Bell, Decora, NITCO, SOMANI, Johnson, KAJARIA
23.	False ceiling- Gypsum/calcium silicate/perforated/metal	India gypsum, Armstrong, Hilux
24.	Zincalume / Galvalume roofing /cladding sheet	Tata Blue scope, Interarch, Pennar, Everest
25.	uPVC/ CPVC / PVC Pipes	Astral, Supreme, Finolex, Prince, Dutron Ashirwad
26.	RCC pipes	Alcock, Indian Hume pipes,

Table A.2: Recommended Makes of Bought out Items for Monorail hoist

S. No	Item	Vendor details
1	Electric motor	Siemens / ABB / Bharat Bijlee / Crompton
2	Fuse switch Unit	Siemens/L&T
3	Power and Control cables	Havells / CCI / Nicco / Torrent/ Gems Cab / Polycab
4	LV Switchgear	GE / ABB / Siemens / Schnieder / L&T / C & S
5	HRC Fuses	Siemens/L&T
6	Contactor/O/L relays	Siemens/L&T

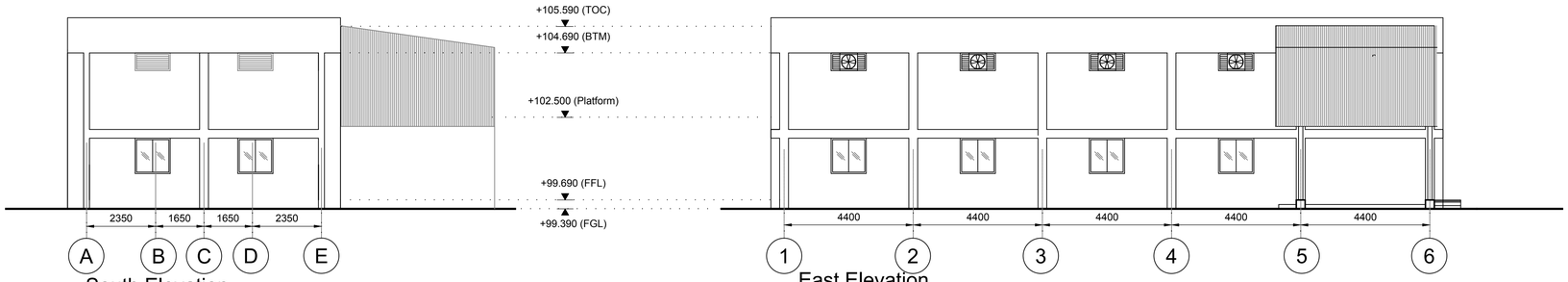
S. No	Item	Vendor details
7	PBS & Indicating Lamps	Teknic/Siemens/L&T
8	MCC	Siemens/L&T
9	Pressure Indicator	H.Guru/General Instruments/Sells Control/Fiebig/Wika/Waree
10	Pressure Switches	Dan foss/Switzer/General
12	Level Switches	Revethi/Levcon/R K Dutt/S B Electromechaic/General/E&H
13	Safety valves	Sebim/Tyco Sanmar/Fainger Lesser
14	Annunciator	IIc/Instalarm Control Products
15	Pipes/ Tubes	Tata / Ratnamani / Jindal/ India Tube Mills / Maharashtra Seamless. (Asian and Tata for ERW)
16	Plate/Steel	Tata / Jindal
17	Gaskets	Uniklinger/Champion / United Gasket Co.
18	Valves	Microfinish/Virco/Audco /BDK
19	Change over valves	Fisher/Audco/Tyco
20	PLC	Siemens / Allen Bradley / Schnieder
21	Pressure gauge	Pricol / Switzer / Wika / Waaree
22	Self-Actuated Pressure Control Valve	Fisher / Dresser / Tyco Sanmar / Instromet / Keye & MacDonald / Nuovo / Nirmal / Vanaz
23	Solenoid Valves	Asco India / Avcon India / Schrader / Parker / Jeffersons/ Rotex
24	Control Valve	Fisher / Flowserve / Nuovo / SPX / Hopkinson / Dembla
25	Gearbox	Bonfiglioli
26	Welding Rod	ESAB
27	Third Party Inspection Agency	Lloyds / SGS / BVQI / TUV
28	Breaks	Electromag/demag/BCH
29	Wire rope	Usha martin/Bombay wire rope
30	Bearing	SKF
31	Third Party Inspection Agency	.Lloyds / TUV / BVQ / DNV
32	Welding consumable	ESAB, ADOR, D&H, HONAVAR.
33	Paint	JOTUN, AKZONOBLE, HEMPEL, SIGMA.
34	Monorail Hoist	Stahl / Konecranes/ Demag Cranes

Appendix B. List of Tender Drawings

Table B.1: List of Tender Drawings

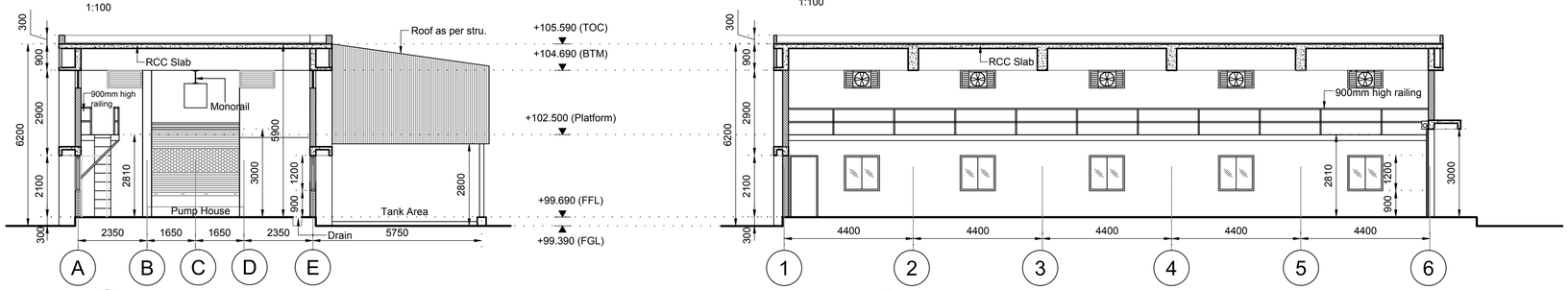
Sr. No.	Drawing No.	Rev. No's	Title
1	322538-MPE-00100-03	Rev.03	Plot Plan
2	322538-ABA-0011-01	Rev 02	Floor Plans, Sections & Elevations
3	322538-CCA-0024-01	Rev 01	Layout & Details of Columns, Footings & Plinth Beams
4	322538-CCA-0025-01	Rev 00	Layout & Details Equipment foundations
5	322538-CCB-0026-01	Rev 01	Layout & Details of Lintel level
6	322538-CCA-0027-01	Rev 00	Layout & Details of Roof beams & slab
7	322538-CMB-0028-01	Rev 01	Layout and Details of Steel Plate Form
8	322538-CMA-0029-01	Rev 00	Layout & Details Platform & Pipe Supports
9	322538-CMA-0030-01	Rev 00	Layout & Details Roof Plan, Rafter & Purlin
10	322538-RPA-0903-05_TEN	Rev 01	Layout and Sections of piping for proposed fire water pump house

Appendix C. Schedule of Quantities



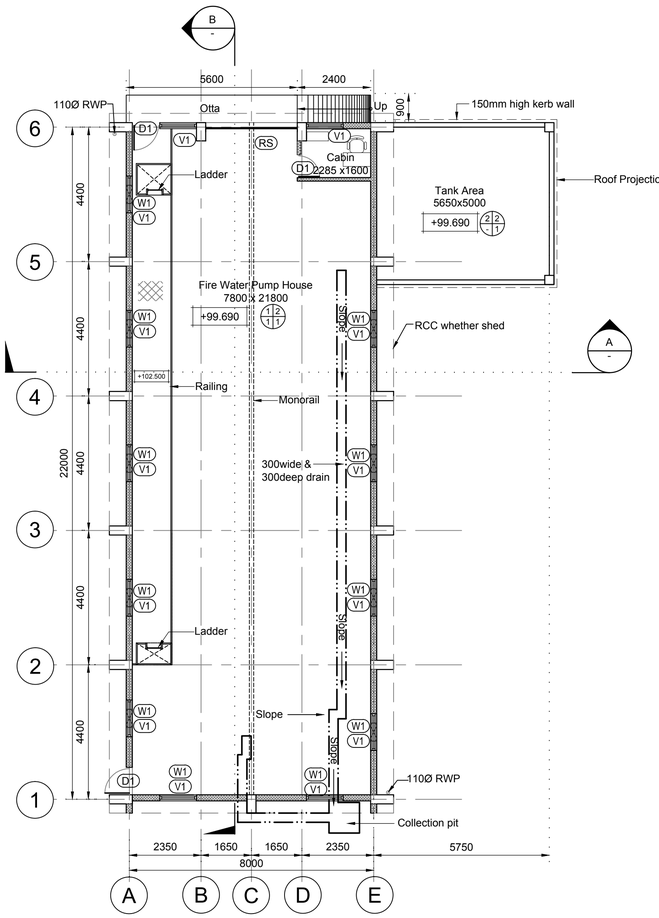
South Elevation
1:100

East Elevation
1:100

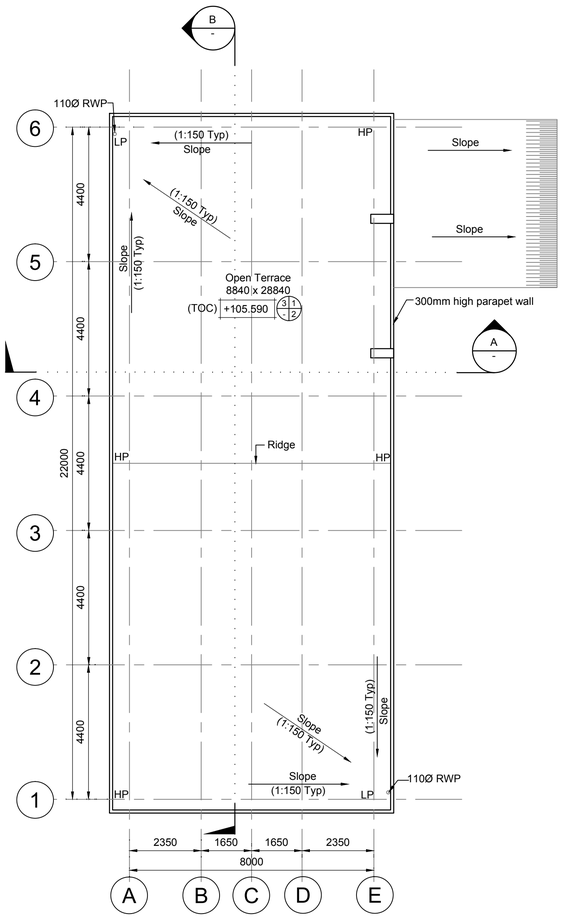


Section A
1:100

Section B
1:100



Ground Floor Plan
1:100 (++99.690m Lvl)



Terrace Plan
1:100 (+105.590m Lvl)

1:100 0 5m 10m

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N

Notes

1. All dimensions are in millimeters & All levels are in meters
2. All dimensions given are excluding plaster thickness
3. All masonary walls are 200 Thk concrete block

Abbreviations :

Alu	= Aluminium	Eq	= Equal	HP	= High point
Req	= Requirement	Typ	= Typical	LP	= Low point
FGL	= Finished Ground Level	BTM	= Bottom	mm	= Millimeters
FFL	= Finished Floor Level	Ø	= Diameter	m	= Meters
IL	= Invert Level				

= Chequred plate
= 200mm thk Block wall

Key to symbols

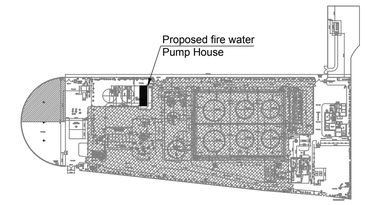
Finish Schedule

F IW
C EW

F : Floor
IW : Internal Surface Of Wall
EW: External Surface Of Wall
C : Ceiling

Floor	(1) IPS flooring
	(2) AR Tiling
	(3) Indian type water proofing
Wall	(1) 19 Thk double coat sand faced plaster with cement paint
	(2) 12 Thk single coat smooth plaster
Ceiling	(1) 10 Thk single coat smooth plaster

N



Key Plan

Reference drawings

322538-RLA-0901-01 for Layout & section of proposed (Fire water pump house)

Schedule of openings Doors & Windows

Type	Size	Sill Top	Lintel BTM	Remarks
RS	3000x3000	---	3000	MS Rolling shutter with mesh
D1	900x2100	---	2100	Alu frame paneled/glazed door
W1	1200x1200	900	2100	Alu frame sliding glazed window
V1	1200x600	-	Beam BTM	Alu frame aluminium louvers

Rev	Date	Drawn	Description	Ch'k'd	App'd
00	10/12/2015	HJG	Issued for Approval		

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IGI Airport,New Delhi - 110061

DAFFPL

Title
Modernization of Existing Fuel Farm

Fire Water Pump House
Floor Plans,Sections & Elevations

Designed	ASP		Eng check	ASP	
Drawn	HJG		Coordination	AKM	
Dwg check	HMT		Approved	BKP/AKS	

Scale at A1	Status	Rev	Security
As noted.	APR	00	STD

Drawing Number
322538-ABA-0011-01

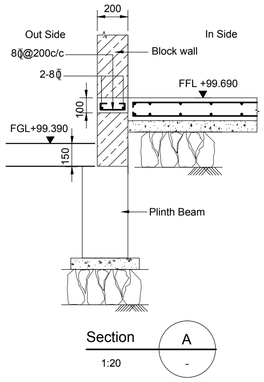
Schedule of RC Footings

Ftg. Mkd.	Size				R. C. Footings			
					Reinforcement			
					e		f	
	A	B	D	d	Nos.	@	Nos.	@
F1	2100	2550	550	200	17	10	14	10
F2	3000	3450	750	300	25	12	21	12
F3	2200	2500	550	200	17	10	15	10
F4	2400	2700	500	200	18	10	16	10

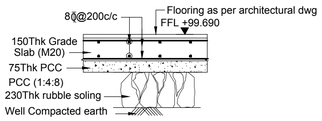
Schedule of plinth beams (TOC +99.240m lvl)

Beam Mkd.	Type	Size		Reinforcement													
				At Centre						At Supports							
				Bottom				Top		Bottom		Top		Bottom		Top		Stirrups
				B1		BP		T1		BS		TR		B2		T2		
		b	d	Nos.	@	Nos.	@	Nos.	@	Nos.	@	Nos.	@	Nos.	@	Nos.	@	@	Spacing
PB1	I	300	600	3	20	-	-	3	16	-	-	2	16	-	-	2	16	8	@ 125 c/c*
PB2	II	300	600	3	20	-	-	3	16	-	-	2	16	-	-	-	-	8	@ 125 c/c*
PB3	II	300	600	3	20	-	-	3	16	-	-	2	16	-	-	-	-	8	@ 125 c/c*
PB4	I	300	450	3	20	-	-	3	16	-	-	2	16	-	-	2	16	8	@ 125 c/c*
PB5	II	300	450	3	20	-	-	3	16	-	-	2	12	-	-	-	-	8	@ 125 c/c*
PB6	I	300	450	3	20	-	-	3	16	-	-	-	-	-	-	2	16	8	@ 125 c/c*
PB7	I	300	600	3	20	-	-	3	16	-	-	2	16	-	-	2	16	8	@ 125 c/c*
PB8	I	300	600	3	20	-	-	3	16	-	-	-	-	-	-	2	16	8	@ 125 c/c*

Up to one Third dist. of Span from both end Support & 8 @150c/c at Rest of span.

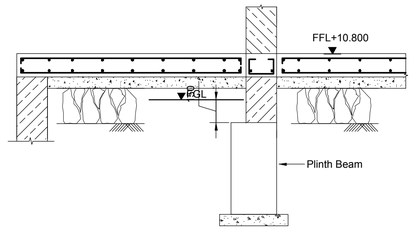


Section A
1:20



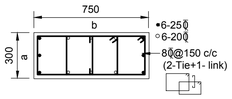
Typical Section For Grade Slab
1:20

Hold

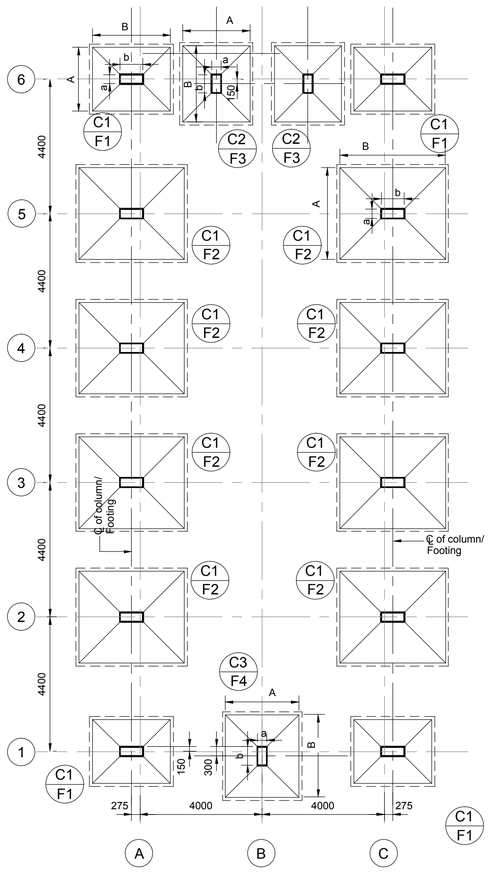


Section B
1:20

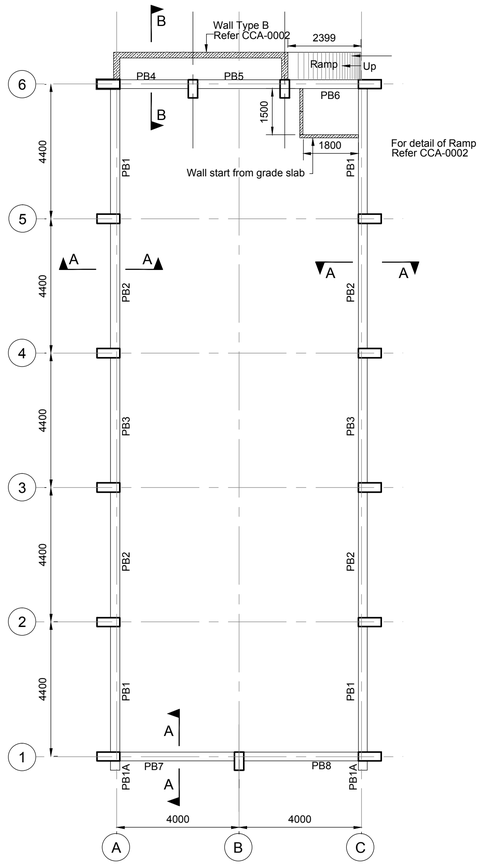
Hold



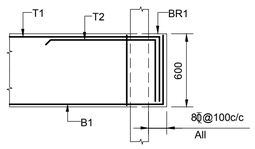
Section C
1:20
Column C1



Structural Layout of Columns and Footings.
1:100

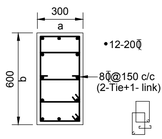


Structural Layout of Plinth Beams
1:100

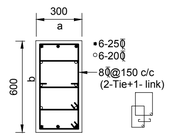


PB1 (300X600)
1:50

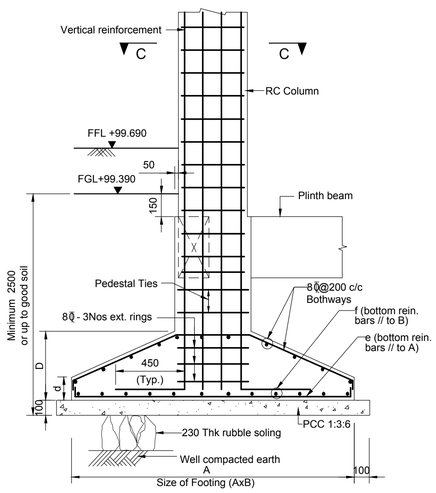
PB1a (300X600)
1:50



Section C
1:20
Column C2



Section C
1:20
Column C3

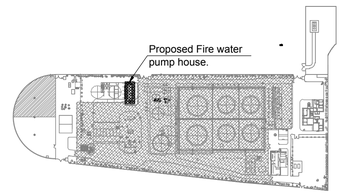


Typical Section of Column & Footing
1:20

Notes

1. All dimensions are in millimetres and levels are in metres.
2. All Concrete grade shall be M25, machine mixed and machine vibrated
3. Reinforcement Grade shall be : Fe 415 TMT bars
4. Layout dimension to be checked with Arch. drg. & if any ambiguity is there, contact design engineer prior to proceed.
5. Footing is designed considering 135 kN/m² SBC at 2.5m Depth from FGL.
6. Clear cover to main reinforcement
   a) Footing = 50mm b) Pedestal = 40mm c) plinth Beam = 30mm

Key to symbols



Key Plan

Abbreviations :

FGL	= Finished Ground Level
FFL	= Finished Floor Level
Thk	= Thick
RC	= Reinforced Concrete
Typ	= Typical
Det	= Detail
Reinf	= Reinforcement

Reference drawings

1. CGA-01 General Notes.
2. CCA-02 Typical Details of Columns, Footings, Beams, Walls etc.
3. RLA-0901-0055-01-P5 Layout and section of proposed fire water pump house

Rev	Date	Drawn	Description	Ch'k'd	App'd
02	08.12.15	MRP	Issued for Tender & Revised as FF drg		
01	24.09.15	DKP	Issued for Tender	ASP	BKP
0	23.09.15	DKP	Issued for Tender	ASP	BKP

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Title
Modernization of Existing Fuel Farm Fire Water pump House

Layout & Details of Columns, Footings & Plinth Beams

Designed	DGR		Eng check	ASP	
Drawn	DK PATEL		Coordination	CT	
Dwg check	ASP		Approved	AKS/BKP	
Scale at A1	Status		Rev	Security	
1:100	TEN		02	STD	

Drawing Number
322538-CCA-0024-01

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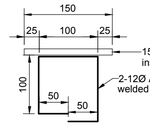
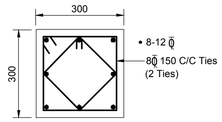
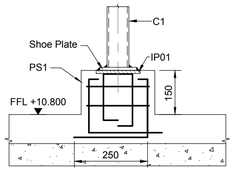


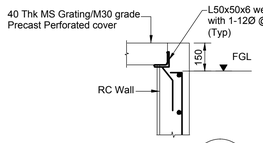
Detail of Insert Plate IP01
1:10



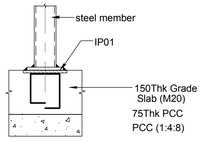
Detail of Pedestal PS1/P10/P11
1:10

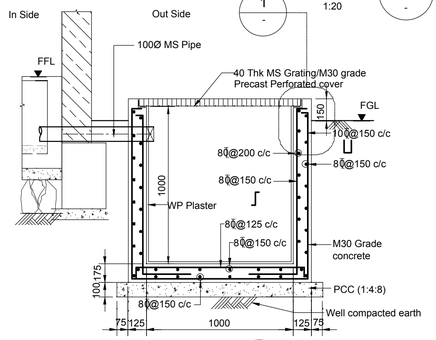


Typical Detail of Pedestal PS1
1:10 For Pipe Support



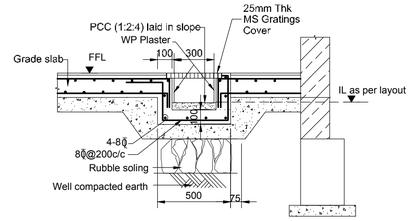
Detail 1
1:10



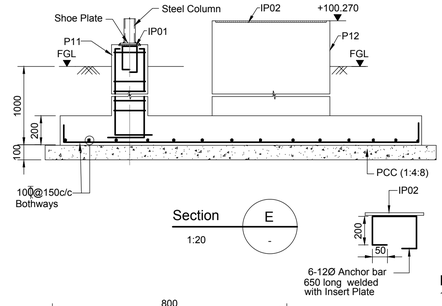


Section A
1:20

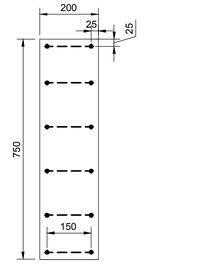
Section 1 D
1:20



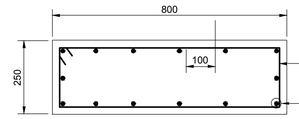
Typ.Detail of Drain Trench
1:10



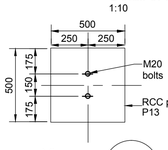
Section E
1:20



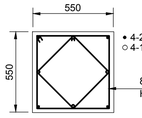
Detail of Insert Plate IP02
1:10



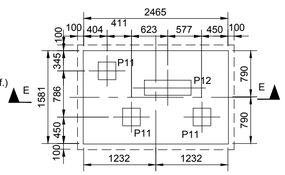
Detail of Pedestal P12
1:10



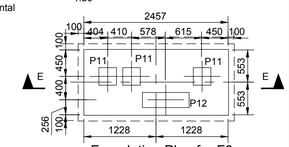
View H
1:20
Detail of Pedestal P13



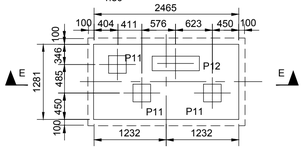
Section G
1:20
Detail of Pedestal P13



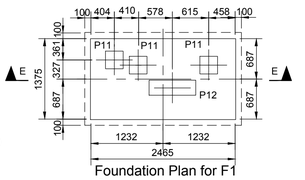
Foundation Plan for F4
1:50



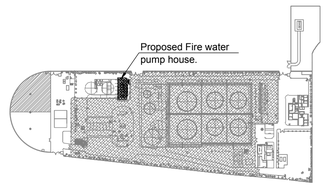
Foundation Plan for F3
1:50



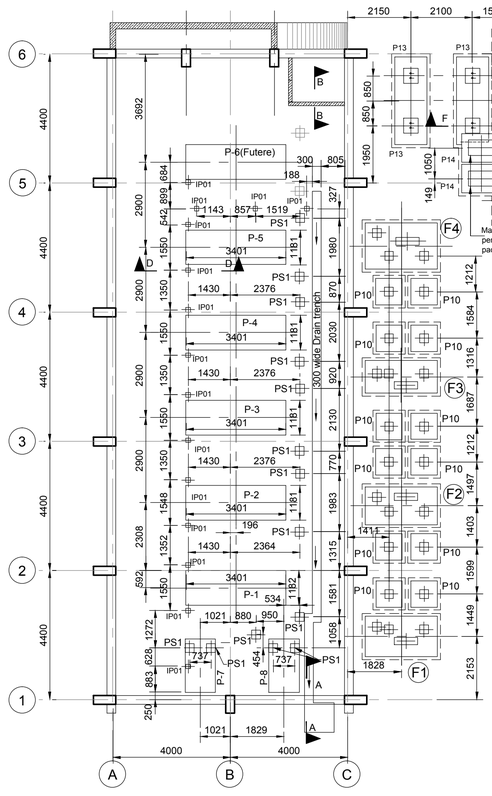
Foundation Plan for F2
1:50



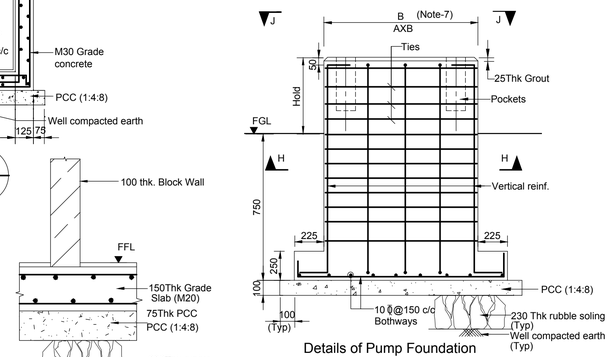
Foundation Plan for F1
1:50



Key Plan

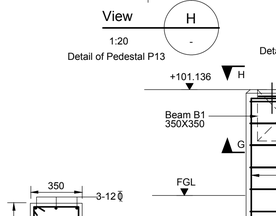


Structural Layout of Equipment Foundation
1:100

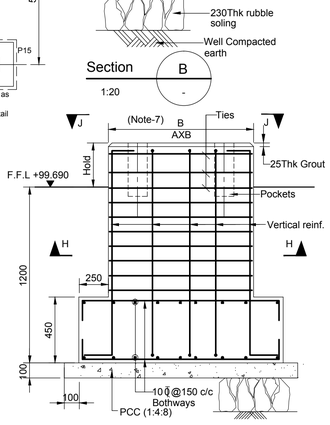


Details of Pump Foundation
1:20 (For Pump P-14)

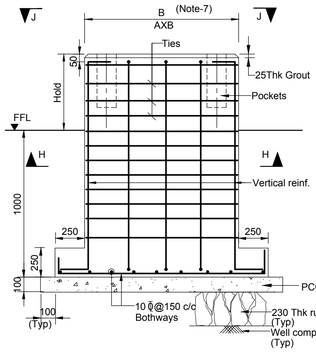
Section B
1:20



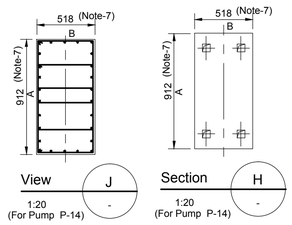
Section F
1:20

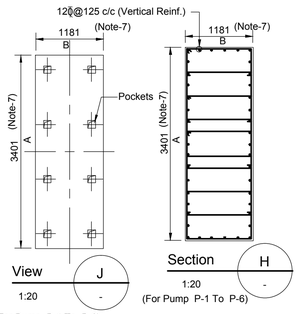


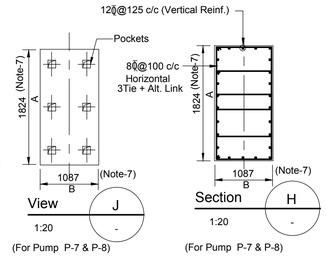
Details of Pump Foundation
1:20 (For Pump P-1 To P-6)



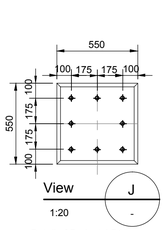
Details of Pump Foundation
1:20 (For Pump P-7 & P-8)



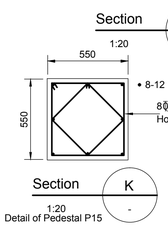




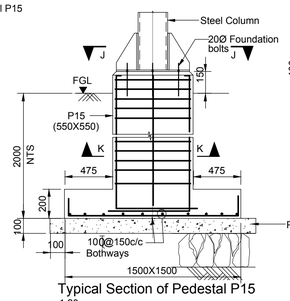
Details of Beam B1
1:20



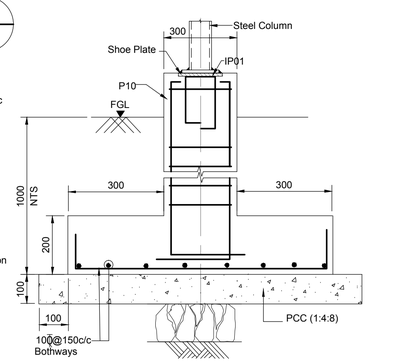
Detail of Pedestal P15



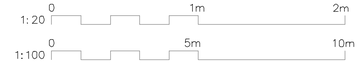
Detail of Pedestal P15



Typical Section of Pedestal P15
1:20



Typical Section of Pedestal P10
1:10



Notes

1. All dimensions are in millimetres and levels are in metres.
2. All Concrete grade shall be M25, machine mixed and machine vibrated
3. Reinforcement Grade shall be : Fe 415 TMT bars
4. Layout dimension to be checked with Arch. drg. & if any ambiguity is there, contact design engineer prior to proceed.
5. Footing is designed considering 135 kN/m² SBC at 2.5m Depth from FGL.
6. Clear cover to main reinforcement
   a) Footing = 50mm b) Pedestal = 40mm c) plinth Beam = 30mm
7. Civil detail and location of pump may be revised as per vendor detail documents

Key to symbols

Abbreviations :

FGL	= Finished Ground Level
FFL	= Finished Floor Level
Thk	= Thick
RC	= Reinforced Concrete
Typ	= Typical
Det	= Detail
Reinf	= Reinforcement

Reference drawings

1. CGA-01 General Notes.
2. CCA-02 Typical Details of Columns, Footings, Beams, Walls etc.
3. RLA-0901-01-P5 Layout and section of proposed fire water pump house

Rev	Date	Drawn	Description	Ch'k'd	App'd
1	08.12.15	MRP	Issued forTendor & Revised as FF drg		
0	01.10.15	DKP	Issued forTendor	ASP	VST

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Aviation Fuelling Station
Shahbad,Muhammad Pur
IGI Airport,New Delhi - 110061

DAFFPL

Title

Modernization of Existing Fuel Farm Fire Water Pump House

Layout & Details of Equipment Foundation and Pipe Support

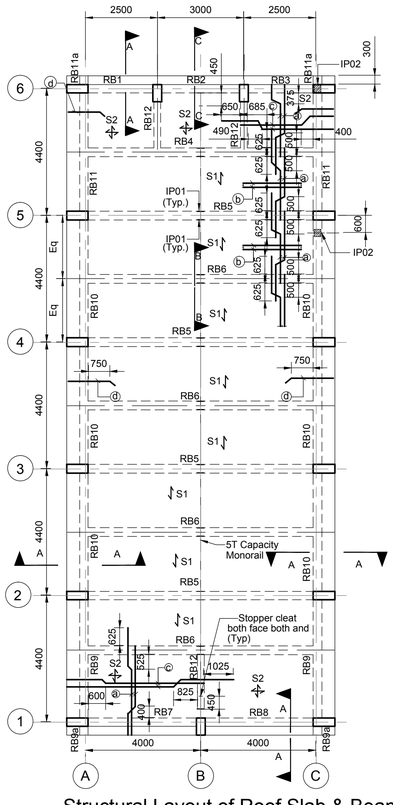
Designed	DGR		Eng check	ASP	
Drawn	DK PATEL		Coordination	AKM	
Dwg check	ASP		Approved	VST	
Scale at A1	Status		Rev	Security	
1:100	TEN		1	STD	

Drawing Number
322538-CCA-0025-01

Schedule of Plinth Beams

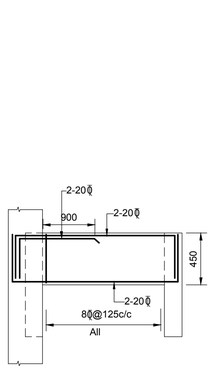
Beam Mkd.	Type	Size		Reinforcement														Stirrups	
				At Centre						At Supports									
				Bottom				Top		Bottom		Top		Bottom		Top			
				B1		BP		T1		BS		TR		B2		T2			
		b	d	Nos.	Ø	Nos.	Ø	Nos.	Ø	Nos.	Ø	Nos.	Ø	Nos.	Ø	Nos.	Ø	Ø	Spacing
RB1	I	300	900	2	20	-	-	2	20	-	-	2	16	-	-	2	16	8	@125c/c *
RB2	II	300	900	2	20	-	-	2	20	-	-	2	16	-	-	-	-	8	@125c/c *
RB3	I	300	900	2	20	-	-	2	20	-	-	-	-	-	-	2	16	8	@125c/c *
RB4	VI	300	900	3	25	2	20	2	20	-	-	-	-	-	-	-	-	8	@125c/c *
RB5	III	300	900	3	20	2	20	2	20	-	-	-	-	-	-	3	20	8	@125c/c *
RB6	VI	300	900	3	25	2	20	2	20	-	-	-	-	-	-	-	-	8	@125c/c *
RB7	I	300	900	2	20	-	-	2	20	-	-	2	16	-	-	2	16	8	@125c/c *
RB8	I	300	900	2	20	-	-	2	20	-	-	2	16	-	-	2	16	8	@125c/c *
RB9	I	300	900	3	20	-	-	2	20	-	-	2	16	-	-	2	16	8	@125c/c *
RB10	II	300	900	3	20	-	-	2	20	-	-	2	16	-	-	-	-	8	@125c/c *
RB11	I	300	900	3	20	-	-	2	20	-	-	-	-	-	-	2	16	8	@125c/c *
RB12	Refer Section																		

* Up to one third dist. of span from both end support & 8 Ø 150 c/c at rest of span



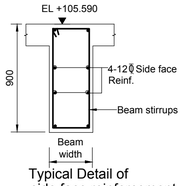
Structural Layout of Roof Slab & Beams

1:100 (All Slabs are 150mm thk.)



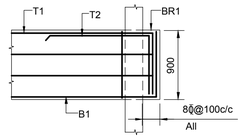
FB12(230X450)

1:50



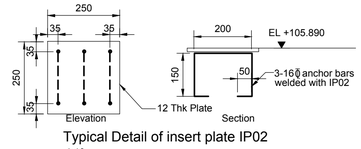
Typical Detail of side face reinforcement

1:20



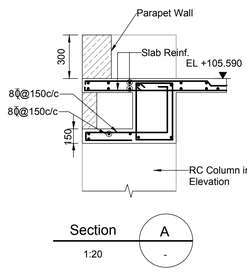
RB9a & RB11a (300X900)

1:50



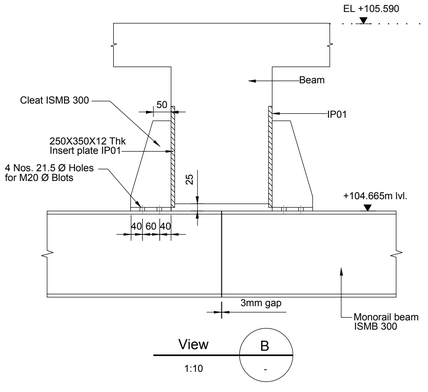
Typical Detail of insert plate IP02

1:10



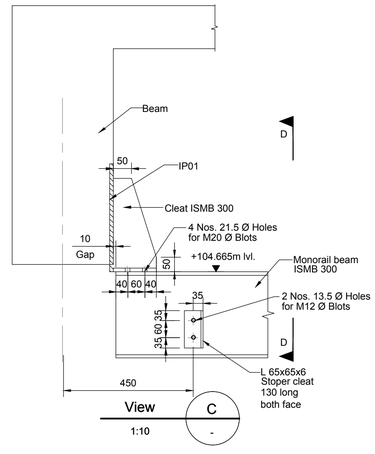
Section A

1:20



View B

1:10

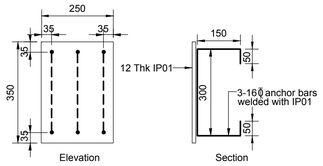


View C

1:10

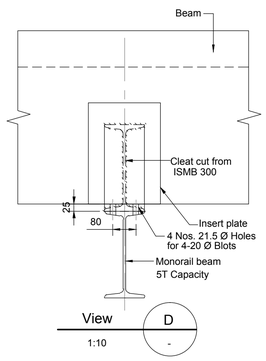
Schedule of Slab Reinforcement

Bar marked	Dia.	Dist. c/c	Remarks
(a)	10	150	Alternet bent up
(b)	8	200	Distribution Steel
(c)	8	150	Alternet bent up
(d)	10	300	Extra at top



Typical Detail of insert plate IP01

1:10



View D

1:10

1:10 0 0.5m 1m

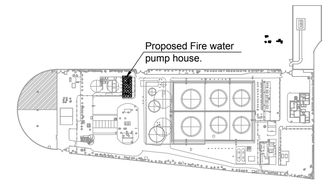
1:20 0 1m 2m

1:100 0 5m 10m

Notes

1. All dimensions are in millimetres and levels are in metres.
2. All Concrete grade shall be M25, machine mixed and machine vibrated
3. Reinforcement Grade shall be : Fe 415 TMT bars
4. Layout dimension to be checked with Arch. drg. & if any ambiguity is there, contact design engineer prior to proceed.
5. Clear cover to main reinforcement
   a) Beam = 25mm b) slab = 20mm
6. In case at footing excavation bottom silt and clay layer is encountered, the same shall be removed before construction of footing

Key to symbols



Key Plan

Abbreviations :

FGL	= Finished Ground Level
Thk	= Thick
RC	= Reinforced Concrete
Typ	= Typical
Det	= Detail
Reinf	= Reinforcement

Reference drawings

1. CGA-01 General Notes.
2. CCA-02 Typical Details of Columns, Footings, Beams, Walls etc.

Rev	Date	Drawn	Description	Ch'k'd	App'd
1	08.12.15	MRP	Issued for Tender & Revised as FF drg		
0	24.09.15	JAP	Issued for Tender	ASP	BKP

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IGI Airport,New Delhi - 110061

DAFFPL

Title

Modernization of Existing Fuel Farm
Fire Water Pump House

Layout and Details of Roof Beams Slabs & Monorail

Designed	DGR		Eng check	ASP	
Drawn	JAP		Coordination	AKM	
Dwg check	ASP		Approved	AKS/BKP	

Scale at A1	Status	Rev	Security
As Shown	TEN	1	STD

Drawing Number

322538-CCA-0027-01

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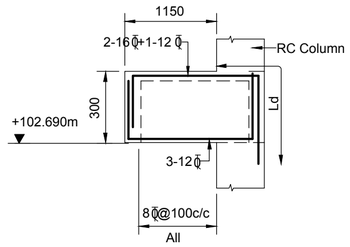


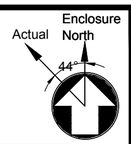
LBR1(300X450)

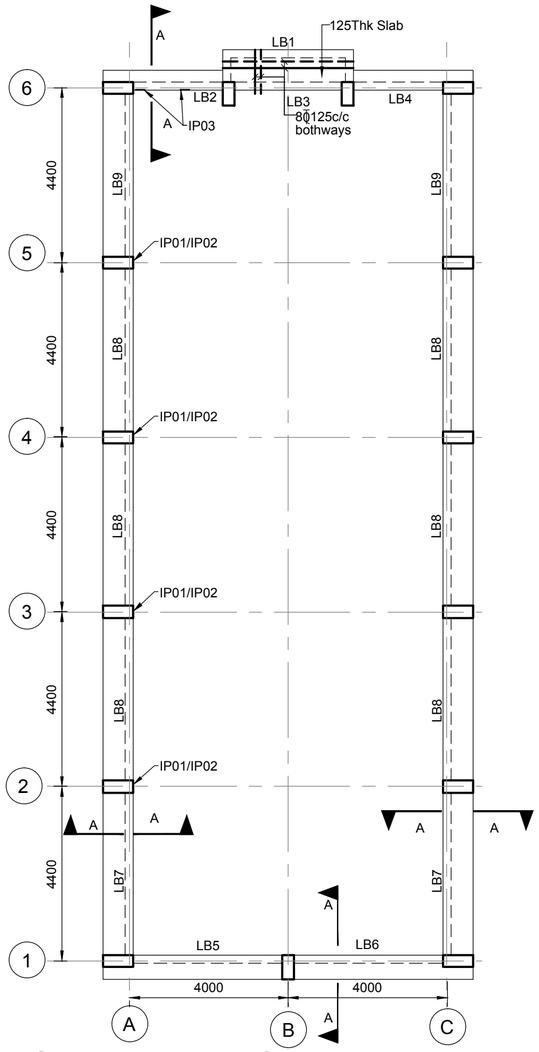
1:50

Schedule of Plinth Beams

Beam Mkd.	Type	Size		Reinforcement														Stirrups		Remark
				At Centre						At Supports										
				Bottom				Top		Bottom		Top		Bottom		Top				
				B1		BP		T1		BS		TR		B2		T2				
		b	d	Nos.	Ø	Nos.	Ø	Nos.	Ø	Nos.	Ø	Nos.	Ø	Nos.	Ø	Nos.	Ø	Ø	Spacing	
LB1	VI	200	300	2	12	-	-	2	12	-	-	-	-	-	-	-	-	8	@125c/c All	
LB2	III	200	450	3	16	-	-	2	16	-	-	-	-	-	-	2	16	8	@125c/c*	
LB3	III	200	450	2	16	-	-	2	12	-	-	-	-	-	-	2	16	8	@150c/c All	+102.690m
LB4	III	200	450	3	16	-	-	2	16	-	-	-	-	-	-	2	16	8	@125c/c*	
LB5	I	200	450	2	16	-	-	2	12	-	-	2	16	-	-	2	16	8	@150c/c All	
LB6	I	200	450	2	16	-	-	2	12	-	-	-	-	-	-	2	16	8	@150c/c All	
LB7	I	200	450	3	16	-	-	2	16	-	-	2	16	-	-	2	16	8	@125c/c*	
LB8	II	200	450	3	16	-	-	2	16	-	-	2	16	-	-	-	-	8	@125c/c*	
LB9	I	200	450	3	16	-	-	2	16	-	-	-	-	-	-	2	16	8	@125c/c*	

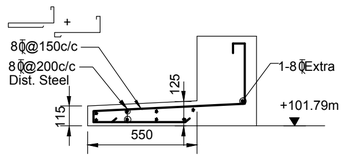
* Up to one third dist. of span from both end support & 8 @150 c/c at rest of span





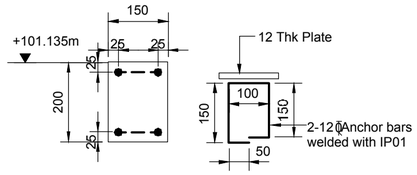
Structural Layout of Lintel Beams

1:100



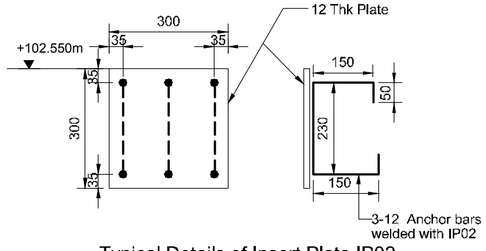
Section A

1:20



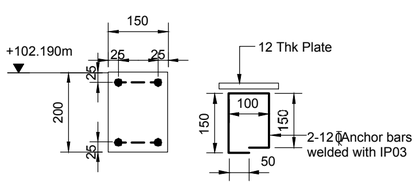
Typical Details of Insert Plate IP01

(in Column)



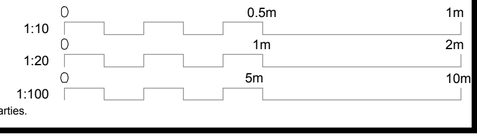
Typical Details of Insert Plate IP02

1:20 (in Column/Beam)



Typical Details of Insert Plate IP03

(in Column)



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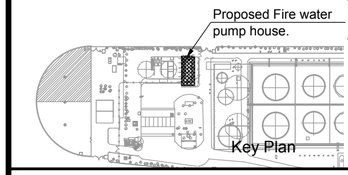
Notes

1. All dimensions are in millimetres and levels are in metres.
2. All Concrete grade shall be M25, machine mixed and machine vibrated
3. Reinforcement Grade shall be :
   Fe 415 TMT bars
4. Layout dimension to be checked with Arch. drg. & if any ambiguity is there, contact design engineer prior to proceed.
5. Clear cover to main reinforcement
   a) Beam = 25mm b) slab = 20mm
6. In case at footing excavation bottom silt and clay layer is encountered, the same shall be removed before construction of footing

Reference drawings



Abbreviations :

FGL	= Finished Ground Level
Thk	= Thick
RC	= Reinforced Concrete
Typ	= Typical
Det	= Detail
Reinf	= Reinforcement

Key to symbols

1. CGA-01 General Notes.
2. CCA-02 Typical Details of Columns, Footings, Beams, Walls etc.
3. CMB-0028 Typical Details of Structural Plate Form at +102.500
4. RLA-0901-0055-01-P5 Layout and section of proposed fire water pump house

Rev	Date	Drawn	Description	Ch'k'd	App'd
1	08.12.15	MRP	Issued for Tenderl & Revised as FF drg		
0	24.09.15	JAP	Issued for Tender	ASP	BKP

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Client

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Aviation Fuelling Station
Shahbad,Muhammad Pur
IGI Airport,New Delhi - 110061

DAFFPL

Title

Modernization of Existing Fuel Farm

Fire Water Pump House

Layout and Details of Lintel Beams

Designed	DGR		Eng check	ASP	
Drawn	JAP		Coordination	AKM	
Dwg check	ASP		Approved	AKS/BKP	

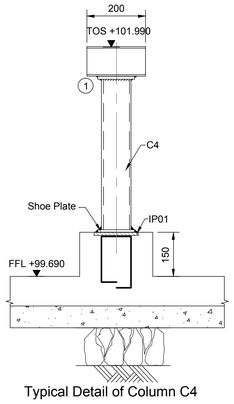
Scale at A2	Status	Rev	Security
AsShown	TEN	1	STD

Drawing Number

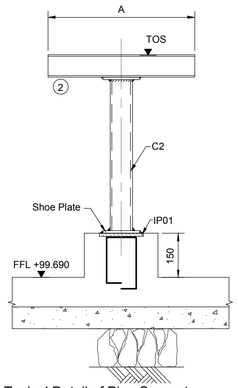
322538-CCB-0026-01

Schedule of Pipe Support

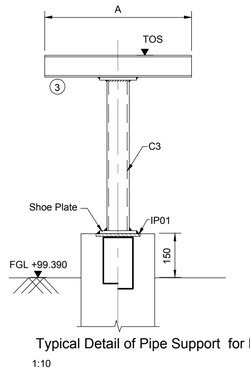
PS No	TOS	'A'
PS1	+100.437	450
PS2	+100.116	250
PS3	-	-
PS4	+100.521	425
PS5	+102.320	600



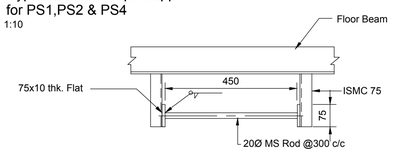
Typical Detail of Column C4
1:10



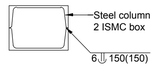
Typical Detail of Pipe Support
for PS1,PS2 & PS4
1:10



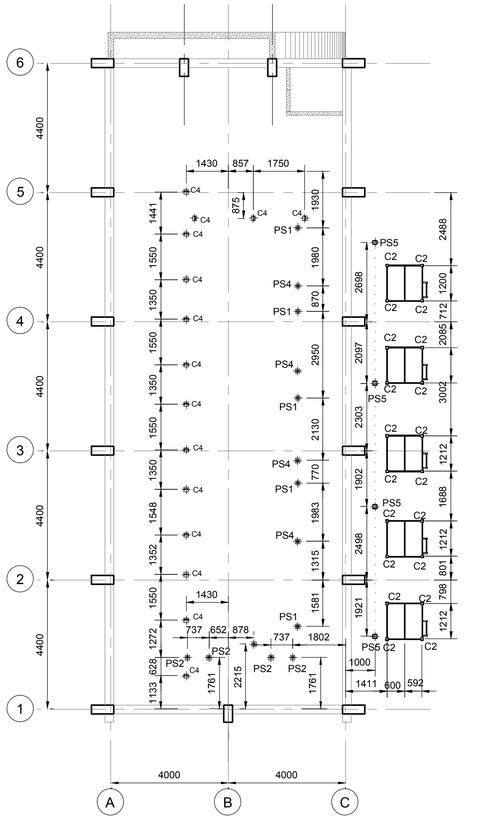
Typical Detail of Pipe Support for P5
1:10



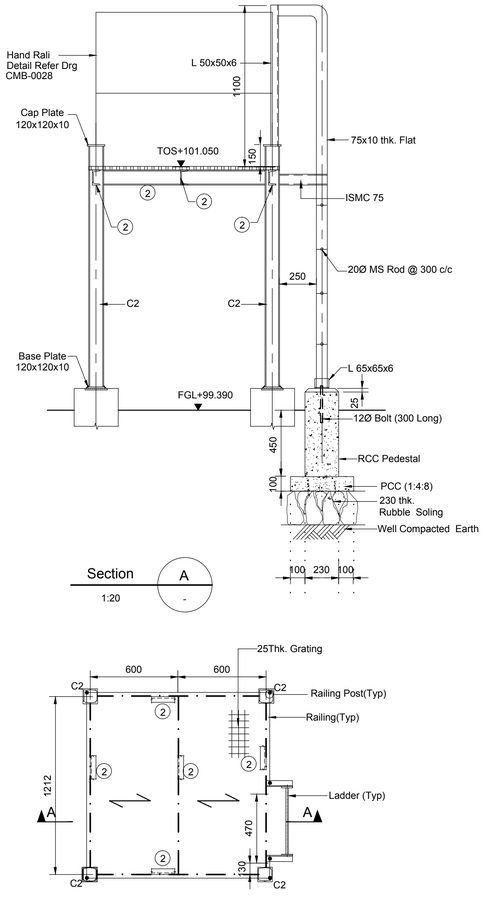
Section C
1:10



Typ.Column Details
1:10

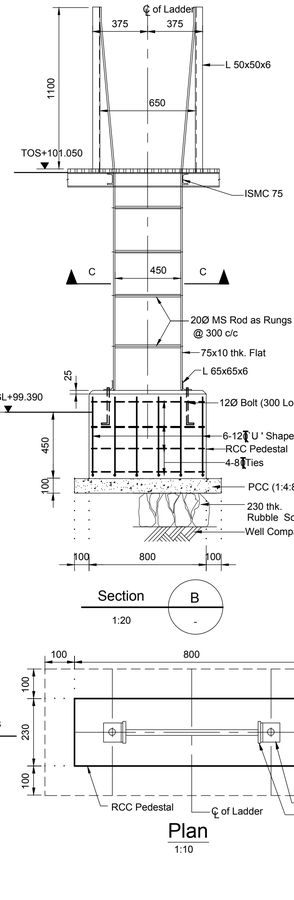


Structural Layout of Pipe Support & Platform
1:100

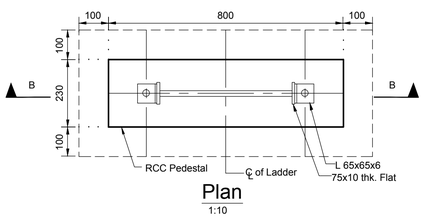


Section A
1:20

Part Plan Platform
1:100



Section B
1:20



Plan
1:10

1:10 0 0.5m 1m
1:20 0 1m 2m
1:100 0 5m 10m

Schedule of Steel Members

Marked No	Member Size
1	ISMC 75
2	ISMC 100
3	ISMC 125

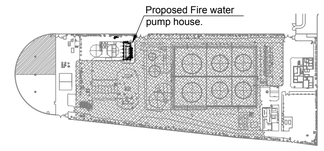
Schedule of Column

Column Marked	Member Size
C1	2ISMC 100 (Box)
C2	2ISMC 75 (Box)
C3	2ISMC 125 (Box)
C4	ISMC 125

Notes

1. For all general notes refer dwg. no. CGA-01
2. All dimensions are in millimetres and levels are in metres unless otherwise specified
3. Contractor shall take extra care to check the straightness of all members and get them inspected and approved before erection
4. All Shop weld shall be 6mm thk. & field weld shall be 8mm thk unless otherwise specified
5. Follow writen dimensions only, do not scale the drawing
6. Layout, dimensions & levels to be checked with Arch. & Mech.drawing & if any ambiguity is found , contact engineer in-charge prior to proceed

Key to symbols



Key Plan

Abbreviations :

FGL	= Finished Ground Level
FFL	= Finished Floor Level
Thk	= Thick
RC	= Reinforced Concrete
Typ	= Typical
Det	= Detail

Reference drawings

1.	ABA-0011	Floor Plans,Sections & Elevations
2.	RBP-0906	13KL Foam concentrate storage tank(Atmospheric).
3.	RPA-0903	Layout and sections of Piping for proposed fire water pump house.
4.	ELA-0002	Power & Earthing Layout, Section & Details
5.	CCA-0025	Layout & Details of Equipment Foundation and Pipe Support

Rev	Date	Drawn	Description	Ch'k'd	App'd
1	08.12.15	MRP	Issued for Tender & Revised as FF drg		
0	13.10.15	MRP	Issued for Tender	ASP	VST

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Aviation Fuelling Station
Shahbad,Muhammad Pur
IGI Airport,New Delhi - 110061

DAFFPL

Title
Modernization of Existing Fuel Farm
Fire Water Pump House

Layout & Details Platform &
Pipe Support

Designed	DGR		Eng check	ASP	
Drawn	MRP		Coordination	AKM	
Dwg check	ASP		Approved	VST	

Scale at A1	Status	Rev	Security
As Shown	TEN	1	STD

Drawing Number
322538-CMA-0029-01

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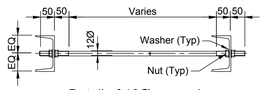
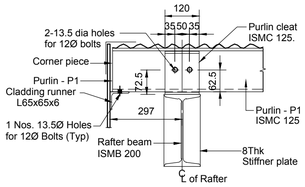
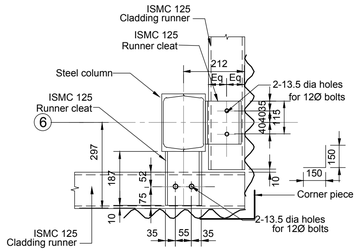


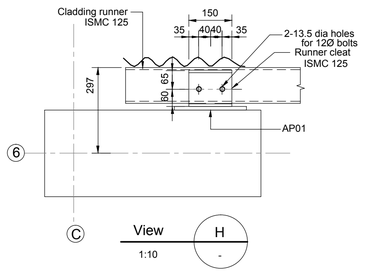
Detail of 12Ø sag rod
1:10 (Typ)



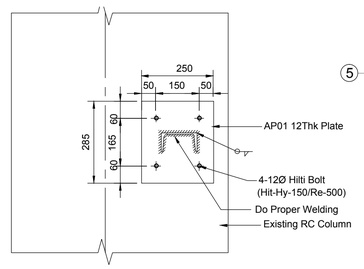
Section D
1:10



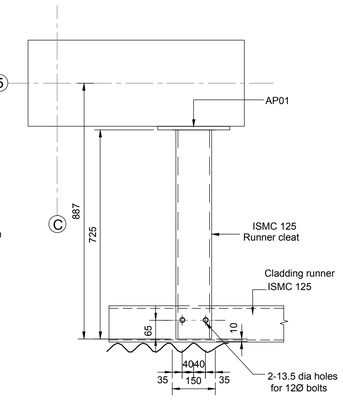
View G
1:10



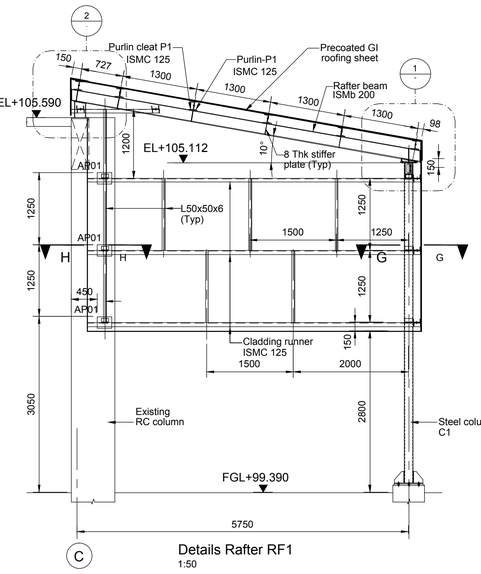
View H
1:10

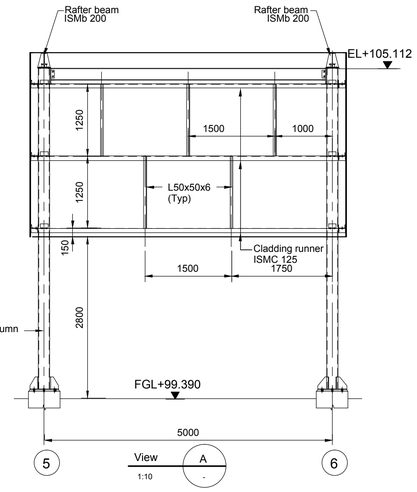


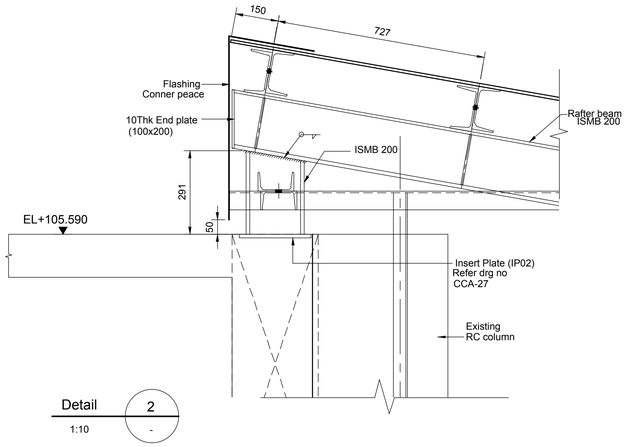
Typical Detail of Anchor Plate
1:10



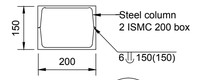
View H
1:10



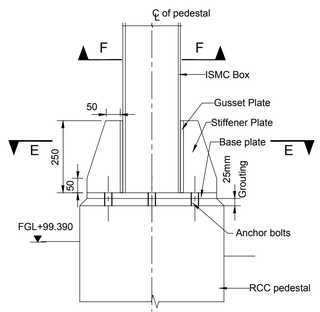




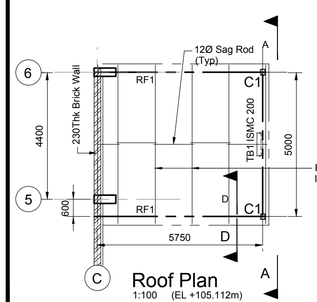
Detail 2
1:10

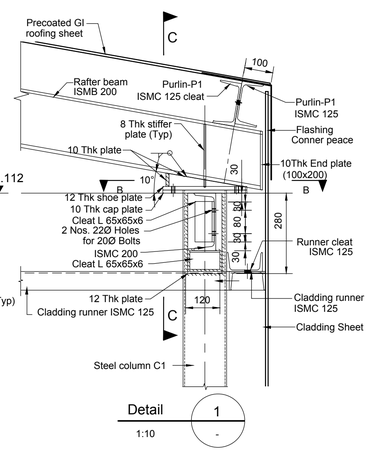


Section F
1:10
Steel column C1

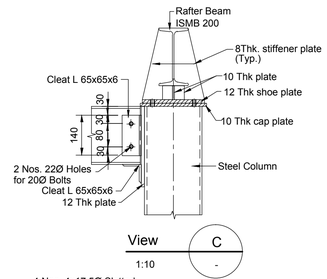


Detail of Steel Column C1
1:10

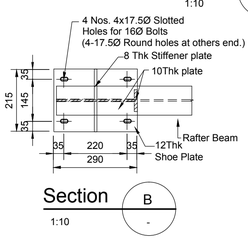




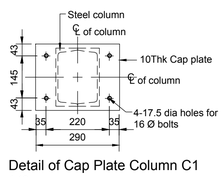
Detail 1
1:10



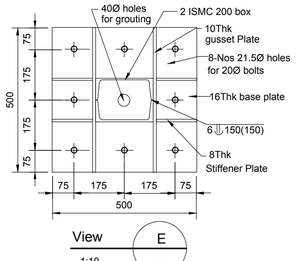
View C
1:10



Section B
1:10



Detail of Cap Plate Column C1
1:10



View E
1:10
Column - C1

1:10 0 0.5m 1m
1:20 0 1m 2m
1:100 0 5m 10m

Notes

1. For all general notes refer dwg. no. CGA-01
2. All dimensions are in millimetres and levels are in metres unless otherwise specified
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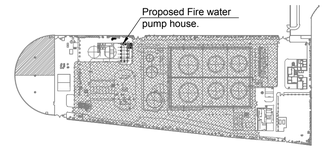
4. All Shop weld shall be 6mm thk. & field weld shall be 8mm thk unless otherwise specified
5. Follow writen dimensions only, do not scale the drawing
6. Layout, dimensions & levels to be checked with Arch. & Mech.drawing & if any ambiguity is found , contact engineer in-charge prior to proceed

Key to symbols



Key Plan

Abbreviations :

FGL	= Finished Ground Level
FFL	= Finished Floor Level
Thk	= Thick
RC	= Reinforced Concrete
Typ	= Typical
Det	= Detail
RF	= Rafter

Reference drawings

1. ABA-0011	Floor Plans,Sections & Elevations
2. RBP-0906	13KL Foam concentrate storage tank(Atmospheric).
3. CCA-0025	Layout & Details of Equipment Foundation and Pipe Support
4.CCA-0027	Layout and Details of Roof Beams Slabs & Monorail

Rev	Date	Drawn	Description	Ch'k'd	App'd
1	08.12.15	MRP	Issued for Tender & Revised as FF drg		
0	08.10.15	MRP	Issued forTendor	ASP	VST

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Aviation Fuelling Station
Shahbad,Muhammad Pur
IGI Airport,New Delhi - 110061

DAFFPL

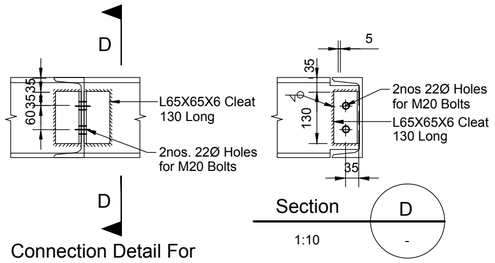
Title
Modernization of Existing Fuel Farm
Fire Water Pump House

Layout & Details Roof Plan,Rafter & Purlin

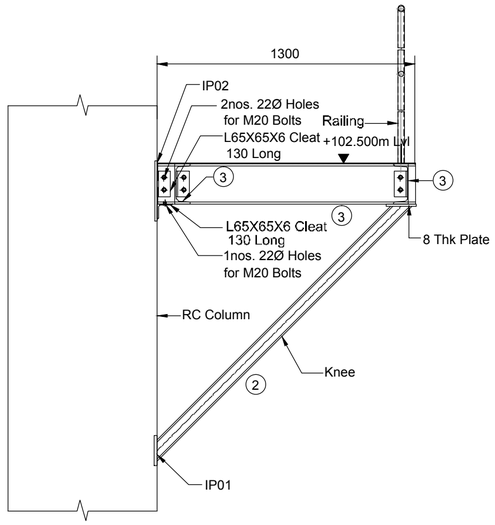
Designed	DGR		Eng check	ASP	
Drawn	MRP		Coordination	AKM	
Dwg check	ASP		Approved	VST	

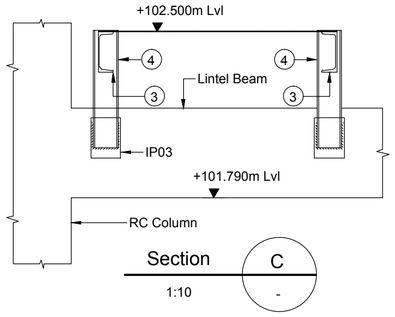
Scale at A1	Status	Rev	Security
As Shown	TEN	1	STD

Drawing Number
322538-CMA-0030-01

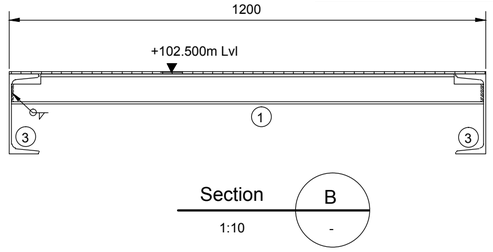


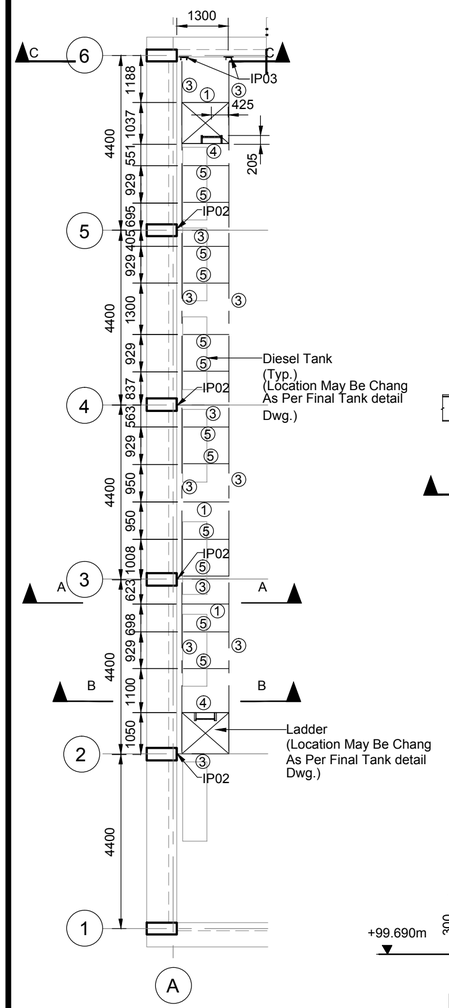
Connection Detail For
ISMC 200 With ISMC 200

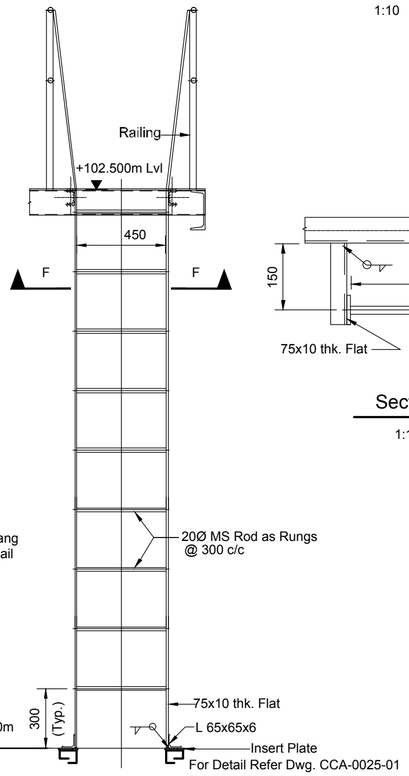


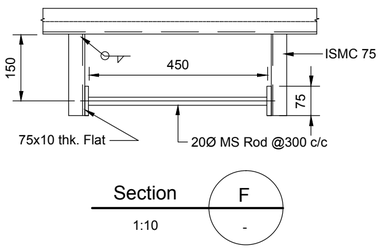


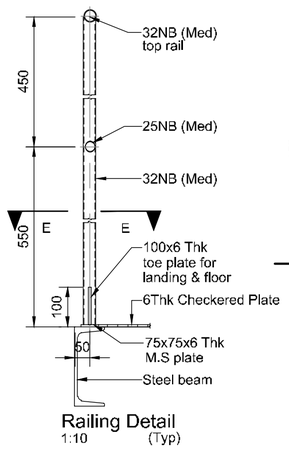
Schedule of Steel Members	
Mkd. No.	Member Size
1	ISMC75
2	ISMC100
3	ISMC200
4	ISMC125
5	2ISMC100 Back to Back

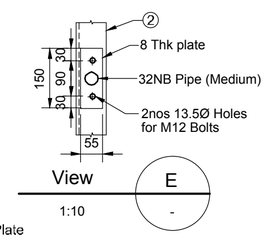


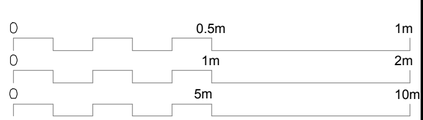












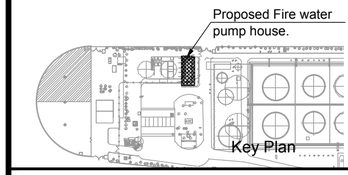
Notes

1. For all general notes refer dwg. no. CGA-01
2. All dimensions are in millimetres and levels are in metres
3. Only written dimension shall be followed unless noted otherwise
4. Contractor shall take extra care to check the straightness of all members and get them inspected and approved before erection
5. All Shop weld shall be 6mm thk. & field weld shall be 8mm thk. unless otherwise specified.

Reference drawings

Abbreviations :

FFL	= Finished Floor Level
NGL	= Natural Ground Level
Thk	= Thick
Typ	= Typical
Det	= Detail
c/c	= Centre to Centre



Key to symbols

1. CGA-01 General Notes.
2. CCA-02 Typical Details of Columns, Footings, Beams, Walls etc.
3. CCB-0027 Layout & Detail of Lintel Beams
4. RLA-0901-0055-01-P5 Layout and section of proposed fire water pump house

Rev	Date	Drawn	Description	Ch'k'd	App'd
1	08.12.15	MRP	Issued for Tender & Revised as FF drg		
0	25.09.15	JAP	Issued for Tander	ASP	BKP

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Client

M/s Delhi Aviation Fuel Facility Pvt. Ltd.
Aviation Fuelling Station
Shahbad,Muhammad Pur
IGI Airport,New Delhi - 110061

DAFFPL

Title

Modernization of Existing Fuel Farm Fire Water Pump House at +102.500m Layout and Details of Steel PlatForm For Diesel Tank

Designed	DGR		Eng check	ASP	
Drawn	JAP		Coordination	AKM	
Dwg check	ASP		Approved	AKS/BKP	

Scale at A2	Status	Rev	Security
AsShown	TEN	1	STD

Drawing Number

322538-CMB-0028-01

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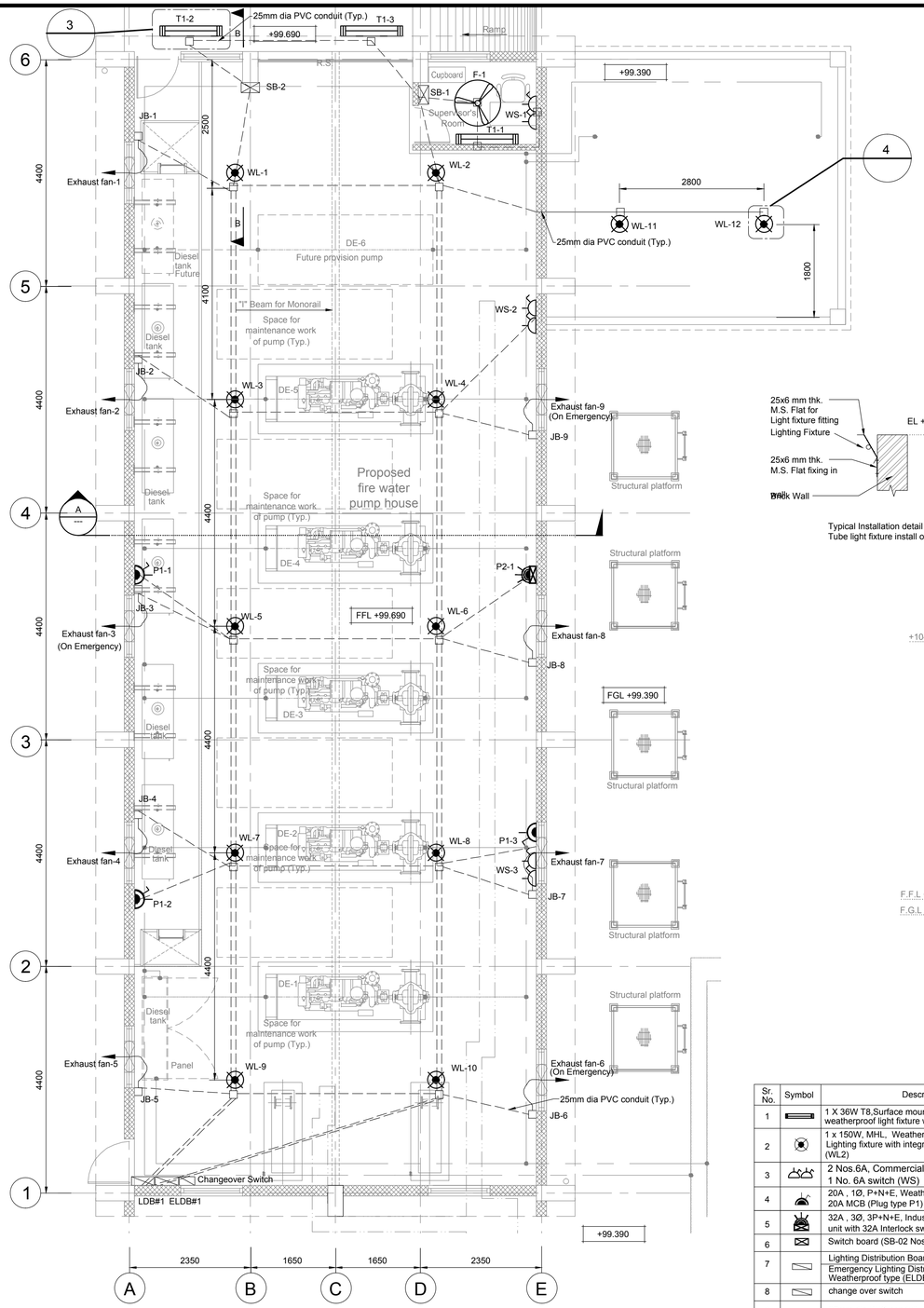
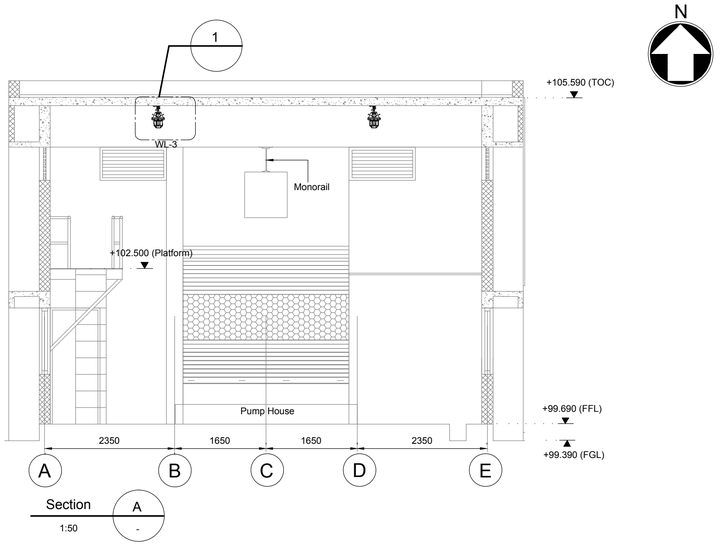
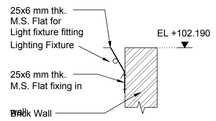


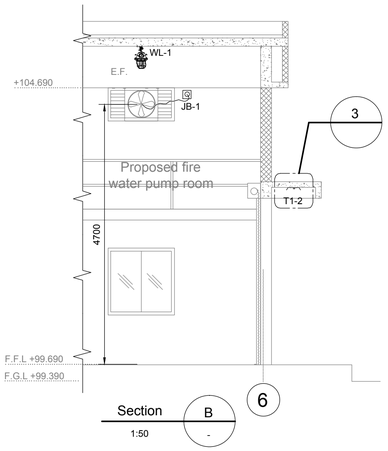
Lighting Layout of proposed Fire water Pump house
1:50



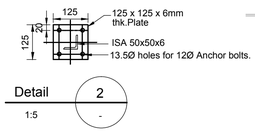
Section A
1:50



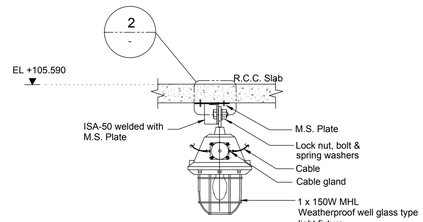
Typical Installation detail for Tube light fixture install on wall



Section B
1:50

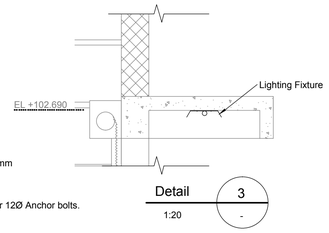


Detail 2
1:5

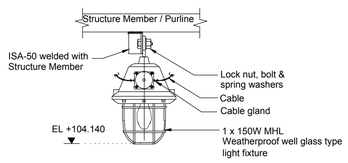


Typical Installation detail for 1 x 150W, MHL, Weatherproof well glass type light fixture mounting below slab

Detail 1
1:10



Detail 3
1:20



Typical Installation detail for 1 x 150W, MHL, Weatherproof well glass type light fixture mounting

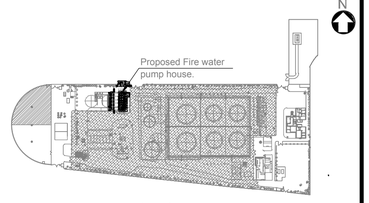
Detail 4
1:10

Sr. No.	Symbol	Description	Qty.
1		1 X 36W T8,Surface mounted / suspended industrial weatherproof light fixture with bottam cover (T1)	03 Nos.
2		1 x 150W, MHL, Weatherproof type well glass Lighting fixture with integral control gear box (WL2)	12 Nos.
3		2 Nos.6A, Commercial power socket with 1 No. 6A switch (WS)	03 Nos.
4		20A , 1Ø, P+N+E, Weatherproof power socket unit with 20A MCB (Plug type P1)	03 Nos.
5		32A , 3Ø, 3P+N+E, Industrial, Weatherproof power socket unit with 32A Interlock switch (Plug type P2)	01 No.
6		Switch board (SB-02 Nos.& ESB-00 No.)	02 Nos.
7		Lighting Distribution Board -Weatherproof type (LDB)	01 No.
		Emergency Lighting Distribution Board - Weatherproof type (ELDB)	01 No.
8		change over switch	01 No.
9		25mm dia PVC conduit	200 mtr. aprox.
10		Junction Box termination facility (JB)	33 Nos.
11		900mm sweep, 1-phase, 240V AC, ceiling fan (F) @ 4mtr height from FFL	01 No.

Notes

(1) All dimensions are in millimeters and elevations/levels are in meters, unless mentioned otherwise.
(2) Dimensions are to be read from the drg. and not to be measured.
(3) Mounting height from FFL as under
- Panels/distribution board - 1500mm.
- Power socket points - 1200mm.
(4) Type of Wiring shall be Cable up to LDB/ELP and then after 25mm dia PVC conduit to be consider.
(5) Looping of cables should be made from fixture to fixture and not from the junction box/pull box.
(6) Refer following documents
- 322538-ECD-xx - for Cable schedule.
(7) Lighting, Power socket of 3 phase & 1 phase, Exhaust fan distribution shall be from provided LDB only.

Key to symbols



Key Plan

Reference drawings

1) 322538-APA-0001-01	Plot plan
2) 322538-RLP-0901-01	Layout & Section of Fire water pump house
3) 322538-RPB-0906-01	13KL Foam concentrate storage tank (Atmospheric)

Rev	Date	Drawn	Description	Ch'k'd	App'd
C	30.12.2015	MCP	Issued for Construction & Revised as per Email dated 23.12.2015.		
B	10.12.2015	UMW	Issued for Construction & Revised as per Arch. layout	PPP	VST
A	08.10.2015	UMW	Issued for Construction	PPP	VST
0	29.09.2015	UMW	Issued for Tender	PPP	VST
P1	18.09.15	MCP	Issued for approval		

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Client
M/s Delhi Aviation Fuel Facility Pvt. Ltd.
Aviation Fuelling Station
Shahbad,Muhammad Pur
IGI Airport,New Delhi - 110061

Title
Modernization of Existing Fuel Farm

Layout & Detaills of Lighting Layout Fire Water Pump House

Designed	DHP		Eng check	PPP	
Drawn	MCP		Coordination	AKM	
Dwg check	DHP/SK		Approved	VST	
Scale at A1: As Shown	Status: CON	Rev: C	Security: STD		

Drawing Number
322538-ELA-0001-01

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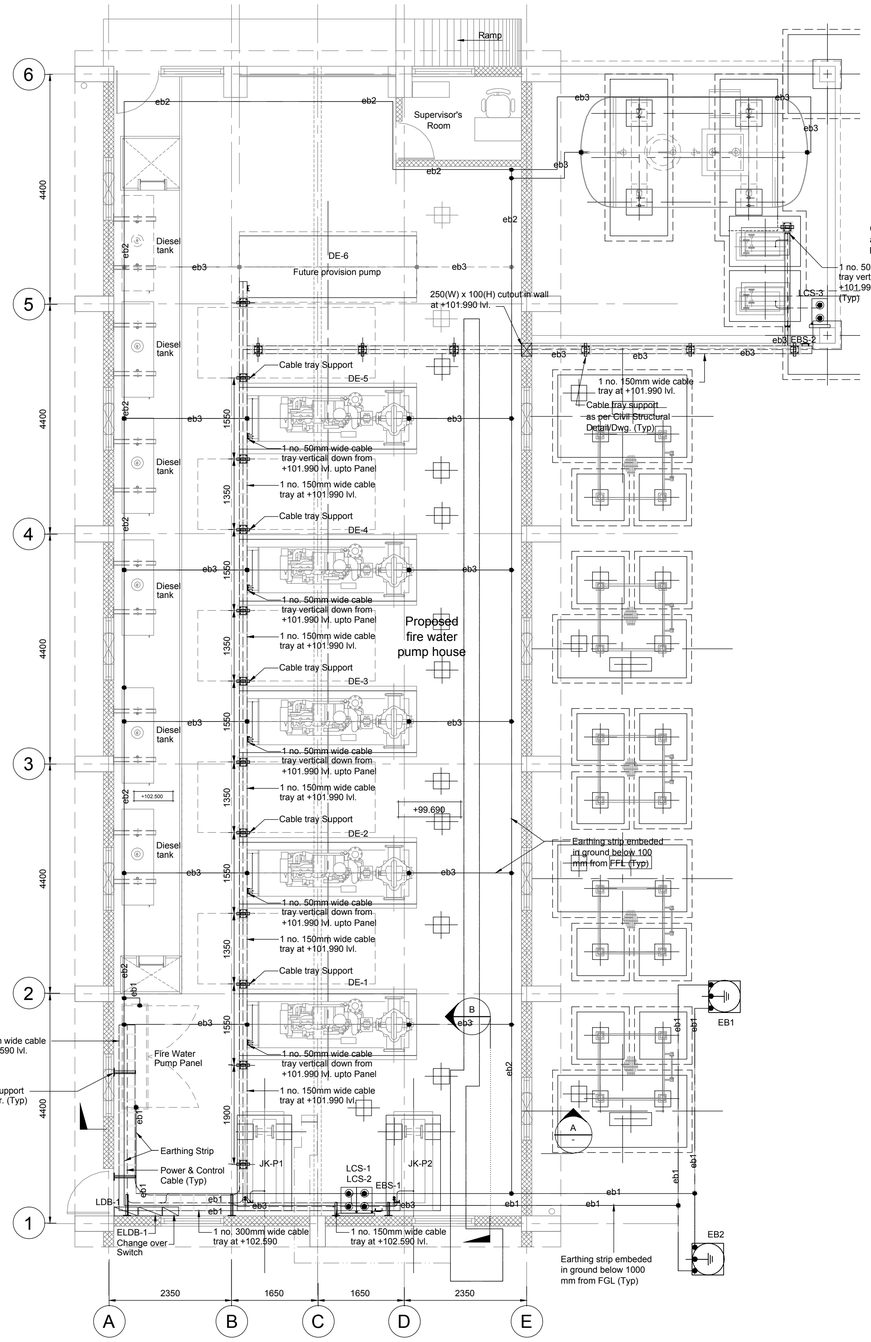
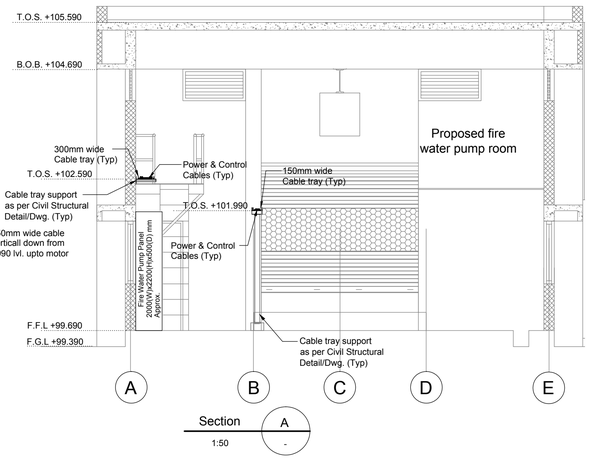


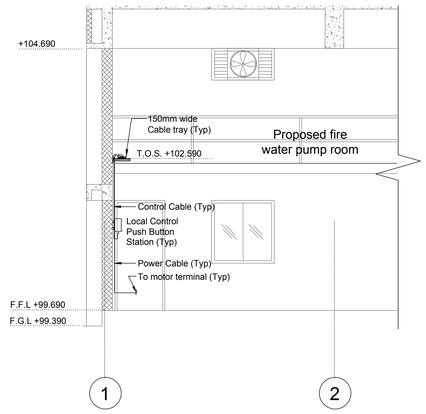
Layout of Cable Rack

1:50 Fire Water Pump House



Section A

1:50



Section B

1:50

Sr. No.	Symbol	Description	Qty.
1	—eb1—	50 x 6 mm G.I Earthing strip for main Earthing Grid, earthing of PCC, PMCC, MPDB, MLDB, ELDB, All Vendor Panels, Storage Tanks & Vessels, Motors above 75 HP(55KW)	40 Mtr. Approx.
2	—eb2—	35 x 6 mm G.I Earthing strip for earthing grid	65 Mtr. Approx.
3	—eb3—	25 x 6 mm G.I Earthing strip for earthing of storage tanks & Vessels, Motors above Up to 55KW	60 Mtr. Approx.
4	—eb4—	4 Sq. mm Cu. FRLS wire for earthing of 1-Ø Power sockets, Push Button Station, etc.	25 Mtr. Approx.
5	—eb5—	16 Sq. mm Cu. FRLS wire for earthing of Motors Up to 15HP	15 Mtr. Approx.
6	•EB	Maintence free Earth electorde 3 mtr .long x 50mm dia Earthing pit (EB)	02 Nos.
7		Local Control Station (LCS)- Weatherproof Type	03 Nos.
8		300 mm wide Cable tray	10 Mtr. Approx.
9		150 mm wide Cable tray	37 Mtr. Approx.
10		50 mm wide Cable tray	20 Mtr. Approx.
11	EBS	Earthing Busbar	02 Nos.

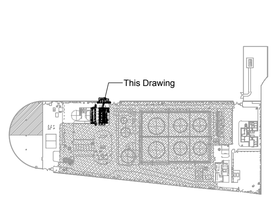
1:50 0 2.5m 5m

2	—eb2—	35 x 6 mm G.I Earthing strip for earthing grid	50 Mtr. Approx.	

Notes

1. All dimensions are in millimeters and elevation in meters, unless specified otherwise
2. Dimensions are to be read from the drg. and not to be measured
3. For Installation standards, refer Tender for Electrical Work, Part-II of III Technical Specification
   a) Electrical Installation - Standards & Specifications
   b) General Notes on Power & Earthing
   c) Relevant standard dwg. on Earthing
4. Two nos. of earthing connection shall be provided for all panels/storage tanks/ vessels and other associated utilities
5. For detail of cable tag refer cable schedule ECD-01
6. Minimum Separtion of 3 Mtrs. shall be ensured between the two earth electrodes
7. Earthing pits shall be kept min. 3000 mm away from the building
8. Contractor shall co-ordinate excavation activities for the earthing installation with Other agencies in consultation with owner's site in-charge. Earthing stations may Be suitably located as per site convenience/conditions
9. All EL/Levels are with respect to FFL +99.690

Key to symbols



Key Plan

Reference drawings

322538-APA-0001-01	Plot Plan
322538-RLA-0901-01	Layout & section of proposed Fire Water Pump House
322538-RPA-0903-04	Layout and sections of Piping for Proposed Fire Water Pump House

Rev	Date	Drawn	Description	Ch'k'd	App'd
C	29.12.2015	MCP	Issued for Construction & Revised as per Email dated 23.12.2015.		
B	10.12.2015	UMW	Issued for Construction & Revised as per Arch. layout	PPP	VST
A	09.10.2015	UMW	Issued for Construction	PPP	VST

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Aviation Fuelling Station
Shahbad,Muhammad Pur
IGI Airport,New Delhi - 110061

DAFFPL

Title

Modernization of Existing Fuel Farm
Proposed Fire Water Pump House

Power & Earthing
Layout, Section & Details

Designed	DHP/SK		Eng check	PPP	
Drawn	ASP		Coordination	AKM	
Dwg check	DHP/SK		Approved	VST	

Scale at A1	Status	Rev	Security
As Shown	CON	C	STD

Drawing Number

322538-ELA-0002-01

Rev	Date	Drawn	Description	Ch'k'd	App'd
0	29.09.2015	UMW	Issued for Tender	PPP	VST
P1	22/09/2015	ASP	Issued for Approval		

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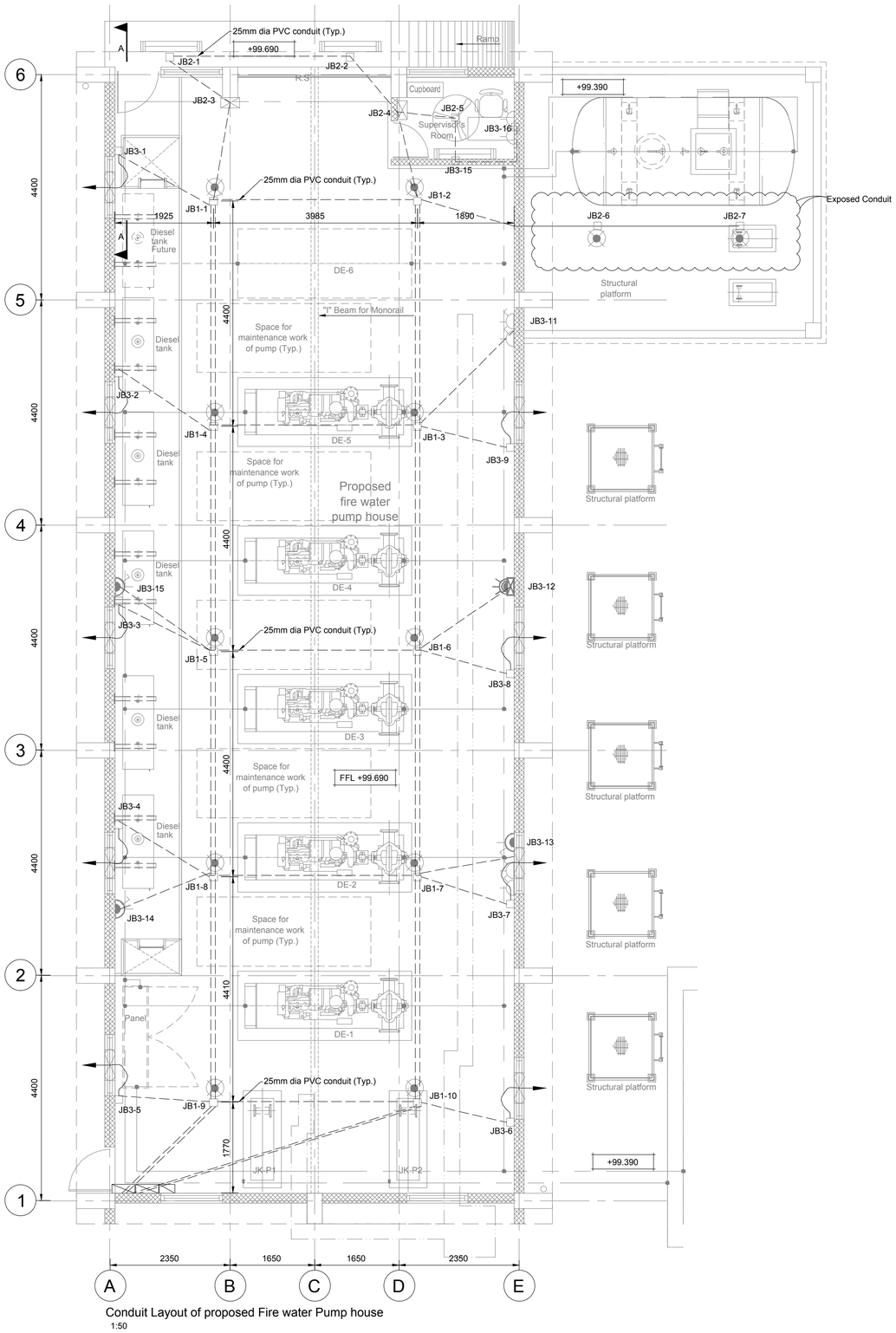
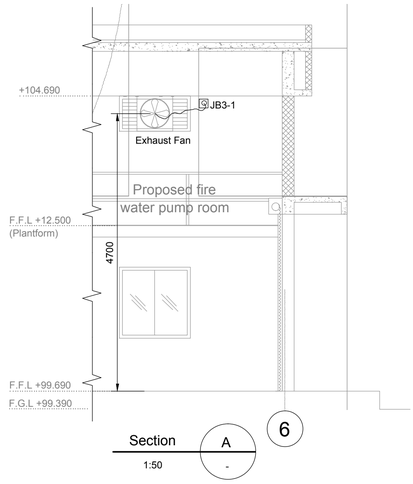


Conduit Layout of proposed Fire water Pump house

1:50

Sr. No.	Symbol	Description	Qty.
1	—·—	25mm dia PVC conduit	200 mtr. aprox.
2	☐	8 way Junction Box in ceiling (JB1)	10 Nos.
3	☐	2 way Junction Box in ceiling (JB2)	07 Nos.
4	☐	Wall mounted Junction Box (including Exhaust fan JB) (JB3)	16 Nos.



Section A-A

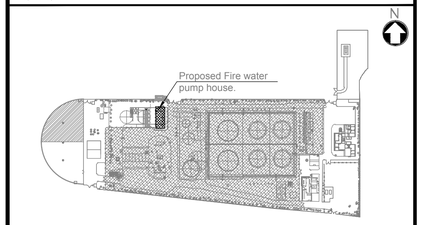
1:50

N

Notes

(1) All dimensions are in millimeters and elevations/levels are in meters, unless mentioned otherwise.
(2) Dimensions are to be read from the drg. and not to be measured.
(3) Mounting height from FFL as under
- Panels/distribution board - 1500mm.
- Power socket points - 1200mm.
(4) Type of Wiring shall be Cable up to LDB/ELP and then after 20mm dia GI conduit to be consider.
(5) Looping of cables should be made from fixture to fixture and not from the junction box/pull box.
(6) Refer following documents
- 322538-ECD-xx - for Cable schedule.
(7) Lighting, Power socket of 3 phase & 1 phase, Exhaust fan distribution shall be from provided LDB only.

Key to symbols



Key Plan

Reference drawings

1) 322538-APA-0001-01	Plot plan
2) 322538-RLP-0901-01	Layout & Section of Fire water pump house
3) 322538-RPB-0906-01	13KL Foam concentrate storage tank (Atmospheric)

Rev	Date	Drawn	Description	Ch'k'd	App'd
B	29.12.2015	MCP	Issued for Construction & Revised as per Email dated 23.12.2015.		
A	10.12.2015	UMW	Issued for Construction & Revised as per Arch. layout	PPP	VST

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IGI Airport,New Delhi - 110061

DAFFPL

Title

Modernization of Existing Fuel Farm

Layout & Detaills of Conduit Fire Water Pump House

Designed	DHP/AB		Eng check	PPP	
Drawn	MCP		Coordination	AKM	
Dwg check	DHP/SK		Approved	VST	

Scale at A1	Status	Rev	Security
As Shown	CON	B	STD

Drawing Number

322538-ELA-0003-01

1:50 0 2.5m 5m

Sr. No.	Description	Size (in Mtrs.)	Area in Sq.Mtrs.	Remarks
1	Security Cabin(4 Nos)	3.8X3.25X4	12.35	
2	Admin And Canteen Building	-	701.25	
3	Pump House	50.2X7.3	366.46	
4	Testing Rig	10X10	100.00	
5	Lt/ht/dg And Control Room	-	295.17	
6	Diesel Tank Farm	3.97X7.0	27.79	
7	Atf Storage Tank Farm	104X76.2	8142.48	
8	Tld Pump House	12mX5.5m	66.00	
9	High Flood Light Tower(20m High)	3Nos	-	
10	Repair Shop	20X20.2	404.00	To be Removed.
11	Meter Calibration Unit (5kl)	2.0X3.0	6.00	To be Removed & relocated
12	Tank Lorry Decanting Gantry	9.2X34.55	317.86	
13	Repair Shop HPCI/IOC	16.0X8.6X2	137.60	To be Removed.
14	U.G. Storage Tank (2 Nos)	-	-	
15	Parking Area	-	-	
16	Fuellers Parking	-	2662.41	To be Removed & relocated
17	Water Storage Tank	9.0mX15m HT	63.61	
18	Fire Hydrant Pump House	30.0mX10m	300.00	To be Removed & relocated
19	Dip Platform	1.2X1.2X2	2.88	
20	Tube Well No.1	6.1X7.6	46.36	
21	Over Head Water Tank	2 X 20.0mØX18m HT		
22	Cooling Tower	4X6+1.2X1.2	25.44	To be Removed.
23	U.G. Slop Tank	-	-	
24	Water Storage Tank	14.0mØX15m HT	153.93	
25	Tube Well No.2	3.46X3.46	11.97	
26	Tube Well No.3	3.46X3.46	11.97	To be Removed.
27	A.O./TLF Room	8X3.7	29.6	New
28	Water Storage Tank	20.0mØX18m HT	628	
29	Road For Fire Tender	-	-	
30	High Mast Tower(2 Nos)	30m HIGH	-	
31	Foam Tank	3mX15mX3m HIGH	4.50	New
32	Connection Point	5.48mX8.75mX5m	47.95	

Detail of Under Ground Proposed Tanks

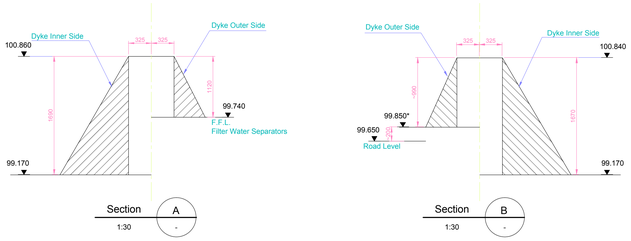
Tank No.	Dia. X Height	Product	Capacity	Remarks
UG-214	3.0m I.Dia. X 6.4m Long	ATF(CLASS-B)	45 KL	New

Detail of Under Ground Existing Tanks

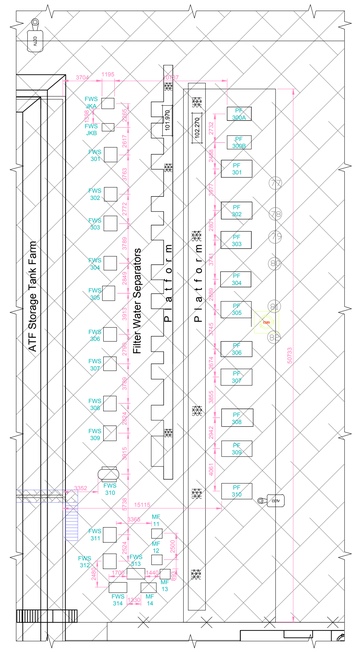
Tank No.	Dia. X Height	Product	Capacity	Remarks
UG-211	2.77m Dia. X 19.66m Long	ATF(CLASS-B)	115 KL	
UG-212	4.016m Dia. X16.80m Long	ATF(CLASS-B)	200 KL	
UG-213	1.84m Dia. X 5.98m Long	ATF(CLASS-B)	10 KL	

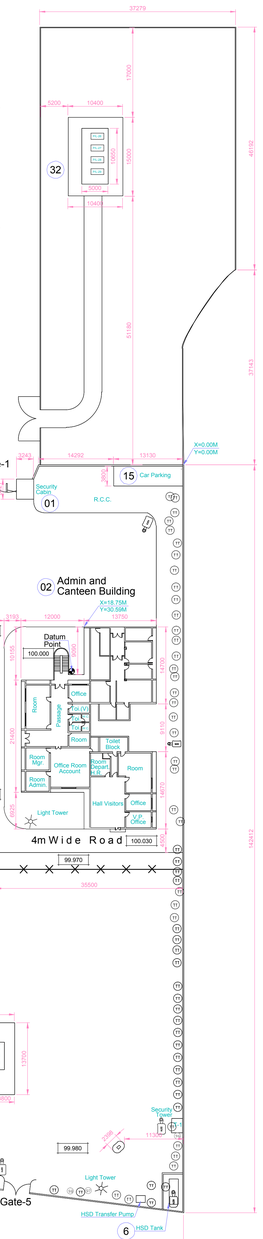
Detail of Above Ground Existing Tanks

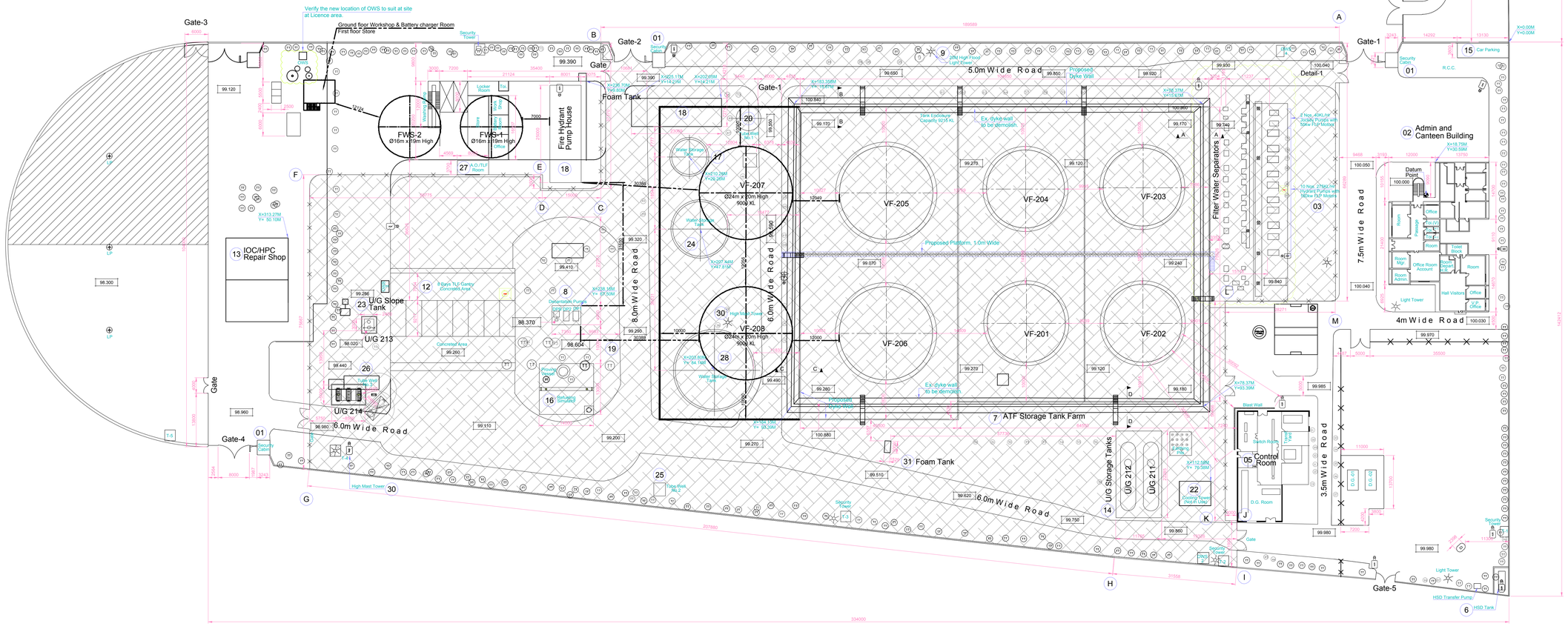
Tank No.	Dia. X Height	Product	Capacity	Remarks
VF-201	20.0m DIA. X 20.0m Height	ATF(CLASS-B)	6200 KL	
VF-202	20.0m DIA. X 20.0m Height	ATF(CLASS-B)	6200 KL	
VF-203	20.0m DIA. X 20.0m Height	ATF(CLASS-B)	6200 KL	
VF-204	20.0m DIA. X 20.0m Height	ATF(CLASS-B)	6200 KL	
VF-205	24.0m DIA. X 20.0m Height	ATF(CLASS-B)	9000 KL	
VF-206	24.0m DIA. X 20.0m Height	ATF(CLASS-B)	9000 KL	



Typical Detail of Existing Dyke Wall



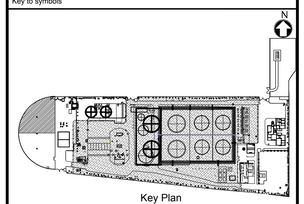




Notes

1) All dimensions are in m.m. & Levels are in mtrs.
2) * Marked levels are to be verified.

Key to symbols



Key Plan

Legend:

- License area
- Un license area (Rest area of the plot other than license area)
- Metal Sheet
- Blast Wall
- Facilities to be retained
- New Facilities to be provided
- Facilities to be demolished
- Facilities in Future

Reference drawings

1) DAFFPL-GEL-PP-005 Plot plan of complete fuel farm

Total plot existing area = 40748 SQM.

Rev	Date	Drawn	Description	Ch'k'd	App'd
03	24.07.15	R.D.	Revised & Issued for Execution	U.J.	V.S.T.
02	10.06.15	R.D.	Revised & Issued for Execution	U.J.	V.S.T.
01	04.06.15	R.D.	Revised & Issued for Execution	U.J.	V.S.T.
0	29.04.15	R.D.	Issued for Execution	U.J.	V.S.T.
P3	23.04.15	R.D.	Revised & Issued for Approval	U.J.	V.S.T.
P2	26.02.15	R.D.	Revised & Issued for Approval	U.J.	V.S.T.
P1	28.01.15	R.D.	Issued for Approval	U.J.	V.S.T.

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Aviation Fuelling Station
Shahbad,Muhammad Pur
IGI Airport,New Delhi - 110061

Title
Modernization of Existing Fuel Farm Layout for Proposed Encloser Modification in Existing Aviation Fueling Facility

Designed	U.J.		Eng check	M.M.S.	
Drawn	R.D.		Coordination	VSG	
Dwg check	U.J.		Approved	VST	
Scale at A0 1:400	Status EXE		Rev 03	Security STD	

Drawing Number
322538-MPE-0100-01

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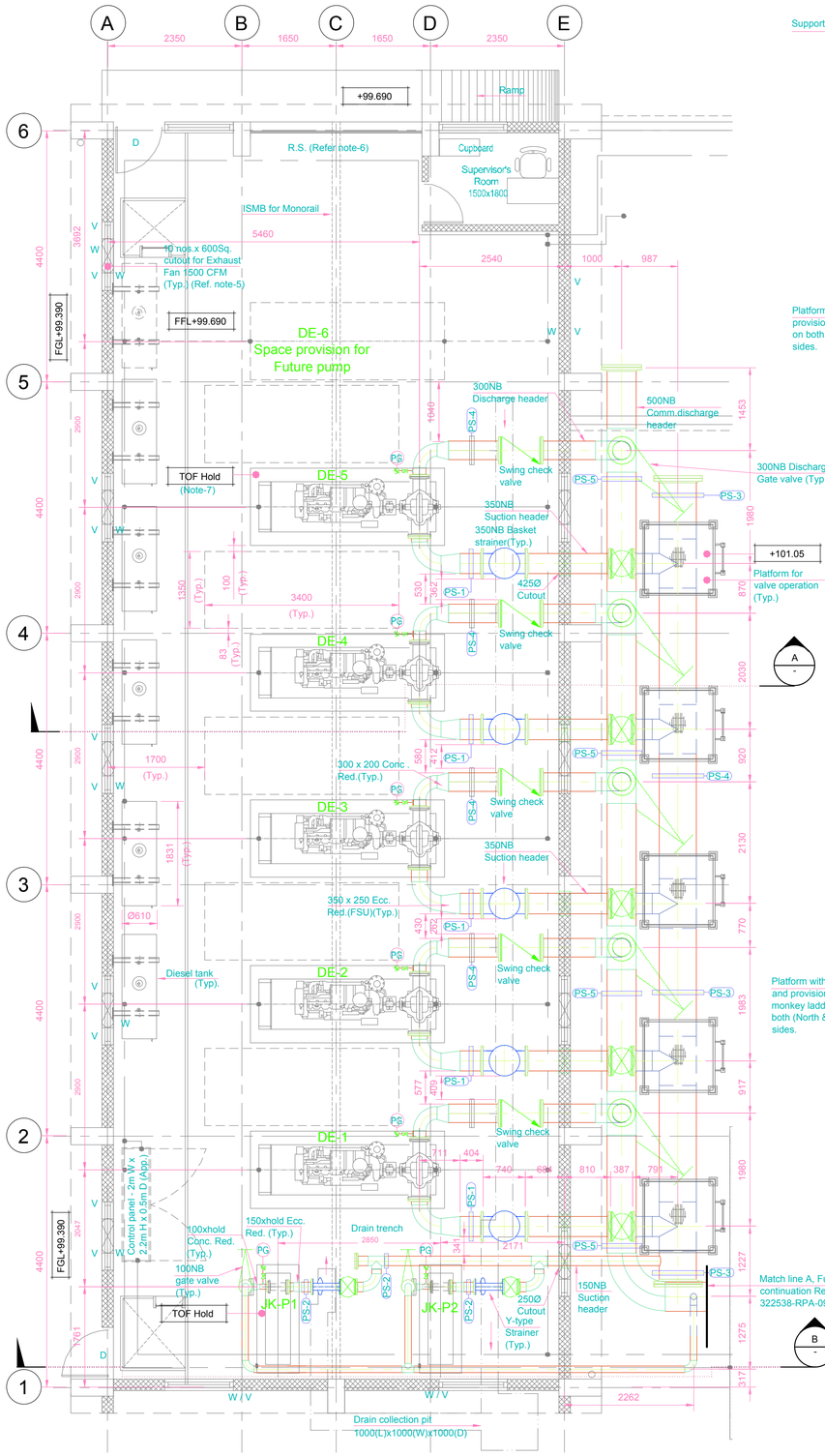
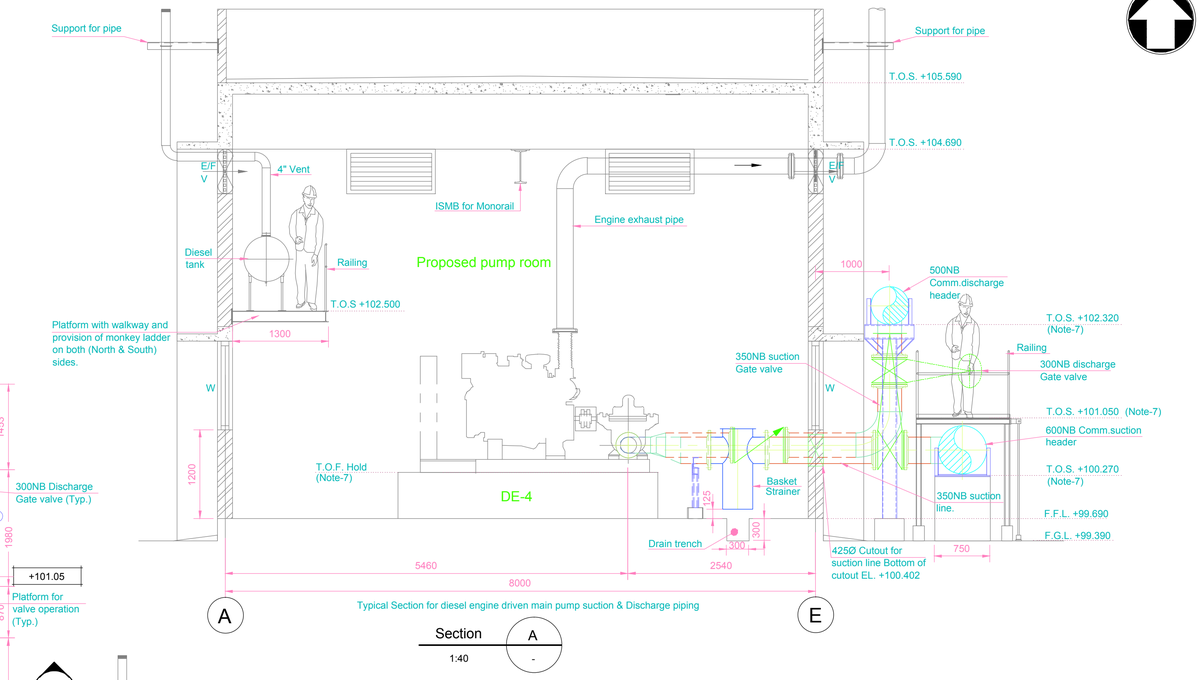
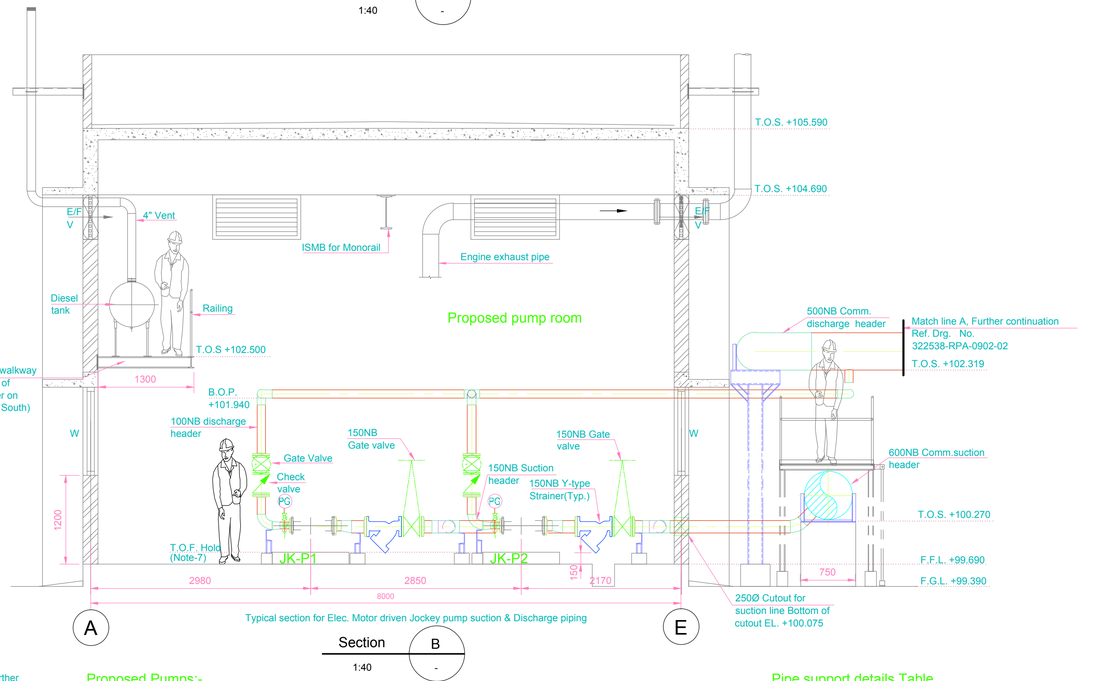


Layout of Suction & Discharge piping for proposed pumps in proposed pump house

1:50





Proposed Pumps:-

Tag No.	Description	Cap/Head	Quantity	Pr.switch setting (kg/cm2)	Remarks
JK-P1	Elec. Motor driven Jockey pump	55 m3/hr. @110mwc	Working	10.5 / 10.0	Auto cut off / cut in
JK-P2	Elec. Motor driven Jockey pump	55 m3/hr. @110mwc	Stand by		
DE-1	Main Diesel Engine driven pump	610 m3/hr. @105mwc	Working	9.5 / -	Auto start, Manual off.
DE-2	Main Diesel Engine driven pump	610 m3/hr. @105mwc	Working	9.3 / -	Auto start, Manual off.
DE-3	Main Diesel Engine driven pump	610 m3/hr. @105mwc	Working	9.1 / -	Auto start, Manual off.
DE-4	Main Diesel Engine driven pump	610 m3/hr. @105mwc	Stand by	Auto start if any of the DE-1 to DE-3 failed to start with 8.9 & 8.7 Pr. switch setting of DE-4 & DE-5 respectively.	Auto start, Manual off.
DE-5	Main Diesel Engine driven pump	610 m3/hr. @105mwc	Stand by		Auto start, Manual off.
DE-6	Diesel Engine driven pump	610 m3/hr. @105mwc	--	--	Future space planning

Pipe support details Table

P.S. No.	No. of Support.	Pipe size (O.D. in mm)	No. of Lines.	Weight / mtr. with water	T.O.S. Lvl. (Note-7)
PS-1	05	356	01	175 k.g.	100.437
PS-2	03	169	01	50 k.g.	100.116
PS-3	04	610	01	300 k.g.	100.270
PS-4	05	324	01	175 k.g.	100.521
PS-5	04	508	01	225 k.g.	102.320

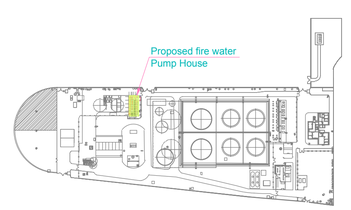
1:40 0 2m 4m

1:50 0 2.5m 5m

Notes

1. All dimensions are in millimeters and levels are in meters, unless otherwise specified.
2. Details shown like structure / civil / architecture are indicative. Refer related drawing for the same. (i.e. stair, roof, column, ramp, wall, door window R.S. etc.)
3. All main pumps shall have manual starting In addition to auto start.
4. Battery charging arrangement shall be provided for stand by batteries also.
5. All ventilation shall be fixed glass of 300x600mm or as shown in the drg.
6. Rolling shutter shall be having bottom grilled type with 1200mm height starting from 1200mm seal level & a wicket gate of 600 W x 2400 H.
7. All levels like top of foundation plan of pumps, suction/discharge lines, pipe supports, platform level etc., subject to change as per the final vendor drawing of pump.

Key to symbols



Key Plan

Abbreviations :

FGL	Finished Ground Level	TOS	Top of Structure
FFL	Finished Floor Level	C/L	Center Line
TOF	Top of foundation	Typ	Typical
BOP	Bottom of Pipe	Lvl	Level
(PS)	Pipe support	D	Door
	Future provision	W	Window
	Proposed fire line	DT	Drain Trench

Reference drawings

1) 322538-MPE-0100-01	Plot plan
2) 322538-ABA-0011-01	Arch. layout of fire water pump house.
3) 322538-RLA-0901-02	Layout & section of fire water pump house
4) 322538-ELA-0002-01	Power & Earthing layout for FWPH

Hold List

1. Pump data/drg. for proposed D.E Driven fire pump.
2. Pump data/drg. for proposed jockey pump.

Rev	Date	Drawn	Description	Ch'k'd	App'd
1	09.12.15	BNC	Revised as per Arch. plan & Issued for Tender		
0	19.11.15	BNC	Issued for Tender		

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IGI Airport,New Delhi - 110061

DAFFPL

Title

Modernization of Existing Fuel Farm

Layout and sections of Piping for proposed fire water pump house.

Designed	KDP		Eng check	MMS	
Drawn	BNC		Coordination	AKM	
Dwg check	KDP		Approved	VST	
Scale at A1	Status		Rev	Security	
As Noted.	TEN		1	STD	

Drawing Number

322538-RPA-0903-05

DELHI AVIATION FUEL FACILITY PRIVATE LIMITED

ANNEXURE II – DEVIATION SHEET

EXCEPTION AND DEVIATIONS STATEMENT				
S.NO.	PAGE NO. OF TENDER DOCUMENT	CLAUSE NO.	SUBJECT	DEVIATIONS

Bidder shall list all the deviations in the following given format only on their Letterhead. The Deviation sheet should be submitted along with technical bid.

In case no deviation sheet is submitted along with technical bid, it would be concluded that bidder has accepted all specifications, terms and conditions.

_____

Sign & Stamp of Bidder

DELHI AVIATION FUEL FACILITY PRIVATE LIMITED

ANNEXURE III – DECLARATION SHEET

Date:

DECLARATION

We, M/s hereby, unconditionally accept all terms & conditions of TENDER NO.: DAFFPL/MOD/FF/2015-16/16 (JOB: Tender for construction of Fire Water Pump House as per specification) including Scope of job, quantities, completion period, terms & condition without any deviations.

Sign & Stamp of Bidder

Note: In case of deviations (whether technical or commercial) the above declaration should not be submitted and the deviations should be mentioned separately on bidders letter head with the heading "DEVIATION SHEET". In absence of "DEVIATION SHEET", it would be concluded that bidder has submitted his offer as per tender specifications, terms & conditions. Corrections in tender booklet will not be accepted.

_____

Sign & Stamp of Bidder

DELHI AVIATION FUEL FACILITY PRIVATE LIMITED

ANNEXURE-IV

PROFORMA OF BANK GUARANTEE
(EARNEST MONEY DEPOSIT)
(On Non-Judicial Stamp paper for appropriate value)

BANK GUARANTEE NO. :
BANK GUARANTEE AMOUNT:
CLAIM:
(Till 120 days from date of submission of Proposal)
TENDER NO. /DATE:
JOB DESCRIPTION/
LOCATION:

Tender Security No. [*]

Name and Address of the Beneficiary: Delhi Aviation Fuel Facility (Private) Limited
Aviation Fuelling Station, Shahabad Mohammadpur, IGI Airport, New Delhi – 110 061, India

We [*name and address of the issuing bank*] have been informed that [*Name of the Interested party*] (hereinafter called the "Interested Party") is submitting a proposal for the Award of the Works in response to a Request for Proposal ("RFP") by Delhi Aviation Fuel Facility (P.) Ltd. ("DAFFPL" or 'Beneficiary") for [*Insert description of work*] ("Works"). The conditions of the RFP, which are set out in a documents entitled Request for Proposal dated [*Please insert*] require its offer to be supported by a Tender Security.

At the request of the Interested Party, we hereby irrevocably undertake to pay you without demur, the Beneficiary, any sum or sums not exceeding Rs. _____ [*Please insert*].

Upon receipt by us of your demand in writing and your written statement (in the demand) stating that:

1) The Interested Party has, without written consent of DAFFPL, withdrawn its offer after the latest time specified for its submission and before the expiry of its period of validity; or
2) The Interested Party has refused to accept the correction of errors in nits offer in accordance with the instructions to Interested parties contained in the RFP; or

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Sign & Stamp of Bidder

3) DAFFPL entered in to the contract with the Interested party but the Interested party has failed to deliver the **COMPOSITE BANK GUARANTEE (SECURITY DEPOSIT & PERFORMANCE**) in compliance with the Contract conditions; or

4) The Interested Party has failed to enter into the Contract within 30 (Thirty) days of being required to do so by the Tender Officer.

Any demand for payment must contain your signature(s). The demand must be received by us at this office on or before the expiry of the earliest of the following dates, when this security guarantee shall expire and shall be returned to us:

a) Date of issue of letter communicating to the Interested Party that it has not qualified for the contract or the Proposal submitted by the Interested Party is unsuccessful or the TENDER is withdrawn and/or cancelled by the Beneficiary; or

b) 7 (seven) days after the date of delivery of an acceptable performance bond complying with the Contract conditions and execution of the Contract after the award of the works to the Interested Party; or

c) 120 (One hundred twenty) days from the last date of submission of Proposal in accordance with the TENDER.

Date:

Signature:

Designation:

Name of the Branch

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Sign & Stamp of Bidder

DELHI AVIATION FUEL FACILITY PRIVATE LIMITED

ANNEXURE-V

PROFORMA OF COMPOSITE BANK GUARANTEE (SECURITY DEPOSIT & PERFORMANCE)

(On Non-Judicial paper of Rs. 100/-value)

To,

DAFFPL

Dear Sirs,

M/s ……..have taken tender for the work ……for DAFFPL,.

The tender Conditions of Contract provide that the Contractor shall pay a sum of Rs. …….. (Rupees ……..) as security deposit & performance guarantee in the form therein mentioned. The form of payment of security deposit & performance guarantee includes guarantee executed by Scheduled Bank at New Delhi, undertaking full responsibility to indemnify DAFFPL, in case of default. The said party …….. have approached us at and their request and in consideration of the premises we …….. having our office at …….. have agreed to give such guarantees as hereinafter mentioned.

1. We ----------hereby undertake and agree with you that if default shall be made by M/s. ----------in performing any of the terms and conditions of the tender or in payment of any money payable to Daffpl. We shall on demand pay to you, without demur, protest or requiring you to seek recourse to M/s _____, in such matter as to you may direct the said amount of Rupees ---------- ----only or such portion thereof not exceeding the said sum as you may from time to time require.
2. You will have the full liberty without reference to us and without effecting this guarantee, postpones for any time or from time to time the exercise of any of the powers and rights conferred on you under the contract with the said ---------- ----------and to enforce or to forbear from endorsing any powers of rights or by reason of time being given to the said ----------which under law relating to the sureties would but for provision have the effect of releasing us.
3. Your right to recover the said sum of Rs. ---------- (Rupees ----------) from us in manner aforesaid will not be affected or suspended by reason of the fact that any

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Sign & Stamp of Bidder

dispute or disputes have been raised by the said M/s. ----------and/or that any dispute or disputes are pending before any officer, tribunal or court.

4. The guarantee herein contained shall not be determined or affected by the liquidation or winding up dissolution or change of constitution or insolvency of the said ----------but shall in all respect and for all purposes be binding operative units payment of all money due to you in respect of such liabilities is paid.
5. Our liability under this guarantee is restricted to Rupees ----------our guarantee shall remain in force until ----------unless a suit or action to enforce a claim under Guarantee is filed against us within six months from ----------(which is date of expiry of guarantee) all our rights under the said guarantee shall be forfeited and we shall be relieved and discharged from all liabilities there under.
6. NOT WITHSTANDING anything hereinbefore contained our liability under this Bank Guarantee is restricted to Rupees ----------(Rupees ----------).This Bank Guarantee shall be valid up to ----------and we are liable to pay the guaranteed amount or any part thereof under this Bank Guarantee only and only if you serve upon us a written claim or demand on or before.
7. This guarantee is to be returned to us within fifteen (15) days from the date it ceases to be in force. If the guarantee is not returned to us within the date of aforementioned it shall be automatically cancelled.
8. We have power to issue this guarantee in your favour under Memorandum and Articles of Association and the undersigned has full power to do under the Power of Attorney dated ----------granted to him by the Bank.

Yours faithfully

----------Bank
By its Constituted Attorney
Signature of a person duly
Authorized to sign on behalf of the bank

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Sign & Stamp of Bidder

DELHI AVIATION FUEL FACILITY PRIVATE LIMITED

Annexure- VI

Form of Letter of Undertaking

[On the letterhead of the Interested Party]

Letter of Undertaking

Date:

Delhi Aviation Fuel Facility (Private) Limited
Aviation Fuelling Station, Shahabad Mohammadpur,
IGI Airport, New Delhi – 110 061, India

Re:
The undersigned Interested Party acknowledges that the TENDER issued is confidential and personal to the undersigned Interested Party and hereby undertakes and agrees as follows:

1. "**Confidential Information**" means the TENDER and everything contained therein, all documentation, data, particulars of the Works and technical or commercial information made by (or on behalf of) Delhi Aviation Fuel Facility (Private) Limited or obtained directly or indirectly from Delhi Aviation Fuel Facility (Private) Limited or its representatives by the undersigned Interested Party or which is generated by the undersigned Interested Party or any information or data that the undersigned Interested Party receives or has access to, as a result of the TENDER, as being confidential information of Delhi Aviation Fuel Facility (Private) Limited, provided that such term does not include information that (a) was publicly known or otherwise known to undersigned Interested Party prior to the time of such disclosure, (b) subsequently becomes publicly known through no act or omission by undersigned Interested Party or any person acting on its behalf.

2. The undersigned Interested Party shall maintain the confidentiality of Confidential Information in accordance with procedures adopted by the undersigned Interested Party in good faith to protect confidential information of third parties delivered to it, provided that the undersigned Interested Party may deliver or disclose Confidential Information to its authorized representatives who agree to hold confidential the Confidential Information substantially in accordance with the terms of this Undertaking.

3. The undersigned Interested Party shall not at any time whatsoever:

   (i) Disclose, in whole or in part, any Confidential Information received directly or indirectly from the Delhi Aviation Fuel Facility (P) Limited to any third party.

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Sign & Stamp of Bidder

(ii) Reproduce, publish, transmit, translate, modify, compile or otherwise transfer the Confidential Information.

4. In case the Proposal of the undersigned Interested Party is not accepted and immediately upon the acceptance of the Proposal of any of the other Interested Party, the undersigned Interested Party, shall:

(i) Return all Confidential Information including without limitation, all originals, copies, reproductions and summaries of Confidential Information; and

(ii) Destroy all copies of Confidential Information in its possession, power or control, which are present on magnetic media, optical disk or other storage device, in a manner that ensures that the Confidential Information is rendered unrecoverable.

5. The undersigned Interested Party shall certify to Delhi Aviation Fuel Facility (Private) Limited that it has returned or destroyed such Confidential Information to the Delhi Aviation Fuel (Private) Limited within two (2) days of such a request being made by Delhi Aviation Fuel (Private) Limited.

Name of Interested Party's

Signature **of Authorized Representative**

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Sign & Stamp of Bidder

DELHI AVIATION FUEL FACILITY PRIVATE LIMITED

Annexure VII

DECLARATION to be submitted along with Technical Bid

(M/s.) hereby declare / clarify that we have not been banned or delisted by any government or quasi Government agencies or Public Sector Undertakings.

Stamp & Signature of the bidder

NOTE: If a bidder has been banned by any Government or quasi Government agencies or PSUs, this fact must be clearly stated with details. If this declaration is not given along with the technical bid, the tender will be rejected as non-responsive.

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Sign & Stamp of Bidder

Client : DELHI AVIATION FUEL FACILITY PVT. LTD.

Project : FIRE WATER PUMP HOUSE for DAFFPL

Consultant : Mott MacDonald

Ref. Doc No (MM) :

Ref. Doc No.:

Prep.	MMP/	12/9/2015
Check	ASP/ VST	12/9/2015
Rev.	02	

Schedule of Quantity for Civil / Structural Work

It. No.	Item Description	Unit	Qty.	Unit rate of supply & Installation, fabricated & completed in all respects, inclusive of necessary testing, taxes and duties, transportation, handling, storage and safe custody at site & all incidental costs.	Total price of items in Rs. (4 x 5)
1	2	3	4	5	6
1.00	**Excavation and Filling**				
1.01	**Excavation** by mechanical or manually in ordinary, hard soil, for foundations of column footings, wall, plinth beams, raft, cable trenches, etc. Including shoring & strutting, bailing out surface water, pumping off water if required. **Refilling the trenches**, foundation pits ramming, watering, consolidating in 150mm to 200mm layers. Rate to include carting away surplus excavated earth, spreading, leveling and compacting, inside/outside the terminal in approved dump yard as directed by Engineer-In-Charge. From existing Ground level up to 1.5 M deep.	Cu.M	337.00		
1.01a	-do- same as per item no. 1.01, for **excavation** Beyond 1.5M to 3 M below the existing ground level.	Cu.M	176.00		
1.02	**Providing and filling** in plinth and trenches, sides of foundation with excavation, supplying & filling **selected earth brought from outside** site including freight, transportation, loading, unloading, taxes, royalty, and screening. Rate to include for spreading, watering, ramming and compacting of each layer of 150 to 200mm by using mechanical plate compactors, up to 95% proctor density achieved etc. complete as directed by Engineer-In-Charge. (CBR not less than 5% in 4 day socked condition) Note : Consolidated measurements of fill shall be paid in case of item no. 1.02 and 1.03.	Cu.M	18.00		
1.03	**Providing and laying** in compact manner **230mm thick (average) rubble soling** in plinth, foundations, plinth protection, Including filling in the visible voids with largest possible chips, covering and levelling the surface with layer of well watered and consolidated sand, rolling with mechanical plate compactor etc. complete including supply and spreading cost of sand at site.	Cu.M	93.00		
2.00	**Concrete & Allied Work**				
2.01	**Providing and laying** machine mixed Plain **cement concrete** of all heights in volumetric proportion **1:4:8** (1 Cement: 4 Sand : 8 Aggregate) with 20mm and down stone aggregates of specified thickness, mix and gradation. Including centering, shuttering if required, laying, spreading, ramming consolidating, finishing, curing etc. complete as directed for all levels & all types of foundations below footings, walls, angle post, roads, rafts, plinth beams, terrace, cable trenches, pile caps. duct, in flooring etc. complete as directed by Engineer-In-Charge.	Cu.M	47.00		
2.02	Providing & laying in position machine mixed and machine vibrated **M20 Grade cement concrete** of controlled grades for Reinforced cement concrete structural elements, of any shape and size viz. foundation, column, raft slab, plinth beam, retaining wall, staircase, cable trenches, Under-ground water tanks, Tank pads, machine foundations. As per structural design and as directed in specified compressive strength in N/mm2 at 28 days confirming to IS 456-1978 using 20mm maximum size aggregates. Including mix design of concrete, weigh batched proportioning, finishing concrete surfaces, curing, wastage, lead, etc. complete but excluding centering/shuttering and reinforcement for below and up to plinth level.	Cu.M	27.00		
2.02a	-do- as per item no. 2.02 but for **M25 Grade concrete.**	Cu.M	141.00		
2.03	Providing & laying in position machine mixed and machine vibrated **M25 Grade cement concrete** of controlled grades for Reinforced cement concrete structural elements, of any shape and size viz. Slab, column, beam, ledge, window sill, Lintel, coping on compound wall, parapet boxes, folded plate, shell roof, fencing post, under ground and & overhead water tanks in any shape as per structural design and as directed in specified compressive strength in N/mm2 at 28 days confirming to IS 456-1978 using 20 mm maximum size aggregates including mix design of concrete, **batching plant proportioning & pouring of concrete by pump OR weigh batched proportioning**, necessary lift and lead as specified finishing concrete surfaces, curing etc. complete but excluding centering / shuttering and reinforcement for super structure **at all height** from finished plinth level.	Cu.M	90.00		

Schedule of Quantity for Civil / Structural Work

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1	2	3	4	5	6
2.04	Providing and erecting in position Steel plate or Plywood form work **shuttering** and boxing using shuttering materials of approved quality shuttering, for concrete elements vertical, horizontal or inclined in all shapes except circular shape, column foundations, pedestals, wall footings, plinth beams, cable trenches, compound wall, U.G. water tank, fins, copings, etc. as per drawing. Including necessary Scaffolding, fastener nails, wires, keeping in position till concrete is laid and concrete members have acquired required strength, removal, thereafter, applying de-shuttering oil etc. complete as directed by structural consultant / Engineer-In-Charge. At all levels **in foundation and up to plinth level.**	Sq.M	561.00		
2.05	Providing and erecting in position steel plate or Plywood form work **shuttering** and boxing using shuttering materials of approved quality for RCC work , in Super structure for all shapes concrete elements, like columns, walls, beams, lintels, suspended slabs, landing, shelves, folded plates, fins, cantilevers, staircase including steps and waist slab, hangers, mullions, fascia, parapets, paragola beams, etc. as per drawing. Including necessary Scaffolding, fastener nails, wires, keeping in position till concrete is laid and concrete members have acquired required strength, removal, thereafter, applying de-shuttering oil etc. complete as directed by structural consultant / Engineer-In-Charge. **for super structure above plinth height from FFL** as directed by Engineer-In-Charge.	Sq.M	510.00		
2.06	Providing and Making Pockets in Equipment foundations for fixing of foundation bolts, with wooden materials, including making templates for except location in concrete works, finishing the surfaces etc. complete. Size upto 130x130x400mm deep	No.	68.00		
2.07	Providing and laying CONBEXTRA GP-2 grout of Fosroc or equivalent make in pockets etc. complete after erection and alignment of equipment's frames etc. complete.	Cu.M	1.70		
2.08	Providing, Fabricating and fixing in position Thermo mechanically Treated deformed steel bars. (TMT) (Having 0.2% proof stress not less than 415 N/mm2) at all heights for steel reinforcement. For all types of RCC structures as per design including loading transporting steel from markets to the work site and incidental charges for unloading handling cutting, bending, providing & binding with double 18 gauge annealed Iron wires (from Contractor), welding if necessary, wastage etc. complete as directed. Payment will be made on the weight basis for the length converted into weight by using standard IS Coefficient. (Having yield stress not less than 415 N/mm2.	M.T.	25.90		
2.09	Providing and placing in position at all levels in floor around Equipment foundations, 15mm thick, joints filler boards of Cross Linked Polyethylene Foam (Cap cell) in HD-100 Grade of approved make at seperation joints of machine foundation, including cutting, wastages, fixing in position, cutting of groove as per detailed drawings and specifications.	Sq.M	20.00		
2.10	Providing and laying 15mmx10mm deep Nito seal PU 280, Polyurethane in construction joint sealing compound of Fosroc, BASF or equivalent make confirming to IS as a filler material as per manufacturer's specifications and detailed drawing, in construction joints at all horizontal planes as directed by Engineer-In-Charge.	R M	129.00		
3.00	**Masonry Work**				
3.01	Providing and constructing for constructing Solid concrete block masonry in CM 1: 5 (1 part Cement and 5 part coarse sand) including scaffolding, raking out the joints, cutting, wastage, curing etc. complete as directed by Engineer-In-Charge. In foundation at all levels below and up to highest plinth level with best locally available approved blocks.	Cu.M	9.00		
3.02	Providing and constructing for constructing 200mm wide Hollow concrete block masonry in C.M. 1: 5 (1 part Cement and 5 part coarse sand) including scaffolding, raking out the joints, cutting, wastage, curing etc. complete as directed by Engineer-In-Charge. In Super structure at all levels from plinth level with best locally available approved blocks.	Cu.M	52.00		
3.03	Providing & laying for **100mm wide hollow concrete** block masonry for super structure at all Height above plinth level.	Sq.M	58.00		
4.00	**Doors and Windows Work**				
4.01	Providing & fixing in position **Powder coated** Aluminium Panelled door single / double leaf door, hinged type, size and shape as per Architect's details by using extruded section from High grade alloy sections fabricated by standard manufacturer like Jindal Aluminium or equivalent make sections consisting of Door frame shall be 63.50x49.50x2.65mm (20001) @ 1.657 Kg/Mtr. Shutter frame shall be Top rail- 83.5x44.45x1.87mm(19582)@1.30kg/Mtr, Middle rail - 83.5x44.45x1.7mm (19535) @1.243 Kg/Mtr, Bottom rail - 83.5x44.45x2.00mm (19581) @ 1.384 Kg/Mtr, Hinge side vertical 83.5x44.45x2.00mm (19581) @ 1.384 kg/Mtr, Handle side vertical 83.5x44.45x1.87mm (19582) @ 1.30 kg/Mtr., Glazing clip 19 x 17.30 x 0.90mm (19360) @ 0.124 Kg/Mtr Aluminium sections finishing shall be 60 Micron (Avg) **Epoxy Powder coated** visibly should look uniform standard.	No.	3.00		

Schedule of Quantity for Civil / Structural Work

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1	2	3	4	5	6
	Shutter panels 5mm thick Modi guardian, saint Gobain or equivalent make clear float glass in top panel and 5mm Thick Aluminium Composite Panel (ALUCOBOND) both side finished in bottom panel. Including all necessary four nos. SS hinges 125mm size for each shutter, aluminium fixtures like concealed type door lock heavy duty Godrej make, handle one pair per shutter (American type), 200 to 250mm long concealed type stopper, heavy duty brass pivot (if required), neoprene rubber lining gasket, good quality rubber flap in vertical style for weathering, filling of silicon sealant wecker brand of natural grade application shall be done through application gun, 8mm dia MS rod both side threaded with nut & washer to be used as a connector in top and bottom shutter rail to strengthen it, etc. complete. Size 900mm x 2100mm				
4.02	Providing & Fixing of door closer of high grade Dorma, Godrej, efficient gadget or equivalent make, heavy duty	No	3.00		
4.03	Providing & fixing in position **Powder coated** aluminium **Sliding Window with Three track**, aluminium sections (3/4" (18mm) Series, size and shape as per Architect's details by using extruded from high grade alloy sections fabricated by standard manufacturer like Jindal aluminium, or equivalent, comprising of pipe framing of 95.0x24.0x1.17mm Rectangle section (14053) @ 0.738kg/Mtr, track bottom 92.00 x 45.50 x 1.50mm (20617) @ 1.659 kg/Mtr. Track top and sides 92.00 x 31.75 x 1.50mm (20831) @ 1.06 kg/Mtr. Shutter bottom 52.0 x 18.0 x 1.56mm (20750) @ 0.651 kg/Mtr, Shutter Top Rail 40x18x1.55mm (20736) @ 0.549 Kg / Mtr, Shutter interlocking 40.0 x 18.0 x 1.45mm (20737) @ 0.607 Kg/Mtr, Shutter Handle 40.0x20.0x 1.55mm (20738) @ 0.547 kg/ Mtr Including panel with 5mm thick Modi guardian float glass, 60 micron (Avg) epoxy powder coating, sliding accessory NSK Japan make neoprene rubber lining gasket, filling of silicon sealant etc. complete as directions of Engineer-in-charge.Size 1200mmx1200mm	No	12.00		
4.04	Providing & fixing in position Powder coated **Aluminium section flexible louvered** type ventilator with aluminium frame of high grade alloy sections fabricated by standard manufacturer like Jindal aluminium or equivalent, comprising of outer frame profile 50.80mmx25.40x1.16mm(20031)@ 0.581Kg/M, Glazing clip 19.00 x 17.30 x 0.90mm (19360) @ 0.124 kg/M. Including 4mm thick frosted / plain glass strips, necessary louver slit fixing arrangement, silicon sealant etc. complete as per drawings, specifications.	No	14.00		
4.05	Providing and fixing in position **interlocking rolling shutters** of approved make of 18 gauge 75mm wide cold rolled MS Lathe interlocked including top cover, spring, axles, guide rails, tees, iron pulleys, bearings, handles etc. and shutters of push and pull type arrangements, with holding-down bolts embedded in CC 1:3:6 including 2 coats of enamel paint over a coat of primer etc. complete as directed by the Site Engineer. (Measurements to be considered for payment shall be the clear size of opening plus guide channels on both sides for width and Top Hood for height). For pull and push type. Rolling shutter shall be having bottom grilled type with 1200mm height starting from 1200mm seal level & a wicket gate of 600 W x 2400 H. RS - Size 3000mm x 3000mm	No	1.00		
5.00	**Plaster finishing Work**				
5.01	Providing and applying 8-10mm thick cement finish plaster in single coat at all heights with C.M. 1:4, finish with using "Iron Plate". Such rubbing shall be done till the surface shows cement paste in line and level for all types of concrete / brick surfaces. Including making drip mould, grooves, pattas, tapaks, double scaffolding, curing etc. complete as directed by Engineer-In-Charge.	Sq.M	363.00		
5.02	-do- same as above but for 12-15mm thick single coat cememt finish plaster.	Sq.M	418.00		
5.03	Providing and applying 20mm thick sand faced cement plaster in two coats at all heights (I) 12mm with C.M. 1:4, (II) 8mm with C.M. (1:2) rough finish with using Wooden Gutka on all types of concrete / brick surfaces making moulded, grooves, tapaks etc. including scaffolding, curing etc. complete as directed by Engineer-In-Charge.	Sq.M	484.00		
5.04	Providing and applying **25mm thick water-proof cement plaster in CM 1:3** with top cement slurry finishing at the rate of 4.4 kg per Sq.M, at all levels using water proofing compound of approved quality as per manufacturer's specification. Rate includes necessary scaffolding, curing, hydraulic testing etc. complete as directed by Engineer-In-Charge.	Sq.M	31.00		
5.05	Providing and fixing hexagonal chicken wire mesh 26 G 15mm square at junction of concrete and brickwork or between different materials and etc. including fixing with nails, raw plugs etc. complete before applying plaster as directed.	Sq.M	20.00		
6.00	**Painting Work**				

Schedule of Quantity for Civil / Structural Work

It. No.	Item Description	Unit	Qty.	Unit rate of supply & Installation, fabricated & completed in all respects, inclusive of necessary testing, taxes and duties, transportation, handling, storage and safe custody at site & all incidental costs.	Total price of items in Rs. (4 x 5)
1	2	3	4	5	6
6.01	Providing & applying Acrylic Emulsion Paint 90-100 microns, premium quality of Asian-Royal, Nerolac-Impression, Burger-Breathe easy, or approved make and shade, Low VOC, water based, including scaffolding at all levels surface preparation uniformity & smoothness, primer & application of Acrylic / Birla white putty in two coats over cement plastered walls, ceilings etc. to achieve even & smooth surface. Paint shall be antifungal & bacterial resistant etc complete and including, providing plastic to cover floor, cleaning of floors, door & windows, etc. including scaffolding, surface preparation, primer etc. complete as directed to get uniform leveled surface as directed by Engineer-in-charge.	Sq.M	781.00		
6.02	Finishing wall with **water proofing cement paint** of approved shade, on any surface (3coats) to give an approved brand or manufacture (Super Snowcem or equivalent) and of required even shade. Including thoroughly brushing the surface to remove all dirt and remaining all loose powdered materials, scaffolding, all heights, curing, primer if required, etc. complete as directed by Engineer-In-Charge.	Sq.M	484.00		
7.00	**Flooring Work**				
7.01	Providing and laying 50 mm thick IPS flooring and skirting, with 43 mm thick CC 1:2:4 (1 cement, 2 coarse sand and 4 stone aggregate 12.5 mm and down graded) finished smooth with 7 mm thick plaster in CM 1:2, and cement slurry 2.2 Kg of cement per Sq.M, Chequered including rounding off the junction and corners with floors and walls, necessary Glass stripe for contraction joints, curing, all levels, etc. complete as directed by Engineer-In-Charge.	Sq.M	177.00		
	Water Proofing				
7.03	Providing and laying water proofing treatment of 115mm average thickness consisting of 15mm thick cement layering in C.M. 1:4 with intergal water proofing compound (Pidiproof LW @ 200ml per bag of cement or any approved equivalent with dosage as per manufacturer's recommendations) and on base constructing and laying brick bat coba in C..M. 1:5 with water proofing compound (as stated earlier in 15mm thick finishing layer) and having average thickness of 80 mm and finishing with 20 mm thick cement plaster layer in C.M. 1:4 with water proofing compound (as stated earlier) including all lead, lift and laid to proper slope to drain off water entirely, including quarter round vata at the junction of parapet and floor up to a height of 300mm. Including top cement finishing, water proofing treatment, false marking of 300 mm by 300mm covering the entire treated area, with 10 years free maintenance guarantee against any leakage, defect etc. on stamp paper etc. complete as directed by Engineer-In-Charge.	Sq. M	240.00		
8.00	**Structural Steel Work**				
8.01	Providing, fabricating, erecting, fixing in position and connecting, MS **structural work** in rafters, purlin, column, cable rack, floor beam, bracing, platform, ladders, support, **Monorail beams,** brackets, Including bolts, nuts, washers, check nuts, welding electrode. Electrode brand required is ADVANI or ESAB or D & H make. Including transporting of material from market to work site, loading & unloading of material, cutting, welding (shop and site), bolting wherever necessary, surface cleaning, providing and applying "Synthetic Enamel Paint" on structural steel surface at all level from Asian, Berger or equivalent approved make. Applying zinc chromate primer coat after erection of structure (DFT 40 micron), and final two coats of Synthetic enamel paint (DFT 25 microns/coat) finish paint on structural steel surface etc., complete as directed by Engineer-In-Charge.	M.T.	8.50		
8.02	Providing, cutting to shape, fabricating, and fixing in position **MS Chequered plate** conforming to IS:3502 in cover for trenches, stair steps, landing, platforms etc. with providing bolts & nuts, washers, check nuts, welding electrode, etc. including transporting of material from market to work site, loading & unloading of material, cutting, welding (shop and site), with necessary stiffeners, including tow coats of synthetic Enamel paint over coat of primer etc. complete as per drawings and as directed by Engineer-In-Charge.	MT	1.60		
8.03	Providing, fabricating and fixing in position **MS insert** in concrete elements, such as nosing angle, corner angles of columns, plates, flats, tees, protection channels of loading / unloading dock, provision for monorail / pipe hangers, pipe sleeve supports, brackets frame around cut-out etc. as per drawings and specifications, in true line and level for embedding into permanent works at the time of casting of RCC, including making necessary template, shuttering, welding, grinding including surface cleaning, applying of 2 coats of Synthetic Enamel (DFT 25 micron / coat) paint over coat of zinc Chromate (25 micron) primer etc. complete as directed. The payment will be made on weight basis of the inserts.	MT	0.70		

Schedule of Quantity for Civil / Structural Work

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1	2	3	4	5	6
8.04	Providing and fixing in exact position mild steel holding down bolts with Nut, washer, upper 100mm portion threaded etc. complete. Rate to include for placing the bolts in position with 75mm dia MS pipe sleeve with 100mm x 100mm x 6mm thick plate welded at bottom etc. and providing necessary templates for keeping the bolts in position complete as per drawing to satisfaction of Engineer-in-charge. The payment will be made on kg basis of wt. of bolts, nuts, washers, pipe sleeve, plates etc. complete as Directed by Enginer-In-Charge.	Kg	111.00		
8.05	Providing, fabricating and fixing in position, MS round pipe sections as per IS 1161 for Pipe hand railing for Stairs, platfroms, Racks, etc. from structural steel sections like mainly MS pipes, flate, plates, etc. as per architect's details including cutting welding, grinding to smooth surface of all works, grouting of anchors, two coats of synthetic enamel paint over coat of zinc Chromate primer etc. complete as directed by Engineer-In-Charge.	MT	1.00		
8.06	Providing and fixing in position MS grating 25/30mm thick in walk ways, platforms, stairs etc. with main bars 25/30mm x 5mm @ 32 mm c/c etc. and cross bars 8mm dia mild round/ square @ 100 mm c/c etc. press cutting and welded construction including fixing clips, nuts, bolts, **including two coats of synthetic enamel paint over coat of zinc phosphate primer** etc. complete as directed by Engineer-In-Charge.	MT	1.00		
9.00	**Sanitary Work**				
9.01	Providing and laying non pressure reinforced cement concrete Hume pipe of approved NP3 class quality including excavation of trenches, cutting of walls, laying the pipes as per layout and drawing, in cable entry below plinth, filling the joints with stiff mixture of cement mortar (1:1) and jute, curing, testing the pipe and refilling the trenches etc. complete as directed by Engineer-In-Charge.				
	(a) for 300mm dia	R.M	10.00		
9.02	Providing and laying uPVC pipe as per IS 4985 : 2000, pressure rating 6 kg /cm2 for Rain water down take pipe and necessary injection moulded fittings, jointed with special quality rubber gasket and rubber lubricant or solvent joints, as per manufacturers instruction. Including fixing pipe clamps at interval of not more than 1 M with fitting like door bend, Tee with door, Y with door bend, shoe etc. complete in line, level to the satisfaction of the Engineer-in charge.				
	(a) 110mm dia pipe	R.M	12.00		
10.00	**Roofing work**				
10.01	Providing & fixing of Zincalume Colour quoted Roofing comprising of Hi-Rib profiled manufactured out of 0.5mm TCT (Total Coated thickness), coated with an alloy in the ratio of 55% aluminium, 43.4% zinc & 1.5% silicon, Zincalume high tensile cold rolled steel as per AS 1397, coating class AZ 150 (min. 150gm/sqm Zinc Aluminium alloy coating mass, total both side, 550 Mpa Yield strength) conforming to AS 1397. The side laps with anti-siphoning feature to prevent leakages. Sheets shall be fixed with self-drilling & self-tapping hot dip zinc coated Buildex / Roofix polymer coated hexed fastener of required length with EPDM washer as per AS-3566 Class 3 approved screws, drilled up to 12mm thick purlins. Complete as per drawings, specifications and directed by the Engineer. Polyester primer and Non-toxic food-graded STANDARD polyester finish paint SDP and approved colour shade.	Sq.M.	33.00		
10.02	Providing & fixing 0.50mm thick Precoated Zincalume Sheet same as above but for sheet Cladding work.	Sq.M.	51.00		
10.03	Providing & Fixing 0.50mm thick plain sheet for as above but for Corner piece 200x200mm sheet	R.M.	24.00		
10.04	Providing & Fixing 0.50mm thick plain sheet for as above but for flashing/apron piece 200x300mm wide sheet.	R.M.	6.00		
11.00	**MONO RAIL Work**				
11.01	Supply and installation of complete **5.0 T Motorized Monorail** on prposed Fire water pump house, as per attached detailed specifications, including required accessories for lifting arrangements, rails, furnished detail drawing along with offer. Room height @ 5.3m max. (5.9m top of slab) (Run length is 25m, Morail beam shall be considered in structural steel work item 8.01)	LS	1.00		
12.00	**INTERNAL CONDUIT WORK**				
	Itemd for conduit work with supply and installation as per menioned below and work shall be carried out as per Drawing 322538-ELA-0003-01				
12.01	Supply and laying of PVC conduits of size 25mm dia, for switch,sockets, plates & concealed boxes etc. of reputed make.	Mtr	200.00		
12.02	8 way junction Box in ceiling	Nos.	10.00		
12.03	2 way junction Box in ceiling	Nos.	7.00		

Schedule of Quantity for Civil / Structural Work					
It. No.	**Item Description**	**Unit**	**Qty.**	**Unit rate of supply & Installation, fabricated & completed in all respects, inclusive of necessary testing, taxes and duties, transportation, handling, storage and safe custody at site & all incidental costs.**	**Total price of items in Rs. (4 x 5)**
1	**2**	**3**	**4**	**5**	**6**
12.04	Wall mounted Junction Box (including exhaust fan JB)	Nos.	16.00		
Sub Total Amount for Civil Work (A) Rs..					
VAT* @ % on % of Sub Total (A).					
SERVICE TAX* @ % on % of Sub Total(A)					
Final Total Inclusive all taxes (A)					

Final Amount (A) in words :

* If VAT / Service Tax not applicable then mentioned as NIL

Signature of Bidder aling with Company Seal