ASSOCIATED ARCHITECTS DUE DATE: 01-07-2025

CIVIL & MEP WORK TENDER

FOR

Proposed Wasroom renovation

of

Ground to Fourth Floor

At

WELINGKAR INSTITUTE OF MANAGEMENT MATUNGA

for

SHIKSHAN PRASRAK MANDALI PUNE

ARCHITECT	EMPLOYER
ASSOCIATED ARCHITECTS "Shreedhar",1170/31/4, Revenue Colony, Shivajinagar, Pune-411005 e-mail: kaison.144@gmail.com	**SHIKSHAN PRASARAK MANDALI, PUNE** **SHARADA SABHAGRUH,** **S.P.COLLEGE CAMPUS,** **PUNE-411030**

JUNE– 2025

Section – 1

TENDER NOTICE

Sealed tenders are invited from Contractors of repute for Civil and MEP Works of proposed Washroom renovation of Ground to Fourth floor At **WELINGKAR INSTITUTE OF MANAGEMENT, MATUNGA**

Tender is Item Rate as per BOQ - Civil & Sanitary, Plumbing, Fire-fighting system works & In line Exhaust system

The completed sealed tender documents printed in hard copies shall be submitted in the office of……

WELINGKAR INSTITUTE OF MANAGEMENT, MATUNGA

Kind Attn : Ps Shaji

On or before 5:00 P.M. on 01-07-2025.

Section – 2

LETTER INVITING TENDER

24th June 2025

To

M/s.----------

Respected Officials

Sub: Proposed Civil and MEP Works for Civil and MEP Works of proposed Washroom renovation of Ground to Fourth Floor At WELINGKAR INSTITUTE OF MANAGEMENT, MATUNGA

We have pleasure in inviting you to quote for the above in line with: -

Sealed tenders in the prescribed tender form in two separate envelopes should be addressed to **SHIKSHAN PRASARAK MANDALI, PUNE; SHARADA SABHAGRUH, S P COLLEGE CAMPUS, PUNE-411030** & submitted at the office of **WELINGKAR INSTITUTE OF MANAGEMENT, MATUNGA**

Kind Attn: **Ps Shaji,**

Envelope - 1 - Technical Bid (Original along with soft copy CD).
Envelope – 2 - Price Bid (Original along with soft copy CD)

A post-bid negotiation meeting can be arranged as per requirement at the office of **SHIKSHAN PRASARAK MANDALI, PUNE; SHARADA SABHAGRUH, S P COLLEGE CAMPUS, PUNE 411030.SHIKSHAN PRASARAK MANDALI, PUNE; SHARADA SABHAGRUH, S P COLLEGE CAMPUS, PUNE411030**
Details of the same will be informed to you.

Late Tenders are liable to be rejected.

a.	**Name of work**	**:**	Proposed Civil & Sanitary Plumbing Works for CIVIL & MEP of proposed Washroom renovation of Ground to First floor at **WELINGKAR INSTITUTE Of MANAGEMENT ,MATUNGA** **for SHIKSHAN PRASARAK MANDALI PUNE.**
b.	Earnest Money Deposit	:	**₹ 3,50,000/- Payable by Cheque drawn on any Nationalize Bank** in favour of the Owner valid for period of 60 days from the date of submission of tender.
c.	Time of completion	:	Schedule with milestones to be provided as part of technical bid, estimated time is **3 months for one floor** including monsoons from date of LOI
d,	Prebid Meeting	:	On -26-06-2025 @ 11.30 am - online
e.	Time & date of submission	:	On -01-07-2025 before 5:00 pm (I.S.T.)
f.	Address	:	Tenders duly filled and sealed shall be **submitted at office of " WELINGKAR INSTITUTE OF MANAGEMENT ", MATUNGA**

BIDDERS QUALIFICATION CRITERIA:

1. The tenderer must be a civil and electrical & MEP contractor having experience in multi-storeyed RCC residential or commercial buildings Experience of having successfully completed similar works during last 5 years, ending on 31st March 2025 of previous financial year to the one in which tenders are invited, should be either of the following**:**

   ***Similar Work:** Similar work shall mean 'the building consisting of RCC Framed including Finishing works, internal Water Supply & Sanitary installations, Internal Electrical Installation, Firefighting systems, etc., all executed under one agreement / contract'.

   Similar completed works referred above means each work and not all works put together.

   It is clarified that the work executed by the contractors for their in-house or capital use need not be considered for the purpose of bidder's experience of completion of similar works.

2. Bidder should have completed at least 3 such jobs as mentioned above in the last five financial Yrs.

3. The Bidder shall have an average annual turnover of minimum ₹ 2 Crores in any of the last five financial years. The COVID-19 period from April 2020 to April 2022 may be excluded.

4. The Bidder shall have completed minimum one job of ₹ 2 Crores in the last five financial years.

Bidders should satisfy the qualifying criteria on their own merits and not as a sum total of their sub-agencies. Joint Ventures / Consortium / MOU shall not be entertained. Power of Attorney given to a person other than the bidder's own employee shall not be accepted.

Note: **The bidders shall submit supporting documentary evidence in support of the qualification criteria viz. work order with detailed scope of work, work completion certificate copy as applicable issued by the party for whom the work is done. SHIKSHAN PRASARAK MANDALI, PUNE; SHARADA SABHAGRUH, S P COLLEGE CAMPUS,PUNE411030 has a right to verify / cross verification of authenticity of the said documents whenever felt necessary.**

SUBMISSION OF BID:

(A) The Tender shall be submitted in accordance with these instructions and any Tender not conforming thereto is liable to be rejected. These Instructions shall form part of the Tender and the Contract.

(B) The Tender document which will be issued to each tenderer comprises of these instructions, Form of Tender with Appendix, Form of Agreement, Specifications and Bill of Quantities as detailed in the Specifications.

(C) The Tender shall be filled in, signed with all particulars complete and submitted by a person who is duly authorized to do so. The Tenderer shall satisfy the Employer that he is competent and authorized to submit the tender and/or to enter into a legally binding Contract with the Employer by furnishing legal documentary evidence in that behalf.

(D) Manner of Submission

a. Tender document
b. Forwarding letter of Bidder
c. **Envelope – 1–**
Technical Bid (Original hard copy print along with soft copy CD).
d. **Envelope – 2 –**
Price Bid (Original hard copy print along with soft copy CD)

(E) The Tender shall be completed with all the documents set out in para (B) and (C) above and other documents set out in these instructions and elsewhere in the Tender documents. In particular the Tenderer shall complete and submit the following with his tender to be considered as bonafide:

- Form of Tender and Appendix
- Bill of Quantities and its summary, each page duly signed, and other Schedules.
- Time Schedule for construction.
- List of Plant/Equipment and personnel (with bio data) to be employed on the works - Important.
- Bidder's Company Profile and Copy of bidder's Shop & Establishment registration certificate.
- Biodata of key personnel & technical team who would be associated with the work with their designations, Qualification & Experience as applicable to determine bidder's capability.
- Audit certified Balance sheet and Profit / Loss A/c for the last 5 years.
- A Certified copy of PAN Card
- A Certified copy of GSTIN.
- Financial status and the Banker/s to whom reference may be made about it.

Submission of offer in Two-Bid System:

Offer must be submitted in Two parts, each offer securely closed (sealed) separately, in Two Envelopes Part – I Technical & Part – II commercial as stated below.

Part-I: Technical bid
This Envelope super scribing the Tender No, Due date & Time should contain the following and it should be submitted along with the tender:

i) Earnest Money Deposit as per tender terms.

ii) Technical Bid including tender document, drawings & technical specifications duly filled wherever required, signed & stamped in Original.

iii) Qualifying documents (Stamped & Signed)

iv) Self-attested (Stamped & Signed) copy of Tender Document.

v) Plant capacity and the ongoing and upcoming project list with total tonnages of each project.

vi) Acceptance on clauses of Tender Enquiry Form (TEF) in the Prescribed Formats duly stamped, signed & filled 'Accepted OR Not Accepted' as applicable for each of the clause - Annexure `K'

vii) Acceptance on clauses of Standard terms & Conditions in the Prescribed Format duly stamped, signed & filled 'Accepted OR Not Accepted' as applicable for each of the clause - Annexure `L'

viii) Bidder's Undertaking in the prescribed format duly filled, signed & stamped – Annexure `M'

ix) Deviation Sheet in case of any deviations from TEF, STACS, GT&C, Special Conditions of Contract and Technical Specifications.

x) Bio-data of key personnel & technical team who would be associated with the work

xi) Corrigendum, if any, duly signed & stamped

Part-II:

The **Proposed Civil & Sanitary, Plumbing Works for Civil and MEP Works of proposed Washroom renovation of Ground to Fourth Floor At WELINGKAR INSTITUTE OF MANAGEMENT, MATUNGA, for SHIKSHAN PRASARAK MANDALI, PUNE; SHARADA SABHAGRUH, S P COLLEGE CAMPUS, PUNE-411030** is an item rate contract and contractor has to submit the final quote for the Building Solution. The payment would be made on a Running Bill basis per month as per the progress of the actual work at the site. The format of the quote is attached as Annexure – "P". The quote shall be including all **taxes, duties, transportation, loading/unloading, Octroi, storage, royalties, handling, etc. All other Civil and Finishes Work or any required Structural Work would be in Item Rate.**

Priced envelopes contacting any new/fresh conditions (Not mentioned in the un-priced envelop) shall be liable to rejection. Clarifications if any are to be sought by the bidders before submission of bid.

These securely closed (sealed) Envelope super scribing Tender No., Due date & Time should contain only THE COST strictly in the prescribed format provided with the tender. Offer in any other format shall not be considered.

Both these securely closed Envelopes I.e. Part-I & Part-II should be put in a Third Bigger Envelope securely closed (Sealed), Super scribed with Tender No., Due date, time, and should be **Submitted** at the office **SHIKSHAN PRASARAK MANDALI, PUNE; SHARADA SABHAGRUH, S P COLLEGE CAMPUS, PUNE411030.**

The bids may also be sent by Speed Post / Courier Service well in advance so as to reach the undersigned well before the due date and time. Timely submission of the Bids is the responsibility of the bidders and no reasons / excuses in this regard will be entertained by **SHIKSHAN PRASARAK MANDALI , PUNE; SHARADA SABHAGRUH,S P COLLEGE CAMPUS,PUNE411030.**

list of similar construction works executed by the tenderer and valued as written in tender notice with testimonials of satisfactory completion from respective Employers / builders / Consultants to be furnished.

The tenderer should study all the tender documents carefully and understand the tender contract conditions, drawings, and specifications etc. before quoting. If there are any doubts, they should get clarifications in writing, but this shall not be a justification for submission of a late tender or extension of opening date. Tender should be strictly in accordance with project Consultants drawings, specifications, and other tender documents and not to stipulate any deviation. Submit Section- 6 duly signed & stamped as a confirmation.

A common schedule of agreed variations if any comprising of conditions accepted by Employers during pre-bid meeting will be given to all tenderers. The tenderers shall return the same conveying their acceptance and indicating any rebate/increase in their price Bids, before the opening of price Bid. The schedule of agreed variations shall form part of the Contract.

The Tenderer must obtain for himself on his own responsibility and at his own expense, all the information which may be necessary for the purpose of filling this tender and for entering into a contract for execution of the same and must examine the drawings and visit the site and acquaint himself with the site conditions before quoting.

SHIKSHAN PRASARAK MANDALI, PUNE; SHARADA SABHAGRUH ,S P COLLEGE CAMPUS,PUNE411030, reserves the right to accept or reject any or all the tenders in whole or in part without assigning any reason for doing so.

In case if you are not interested in submitting tender for the above work, please state the same in a regret email with reason for the same.

Please acknowledge receipt of this letter along with all the enclosures and confirm that you will submit the offer before the due date.

Thanking You,

Yours faithfully,

The Secretary
SHIKSHAN PRASARAK MANDALI , PUNE;
SHARADA SABHAGRUH,
S P COLLEGE CAMPUS, PUNE411030.

TABLE OF CONTENT

Section – 3

LETTER FOR SUBMISSION OF TENDER.

From:

To,
THE CHAIRMAN / THE SECERETARY
SHIKSHAN PRASARAK MANDALI, PUNE;
SHARADA SABHAGRUH,
S P COLLEGE CAMPUS, PUNE-411030.

Sub: Proposed Civil Works for Construction of Proposed Civil Works for Civil and MEP Works of proposed Washroom renovation of Ground to Fourth floorAt WELINGKAR INSTITUTE OF MANAGEMENT, MATUNGA

Dear Sir,

1. Having visiting the site & examined the Tender document consisting notice Inviting Tender, General Conditions of contract, specifications, Drawings, Time Schedule, Schedule, Schedule of Rates and other documents and papers, all as detailed in the tender documents prepared by your Consultants **Associated Architects** and having understood the provisions of the said tender documents and having thoroughly studied the requirements of **SHIKSHAN PRASARAK MANDALI , PUNE; SHARADA SABHAGRUH,S P COLLEGE CAMPUS,PUNE411030.**related to the work tendered in connection with the project and having conducted a thorough study of the job, Site(s) involved, the site conditions, soil condition, the climatic conditions of labour, power, water, material & equipment availability and suitability of borrow area, the availability of land for right of way and temporary office and all other factors and facilities and things whatever necessary to related to the formation of the tender and the performance of work, I/We hereby submit my/our tender for the performance of proposed work in accordance with the terms and conditions and within the time mentioned in the Tender Documents at the rate(s) quoted by me/us in the accompanying Schedule(s) of Rates included within the Tender Documents.

2. It has been explained to me / us that the time stipulated for job(s) and Completion of Works (s) in all respects and in different stages mentioned in the “Time Schedule of Completion of jobs” and signed and accepted by me / us is **ESSENCE OF THE CONTRACT.** I/We agree that in case of my/our failure of strictly observe the time completion of work in all respects according to the schedule set out in the said “Time Schedule of completion of job (s)”, I/We shall pay liquidated damages to the Employer as per provisions of tender documents.

3. I/We agree to pay the Earnest Money & Security Deposit / Performance Guarantee and accept the terms & conditions laid down in the memorandum below in this respect.

4. I / We have annexed the following documents to this tender.

    i) SECTION 5- MEMORANDUM
    ii) SECTION 6- NO DEVIATION CONFIRMATION
    iii) ANNEXURE A- APPENDIX TO CONDITIONS OF CONTRACT
    iv) ANNEXURE B- FORM OF AGREEMENT
    v) ANNEXURE C- PROFORMA FOR STRUCTURE & ORGANIZATION DETAILS
    vi) ANNEXURE D- PROFORMA FOR DETAILS OF TECHNICAL & ADMINISTRATIVE PERSONNEL OF THE COMPANY.
    vii) ANNEXURE E- PROFORMA FOR ENROLLMENT WITH VARIOUS ORGANISATIONS.
    viii) ANNEXURE F- LIST OF MAJOR WORKS COMPLETED DURING LAST SEVEN YEARS.
    ix) ANNEXURE G- LIST OF MAJOR WORKS ON HAND
    x) ANNEXURE H- DETAILS OF PLANT AND EQUIPMENT WITH BIDDER
    xi) ANNEXURE I- OTHER RELEVANT INFORMATION
    xii) ANNEXURE J- SCHEDULE – "F"
    xiii) ANNEXURE K - TEF ACCEPTANCE
    xiv) ANNEXURE L - PAYMENT TERMS ACCEPTANCE
    xv) ANNEXURE M - UNDERTAKING
    xvi) ANNEXURE N - RTGS-NEFT BANK DETAILS
    xvii) ANNEXURE O - PAYMENT TERMS
    xviii) ANNEXURE P - PRICE BID
    xix) ANNEXURE Q - PROFORMA FOR WATERPROOFING QUALITY PERFORMANCE GUARANTEE
    xx) ANNEXURE R - PROFORMA FOR ANTI-TERMITE TREATMENT PERFORMANCE GUARANTEE
    xxi) ANNEXURE S - CONFIRMATION ON SCHEDULE OF RATES
    xxii) ANNEXURE T - SCHEDULE OF LABOUR/RATES
    xxiii) ANNEXURE U - LIST OF DISPUTES
    xxiv) ANNEXURE V - SUBMISSION OF QUALITY ASSURANCE PLAN
    xxv) ANNEXURE W - CONFIRMATION ON HOUSEKEEPING
    xxvi) ANNEXURE X - MATERIAL PROCUREMENT PLAN

5. I/We hereby undertake that the statements made herein and the information given in the Annexure referred to above are true in all respects, and that in the event of any such statement or information being found to be incorrect will entitle the Employers to resend any resultant Contract.

6. I/We agree to complete the work within **3 months for each floor** or mutually accepted schedule from the date of award of the work.

7. I / We agree to pay the Government Tax (State and Central) works contract as required by you.

8. I / We, understand and agree that if I / We am/are awarded the work, on the Retention Money amount / any pending amounts including of running Accounts bills, price differential for agreed materials, final bill amount lying with the Employers from submission of this tender document till the finalization of bills and defects liability period, will not bear any interest under any circumstances and the Employers will not be liable to pay any amount towards interest, compensation, demurrage charges, finance charges, delayed payment charges etc. on such amounts.

9. I / We agree to pay the Government Sales Tax (State and Central), works contract tax, Turnover tax, octroi, duties and any other taxes applicable and prevailing from time to time on such items for which the same are leviable and the rates quoted by me / us are inclusive of the same."

10. I/We, am/are submitting herewith my/our authority to sign the above tender document and the same shall be binding on my / our company for all the times during the pendency of contract. Dated this day of _____ 2025.

Yours faithfully,

SIGNATURE OF THE TENDERER

Name & Designation of Authorized
Person signing the tender on behalf
of the tenderer (s).

Encl: As Stated.

Section – 5

MEMORANDUM

a)	General description of work	:	**Proposed Civil & Sanitary,Plumbing Works for Civil and MEP Works of proposed Washroom renovation of Ground to Fourth Floor At WELINGKAR INSTITUTE OF MANAGEMENT, MATUNGA**
b)	Earnest Money	:	**₹ 3, 50,000/-** payable Cheque drawn on any Nationalize Bank in favour of the Owner valid for period of 60 days from the date of submission of tender.
c)	Performance Security	:	1% of Contract Value in the form of a bank guarantee issued by a Nationalised bank in favour of the Owner shall be submitted at starting of the work & same shall be released along with the Final Bill.
d)	Retention Money	:	In addition to performance security, 5% (Five percent) of the value of the work done and approved by the Engineer-In-Charge at the time of approving the relevant R. A. Bill will be deducted in cash from each R.A. Bill. Retention Money will be released along with payment of after the Defects Liability Period of 12 months OR against issuance of a PBG issued by a Nationalised Bank (acceptable to the owner) of an amount equal to the Retention Money for the term of the Defects Liability Period.
e)	Time allowed to start the work	:	7 days.

1. Should this tender be accepted, I / We hereby agree to abide by and fulfill all terms and conditions referred to above and in default thereof, to forfeit and pay to the OWNER or its successors or its authorized nominees such sums of money as we stipulated in Tender Documents.

2. I/We hereby pay the Earnest Money of Rs. _____ in Bank cheque No. _____ drawn on _____ (Name and office of Indian Nationalized Bank) in favor of **SHIKSHAN PRASARAK MANDALI , PUNE; SHARADA SABHAGRUH,S P COLLEGE CAMPUS,PUNE411030** If I/We fail to commence the work specified in the Memorandum above, or I / We fail to deposit the amount of Security Deposit specified in the Memorandum above, I / We agree that the said OWNER or its successors without prejudice to any other right or remedy be at liberty to forfeit the said Earnest Money shall be retained by OWNER towards the Security Deposit specified in (c) above. The said OWNER shall also be at liberty to cancel the Notice of Acceptance of Tender if I/We fail to deposit the Security Deposit as aforesaid or to execute an Agreement or to start SUPPLY as stipulated in the Tender Documents.

I/We enclose herewith evidence or my / our experience of execution of works of similar nature and magnitude carried out by me/us in the prescribed Proforma and also the Income-tax and Sales-tax Clearance Certificates.

Dated the _____day of _____2025.

Witness:

Name in Block letters:
Address

Yours faithfully,

SIGNATURE OF THE TENDERER

Name & Designation of Authorized
Person signing the tender on behalf
of the tenderer (s).
Encl: As Stated.

Section – 6

Bidders are required to give their No Deviation confirmation and certificate in the prescribed format as below on their letterhead.

NO DEVIATION CONFIRMATION

TENDER NUMBER:

Sub: Proposed Civil &Sanitary,Plumbing Works for Civil and MEP Works of proposed Washroom renovation of Ground to Fourth Floor At WELINGKAR INSTITUTE OF MANAGEMENT,MATUNGA

We understand that any deviation / exception in any form may result in rejection of bid. We, therefore, certify that we have not taken any exceptions/deviations anywhere in the bid and we agree that if any deviation / exception is mentioned or noticed, our bid may be rejected.

(SEAL AND SIGNATURE OF BIDDER)

Section – 7
SCOPE OF WORK

Proposed Civil & Sanitary,Plumbing Works for Civil and MEP Works of proposed Washroom renovation of Ground to Fourth Floor At WELINGKAR INSTITUTE OF MANAGEMENT,MATUNGA

Location of site: - At WELINGKAR INSTITUTE OF MANAGEMENT, MATUNGA

The Scope of work shall include execution of work in accordance with Detailed Specifications of all the works; Tender Drawings, Architectural, Approved Structural & Services Drawings, list of Approved makes of works, General Technical specifications of works and other conditions stipulated in Tender Document.

The scope shall generally include but not limited to Demolition Supply, Construction, Testing and Commissioning of bidder's work comprising Civil, Structural, Structural Strengthening, Demolition and land development works at site and allied works. All the works are described in detail in the form of Tender drawings, detailed section wise technical specifications, Quality Assurance plan, Finishing Schedule, Schedule of rates, which shall be an integral part of this tender document.

The tender document consists of aspects like Special Conditions of Contract, Safety Clauses for contract execution, Interpretation of various items, List of approved makes and Quality of materials to be used for construction, and various Proforma that are required to be submitted by bidder along with their bids, also the detailed Technical Specifications, Quality Assurance Plan Tender drawings and Finishing Schedule have been attached. Bidders are requested to go to all the documents of the **tender in conjunction** to get a better understanding of the project.

The scope of work shall be carried out as per the conditions of the contract as explained in the Special conditions of the contract, General conditions of contract, and other conditions and due diligence to adhere to the quality and safety standards as explained in the contract and to the satisfaction of the owner.

The Contractor will submit the detailed PERT/CPM chart to consultant/PMC after award of the work so that planning of release of stage-wise drawings may be ensured. Accordingly, stage-wise GFC drawings will be released as per the progress of the works achieved by the Contractor. The GFC drawings will be issued after scrutiny of the drawings by consultant/PMC and proper approvals from Client. No advance drawings shall be issued to the Contractor. The Contractor may make advance planning according to the drawings attached with the Tender document as the drawings are detailed and comprehensive.

The contractor shall arrange water and electricity at his own cost within the quoted rates along with its distribution arrangement which shall be required for carrying out the scope of work as above.

The proposed scope of work consists of:

Sl. No.	Floor	Approximate Area (Sq. Meters)
1.	Ground Floor	87.78.00 SQM Approx
2.	First Floor	107.56 SQM Approx
3.	Second Floor	78.78 SQM Approx
4.	Third Floor	78.78 SQM Approx
5.	Fourth Floor	78.78 SQM Approx

- Shore Piling
- Demolition works as per site requirements.
- Earth Work in soil, soft rock, hard rock excavation and filling
- Foundation works open foundation, Rafts
- RCC Retaining Walls
- RCC works
- Vacuumed dewatered Floor
- Masonry work, Plaster, Painting
- Tilling
- False Ceiling Work
- Storm water drain, Rainwater harvesting works.
- Water proofing work as specified.
- Door and window work.
- Landscaping, hardscape, Pavers
- Plumbing and sanitation works
- Underground & Overhead Water Tank
- Hard Paving
- Site Development works comprises of 1.5m high 230mm thick brick compound wall on the two sides of the plot with 600mm high chainlink fencing above it, internal side of the brick compound wall shall be cladded with 18mm thick granite stone of approved quantity. The top of the brick wall shall be finished with broken glass pieces. Extreanl side of the compound wall shall have 20mm plaster with Apex paint + entrance gate,
- Storm water drain, landscaped area at the entrance and external courtyards, pathways, car and bicycle parking.
- Electrical, CCTV, PA, Firefighting System as per Drawing and specifications
- Miscellaneous works.

Exclusions:

- Design, Supply and installation of PEB Structure.
- Deck Sheeting.
- Cost of Furniture (Table, chairs, bed, mattress) & Interior Works

- HVAC
- Supply of Lift

The scope of work is not restricted to the above. The contractor is bound to execute any other work required for the completion of the project.

The consultants / client may decide to award part of the work to other contractor(s) without assigning any reason whatsoever at any point of time.

The whole of the work may / may not be allotted to one Contractor. If at any stage of the work, if the Consultant/client is so satisfied that there would be substantial delay on the part of the contractor to complete the works or the contractor is unable to deliver desired quality workmanship, the Employer after having received such advice from the Consultant, shall be at liberty to allot such parts of the work as advised by the Consultant, to any other agency.

NOC'S / APPROVALS/ CLEARANCE OF PROJECT FROM LOCAL BODIES/ AUTHORITIES

The Contractor will take necessary Statuary Approvals/ NoCs / Clearance from all concern Local Authorities / Departments (MCGM/ State Electricity board etc./ Electrical inspectorate/ pollution department/ forest department etc.), if any, required before start of the work / during the work / after execution of work & before handing over the Project.

The fee for getting these approvals, shall be deposited by the Contractor to the concerned Department / Authorities and will be reimbursable to the Contractor on producing of original receipt of deposited fee and no extra cost for the same shall be claimed by the contractor.

The contractor shall mobilize the resources at site after getting approval / NoC's/ Clearance from all concern Local Authorities / Departments if any, essential before start of the construction and shall not make any claim due to any delay in approval.

The contractor will follow all the Guidelines for Air Pollution Mitigation act per MCGM Notice no MGC/F/1102/ Dated 25-10-2023.

1. Solid waste Management NOC till the completion of the project in all respects. i.e. up to obtaining the completion certificate or Occupation certificate from MCGM.
2. Royalty for the excavation
3. Final Tree NOC
4. Final CFO NOC
5. Carriage entrance from F- North Ward.
6. Water connection execution outside our plot
7. BEST/Adani/Power Supply Agency for electric connection work
8. Street connection for sewerage outside our plot.
9. Local police station
10. Local ward office i.e F- North Ward. issues during construction
11. Local complainants during execution of work
12. Construction Water and Electric connection
13. Labour hutments and related issues.
14. Temporary office for construction purpose permission.
15. Lift certificate from concern authority.
16. As per a recent circular from MCGM. daily the work to be carried out between 6 AM to10PM.
17. The contractor is binding for the circulars /notifications issued by authorities from time to time.
18. During construction the height of the barricading shall be 25 Mtrs and green cloth up to 20th floor for covering the building from all the sides. Contractor has also to provide water sprinklers on the site as dust mitigation.

Section – 8

SPECIAL CONDITIONS OF CONTRACT

Contents:

1. DEFINITIONS

"Design consultant" shall mean **ASSOCIATED ARCHITECTS** having their office at "Shreedhar",1170/31/4, Revenue Colony, Shivajinagar, Pune-411005

PMC shall mean---------- having their office at

Electrical Consultant shall mean ----------having their office at

Plumbing Consultant Shall mean---------- having their office at

HVAC consultant shall mean---------- having their office at

Engineer-in Charge shall mean Resident Engineer at site designated by Employer.

2. GENERAL

2.1 These Special Conditions of Contract (SCC) shall be read in conjunction with the General Conditions of Contract (GCC), Schedule of Rates, specifications of work, drawings and any other document forming part of this Contract wherever the context so requires.

2.2 The Contractor may please note that Special conditions are part of the Contract Documents, which he shall fulfill in all respects. The cost towards these shall be included in BOQ rates.

2.3 In case of variation the contents in Special conditions of contract shall take precedence over General conditions of Contract.

2.4 Notwithstanding the sub-division of the document into these separate sections and volumes, every part of each shall be deemed to be supplementary of every other part and shall be read with and into the Contract so far as it may be practicable to do so.

2.5 If any provision in the General Conditions of Contract / General Purchase Conditions is repugnant to or at variance with any provision(s) of the Special Conditions of Contract and / or the Agreed Variations or if any provision of the Special Conditions of Contract is repugnant to or at variance with any provision(s) of the Agreed Variations, and the two cannot be reconciled or otherwise co-exist, then unless a different intention appears, the provision (s) of the Special Conditions of Contract shall be deemed to override the provision (s) of General Conditions of Contract and the provision (s) of the Agreed Variations shall be deemed to override the provision(s) of the Special Conditions of Contract, but only to the extent that such repugnancies in the General Conditions of Contract cannot be reconciled with the Special Conditions of Contract and / or Agreed Variations or to the extent that such repugnancies in the Special Conditions of Contract cannot be reconciled with the Agreed Variations, as the case may be.

2.6 It will be the Contractor's responsibility to bring to the notice of Engineer-in-Charge any irreconcilable conflict in the Contract documents before starting the work (s) or making the supply with reference to which the conflict exists.

2.7 Wherever it is stated in this Bidding Document that such and such a supply is to be affected or such and such a work is to be carried out, it shall be understood that the same shall be effected/carried out by the Contractor at his own cost, unless a different intention is specifically and expressly stated herein or otherwise explicit from the context. Contract value (also referred to as Contract Price) shall be deemed to have included such cost.

2.8 The materials, design and workmanship shall satisfy the applicable 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 / Specifications/Codes of practice for detailed specifications covering any part of the work covered in this Bidding Document, the instructions/directions of Engineer-in-Charge will be binding on the Contractor.

In the absence of any Specifications covering any material, design or work(s) the same

shall be performed/ supplied/ executed in accordance with standard Engineering practice as per the instructions/directions of the Engineer-in-Charge, which will be binding on the Contractor.

3. CONTRACT PERIOD:

The contract shall be valid for a period of **36 months** from the date of Intimation by Shikshan Prasarak Mandali, Pune's contract coordinator to the contractor to start the work and shall include the rainy season.

4. DRAWINGS:

Tender Drawings issued with the Bid documents give details necessary to understand the work. The contractor is to submit as built drawings along with the final bill.

5. DOCUMENTS TO BE MAINTAINED AT SITE:

The following registers/documents will be maintained at site by the contractor at his own cost but may not be limited to the below list. And would be as per the format given by the consultant. They should be available for inspection by the Consultant's representative during his site visit or as required by Consultant.

1. Work order copy
2. BOQ with final rates
3. Tender
4. Company quality and safety manual
5. Organization chart
6. Drawing register
7. Drawings new and superseded in separate folders
8. Latest bar chart
9. Daily progress reports
10. Weekly progress reports
11. Monthly progress reports.
12. Hindrance register
13. Material receipt
14. Material challans
15. Cement stock register
16. Sand stock register.
17. Steel stock register
18. Strata testing report
19. Cement testing report
20. Sand testing report
21. Steel testing report
22. Cube register
23. Pour cards
24. Other material test reports
25. Triplicate book for Memos.

6. PAYMENT:

Running Account Bills should be presented for settlement. The Running Account Bills will be checked & certified by the Consultant within a period of 7 working days to check and certify the bill by consultant after receiving soft and hard copy of bill along with all necessary documents and payment shall be paid within 15 working days from the date of certification by consultants. All bills shall be submitted in soft copy as well as hard copy. The minimum amount of RA bill shall be Rs One Crore & duration of bill shall not be more frequent than One Month. All the Test reports, Joint Measurement Reports, Progress reports with photographs, Excess savings statements are also to be submitted along with the Running Account Bills. The Employer / Consultant shall be within his rights to adjust and deduct the advances such that full recovery will be made at appropriate stage.

7. CANCELLATION OF TENDER:

Shikshan Prasarak Mandali reserves the right to cancel this tender on its own discretion without assigning any reason. Shikshan Prasarak Mandali reserves the right to modify / withdraw this tender based on its project needs which are dynamic in nature and accordingly may decide to modify / cancel this tender. Under such circumstances, Shikshan Prasarak Mandali shall return the Tender Fees and the EMD amount to all the bidders within 30 days of cancellation of Tender. No interest shall be payable on the Tender fee and the EMD amount.

8. SECURITY DEPOSIT/PERFORMANCE GUARANTEE:

Contractor to submit **1%** of Contract Value in form of performance bank guarantee (PBG) valid till contract period + 2 months, if project extends the bank guarantee needs to be extended without any cost to client. The bank guarantee will be returned on project completion.

9. LIQUIDATED DAMAGE / BONUS:

Penalty for Delay: All the Works will have to be completed as per the Work Schedule, which may be amended by the Contractor and the Owner jointly from time to time. In the event that the Contractor fails to achieve Completion of the entire Civil Works within the time stipulated plus such reasonable extension of the time as the Engineer-In-Charge may allow on account of delay in the Civil Works due to circumstance beyond the Contractor's control, liquidated damages / penalty shall be levied at **0.5%** of the Contract Value per week or part there of (including Sundays & holidays) up to a maximum of 5% (Five Percent) of the Contract Value and the amount of such liquidated damages / penalty shall be recovered from the Contractor.

Bonus for Early Completion of Work: In case of early completion of work before period of completion 24 months or more, when there is no reduction in original scope of work by more than 10%, and no extension granted on either **SHIKSHAN PRASARAK MANDALI, PUNE; SHARADA SABHAGRUH, S P COLLEGE CAMPUS, PUNE411030** or Contractor's account, Contractor shall be entitled for a bonus of 1% for each 30 days early completion of work. The period of less than 30 days shall be ignored while working out bonus. The maximum bonus shall be limited to 2.5% of original contract value. The completion date shall be reckoned as the date of issuance of completion certificate by engineer.

10. MOBILISATION ADVANCE:

The contractor, if requested, shall be paid recoverable Mobilisation advance upto the maximum 5% of awarded contract value .

RECOVERY OF MOBILISATION ADVANCE:

Mobilization advance shall be completely recovered from first five bills. The Bank guarantee furnished shall be valid up to date of completion of entire work as stipulated in the contract. Bank guarantee will be released once the Mobilization advance is recovered.
Mobilization at site by the contractor is not subject to disbursement of Mobilization Advance by client.

11. TAXES AND DUTIES

a) Bidders are required to quote prices as per the bill of quantities (BOQ) and rates shall be inclusive of all taxes and duties except GST. The rate of GST shall be indicated separately in the Price Bid and also in the technical bid. Bid shall be evaluated based on landed cost at site after taking into account Input Tax Credit Benefit if available to Shikshan Prasarak Mandali as per Tax Regulations at the time of price evaluation. The bidder shall provide details, namely GST Registration Number along with the copy of registration certificate.

b) Devi Ahilyabai Smarak Samitee, Dhantoli, Nagpur,

may claim GST, if applicable as per tax regulations" The bidders should quote GST separately (In rates as well as in values). GST thereon shall be payable extra as actual against copy of invoice in triplicate indicating GST registration number and category of service. Bidders shall furnish the present rates of GST as applicable.

c) All the invoices raised shall be "Tax Invoice" and shall be in the manner set out under Section 86 of the Act, so as to ensure that Input Tax Credit could be availed by Shikshan Prasarak Mandali on payments to the Contractor.

d) Any Statutory variation in GST, within the contractual completion period, shall be on Employer's account, against submission of documentary evidence. However, in case of delay in completion period beyond the contractual date, for reasons attributable to contractor, any increase in these rates shall be borne by the contractor, whereas any decrease shall be passed on to the Employer.

e) Further, in case of delay in completion of work, due to reasons attributable to contractor, any new or additional taxes, duties or levies imposed after the contractual completion date shall be on contractor's account.

f) Notwithstanding the foregoing, EMPLOYER shall not bear any liability in respect of:

   i. Personal taxes on the personnel deployed by the Contractor, his Sub Contractor and Agent etc.

   ii. The Corporate Taxes in respect of Contractor and his Sub-Contractor and other Agents.

iii. Any other taxes / duties/ levies

12. STATUTORY APPROVALS

Contractor is responsible for taking statutory approvals except in places where ever stated in the bill of quantities or other pales in the tender. And account of the same to be taken in the rates quoted for those items. However, if any documents related to approval is required from the contractor the same to be furnished to the client.

13. INCOME TAX

Income tax at the prevailing rate shall be deducted from the CONTRACTOR's bills as per the Income Tax Act. EMPLOYER shall issue the necessary TDS Certificate to the CONTRACTOR. Bidders Shall provide their PAN No., GST Registration No. in their un-priced bid.

14. GST

Contractors shall submit proper tax invoices for local purchase, as per the GST Act, to enable Shikshan Prasarak Mandali to take full input tax credit under GST Act, in the absence of which, payment shall not be released. T.I.N. No. shall be indicated in all local purchase orders / invoices towards procurement of materials. T.I.N. no will be provided to Contractor after the job is awarded.

15. RETENTION MONEY:

5% retention money towards further security will be deducted from all the interim bills including final bill. 100% will be released after 1 year from completion (Defect liability period). The amount can be released after submission of Equivalent amount of bank guarantee from a nationalized bank valid for a period of minimum one year (Defect liability period).

16. WATER AND ELECTRICITY:

Water for construction shall not be made available to the contractor. Contractor has to arrange the construction water without any extra cost. The contractor at his own cost shall arrange distribution of pipe networks, storage and such distribution network arrangement shall have the prior approval of the Engineer-in-Charge so as not to interfere with the layout and progress of other jobs.

All temporary arrangements for distribution of construction water shall be removed forthwith after completion of the work or if there is any hindrance caused to the other works, the contractor will re-route or remove the temporary lines at his own cost in a manner so as to continue his (contractor's) work in an uninterrupted manner.

Supply of electric power for the work shall be in scope of contractor within quoted rates. Owner will not provide source of electricity for the work. Further arrangement for power distribution shall be made by contractor depending upon the construction power requirement at his own cost as per Electricity Act and Rules framed there under and approved by Engineer-in-Charge. No power shall be provided for structural fabrication/ erection/ welding work at site. The contractor will arrange DG set on his own till construction power is established.

All temporary arrangements for distribution of construction power shall be removed forthwith after completion of the work or if there is any hindrance caused to the other works, the contractor will re-route or remove the temporary lines at his own cost in a manner so as to continue his (contractor's) work in an uninterrupted manner.

The contractor will be responsible for overall lighting of the site.

17. SITE FACILITIES

(a) Contractor shall provide and maintain site office of minimum size 10' feet X12' feet for consultant with toilet facility and air-conditioning including furniture, fixtures, drinking water and electrical power. The location shall be finalized by the Engineer-In-Charge. The contractor shall be responsible for obtaining permission for temporary office for construction purpose .

(b) The site office can be made in Porta cabin shall be completed and handed over within 7 days of Notice to proceed.

(c) The Contractor shall establish his office, laboratory, stores, steel storage and fabrication yard, cement storage shed in watertight construction and of adequate capacity, drinking water facilities, sanitization facilities, rest room, for his staff and workers. Proper access and internal roads for vehicular traffic in all-weather shall be provided. The contractor shall prepare and submit to Shikshan Prasarak Mandali such a drawing/layout showing all the above facilities.

(d) No storage of material would be allowed in the existing factory premises.

(e) Cement godown of minimum 500 bags.

(f) Statutory approvals, licenses for above mentioned facilities shall be obtained and maintained by the contractor at his own cost

(g) No labour camp shall be allowed inside the site premises.

(h) Contractor to make arrangement for Labour toilets and staff toilets in form of porta cabin along with septic tank and soak pit and the same need to be maintained till the completion of project

(i) Contractor shall have to provide computer facilities at site for keeping various records, filling of all projects related data etc. with Xerox facility.

(j) Fax facility, land line / mobile at site for efficient communication.

(k) Contractor shall have to retain four wheeler like jeep, at site for easy maneuvering of men and materials.

(l) Contractor shall have to establish site laboratory for testing of civil materials.

(m) Manpower required at site:

Contractor shall have to engage minimum:

- 1 full time Project manager (Degree holder) – minimum 15 years of experience at site.
- 2 Full time engineers (Degree holder) – minimum 5 years of experience at site.
- 1 Safety Officer, certified in fire & safety at site.
- 2 Supervisors (Diploma holder) with 4-5 years' experience at site:
- 1 full time storekeeper
- 1 office assistant

(n) Colored photos of size 8" x 6" ~~with negatives~~, covering all important activities of all structures shall be submitted with the RA Bills every month.

18. MONTHLY RUNNING BILL:

The contractor shall prepare and submit a running bill once a month covering work done in that particular month. **The minimum R A Bill amount shall be rupees fifty lakhs**. The Engineer-In-Charge shall check, certify and forward to the Employer for further necessary action.

19. FINAL BILL

I. Only on obtaining virtual completion certification from the Employer, the Contractor shall submit the FINAL BILL which will be settled within a period of two months provided there is no dispute. The completion certificate will be issued only after all the defects pointed out are rectified completely to the satisfaction of the Employer and documented in the form of Acceptance of work by the Employer. Reconciliation of all the materials should be submitted along with the bill.

II. **Final Bill**:

(a) As soon as possible after the Works/Plant/Equipment have been completed and successfully commissioned the Contractor shall forward a certified final account to the Consultant. This shall include a reconciliation of all materials or things issued by the Employer. No claims will be entertained after receipt of the final bill. It would require 45 days for certification of final bill and payment shall be paid within 45 working days from the date of certification by consultants.

(b) The Consultant shall check and certify the final amount admissible on the final bill. The Contractor shall be entitled to be paid this amount less than percentage (%) indicated in the Tender as Security for performance during the Maintenance period, and the value of all payments made on account against Interim Certificates, and any other amounts payable to the Employer and any other deductions required by law.

(c) The amount retained from the Final Bill towards security for the performance during the Maintenance period shall be released by the Employer on the issue of the Maintenance Certificate. The Security Deposit shall be released along with the payment of the final bill.

(d) The final bill shall be submitted by the Contractor in a form approved and in the manner prescribed by the Consultant.

(e) At the time of receiving the final payment the contractor has to submit no due and no claims certificate to the client.

(f) Final payment will be done only after complete site clearance and demobilization from site and removing all temporary structures, material, machineries, site office etc. complete to the satisfaction of client and consultant.

III. **Recovery of Sums Due**:

Whenever under the Contract any sum of Money shall be recoverable from or payable by the Contractor, the same may be deducted from any sums then due or any become due to the Contractor under the Contract or under any other Contract with the Employer.

20. MINIMUM RESOURCE REQUIREMENT

Contractor to provide detailed resource planning including machines, men and material required to complete the project within the duration as stipulated in the tender. Resource planning should be indicated per week basis for all activities required for completion of the project. Deficiency if any in the resource planning shall be rectified and resources required shall be mobilized by contractor as per instruction of consultant/ employer with no additional cost.

This resource chart will be reviewed and tracked on every week basis and a penalty of Rs. 50,000/- per week would be imposed if there is any shortfall in the resource deployment to maximum limit of 5% of contract value.

Contractor to provide on site one full time project manager of minimum 15 Years of experience from the start of the project as stated in the tender. If the contractor fails to provide the same Penalty of Rs. 5,000 per day shall be levied on non-availability of project manager at site maximum up to 5% of contract value, deductible from next immediate bill of the contractor.

21. PROJECT MANAGEMENT TEAM

Contractor to work in close coordination with the project management team appointed by client at site and will strictly abide to the instruction and requirement given by them.

SECTION- 9

HSE & Safety Clauses for Contract Execution

HSE Guidelines for Contractors:

Introduction

Health and safety in construction is not a matter to be taken lightly. In fact, health and safety needs to be front of mind in every aspect of construction at all times. The construction industry is prone to many hazards and accident potential. Construction materials, tools, machinery and handling techniques all come with their own dangers. The main types of accidents which cause death or serious injury on construction sites include falls, incidents with site vehicles, collapsing materials and mobilized cranes and contact with overhead power lines.
Most accidents can be avoided by proper training & awareness, implementing stringent health and safety protocols and ensuring those protocols are constantly maintained. H&S methods will ensure the construction site has a good design; proper planning and uses tried and tested safety techniques.

There is simply no excuse for slacking or cutting corners when it comes to health and safety in construction. Poorly implemented health and safety techniques and design with improper management can result in accidents, illness and even death.
Construction is a high hazard industry that comprises a wide range of activities involving construction, alteration, demolition, digging, material stacking, and/or repair. Examples include residential construction, bridge erection, roadway paving, excavations, demolitions, and large scale painting jobs. Construction workers engage in many activities that may expose them to serious hazards, such as falling from rooftops, unguarded machinery, working in confined space, being struck by heavy construction equipment, electrocutions, silica dust, and asbestos.

Potential hazards for workers in construction include:
• Scaffold collapse;
• Falls (from heights);
• Falling of object;
• Failure to use proper personal protective equipment.
- Electric Shock /Electrocution
- Fire
- Dust and pollution

Everyone is responsible to act in a manner so as to provide:
a) Safety to himself.
b) Safety to his fellow employees
c) Protection to the public and environment
d) Protection to the company's property

- Help prevent accidents and injuries before they occur. Stay alert at all times. Watch for any situation that may cause (or) lead to accident and injury to yourself and others on the job.
- Practical jokes, horseplay, drinking of alcoholic beverages, fighting and use of illicit drugs are strictly prohibited.

- Always obey work instructions given to you. If you are not clear what you have to do, ask your supervisor.
- What is familiar to you is new to the new workers. Explain and show them the correct way of working.
- Always remember that low accident rate increases productivity and reduces cost.
- Report promptly any near miss, incident (or) dangerous occurrence to your supervisor immediately and cooperate fully in any investigation.
- Report all unsafe conditions, tools, equipments to your supervisor so that any dangerous condition can be corrected before it can cause accident.
- Flammable materials should not be carried inside the plant premises without any obstruction.
- No one will remove, displace, damage or destroy safety equipment furnished for use on the job nor interfere with its use.
- Handle all compressed gas cylinders with care, use in upright position well secured and each type of gas separated with valve protection caps in position. Storage of cylinder with upright position and properly tied with chain.
- For working at height for longer periods use a ladder fixed with Height (4) = Ground Width (1) ratio (or) properly erected scaffolding.
- Obey the instructions mentioned in the safety signs posted in the plant premises.
- Actively participate in the emergency drills and exercises conducted in the plant and act as per your role.
- Actively participate in safety meetings and contribute through your valuable suggestion for the promotion of safety.
- Know the location of the emergency exits and exits and emergency equipments. Familiarize yourself on the use of all emergency equipments e.g. Self-Contained Breathing apparatus.
- Wear / use all safety / protective gear provided for your safety. Use them even if slightly inconvenient: slight inconvenience is better than an injury.
- Wear hard hat at work and inside the designated areas.
- High levels of noise will damage your hearing. Hearing protection devices are required to be worn in designated high noise areas.
- When working over water / at a height of more than 2 mts, safety belt / harness should be used. (According to rule heights more than 1.8 mts height full body harness should be used also use LIFE LINE)
- Don’t use compressed air for cleaning your clothes (or) body
- Drive carefully and obey all road safety rules and speed limits
- Unauthorized entry of vehicle/persons inside the plant is strictly prohibited
- All jobs should be carried only with a valid work order and ensuring to have a authorized license to work / and (or) a work permit.
- Keep assembly point/ area free of obstacles/ hurdles and easily accessible.

- Display signages directing the safety devices (extinguishers/ sand buckets/ hydrants etc.)
- Display signages for assembly point location.
- Display signage for fire safety staircase.
- Display emergency call numbers at various locations.

Definitions

Areas of Accountability: Pre-designated area(s) normally located ≥ 15 m from the building / construction site, where a headcount is conducted after an emergency evacuation.

Authority Having Jurisdiction (AHJ): The regulatory agency, typically the city or town inspector charged with code compliance, as it pertains to the specific code.

Barrier Protection: Physical separation of adequate size and strength to prevent unauthorized access to an area, building, section of a building, excavation or space where persons and/or vehicles are excluded or protected.

Competent Person: The two most appropriate definitions, as it pertains to a site specific safety plan are included here-in. A competent person could be either a technically qualified and trained individual for a specific task, such as a scaffold erector or a construction supervisor, or it could be an individual who has the ability to recognize a hazard, and has the ability to promptly correct it.

- a person with the appropriate certification, knowledge, or who is a technically qualified and trained individual for a specific task, or a person who is capable of identifying existing hazards in the workplace, selecting the appropriate control strategy, and has the authority to take prompt corrective action to eliminate the hazards

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Confined Space: any space that meets the following 3 criteria:

1. Is large enough and so configured that an employee can bodily enter and perform assigned work.
2. Access doors and panels measuring as an example; 450 mm x 450 mm, 600 mm x 600 mm, 900 mm x 900 mm etc.
    - Manhole(s)
    - Tunnels
    - Has limited or restricted means of ingress or egress, such as, but not limited to:
    - Boilers, ductwork, elevator hoist-ways, overheads and pits, excavations, pits, stacks, tanks, tunnels, vaults
3. Is not designed for continuous occupancy.
   There are only two classifications for confined spaces;

Contract: an agreement between two or more parties for the doing or not doing of something specified.

Contractor: a person who contracts to furnish supplies or perform work at a certain price or rate. A written agreement between clients, contractors and their sub-contractors.

- Contractors, unless specifically identified as Main Contractor(s), shall include both Main and subcontractors.

Employer: a person or business (contractor and/or sub-contractor) that employs one or more people, esp. for wages or salary:

Excavator: any company or person, including the client who performs an excavation

Facility: any building, pipe, underground enclosure such as a vault or manhole.

Inspector: a person from a local, state or federal regulatory agency who is on site for the purpose of inspecting for compliance.

Multiple Employer Work Site: is made up of:

- The Creating Employer: the employer that caused a hazardous condition that violates an OSHA standard.
- The Exposing Employer: an employer whose own employees are exposed to the hazard.
- The Correcting Employer: an employer who is engaged in a common undertaking, on the same work site, as the exposing employer and is responsible for correcting a hazard.
- The Controlling Employer: an employer who has general supervisory authority over the work site, including the power to correct safety and health violations itself or require other to correct them. Control can be established by contractor or, in the absence of explicit contractual provisions, by the exercise of control in practice.

Client: a person who owns; possessor; proprietor.

Project: a large or major undertaking, esp. one involving considerable money, personnel, and equipment.

Trench: a subsurface excavation >900 mm in depth, and is $\leq$ 1.5 M between soil walls, as measured from the bottom.

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1. <u>Safety Officer:</u>

The Contractor shall appoint Safety Officers for site from day one till end of the job with qualification & experience as given below,
A person shall not be eligible for appointment as a safety office unless he is,

a. B.E. with 2 Years experience
b. 3 years Diploma in Engineering & 3 Years experience
c. Any other graduate or +12 with Diploma in Fire & Safety will not be treated as qualified safety officer.

Such Safety Officers may be assisted by suitable and adequate staff.

RESPONSIBILITES AND AUTHORITES OF SAFETY ENGINEER/ OFFICER-

a. **RESPONSIBILTIES:-**

1) Identify the hazards associated / related to the task.

2) To advice on safety aspects in all job studies and to carry out detailed job safety studies of selected job.

3) Suitable and sufficient risk assessment shall be carried out by the site safety engineer/ officer.

4) Providing Information on Legal requirements to site team.

5) To advice management on prevention of personal injuries and maintaining a safe working environment.

6) To advice the concerned departments in planning and organizing measures necessary of the effective control of personal injuries.

7) To advice on matters related to carry out safety inspections.

8) To check and evaluate the effectiveness of action taken OR proposed to be taken to prevent personal injuries.

9) Develop Implement & and maintain Safe System of Work and Performance standard.

10) To carry out plant / site safety inspections in order to observe the physical condition of work and the work practice and procedures followed by worker.

11) To advice on measures to be adopted for removing the unsafe physical conditions and preventing unsafe actions by workers.

12) Investigating accidents / incidents keep records and give feedback to management.

13) To design and conduct suitable training and educational program for the prevention of accidents and personal injuries.

14) Develop and maintain the interest of the workers in establishing and maintaining safe system / condition of work and procedures.

15) Conduct Safety Trainings every 30 days, induction training start of project and for every new person on board, tool box talk daily, etc. and maintain record of same.

16) To advise and assist the management to fulfill the Health, Safety and Environment requirement, Complying with all applicable Laws, Regulation, Standard and Procedures, Legal and Other requirement.

17) To advice the purchase and store department in ensuring high quality and availability of Personal Protective Equipment's. Maintain PPE inventory and stock record for checking.

18) Investigate accident / incident and give the feedback to management to avoid re-occurrence of same accident / incident.

b. **AUTHORITIES:-**

1) Can stop the unsafe work which is consider dangerous for life OR bad for Environment only if the Safety Manager will not present on site OR on his behalf of site.

2) Cannot restart the work unless it is checked by Safety Manager OR without his written clearance/ decision.

3) Can give Non Conformity OR Violation notice to contractors, sub – contractors, OR individual worker if failed to comply with HSE requirements and or even stop work for noncompliance as deem fit for valid reasons.

4) Can take disciplinary action against any contractor, sub – contractor, and any individual if repetitively failed to comply with HSE requirements, including Termination from job or site / plant.

5) Ensure compliance of the requirement or recommendation made by from Directorate of Industrial Safety & Health (DISH).

6) Can take disciplinary action against individual as penalty, fines if observed in un safe manner.

7) Report unsafe acts, conditions to safety manager, H.O.D, Project Manager, Site in-charge.

8) Reject homemade and modified tools and equipment using at site / plant.

9) Reject any P.P.E. which is not suitable OR incompatible for the task.

10) Can purchase P.P.E. OR any First – Aid accessories if required urgently.

11) Stop anybody to enter into the plant / site without wearing proper P.P.E. (Mandatory P.P.E).

12) Can check license, Certificates of organization, Machine, Equipment and Tools OR Individuals.

2. Personal Protective equipment (PPE):

Contractor shall provide all required PPEs as specified by HUHTAMAKI INDIA LIMITED to all employees, work force deployed and be responsible to train his/her employees on the correct use and maintenance of personal protective equipment. The contractor will also ensure that additional 10% PPE are available all the time in the store locally. All PPE should be conforming to applicable IS standards.

a. **Eye and Face Protection**

- ✓ Safety glasses or face shields must be worn anytime during operations/ task such as welding, grinding, cutting, breaking etc. else it can cause foreign objects getting into the eye.
- ✓ Eye and face protectors are selected based on anticipated hazards.
- ✓ Safety glasses or face shields are worn when exposed to any electrical hazards including work on energized electrical systems.
- ✓ Use of lose glass piece instead of face shields/ safety goggle is not permitted strictly.

b. **Foot Protection**

- ✓ Construction workers should wear work shoes or boots with slip-resistant and puncture-resistant soles.
- ✓ Safety-toed footwear is worn to prevent crushed toes when working around heavy equipment or falling objects.

c. **Hand Protection**

- ✓ Gloves should fit easily.
- ✓ Workers wear the right gloves for the job (for example, welding gloves for welding, insulated gloves and sleeves when exposed to electrical hazards).
- ✓ The contractor will also ensure gloves suiting the activity are provided to workmen involved in special jobs such as welding etc.

d. **Respiratory Protection**

- ✓ Wear appropriate respirators/ nose masks in areas where health hazards exist due to accumulation of dust, fumes, mists (or) vapors.

e. **Head Protection**

- ✓ Workers shall wear hard hats where there is a potential for objects falling from above, bumps to their heads from fixed objects, or of accidental head contact with electrical hazards.
- ✓ Hard hats are routinely inspected for dents, cracks or deterioration.
- ✓ Hard hats are replaced after a heavy blow or electrical shock.
- ✓ Hard hats are maintained in good condition.

f. **Body Protection**

- ✓ Wear protective clothing, suit or apron as appropriate when needed.
- ✓ Compressor operators and welders will be provided with boiler suits of made up of cotton fabric.
- ✓ Wear reflective jackets during night works.

g. **Hearing Protection**

✓ Ear plugs/ muffs must be worn at all time in high noise areas.

h. **Working at height**

✓ Double lanyard full body harness must be worn for any over head jobs exceeding 1.8 mts. or at places where there is imminent danger of injury due to falling has been identified in site based risk assessment.

i. **Work Over Water**

✓ Life jacket and safety belt/ Full body harness must be worn while working over water.

3. <u>Health and fitness for duty:</u>

The contractor is responsible for defining and implementing health and fitness requirements for each type of duty (e.g. avoiding vertigo in elevated works and claustrophobia in confined spaces, etc.). Work permits/ health certificates is a must for all workers by competent authority.

a. **<u>First Aid Kit</u>**

First-aid boxes.—the contractor shall ensure at a construction site of a building or other construction work that—

- sufficient number of first-aid boxes or cupboards are provided and maintained for providing first-aid to the building workers;
- every first-aid box or cupboard is distinctly marked “First-Aid” and is equipped with the articles specified in Schedule III annexed lo these rules;
- nothing except appliances or requisites for first-aid is kept in a first-aid box or cupboard and such box or cupboard is so kept as to protect it against contamination by dust or other foreign matter and against penetration of moisture and such box or cupboard is kept in the charge of a person trained in first-aid and is always readily available during working hours.
- First Aid box to contain all medicines/ ointments as specified by safety officer (listed below for ref.) and shall be available for checking any time during work.

The Building and Other Construction Workers’ (Regulation of Employment and Conditions of Service) Central Rules, 1998

The following list sets forth the minimally acceptable number and type of first-aid supplies for first-aid kits required. The contents of the first-aid kit listed should be adequate for small work sites, consisting of approximately two to three employees. When larger operations or multiple operations are being conducted at the same location, additional first-aid kits should be provided at the work site or additional quantities of supplies should be included in the first-aid kits:

1. Gauze pads (at least 4 x 4 inches).
2. Two large gauze pads (at least 8 x 10 inches).
3. Box adhesive bandages (band-aids).
4. One package gauze roller bandage at least 2 inches wide.
5. Two triangular bandages.
6. Wound cleaning agent such as sealed moistened towelettes.
7. Scissors.
8. At least one blanket.
9. Tweezers.
10. Adhesive tape.

11. Latex gloves.
12. Resuscitation equipment such as resuscitation bag, airway, or pocket mask.
13. Two elastic wraps.
14. Splint.
15. Directions for requesting emergency assistance.

[59 FR 51672, Oct. 12, 1994; 60 FR 47022, Sept. 8, 1995]

OR

As per American National Standards Institute

Kit Includes:

(1) Plastic case w/gasket,7-11/16" x 4-9/16" x 2-3/8"
(30) 1" x 3" Adhesive plastic bandages*
(3) Knuckle fabric bandages
(3) Fingertip fabric bandages, large
(1) 3" Conforming gauze roll bandage
(1) 40" Triangular sling/bandage, w/2 safety pins*
(4) 3" x 3" Gauze dressing pads*
(1) 5" x 9" Trauma pad*
(30) Antiseptic cleansing wipes (sting free)*
(10) First aid/burn cream pack, 0.9 gm
(1) 1/2" x 10 yd. First aid tape roll*
(1)4-1/2" Scissors, nickel plated
(1)4" Tweezers, plastic, one time use
(4) Exam quality gloves, 2 pairs*
(1) First Aid Guide

Also, Contractor need to ensure that at all time at site, sufficient & effective Snake Bite's Anti Venom Medicines & other essential requirements for same should be present at site. A trained person should be available at site at all time, whose responsibility would be to provide First Aid in case of a Snake Bite & further arrange and send for further required medical attention.

b. **Vehicular traffic**

- ✓ Vehicular traffic in work place should be kept at a minimum.
- ✓ Passage for vehicular traffic during normal conditions should be clearly marked.
- ✓ Safety signage should be placed to warn workmen of danger of possible vehicular impacts.
- ✓ Stoppers should be provided and used during vehicle parking.
- ✓ The drivers for the vehicles used at sites should be trained and should have valid driving license.
- ✓ Traffic marshal must be deputed by contractor for controlling traffic if instructed and found necessary by **Huhtamaki-India Limited** at contractor's own cost.

Topics to be included whenever necessary:

It is not permitted to block roads with vehicles, equipment or work operations without special consent.

- Driving elsewhere than on the Site roads is not permitted.
- Overtaking is not allowed.
- Parking is only permitted in approved parking locations.
- Impeding access to fire hydrants is not permitted.
- All vehicles must have a gate pass to access on site.
- Always take into consideration that you are on a work site where unexpected traffic situations can occur.

- No person is allowed to drive a motor vehicle on the site unless he/she is in possession of a valid driver's license and valid full bid for the vehicle in question.
- Observe Company site speed limits on all roads.
- Look for the Company traffic signs.
- The wearing of seat belts is compulsory whilst driving on the site.
- Employees walking on the road must do so facing the oncoming traffic towards them where possible.
- Personnel shall only ride in vehicles when sitting on seats designed for that purpose
- Drivers shall give pedestrians the right of way.
- Other topics as directed by client depending on site road safety requirements.

c. **General Health and Sanitation**

The Main contractor is responsible for health and sanitation on this project.

- Housekeeping practices are reflective of the site health and sanitation program
- The Main contractor shall be responsible for providing the work site with adequate potable drinking water. Water to be tested periodically at contractors cost.
- The Main contractor shall provide the appropriate sanitary cans for restroom facilities
- All restroom facilities including sanitary cans shall have, as a minimum alcohol-based hand cleaners and disposable toilet paper and towels.
- Provision of adequate refuse bins to be mad by contractor at various locations of site.

Summer Weather

- Heat Related Illnesses – the Emergency Action Plan must be kept up to date in order to handle heat related illnesses such as heat exhaustion and heat stroke which may arise in the summer months.
- First Aid – members of the Emergency Action Plan must be properly trained in order to handle such heat related illnesses.
- Drinking Water – adequate potable drinking water must be provided on site at any given time so that the workers can drink ample fluids throughout the day.

4. Medical examination/Certificate Labours

The employer shall ensure at a construction site of a building or other construction work that—

i. a building worker who is employed for a work involving such risk or hazards, inherent in such work as the Safety In-charge considers appropriate for the periodical medical examination of such worker, is medically examined at such intervals as the Safety In-charge may direct from time to time;

ii. every operator of a crane, winch or other lifting appliance, transport equipment or vehicle, is medically examined before employing such operator and again periodically, at such intervals as the Safety In-charge may direct from time to time;

iii. the medical examination referred to in sub-clause (i) and sub-clause (ii) is to be conducted by such medical officers or at such hospitals as are approved by the Central Government for the purpose from time to time;

iv. In case of a building worker who is exposed to special occupational health hazard owing to job or work assigned to such worker, the periodical medical examination referred to in sub-clause (i) or sub-clause (ii) includes such special investigation as may be deemed necessary by the construction medical officer examining such building worker for the diagnosis of occupational disease.

a. No building worker is charged for the medical examination referred to in sub-clause (i) or sub-clause (ii) of clause (a) and the cost of such examination is borne by the employer employing such building worker.

b. Certificate of medical examination referred to in sub-clause (i) or sub-clause (ii) of clause (a) is issued in Form Annexure 5 to these rules.

c. The record of the medical examination referred to in sub-clause (i) or sub-clause (ii) of clause (a) of every building worker employed by him is maintained in a register and such register shall be made available to the inspector having jurisdiction, on demand.

d. in case a construction medical officer examining a building worker under sub-clause (i) or sub-clause (ii) of clause (a) is of the opinion that such building worker so examined is required to be taken away from the building or other construction work at which he is employed for health protection, such medical officer shall inform the employer of such building worker accordingly and such employer shall inform such opinion to the Board where such worker is registered as a beneficiary.

Reference- The Building and Other Construction Workers' (Regulation of Employment and Conditions of Service) Central Rules, 1998

5. Contractor's responsibility

Contractor will be solely responsible for health and safety of their personnel and Client will not take any responsibility for any mishap / accident / damages etc, occurring due to your negligence and / or failure to follow safety instructions.

6. Safety instructions:

Contractor will follow all the safety and security instructions given time to time by Client management.

7. Safety regulations:

In respect of all labour, directly or indirectly employed in the work for the performance of Contractor's part of this agreement, the Contractor shall at his own expense arrange for all the safety provisions as per safety codes of Indian Standards Institution, statutory requirements of Factory Building Act and all other statutory requirements, Regulations, Rules, and orders made there under and such other acts as applicable. Special attention shall be given to the various provisions of safety codes of Factories Act, 1948 & statutory amendments or modifications enforced time to time.

The Contractor shall observe and abide by all safety, fire safety regulations adopted by the Employers. Before starting construction work, Contractor shall consult Employers safety Security officer and must make good to the satisfaction of the Employer any loss or damage due to fire to any portion of the work done or to be done under this contract or to any of the Employer's existing property.

The Contractor shall organize his operations in a workmanlike manner and take all necessary precautions to provide safety and prevent accidents on the site to both person and property. The Consultant shall have the power to require the Contractor to adopt from time to time such measures as he may consider necessary to ensure the above requirement.

(i) All personnel of the Contractor working within the plant site shall be provided with safety helmets, safety shoes, goggles, gloves and Safety Harness for working at height. All welders shall wear welding goggles while doing welding work and all metal workers shall be provided with safety gloves. Persons employed on metal cutting and grinding shall wear safety glasses.

(ii) Adequate precautions shall be taken to prevent from electrical equipment. No materials on any of the sites of work shall be so stacked or placed as to cause danger or inconvenience to any person or the public.

(iii) Contractor shall maintain first aid facilities for his employees and those of his specialized agencies.

(iv) All critical, industrial, reportable and fatal injuries shall be reported promptly to Employers first and then to Factory Building inspector's office and police department and a copy of Contractor's report covering each personal injury requiring the attention of a physician shall be furnished to the Employers. A Contractor shall take all necessary action vis a vis the compliance of statutory requirements of said authorities. Contractors shall settle all such incidences and keep the Employer indemnified against complications arising out of the same.

GENERAL RULES:

Smoking within the Work Area, is strictly prohibited. Violators of the "No Smoking" rules shall be discharged immediately. No smoking signage to be displayed at various visible locations.

8. Job Hazard Analysis (JHA) or Job Safety Analysis (JSA)

A JHA or JSA shall be developed for all non-routine activities, as well as for major construction operations. The Analysis shall be performed by a competent person, and shall be appropriately documented. A copy of the JHA / JSA shall be provided to the company safety officer or their safety representative.

The JHA or JSA is performed to be used as an operating procedure, and shall be made available for review and training for personnel performing the identified work.

- A copy of the JHA / JSA shall remain on site.

9. Record Keeping

- Certificates and reports received by a contractor in respect of any test, inspection or examination of any equipment, excavation, shores, earthwork, etc, should be kept at the relevant construction site. These certificates and reports should be readily available for inspections by senior officers and other concerned authorities.

10. Hazard Identification & Risk Assessment

The procedure of Hazard Identification & Risk Assessment is applicable to all activities carried out in HUHTAMAKI INDIA LIMITED. The purpose if HIRA is to establish, implement & maintain a documented procedure for carrying out a careful

examination of all activities at each workplace, which could cause harm to people. Thereafter identify the hazards associated with each activity on an ongoing basis & assess the associated risks. Finally determine and implement control measures to bring down the identified risks to an acceptable level. The contractor should ensure that copy of site specific HIRA signed by HUHTAMAKI INDIA LIMITED Engineer In charge & HUHTAMAKI INDIA LIMITED HSE Engineer. Format for the same is given at the Annexure 6.

11. Means of Egress

All means of egress within the area or building shall be properly maintained for health and safety reasons.

- Personnel must be able to enter and exit the area, building or facility without hazard.
- All corridors and other walk / work surfaces shall be free of accumulated dust(s) and waste.
- Boxes, cardboard and other combustible material shall be kept to a minimum at designated locations to reduce the risk of fire.
- Cords and other potential trip hazards shall be run along the base of the wall or overhead.
    - Cords run overhead shall not be run above ceilings, ceiling grids or through walls.
    - Cords run overhead should be hung by non-metallic means such as rope, string or tape.
- Corridors shall not be used for the storage or placement of gases.
    - Combustible storage should be placed in a separate area or room, in case of fire.
    - Equipment should be properly stored to prevent trip and fall, and for ease of retrieval.
- Flammable Gas and Liquid storage shall be kept to a minimum, and shall be stored in a manner acceptable to the client and the local fire department.
    - Flammable gases and liquids shall not be placed or otherwise stored in a “means of egress”, such as a corridor or exit.
    - Flammable and combustible liquids shall be placed in approved metal (self-closing) cans and Flammable Storage Cabinets.
- All floors, unless otherwise permitted by the Building Official, shall have (2) separate and distinct means of egress.
    - If a stairwell must be removed, or temporarily made inaccessible, it shall be the responsibility of the Main contractor to create another means of emergency egress, which could include, but is not limited to;
        - Safety Ladders to lower floor or ground
        - Safe Access to scaffold/staging

- Whenever an Exit is temporarily closed or relocated, the main contractor shall make the following site modifications;
    - Cover or remove any reference to the existing signage
    - Post exit signage at the new location and
    - Direct employees and visitors to the new or temporary exit, as required

All means of egress must be properly identified, as required by the building official and OSHA. At a minimum the EXIT sign must be;

- Green or Red in color
- At least 600mm above the floor
- Easily recognizable & readable font even from distance
- All **EXIT** signs that no longer serve an actual exit, must…
    - be covered to prevent confusion, and
    - Shall have alternative exit signage (with arrows) in place to re-direct occupants to the new exit.
- Lighting is the responsibility of the main contractor, or their identified designee. Adequate illumination must be maintained at all times for reasons of safety.
- Emergency lighting is required in areas where work may be necessary at night, or in locations below grade, in cases of power failure
- All temporary lighting must have the appropriate guards, as required

The wattage of the light bulbs shall not exceed the manufacturer's specifications for the light fixture

12. <u>Lighting</u>

- shall be adequate for the job site
- lighting shall be of the appropriate wattage, and placed in fixtures, including temporary in a manner specified by the lighting manufacturer
- emergency lighting is required if work on the project will extend to after daylight hours

Emergency lighting is required for below grade areas of the project and other areas where natural lighting is not available, in the event of a power failure

13. <u>Emergency Action Plan</u>

Fire Alarms – All employees and visitors are required to evacuate the building or site in the event of a fire alarm, regardless of cause or time.

- For reasons of accountability, the Main Contractor shall, before any work is initiated, identify specific **areas of accountability** for each contractor, trade or manageable group.
- Accountability areas shall be > 15 m from the building.

- It is the responsibility of the individual group, (by contractor, trade etc.), to determine whether or not all of their personnel evacuated the building, and if not, to report the names of the missing (or unaccounted person(s)) to the fire department incident commander, the local police/security department, and the project In-Charge.

Fire – In the event of an actual fire or smoke condition, the previously identified (through training) procedures shall be followed: Notify all persons in the immediate area of the fire to initiate evacuation

1. **Close** the door to the fire area/room to contain the fire and/or smoke condition after everyone has left area.
2. **Activate Alarm** (fire alarm, horn or other suitable warning device) to initiate building/site evacuation.
3. **Phone Police** or local Emergency Number (100)
4. **Evacuate** the building/site or **extinguish** the fire, if properly trained.

Medical Emergency

Emergencies (which include significant lacerations, amputations, head, neck or back injuries, loss of consciousness, allergic reactions, diabetic emergencies, seizures, Snake Bites, difficulty breathing, stroke and unknown illness or injuries) shall require the response of an ambulance.

Unless required for reasons of personal safety (such as explosion, fire, structural failure etc), no person needing emergency first aid shall be relocated, as this may compromise their health, safety and well-being.

- A designated person shall be identified to meet the ambulance at a pre-determined location, and direct the ambulance crew into the area or building where the incident has occurred.

Emergency Equipment

- First Aid Kits, Fire Extinguishers and Air Horns shall be conspicuously placed by the Exit on each floor.
    - First Aid Kits shall be maintained by the project in charge or his/her designee.
    - At the above locations, the names of personnel on site with CPR and / or First Aid Training shall be posted.

Illness and Minor Injuries

- All minor injuries and illness shall be reported to one of the following person(s) as soon as possible.

For minor injuries and illnesses, provided there has been no head or back injuries, loss of consciousness, difficulty breathing, significant bleeding, seizures, diabetic emergency, or decreased level of consciousness, a patient can be transferred to an approved medical facility by an authorized "trained" employee, in a company vehicle. Minor injuries and illnesses might include flu-like symptoms or minor lacerations (less than 5 stitches).

14. <u>Emergency procedures:</u>

Emergency site procedures shall be communicated to the contractor's manager or HSE Representative at the start of the work (e.g. during the first HSE meeting). Prior to starting work, the Company shall ensure that all contractors' employees are fully aware of the company emergency procedures

15. <u>Confined Space</u>

It is the responsibility of the Main contractor, in cooperation with the client to determine where confined spaces are, or may be located on the construction site.

- Examples of hazards include, but are not limited to;
  - 1.5 cm of water on the floor
  - Atmospheric hazards such as **carbon monoxide** (> 35 ppm), **lower explosive level** (> 10%), **hydrogen sulfide** (sewer gas) (> 10 ppm), **oxygen** deprivation (< 19.5%) or enrichment (> 23.5%)
  - Chemical
  - Electrical hazards
  - Engulfment
  - Entrapment
  - Environmental and physical hazards (temperature, fire, hot water and steam etc.)
  - Mechanical hazards (moving objects)

The following are the minimum requirements for Confined Spaces;

- 4 gas (Oxygen, LEL, CO and H2S) monitor for space (atmospheric evaluation)
- Personal protective equipment, which might include a tripod for personal rescue
- Attendant (person remaining outside the confined space) for the purpose of occupant safety
  - Attendant must be equipped with, and know how to use a means of communication to contact a rescue service
  - An authorized, properly trained attendant shall monitor the entrant / occupants within the confined space, the atmospheric / environmental conditions, communication with entrant / occupants and emergency services. The attendant is not permitted to leave the confined space opening until all entrants / occupants are out of the space, or he / she is relieved by another qualified attendant.
- Notification or arrangement of a "designated" rescue service (ex: local fire department)
  - Failure to procure a rescue service (in advance) is an OSHA non-compliance issue
- Permit, completed in advance, which identifies potential hazards and corrective measures

- Copies of the permits must be provided to any and all entities that require same, before the confined space is entered.

16. Hazardous substances:

Hazardous substances must not be used where a practicable safe alternative exists. All hazardous substances purchased for site whether by contractors or subcontractors shall be shipped with a Safety Data Sheet. All MSDS shall be collected by the contractor's HSE representative and be freely available for inspection by any worker.
All hazardous substances must be stored in accordance with the manufacturer's instructions and employees using those substances must be trained in their safe use. Combustible material must be kept away from ignition sources. The contractor shall implement a safe system of work and provide all relevant PPE to ensure that the risks associated with the use, handling, storage and disposal of such substances are minimized. He/she will ensure that any person handling such substances has received instructions regarding the hazards, the system of work to be adopted and the actions required in the event of spillage. The contractor's HSE instructions to workers may include the identification of risks, HSE precautions, and spillage, waste and emission control procedures. In addition, any work involving the usage of X-ray equipment shall be executed in strict accordance with legal regulations and by qualified people. Warning signs and barricades will be used when required.

17. Housekeeping

The contractor shall make sure workers adhere to housekeeping requirements of the company site.
Topics to be included whenever necessary:

- Work locations, equipment and buildings are to be kept clean and orderly at all times.
- All work areas are to be free of dangerous projections or obstructions, and are to be maintained free of rubbish, oil, grease and water.
- All toilet facilities, including hand basins should be maintained in a clean and hygienic condition.
- No food should be kept in work areas.
- Flammable waste must be stored in metal containers located at a safe distance from any possible ignition source.
- Leave your place of work tidy when your work is finished so that nobody will run the chance of falling over something.
- For that matter, do not be disorderly during your work either. Take care in what you do.
- All stacking of material must be made on ground that is level and all stacks must be neat and stable.
- All circular objects must be suitably locked to prevent them from rolling.
- To protect the environment and save expenses:
- Do not allow products to run off into the soil, but collect them or have them suctioned of.
- Spillage of oil, grease, etc. must be cleaned up as soon as it is practicable.
- All scrap or refuse bins must be clearly marked as to the type of scrap or refuse that must be deposited in them.

- Scrap and refuse bins must be removed by the contractor on a regular basis.
- Clean up any leakages and prevent the spread of bad smells.
- Ensure that oil or chemical products do not leak away into soil, cooling water or sewer system. This can cause difficulties for subsequent water treatment.
- Pay attention to household refuse,
- Metal or chemical waste should be deposited separately in containers.
- Hazardous substances have to be handled and used in accordance with legal requirements and good practice.
- Hazardous waste has to be properly, safely and legally managed from the point of creation to the point of final disposal.

18. <u>Waste</u>

Proper waste management is an environmental issue. The generation of waste has to be avoided or minimized. If waste is generated the contractor has to take all practical steps to ensure that all wastes are properly, safely and legally managed from the point at which they are created to the point of disposal. Contractor shall obtain Solid waste Management NOC till the completion of the project in all respects within quoted rates i.e. up to obtaining the completion certificate or Occupation certificate from MCGM.

General waste

Disposal of general waste generated during contractor's work at site is not allowed at the plant site. If waste disposal is part of the contract or accepted by the plant manager/coordinator it must be advised where the disposal should be made, preferably supervised by the plant manager/coordinator.

Hazardous waste

Hazardous waste has the potential to cause air, soil or groundwater pollution if not handled or disposed of properly. Hazard waste to be identified and disposed off as per directions of SHIKSHAN PRASARAK MANDALI,PUNE;SHARADA SABHAGRUH,S P COLLEGE CAMPUS,PUNE411030authorities.

19. <u>CONTRACTOR'S BARRICADES:</u> (All barricading shall be executed as per directions/ approval of SHIKSHAN PRASARAK MANDALI,PUNE;SHARADA SABHAGRUH,S P COLLEGE CAMPUS,PUNE411030authorities)

I. Contractor shall erect and maintain at his own cost barricades required in connection with his operation to guard or protect the entire working area, sea fronts and site offices etc.

II. Barricades and hazardous areas adjacent to but not located in normal routes of travel shall be marked by red flasher lanterns (blinkers/ LED strip lights) at night without any extra cost.

III Complete Construction site shall be barricaded by contractor without any extra cost. Temporary barricading shall be done for minimum **6.0 mt** (25ft) height using Colour coated GI sheets with proper supporting system made of structural steel and shall have wicket gate and material gate. **Security shall be provided to all gates to control the entries without any extra cost by Contractor.**

IV. The contractor has to provide Sign board at site with detailed name of project, name of client and name of consultant with name of contractor at the entrance of the site and shall be clearly visible without any extra cost.

V. The Contractor shall also comply with the provisions of Environment Protection Act with regard to air, water & noise pollution.

VI. The contractor shall provide suitable safety net to prevent damage to man / material at site without any extra cost.

VII. Contractor's employees and those of his agencies shall become acquainted with Employer's barricading practice and shall respect the provisions thereof.

VIII. Contractor to make proper arrangement for barricading and curtaining off all the existing parts of the factory using Colour coated GI sheets with proper supporting system made of structural steel as directed by the engineer in charge at no extra cost.

20. <u>Scaffolding:</u>

All scaffolds are tubular steel double leg with horizontal members at every three feet and properly tied laterally without making holes in the masonry. All standards to have proper base plates of min. 4" x 4" and must be resting on proper sole plate. No extra payments shall be entertained towards this and contractor's rates shall be inclusive with these conditions. Movable scaffolding to have heavy duty wheels with breaking arrangement. The scaffold shall be erected and maintained strictly in accordance with applicable Indian Standard.

i) Suitable scaffoldings shall be provided for workmen for all works that cannot safely be done from the ground or from solid construction except such short period works as can be done safely form ladders. When a ladder is used a Mazdoor shall be engaged for holding the ladder and if the ladder is used for carrying materials as well suitable foot-holds and handholds shall be provided on the ladder and the ladder shall be given an inclination not steeper than 1 in 4 (1 horizontal and 4 vertical)

ii) Scaffolding or staging more than 4 meters above the ground or floors swing or suspended from an overhead support or erected with stationary support shall have a guard rail properly attached, bolted, braced and otherwise

retarded at least one meter high above the floor or platform of such scaffolding or staging and extending along with entire length of the outside the ends thereof with only such openings as may be necessary for the delivery of materials. Such scaffolding or staging shall be so fastened as to prevent it from swaying from the building or structure. Only steel scaffolding with 'H' frames and double support, properly braced shall be allowed to be used.

iii) Working platform, gangways and stairways shall be so constructed that they should not sag unduly or unequally and if the height of the platform of gangway or the stairway is more than 4 meters above ground level or floor level, they should be closely boarded, should have adequate width and should be suitable fastened as described in (ii) above.MS planks/ jallis used for gangways shall be tied double for stiffness and safety. Gangways, platforms shall be provided with safety railing of adequate height (1m). Toe board shall be provided to either sides of gangways/ platforms.

iv) Every opening in the floor of a building or in a working platform is provided with suitable means to prevent the fall of persons or materials by providing suitable fencing or railing whose minimum height shall be 1 meter.

v) Safe means of access shall be provided to all working platforms and other working places. Every ladder shall be securely fixed. No portable single ladder shall be over 9 meters in length. The width between the side rails in run ladder shall in no case be less than 30 cm for ladder up to and including 3 meters in increased at least 15 mm for each additional meter of length. Uniform step spacing shall not exceed 30cms. Adequate precautions shall be so stacked or placed as to cause danger or inconvenience to any person or public. The Contractor shall also provide all necessary fencing and lights to protect the workers and staff from accidents, and shall be bound to bear the expenses of defense of every suit action or other proceedings of law that may be brought by any person for injury sustained owing to neglect of the above precautions and to pay any damages and cost which may be awarded in any such suit or action or proceedings to any such person or which may with the consent of the Contractor be compromise any claim by any such person.

vi) The Contractors shall give all technical details about scaffolding systems before erecting the same and only after obtaining specific sanction from Client/consultants shall erect the same. In any case all the responsibility of safety aspect shall be borne by Contractors only.

vii) The contractor should provide aluminum staircase for easy access to the scaffolding and other inspection areas free of cost.

21. <u>Safety Tips for Painting</u>

Using Protective Equipment

The basic gear you need for a safe DIY paint job are: gloves, safety glasses or goggles, a dust-mask for sanding, and sensible shoes with a good grip.

Skin protection:

- Wear the appropriate gloves: cloth or leather gloves for sanding and scraping, impermeable gloves for applying water-based paint, solvent-resistant chemical gloves for handling solvent-based products.

Eye protection:

- Use eye goggles or glasses, or a face mask.

Lung Protection:

- Wear an anti-dust mask whilst sanding a surface or a solvent-respirator if working with solvent-based products.
- Ensure good ventilation with open windows and doors.
- Remove sources of ignition.

Handling Solvent-based Products

All organic-based solvents – including white spirit, solvent-based paints, solvent-based thinners and primers, solvent-based wood treatment products as well as paint strippers – represent potential health hazards, and require that particular precaution be taken both in use and in storage.

Here are some tips:

- Read the label carefully for information on safety and health-related issues.
- Solvents are highly flammable – keep these paints away from all sources of heat, and never expose directly to an open flame.
- Store in cool, well-ventilated areas.
- Keep these products out of reach of pets and children.
- Dispose of rags properly – rags soaked with oil-based materials can ignite spontaneously if not spread out to dry.
- Ensure good ventilation with open windows and doors.
- Wear protective equipment.
- Keep children and pets out of the painted area.

Water-based paints: a viable alternative to solvent based paint:

To a large extent, water-based paints pose fewer risks and health hazards than solvent phase paints. Modern, high quality water-based paints offer an excellent performance profile – superior durability and color retention, excellent washability, for example. They are also more convenient to use – low in odor, they dry quickly, and brushes can be cleaned with warm, soapy water, with no need for white spirit or turpentine. And of course they are more environmentally-friendly.

Using Step-Ladders Safely

Step ladders are very often both a central part of a painting job, but also a key danger area. Here are some tips on how to minimize the likelihood of a ladder-related accident:

Inspect the ladder:

- Take time to check the condition of the ladder both before and after use.
- Check that the ladder is sufficiently robust to support your weight.
- Make sure the steps are free of oil, wet paint, mud, or any other potentially slippery substance.
- Use of wooden ladders should be avoided as far as possible. Steel ladders sall be preferred over wooden ladders.

Erecting the ladder:

- Clear the area around the ladder from any clutter. Make sure that no electrical cords or wire leads are close.
- If the ladder needs to be in front of a door, consider locking the door to prevent surprise openings.
- If the ladder is in a high-traffic area, draw attention to this fact in the house – a hand-written sign would do.
- Make sure the floor is even and stable. Avoid wet or slippery surfaces.
- Always support the ladder at four points
- Engage additional mazdoor for securing (holding) ladder if it cannot be secured safely.
- For high level works above 3.0m, ladder to be provided with side rails of min. 300mm.

Climbing the ladder:

- Wear suitable shoes – no heels, barefoot is not good, nor are most sandals.
- Never climb onto wet or slippery steps, make sure they are dry.
- Never overstretch – do not climb beyond the last three steps of a ladder.
- Keep your shoulders between the rails and don't over-reach – move the ladder instead.
- Always keep 3 point contact with the ladder.
- If your ceilings are high, but your ladder is too small, don't try to overreach yourself – renting or borrowing a suitable ladder is much safer.
- Don't let your children climb up the ladder: prevent access at the end of the day if you have to, or fold it up after use.
- Be prepared for an unforeseen vertigo attack – don't look down, breath slowly and steadily, and go back down step by step.

Top 10 Painting Safety Tips

Painting is a simple process, but it's not without its potential dangers. These painting safety tips, along with some common sense, will ensure that your next painting project comes off mishap-free.

1. Ventilate the area that you're painting. Open all doors and windows in the room, and use fans to keep the air flowing.
2. If the area being painted can't be properly ventilated for some reason, wear a respirator while painting and only work for short periods of time.
3. If you're going to be sanding, wear safety goggles and a dust mask. If possible, use a power sander with a bag for collecting dust.
4. If you're using stripper, cleaners, or any other chemical solutions, wear safety goggles, a respirator, and gloves.

5. Use canvas drop cloths instead of plastic to protect your floors. Cloth stays in place better than plastic and is less slippery.

6. Paint is extremely flammable. Keep it away from any heat sources, such as water heaters or fireplaces, and never smoke while painting!

7. If you're painting or working near any electrical outlets, cover them with painter's tape and turn off the power to the room before you begin.

8. Make sure your ladder is on an even surface and that the cross braces are locked. Never stand on the top rung or the utility shelf of a ladder. If you're having trouble reaching a spot, climb down and move the ladder instead of leaning out.

9. Clean up thoroughly at the end of each day. If you have any rags with alkyd paint or thinner on them, place them outside to dry to avoid spontaneous combustions. When they are thoroughly dry, dispose of them at a hazardous waste site.

10. Once a room is painted, give it at least two days to dry thoroughly before using it. In particular, children and pets should be kept clear of the freshly painted room.

22. <u>Cranes and lifting equipment:</u>

All cranes and lifting equipment, whether owned by contractor or hired, must carry relevant test Certificates and thorough examination reports, together with the manufacturer's handbook. Form No. 11 is mandatory requirement for any Lifting Tool / Tackle / Machine. This Documentation must be submitted to the company for inspection before use (or shipment to site).Only qualified & experienced operators and trained riggers, authorized by the contractor, shall be allowed to operate cranes. The contractor must be able to prove, to the satisfaction of the company, the competence of its employees to operate such equipment prior to its use. Operators must be qualified for each make and model of crane operated. Crane operators or other competent persons must carry out daily inspections and enter these in the crane register. In addition contractor will implement a regular inspection and maintenance program to ensure that all components of the lifting devices are in good conditions.

a) **Crane**

- Cranes must not be used to hoist people for elevated work
- The operator must inspect the machine including safety devices before starting.
- The operator has full responsibility for the safety of a lift and may not make a lift until safety is assured.
- He must be medically examined prior to be deployed for the job for fitness test.
- He must be nonalcoholic and or possess any other intoxicating habits
- The operator must understand and be able to determine the crane's capacity.
- A copy of the load chart must be in the crane whenever it is being operated.
- Accessible areas within the swing radius of the rotating superstructure counter weight of a crane shall be barricaded to prevent people from being struck or crushed by counterweight.
- The load shall not be swung over other people and no individuals shall position themselves under a load.

- The load must be controlled from the ground by means of taglines.
- Crane outriggers must be leveled and fully extended and on solid compacted soil when making a lift. Outriggers should be supported if necessary.
- No part of the crane, load, hoist (load and boom) lines, boom and tag line shall come within 5 metres of energized electrical line.
- Crane contractors shall be approved by company
- Hooks, shackles, beam lamps and slings
- Only one eye in a hook. Use a shackle to hold two or more eyes.
- All hooks must have a safety latch or be mouthed (steel erection and shake-out hooks are exceptions).
- Always place a load in the centre of a hook and never on the edge.
- Get approval from your supervisor before rigging from any structural member to ensure that it will support the load raised.
- Never use plate grips, tongs, pipe clamps etc. as substitutes for beam clamps.
- Hooks, shackles and beam should be inspected and approved before use. Do not exceed the capacity marked on the equipment.
- He must pick up and understand and be well conversant with signals given by signal person.

b) **Chain hoists**

- A chain hoist must be used within its rated capacity.
- Make sure that the capacity is marked on the equipment. Chain hoists are designed so that one person can operate the hand chain to lift the maximum load for the chain hoist.
- Do not leave an unsecured and unattended load hanging on a chain hoist.
- Do not stand or have any part of the body below a load suspended on a chain hoist. Do not wrap the load chain around the load to be lifted.
- Every chain hoist should be inspected before making a lift. Your visual check should include the hooks & hook latch for any irregularities, the chain for wear or damage from abusive treatment.
- Use softeners, where possible, to obtain a "bite" on material rigged.

c) **Ropes**

- **Wire:** inspect for frays, kinks, broken wires and worn spots before using.
- **Fibre**: inspect for excessive broken fibres, worn out and deteriorated inner and outer strands before using.

23. Electrical Safety:

- ✓ Before carrying out any live Electrical work , Electrical isolation permit required to be obtained.
- ✓ No electrical equipment is safe if it is misused. Treat all electrical wires as live wires. Don't insert bare electric wires in socket. Use proper plugs and industrial sockets.
- ✓ Never interfere with electrical equipment. If there is trouble get the electrician. He knows what to do, that is his job.
- ✓ Pay special attention to cables of portable tools and their earthing. Extension cords are often the cause of electric shock. Examine them carefully for worn out insulation and exposed wires before use.
- ✓ Don't drag cords over sharp edges (or) take them across aisles. They may get damaged.
- ✓ Never use portable electrical equipment with wet hands.
- ✓ Before commencing repair (or) maintenance work on any electrical equipment switch off main supply, lock out and remove fuses. Display caution tags on machine and switch boards. Obtain electrical line clearance certificate of required.
- ✓ Use only approved flame proof or explosion proof equipment in hazardous areas/ zones.
- ✓ Work on new and existing energized (hot) electrical circuits is prohibited until all power is shut off and grounds are attached.
- ✓ An effective Lockout/Tag out system is in place.
- ✓ Frayed, damaged or worn electrical cords or cables are promptly replaced.
- ✓ All extension cords have grounding prongs.
- ✓ Protect flexible cords and cables from damage. Sharp corners and projections should be avoided.
- ✓ Use extension cord sets used with portable electric tools and appliances that are the three-wire type and designed for hard or extra-hard service. (Look for some of the following letters imprinted on the casing: S, ST, SO, STO.)
- ✓ All electrical tools and equipment are maintained in safe condition and checked regularly for defects and taken out of service if a defect is found.
- ✓ Do not bypass any protective system or device designed to protect employees from contact with electrical energy.
- ✓ Overhead electrical power lines are located and identified.
- ✓ Ensure that ladders, scaffolds, equipment or materials never come within 10 feet of electrical power lines.
- ✓ All electrical tools must be properly grounded unless they are of the double insulated type.
- ✓ Multiple plug adapters are prohibited.

24. Use of Compressor

Before use of any compressor a test certificate of the pressure vessel need to obtained from competent person in Form No. 13

25. <u>Portable electrical/power equipment and hand tools:</u>

Tools need to be kept in good condition and used for their intended purpose according to Manufacturer's recommendations.

a) **Electrical/Power Tools-**

- Don't force tools beyond their capacity or use "cheaters" to increase their capacity.
- Portable Electrical equipment and tools must be "double insulated" or earthed.
- Trigger locks, on all power tools shall be removed.
- Air supply to pneumatic tools must be shut off and "bled down" before disconnecting.
- Only qualified and authorized personnel may execute work on electrical equipment and installations.
- Before using a portable electrical tool, check to see it is properly earthed, unless it is an approved type that does not require earthing.
- Before using an electric tool, make sure that the casing is undamaged. If it is damaged, don't use the tool.
- Make sure that all cables, plugs or connectors are sound and properly wired up.
- Use tools only on the correct power supply as instructed on the maker's label.
- Make sure that the power cable is long enough to reach your working place without straining it.
- Keep power cables off the floor. They may get damaged or trip somebody.
- Never stand on a damp or wet surface when using electrical equipment, and keep the equipment clean and dry.
- Portable electric tools should only be used for their designed purpose.
- Never connect a portable electric tool to a lighting socket.
- Never use worn, blunt or damaged bits or other accessories.
- Disconnect tools when not in use.
- Electric power tools should be regularly inspected and maintained by a competent electrician.
- Protect the cord from heat, oil, solvents and from being run over by vehicles, etc.
- Do not disconnect the plug by pulling the cord.
- Do not carry tools suspended by the cord.
- Ensure that the operating switch is off before plugging the tools into an electrical outlet.
- Check for proper functioning of control switches, condition of cables and sockets before use.
- Ensure that the guards are in place for the power tools.

b) **Hand Tools-**

- Inspect hand tools for defects before use.
- Always keep hand tools in good condition. Never use defective (or) worn out tools.
- Use the right tool for the job. Use it correctly and safely. For example don't use a screw driver as a chisel (or) a spanner as a hammer. Hand tools are provided to perform specific jobs. Use them on jobs they are intended for.
- Don't carry sharp tools in your pocket.
- Never throw tools. Don't leave them at height.

- People should be trained in the safe use of tools and equipment applicable to their trade.
- Tools or guards are not to be altered. "Home-made" tools are not permitted.
- Personal tools are subject to inspection at any time.
- Tools subject to impact (chisels, star drills) tend to "mushroom". Keep them dressed to avoid flying fragments. Use tool holders.
- Keep the hand tools tied while working at height to prevent accident due to falling.

26. <u>Equipment for elevated works:</u>

Ladders, scaffolds and barriers, will be made available by the contractor whenever necessary.

a) **Ladders**

- Ladders are to be soundly constructed and maintained.
- Ladders are to be inspected before and after use and any observed defects must be reported to our supervisor for repair or disposal.
- Ladders must be fitted using non-slip feet like rubber buffers (merely tying empty plastic bags to toes is not preferred from safety point of view), the frame should be firm and in a good state or repair.
- Non-conductive ladders must be used for electrical work.
- While ascending or descending a ladder, do not carry anything that will prevent you holding on with both hands.
- Wooden ladders are allowed on the site if approved by the safety engineer.
- No ladder must be worked on without it being secured or held in position.

Ladder Check List-

✓ Use the correct ladder for the task.

✓ Have a competent person visually inspect a ladder before use for any defects such as: Structural damage, split/bent side rails, broken or missing rungs/steps/cleats and missing or damaged safety devices; Grease, dirt or other contaminants that could cause slips or falls; Paint or stickers (except warning labels) that could hide possible defects.

✓ Make sure that ladders are long enough to safely reach the work area.

✓ Mark or tag (“Do Not Use”) damaged or defective ladders for repair or replacement, or destroy them immediately.

✓ Never load ladders beyond the maximum intended load or beyond the manufacturer’s rated capacity.

✓ Be sure the load rating can support the weight of the user, including materials and tools.

✓ Avoid using ladders with metallic components near electrical work and overhead power lines.

✓ When a ladder is used a Mazdoor shall be engaged for holding the ladder and if the ladder is used for carrying materials as well suitable foot-holds and handholds shall be provided on the ladder and the ladder shall be given an inclination not steeper than 1 in 4 (1 horizontal and 4 vertical).

✓ No portable single ladder shall be over 9 meters in length. The width between the side rails in run ladder shall in no case be less than 30 cm for ladder up to and including 3 meters in increased at least 15 mm for each additional meter of length. Uniform step spacing shall not exceed 30cms.

b) **Scaffolds**

- Each scaffold shall be inspected and "tagged" before it is released for use.
- All scaffolds must be erected by a competent worker authorised by the contractor.
- Rolling and tower scaffolds with a height greater than three times the minimum base dimension shall be guided or tied-off while being used.
- Rolling scaffolds shall be free of men, material and equipment before being moved.
- All hydraulic platforms shall only be operated by a trained operator.
- Scaffolds structures may not be used to support any load (e.g. pipe spools, structural steel, concrete form work etc.) unless the safety representative has been consulted and the necessary modifications carried out and approved by him/her.

Scaffolding Checklist:-

✓ Scaffolds should be set on sound footing.

✓ Damaged parts that affect the strength of the scaffold are taken out of service.

✓ Scaffolds are not altered.

✓ All scaffolds should be fully planked.

✓ Scaffolds are not moved horizontally while workers are on them unless they are designed to be mobile and workers have been trained in the proper procedures.

✓ Employees are not permitted to work on scaffolds when covered with any materials.

✓ Scaffolds are not erected or moved within 10 feet of power lines.

✓ Employees are not permitted to work on scaffolds in bad weather or high winds unless a competent person has determined that it is safe to do so.

✓ Ladders, boxes, barrels, buckets or other makeshift platforms are not used to raise work height.

✓ Extra material is not allowed to build up on scaffold platforms.

✓ Scaffolds should not be loaded with more weight than they were designed to support.

c) **Barriers**

- Protective barricades are required around excavations, holes or openings in floor or roof areas, edges of roofs and elevated platforms, around certain types of overhead work and wherever necessary to warn people against falling in, though or off. Protective barricades must be of a physical nature.
- Protective barricades may be built of timber, metal poles, cable and wood post and chain.

- Flashing / blinking lights must be used on roadblocks after dark

27. <u>Welding and cutting:</u>

For all welding, cutting and grinding activities, the contractor will only use competent certified and authorized welders and all welding activities will be subject to a hot work permit.

- Only certified and authorized workers may use welding and cutting equipment.
- Welders shall check their equipment before use for:
- Damage insulation on welding leads, electrode holders and connections. Faulty earth clamps gauges, pressure reducers, flashback arrestors and torches. Worn or damaged hoses.
- Fire extinguishers shall be available at the welding/cutting site.
- All workers engaged in welding and cutting activities shall be dressed with the appropriate protective clothing and equipments
- A flashback arrestor shall be fitted on oxy/fuel system immediately downstream of the pressure regulator and a non-return valve shall be fitted in each gas supply system at the torch.
- Compressed gas cylinders shall not be taken into confined spaces or buildings or placed on scaffolds.
- Valves of compressed gas cylinders shall always be closed and secured by protection caps except when in use.
- Compressed gas cylinders shall always be secured to prevent falling, and shall be protected from being struck by moving equipment and falling objects.
- Oxygen cylinders when in storage shall be separated from fuel gas cylinders or combustible material in accordance with local rules or regulations.
- To ensure that welding machines are properly earthed and return earthing is provided
- Fire blanket must be provided under welding areas for preventing spatters to fall on ground or persons underneath.
- Area under welding zone shall be barricaded.

Handle all gas cylinders with care, as follows:

- Lift to upper levels with certified cages only.
- Do not strike an arc on cylinders.Do not use cylinders as rollers.
- Do not lift with slings or by protective cap.

28. <u>Special Measures for Structural steel Works:</u>

<u>Safety :</u>

It is common sense to work safely, protecting yourself and workmates from accidents on the site. Safety includes the practices you use; as well as personal protection of eyes and skin from sunburn, and hearing from noise.

Occupational health and safety laws enforce safe working conditions in most locations but we recommend that you aquatint yourself with all local codes of safe practice and you adhere strictly to all laws that apply to site.

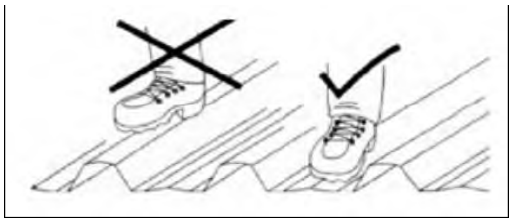
<u>Care and storage before installation :</u>

Rain or condensation is easily drawn between surfaces of stacked sheets by capillary action, or they can be driven in by wind. This trapped moisture cannot evaporate easily, so it can cause deterioration of the coating with may lead to reduced life-expectancy or poor appearance.

If materials are not required for immediate use, stack them neatly and clear of the ground. If left in the open, protect teems with water proof covers.
If stacked or bundled product becomes wet, separate it without delay, wipe it with a clean cloth and stack it to dry thoroughly. The sheeting material should be placed with a minimum 50 slope to avoid a water pond.

Handling cladding on site :
On large building projects you can reduce handling time by lifting bundles with a crane direct from the delivery truck onto the roof frame. Use a spreader bar for long sheets. For without mechanical handling facilities, you can unload sheets by hand and pass tem up to the roof one at a time.
For personal safety, and to protect the surface finish, wear clean dry gloves. Don't slide sheets over rough surfaces or over each other. Always carry tools, don't drag them.

Walking on roofs :
It is important that you walk on roofing carefully, to avoid damage to either the roofing or yourself.
Generally, keep your weight evenly distributed over the soles of both feet to avoid concentrating your weight on either heels or toes. Always wear smooth soft soled shoes; avoid ribbed soles that pick up and hold small stones, swarf and other objects.



When you walk parallel to the ribs: for ribbed roofing walk on at least two ribs or corrugations and for pan-type roofing walk in the pans.
When you walk across the ribs, walk over or close to the roofing supports. Be careful when moving between supports. Do not walk in the pan immediately adjacent to flashings or translucent sheeting. Walk at least one pan away.
Always take particular care when walking on wet or newly laid sheets – particularly on steeply pitched roofs.
If there will be heavy foot traffic on a roof, provide a temporary walkway or working platform to minimize damage.
Never step on the skylight panel or translucent panel.

Marking out, cutting and drilling :
Marking Out – A pencil of any colour may be used except black or so-called lead pencils. Don't use black pencils to mark roofing or walling because the graphite content can create an electric cell when wet and thus cause deterioration of the finish. You can also use a string line with dust, or a fin, felt – tipped marker.
Cutting – Where possible, you should minimize site-work by using sheets cut to length in the factory. For cutting thin metal on site, we recommend that you use a power saw with a metal – cutting blade because it produces fewer damaging hot metal particles and leaves less resultant burr than does a carborundum disc.
Cut materials over the ground and not over other materials where hot particles can fall and cause damage to finishes – especially COLOURBOND steel pre painted finishes. It is best to have the exterior colour finish of a COLOURBOND pre painted sheet facing down; however you must then protect the paint finish from scratching by your work supports.
If you have to cut materials near sheets already installed, mast them to direct the stream of hot particles away.

Reciprocating nibbles are also widely used in the roofing trade, and they produce an excellent cut. The resulting small, sharp scraps can rust and damage finishes; and they can cause personal injury. Take special care to collect these scrapes.
Making holes – holes are often made by drilling or cutting by hole saw or jig saw. Mask there area around the hole to protect paint from damage by swarf.

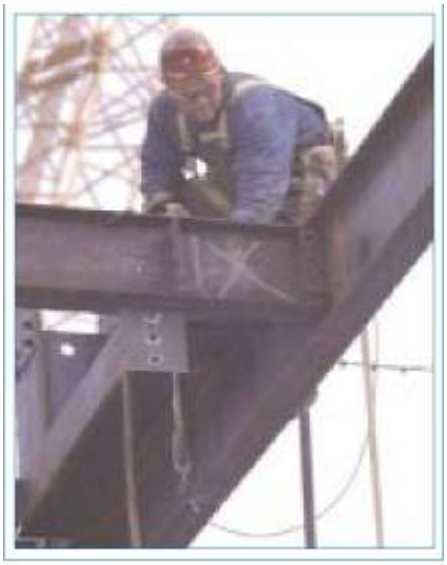
Clean Up :
Swarf (metal scraps or abrasive particles resulting from cutting and drilling) left on the surfaces of materials will cause rust stains which can lead to reduced life of the material.
Sweep or hose all metallic swarf and other debris from roof areas and gutters at the end of each day and at the completion of installation.
If swarf has become stuck on a finish, it can be removed.
Take great care not to remove the paint or the metal coatings.
For critical applications inspect the job two weeks after completion, when rain or condensation will have caused any remaining swarf to rust, and thus highlight affected areas.

Warn other contractors :
Many stains arising from swarf do so, not from the work of roofing- installers, but from other contractors working on the job. Similarly, problems can arise from contact with incompatible materials, like copper piping or chemically treated timber. Acid cleaning of bricks can also be a problem. Architects and builders need to be aware of this, and warn contractors accordingly.

Fall Protection
Hazard: Each year, falls consistently account for the greatest number of fatalities in the construction industry. A number of factors are often involved in falls, including unstable working surfaces, misuse or failure to use fall protection equipment and human error. Studies have shown that using guardrails, fall arrest systems, safety nets, covers and restraint systems can prevent many deaths and injuries from falls.

Solutions:

- Consider using aerial lifts or elevated plat-forms to provide safer elevated working surfaces;
- Erect guardrail systems with toe boards and warning lines or install control line systems to protect workers near the edges of floors and roofs;
- Cover floor holes; and/or
- Use safety net systems or personal fall arrest systems (body harnesses).
- Provide safety life line for hooking of safety harness along the periphery or at locations identified for additional safety while working at heights.



Ladders

Hazard: Ladders and stairways are another source of injuries and fatalities among construction workers.

Solutions:

- Use the correct ladder for the task.
- Have a competent person visually inspect a ladder before use for any defects such as:
    - Structural damage, split/bent side rails, broken or missing rungs/steps/cleats and missing or damaged safety devices;
    - Grease, dirt or other contaminants that could cause slips or falls;
    - Paint or stickers (except warning labels) that could hide possible defects.
- Make sure that ladders are long enough to safely reach the work area.
- Mark or tag ("Do Not Use") damaged or defective ladders for repair or replacement, or destroy them immediately.
- Never load ladders beyond the maximum intended load or beyond the manufacturer's rated capacity.
- Be sure the load rating can support the weight of the user, including materials and tools.
- Avoid using ladders with metallic components near electrical work and overhead power lines.
-

Stairways

Hazard: Slips, trips and falls on stairways are a major source of injuries and fatalities among construction workers.

Solutions:

- Stairway treads and walkways must be free of dangerous objects, debris and materials.
- Slippery conditions on stairways and walk-ways must be corrected immediately.
- Make sure that treads cover the entire step and landing.

- Stairways having four or more risers or rising more than 30 inches must have at least one handrail.

Cranes

Hazard: Significant and serious injuries may occur if cranes are not inspected before use and if they are not used properly. Often these injuries occur when a worker is struck by an overhead load or caught within the crane's swing radius. Many crane fatalities occur when the boom of a crane or its load line contact an overhead power line.

Solutions:

- Check all crane controls to insure proper operation before use.
- Inspect wire rope, belts, chains and hook, hook latches for any damage.
- Know the weight of the load that the crane is to lift.
- Ensure that the load does not exceed the crane's rated capacity.
- Raise the load a few inches to verify balance and the effectiveness of the brake system.
- Check all rigging prior to use; do not wrap hoist ropes or chains around the load.
- Fully extend outriggers.
- Do not move a load over workers.
- Barricade accessible areas within the crane's swing radius.
- Watch for overhead electrical distribution and transmission lines and maintain a safe working clearance of at least 10 feet from energized electrical lines.

Crane Safety

- The upper rotating structure supporting the boom and materials being handled is provided with an electrical ground while working near energized transmitter towers.
- Rated load capacities, operating speed and instructions are posted and visible to the operator.
- Cranes are equipped with a load chart.
- The operator understands and uses the load chart.
- The operator can determine the angle and length of the crane boom at all times.
- Crane machinery and other rigging equipment is inspected daily prior to use to make sure that it is in good condition.

- Tag lines are used to prevent dangerous swing or spin of materials when raised or lowered by a crane or derrick.
- Illustrations of hand signals to crane and derrick operators are posted on the job site.
- The signal person uses correct signals for the crane operator to follow.
- Crane outriggers are extended when required.
- Crane platforms and walkways have anti-skid surfaces.
- Broken, worn or damaged wire rope is removed from service.
- Guardrails, hand holds and steps are provided for safe and easy access to and from all areas of the crane.
- Load testing reports/certifications are available.
- Tower crane mast bolts are properly torqued to the manufacturer's specifications.
- Overload limits are tested and correctly set.
- The maximum acceptable load and the last test results are posted on the crane.
- Initial and annual inspections of all hoisting and rigging equipment are performed and reports are maintained.
- Only properly trained, experienced and qualified operators are allowed to work with hoisting and rigging equipment.

29. <u>Essential Safety Points-</u>

a. <u>Incident / Accident Investigation, Reporting and Record keeping</u>

Emergency incidents should take precedence over all investigations, recordkeeping and reporting. Ill or injured employees should be provided with the most appropriate medical response for the incident, as soon as possible.
After the ill or injured employee has been provided with the most appropriate first aid care (ambulance, medical facility or on-site first aid), the supervisor or their designee shall initiate an incident investigation to correct hazards and prevent re-occurrence.

- An incident report, with as much information as possible should be completed within 24 hours.
    - Additional information can be added to the reports, as it becomes available, and when the injured or ill employee has returned to work or is capable of providing the necessary information.
- The Project In-Charge shall correct all identified hazards immediately, and prevent reoccurrence of the incident and (when necessary) go over the incident and the corrective actions with the project supervisors and/or the employees.
- It is the responsibility of the Main contractor to develop a site specific emergency evacuation plan with procedures and emergency equipment placement for every project.

The Project In-Charge shall correct all identified hazards immediately, and prevent reoccurrence of the incident and (when necessary) go over the incident and the corrective actions with the project supervisors and/or the employees.

It is the responsibility of the Main contractor to develop a site specific emergency evacuation plan with procedures and emergency equipment placement for every project.

b. <u>All Hazards Plan</u>

It is the responsibility of the **Main contractor** to identify other potential emergencies that could occur on site. An All Hazards Plan is a regulatory requirement that indicates the contractor considered other risk factors on the project, and that they are initially prepared to respond to the incident.
The All Hazards Plan should include events that are likely to occur on the project or site, such as floods, high winds, potential falls, structural collapse and environmental emergencies.
The contractor must be prepared for, and be able to notify (in an approved manner) the entire work site about the emergency and the proper evacuation or procedural protocols.

c. <u>Hazardous Materials</u>

- The Main contractor shall make the **client or the client's** designee/representative aware of any hazardous materials found on site that were not previously addressed or identified at the beginning of the project.
- The Main contractor shall notify the client or the client's designee/representative about any hazardous material incidents on site, regardless of size or quantity.
    - Leaks, spills or other types of contamination to air, soil or water which include chemicals, gasoline, hydraulic fluids and oils must be reported immediately
    - Hazardous materials shall be contained and labeled in a manner acceptable to the authority having jurisdiction.
    - Hazardous Materials, including paints, adhesives, etc... shall not be left on site, even after a project completion, unless specifically permitted by the client.
    - The contractor will ensure proper storage of hazardous material if any and make provision of the suitable bund to arrest the spillage if any.
- The Main contractor shall identify, with appropriate environmental assistance, the most appropriate manner in which to properly discard the hazardous material or waste, in accordance with the requirements of the state and federal environmental protection requirements.
    - For additional information and regulatory requirements, see the following sections;
        - Hazardous Waste
        - Solid Waste and Recycling
        - Storm Water
        - Universal Waste
        -

d. <u>Cranes, Derricks, Hoists and Lifts</u>

All crane, derrick, hoists and lift operators who are hoisting and/or moving materials shall be licensed.

- The Main contractor, working with the crane operator shall insure that a "competent" person has been appointed to act as the person-in-charge for all lifts involving cranes, regardless of size and/or weight capacity.
- A backhoe, or similar piece of equipment used for lifting is considered a crane, and is subject to this requirement.

  The person-in-charge is required to have a pre-lift plan for regulatory and safety reasons. The plan must include, but is not limited to the following requirements;
- The operators name and proof of certification, as well as the signaler name and verification of training
- Area survey to insure that the work site is stable and appropriate for the weight and work activities of the crane
- Description, type and rated capacity of the crane being used for the lift
- The list of the equipment or material being lifted, including weight, dimensions and other applicable information
- Appropriate sketches or blueprints of how the material will be lifted.
- Boom and swing angles, crane orientations, lifting points, methods of attachment and rated capacity.
- A pre-lift meeting with all personnel that will be involved with the lift, or in close proximity to same.

  The Main contractor or their designee is required to barricade or provide warnings to alert persons in close proximity about the overhead work. This shall include, but is not limited to;
- protection of doorways and exits, which might include redirection to an alternative entrance / exit
- tape off hazardous areas, including swing zones and areas where overhead hazards are likely to fall
- examples:
    - removal of dumpsters from the roof
    - lifting and/or moving equipment / materials directly overhead of site personnel
    - personnel are not permitted to work under the load being lifted or moved.
- Inspections of cranes, derricks and associated attachments shall be made by a competent person prior to each use

- Cranes, derricks, backhoes and other lifting equipment shall not be used within 4.5 M (minimum) of power lines > 5kV.

Crane Operators are responsible for operations under their direct control. They shall;

- not engage in any practice that will divert their attention while operating the hoisting equipment
- not operate the lift if their operation is / might be impaired (mentally or physically)
- perform an equipment assessment (walk around inspection) to verify personnel, equipment and site safety
- place appropriate barriers or warning lines around the superstructure to prevent unauthorized entry into the site / area of swing
- test all controls and emergency stops
    - improperly functioning / working controls must be adjusted / repaired before the equipment is used.
    - If not repairable, the unit must be removed from service and locked and / or tagged "out-of-service".
- respond appropriately to any signals from a trained "signal person"
- be responsible for anyone working under their direct control, and shall stop any unsafe or potential unsafe operation until corrections can be made
- if a "warning signal" is provided, it shall be sounded just before any move is made
- secure and make safe any unattended hoisting equipment
    - when practical, suspended loads shall be landed under brake control
- not permit any person to work under / beneath the boom or suspended load
  A competent, authorized and properly trained person shall inspect cranes, derricks and associated equipment, as specified by the manufacturer, prior to each use.
- Crane operators are responsible for their cranes and derricks before, during and after any lift.
    - If the safety of the personnel, equipment or facility is in question, the competent person shall;
        - Stop all hoist activities
        - Refuse to handle or lift non-conforming loads
- Headache balls cannot be used to transport personnel
- Safety latches on crane hooks (regardless of hook capacity and size) shall not be deactivated, removed or disabled
- Crane Inspections shall;
    - be performed by a competent person and shall include all aspects, as specified by the manufacturer of the crane.

Use of cranes, including lifting procedures shall be done in accordance with manufactures specifications.

e. Demolition

Before demolition work is initiated, an engineering survey shall be performed by a competent, qualified person to determine the condition of the structure, inclusive of the framing, floors, walls and the possibility of unplanned collapse of any portion of the structure, or any adjacent structures where persons may be exposed.
Following general precautions are necessary for all demolition work:
a) Danger signals should be conspicuously posted around the structure as well as at its doors and openings.

b) During night time, red lights should be placed on and around all barricades.

c) Watchman should be posted at entry points.

d) Protective equipment should be supplied to all workers and their use enforced.

e) Electrical wires, telephone lines and water pipes should be switched off when demolition work is in progress.

f) Protected walkways and passageways should be provided for the use of workers and others.

The **mechanical devices** for demolition include weight balls, power shovels, concrete saw, etc. The selection of the best method is a function partly of time, money and the surrounding environments.

The following precautions should be observed in **mechanical demolition**.

a) The area of demolitions should be barricaded for a minimum distance of 1.5 times the height of the wall.

b) While the mechanical device is in operation, no worker should be allowed to enter the building under demolition,

c) The device should be so located as to avoid falling debris.

d) The mechanical device should not cause any damage to the adjacent structure, power lines, etc.

f. Structural Steel Works

The strength and the main support to a building are provided by its columns. The columns, in turn, are anchored firmly to the foundations by means of holding bolts. Sometimes, the columns may have loose holding bolts that are grouted in concrete after the structure is leveled, aligned and plumbed. They are held in position prior to grouting by temporary guys. Often, some of the guys are required to be loosened or removed temporarily to facilitate erection of other components of steelwork. Here, even a little carelessness can bring the entire structure down resulting in serious or fatal accidents. The basic safety practice in his case is that the erector should get the first four columns of a bay, facing diagonally opposite to one another grouted soon after the bracing of the steelwork and its aligning and plumbing the portion of structure. It is advisable to use anchored heavy duty bolts with open pockets. It will facilitate easy erection and alignment.

Leveling, Aligning and Plumbing a/Columns

For leveling, aligning and plumbing of columns, screed bars or level pads are generally provided. In some cases, they are not provided for columns of light and medium structures. The erection of steel work may proceed row after row without initially paying sufficient attention to leveling and plumbing of columns. It becomes difficult to bring the structure in plumb subsequently in the absence of level pads. Thus the structure remains out of plumb and it may collapse if subjected to winds of high velocity. Such mishaps can be minimized by getting the level pads fixed on footings of all main columns.

Slinging of Heavy Components

Sometimes the design of the structure may not facilitate the slinging of heavy components from structural members for hoisting. Such a design is not safe. Further, the de-slinging of the tall erected columns, especially the plain plated, may pose a problem. In such cases, the rigger climbs up the structure with the help of a rope or a rope ladder fixed to the column before lifting the same. This design is not safe. It is necessary to design a proper access to the wieldable bent rungs and other points.

Fastening

The upper parts of tall structures are subject to higher wind pressure due to higher wind velocity at higher altitude. It is advisable to stabilize the erected anchored columns by fastening temporary wire guys till four column-square is completely braced, leveled and plumbed.

Lifting of Columns

Usually, the foundation pits are back filled with loose earth but the area is seldom rammed. Thus, while lifting the heavy columns by a crane, the earth under the forefront of the crawler gets depressed the front portion of the crawler sinks and the load gets thrown out of radius. Consequently, the crane loses its stability and topples over, causing fatalities. Therefore, the filled in pits must be either manually rammed or rolled over by a heavy roller, and sleepers should be laid over the area. This arrangement will increase the stability of the crane.

g. <u>Steel Erection</u>

Safety practices for erection will vary as per the job. For buildings, riveting or welding should be done to maintain stability of the structural frame at all times during the construction. Safety nets shall be provided within two stories or 10 m below the height of work which is being performed. Safety belt with lanyards attached to catenary line or other substantial anchorage should be used by workers on work which exposes to working at heights of 10 m or more. Personal protection equipment of the specified standard should be used by all workers.

- A pre-planning meeting is required for steel erection and the use of overhead cranes. The main contractor, appropriate sub-contractors and all other parties responsible for the work shall meet, review and modify as necessary all aspects of the site steel erection, before work is initiated.
- A Site Specific Erection Plan with alternate means and methods must be provided.
- Pre-construction conferences and site inspections must be held between the Steel Erector, the Main (controlling Contractor) and all applicable Project Engineers and Fabricators before starting the steel erection.

- The Main Contractor must provide a written notification to the steel erector insuring that;
    - Concrete footings, piers and walls have cured to a level that will provide adequate strength to support any forces imposed during steel erection.
    - Anchor bolt repairs, replacements and modifications were done with the approval of the Project Structural Engineer of Record.
    - A site-specific erection plan is developed during one or more pre-construction conference and site inspections involving the erector, the controlling contractor and others such as the project engineer and the fabricator.

Steel Erection Training

Employee training for all aspects of steel erection must be provided by a qualified person. It must include as a minimum;

- recognition and identification of fall hazards
- use and operation of protective systems and equipment
- protection from falls
- site inspections and safety requirements
- multiple-lift rigging
- correcting
- hoisting
- hooking and unhooking

- Before authorizing the steel erection, the Main contractor shall ensure that the Steel Erector has the following written notifications;
- Commencement of Steel Erection – Proof that the concrete meets the ASTM standards for strength. Site Layout of the project for roads, equipment movement and stability of area for operation of cranes
- Pre-Planning of Overhead Hoisting Operations
- Site Specific Erection Plan
    - Sequence of steel erection activity
    - Description and operation of cranes, and derricks to be used on site
    - Including the pre-shift visual inspection of the equipment referenced above
    - Description of steel erection activities and procedures shall include;
        - identification of the Qualified Rigger:
        - including multiple lift rigging methods, procedures and requirements
        - employee and pedestrian safety under and around the work area
        - maintaining walk / work surfaces
        - metal decking handling procedures

- protection of floor, roof and wall openings
- column anchorage procedures
- beam and column requirements
- open web steel joists installation and safety
- hooking and unhooking loads
- initial corrections

h. Pre-fabricated Members

Use of pre-fabricated member is becoming popular due to the ease in assembly and time saved during construction. The pre-fabrication is done at site or in the workshop depending on the size of the member and the facility available for transportation and lifting.
Launching girders are normally used to place prefabricated girder bridges at the site. Use of cranes is also common in lifting them. If the lifting is not done properly, the member may crack. The spreader beam should be used for this purpose. No one should be allowed under the member when they are being lifted, transported or erected. The lifting wire should be tested for the double load to be handled at least once in six Months. The method of assembly and erection as specified by the designer should be strictly adhered to.

i. Electrical Cords

- **Must be protected from physical damage**
  - flexible cords must be free of damage, splices and taps
  - flexible cords shall be properly maintained and stored
  - twisted cords shall be removed from service and destroyed to prevent future use
  - flexible cords should not be so placed that they are considered a trip and fall hazard

Extension Cords

- cords shall not be placed across a means of egress, or left in/on a walk/work surface
- shall be connected to a GFCI protected outlet, for the duration of the project

j. Roof Work

- All roof work which is greater than 2 M above a lower level is required to have fall protection, including flat and low-slope roofs.
- A competent person must identify the appropriate means of fall protection to be used, for the work being performed.

k. Fire Protection:

✓ Fire plan shall be displayed at site and contractor shall be aware of the same.

✓ Know the location of fire extinguishers, their operational use and the type of fire they are meant for.

✓ Check for flammables before starting welding (or) gas cutting work.

- ✓ In case of fire, warn others on the job and shout for fire. Stay calm, go to the nearest fire call point/ ESD and activate. Only then try to extinguish using the fire extinguisher or else assemble at assembly point.
- ✓ Access to fire extinguishers and fire hydrants should never be blocked. This equipment should always be kept clear of any obstruction.
- ✓ Obey "No Smoking "& "No Open Flame "signs.
- ✓ Know the location of fire call point in your area.
- ✓ Report all fire hazards to your supervisor immediately.
- ✓ Ensure that the vehicle engines are shut off during loading (or) fueling operations.
- ✓ Ensure proper earthling and bonding of vehicle inside hazardous area.
- ✓ Ensure that all vehicles entering in hazardous area have spark arrestor fitted on exhaust.

l. Fire Extinguishers

Shall be conspicuously placed in appropriate areas of the construction or project site. Fire Extinguishers on site shall have the following;

- annual (in date) inspection tag
- a gauge indicating fully charged, and pin with security seal
- Test certificate as per statute

m. Welding / Cutting / Hot Work Activities

Brazing, cutting, heating, soldering, welding and other spark producing work on this job requires the acquisition of a Hot Work Permit
The basic requirements of a Hot Work Permit are;

- The area(s) in which the Hot Work will be performed must be inspected
- All containers, pipes and tanks that were used for other than water or steam shall first be purged and cleaned
- All combustible material shall be located at least 10 M away from the Hot Work Area
- Fire extinguishers must be of proper size and type for the Hot Work activity, and shall be located within 8 M of the Hot Work Area

n. Machine and Equipment Safety &Guarding

Moving machinery can cause injuries in many ways:

- People can be struck and injured by moving parts of machinery or ejected material. Parts of the body can also be drawn in or trapped between rollers, belts and pulley drives
- Sharp edges can cause cuts and severing injuries, sharp-pointed parts can cause stabbing or puncture the skin, and rough surface parts can cause friction or abrasion

- People can be crushed, both between parts moving together or towards a fixed part of the machine, wall or other object, and two parts moving past one another can cause shearing
- Parts of the machine, materials and emissions (such as steam or water) can be hot or cold enough to cause burns or scalds and electricity can cause electrical shock and burns
- Injuries can also occur due to machinery becoming unreliable and developing faults or when machines are used improperly through inexperience or lack of training

Before you start

Before you start using any machine you need to think about what risks may occur and how these can be managed. You should therefore do the following:

- Check that the machine is complete, with all safeguards fitted, and free from defects. The term ‘safeguarding’ includes guards, interlocks, two-hand controls, light guards, pressure-sensitive mats etc. By law, the supplier must provide the right safeguards and inform buyers of any risks ('residual risks') that users need to be aware of and manage because they could not be designed out
- Produce a safe system of work for using and maintaining the machine.
- Maintenance may require the inspection of critical features where deterioration would cause a risk. Also look at the residual risks identified by the manufacturer in the information/ instructions provided with the machine and make sure they are included in the safe system of work
- Ensure every static machine has been installed properly and is stable (usually fixed down)
- Choose the right machine for the job and do not put machines where customers or visitors may be exposed to risk
- Note that new machines should be CE marked and supplied with a Declaration of Conformity and instructions in English

Make sure the machine is:

safe for any work that has to be done when setting up, during normal use, when clearing blockages, when carrying out repairs for breakdowns, and during planned maintenance

- properly switched off, isolated or locked-off before taking any action to remove blockages, clean or adjust the machine

Also, make sure you identify and deal with the risks from:

- electrical, hydraulic or pneumatic power supplies
- badly designed safeguards. These may be inconvenient to use or easily overridden, which could encourage your workers to risk injury and break the law. If they are, find out why they are doing it and take appropriate action to deal with the reasons/causes

Machine & Equipment Hazards:

Electrical Hazards – equipment that uses electricity as a power source is a potential electrocution hazard. Check power cords, switches and connections for exposed wires or broken parts.

Amputation & Caught-in Hazards – machine guards on equipment are installed to protect our employees from moving parts. Of course if they have been removed

during maintenance or adjustment they will no longer provide protection. Check equipment every day to ensure that all guards are in place.
Chemical Hazards – processing equipment that uses chemicals can be sources of numerous hazards. Leaks can cause slip hazards as well as possible exposure to harmful chemicals. Hoses that leak could create a respiratory problem from vapors.
Sharp Edges – simply walking past machinery may be hazardous if sharp edges are not guarded check equipment mounting brackets, sign edges and control boxes to see if sharp edges are present.
Eye Hazards – tools and equipment that create chips, sparks or dust are potential eye hazards. These types of eye hazards are generally controlled by safety glasses, goggles and face shields. Check eye protection your workers use to make sure they are not broken, scratched and are the correct type for the hazard. As a minimum, anyone who uses hand or power tools should wear safety glasses.
PPE – personal protective equipment should be considered a secondary line of defense against equipment hazards. Employees need to know how to properly select, use and clean any PPE they use. PPE does wear out and has limitation on the level of protection against hazards – your workers should know these limitations.

Hazards:
Use of machinery or equipment with inadequate guards or damaged controls can result in:
- Amputation
- Skin Burns
- Cuts & fractures
- Death

Hazard Controls:
Control used to prevent exposure to moving or energized machine parts includes:
- Machine guards
- Interlocks
- Presence sensing devices
- Gates
- Two-hand controls
- Employee training

Preventing access to dangerous parts
Think about how you can make a machine safe. The measures you use to prevent access to dangerous parts should be in the following order. In some cases it may be necessary to use a combination of these measures:
- Use fixed guards (eg secured with screws or nuts and bolts) to enclose the dangerous parts, whenever practical. Use the best material for these guards – plastic may be easy to see through but may easily be damaged. Where you use wire mesh or similar materials, make sure the holes are not large enough to allow access to moving parts

- If fixed guards are not practical, use other methods, eg interlock the guard so that the machine cannot start before the guard is closed and cannot be opened while the machine is still moving. In some cases, trip systems such as photoelectric devices, pressure-sensitive mats or automatic guards may be used if other guards are not practical

- Where guards cannot give full protection, use jigs, holders, push sticks etc if it is practical to do so Control any remaining risk by providing the operator with the necessary information, instruction, training, supervision and appropriate safety equipment

Other things you should consider

- If machines are controlled by programmable electronic systems, changes to any programmes should be carried out by a competent person (someone who has the necessary skills, knowledge and experience to carry out the work safely). Keep a record of such changes and check they have been made properly
- Ensure control switches are clearly marked to show what they do
- Have emergency stop controls where necessary, eg mushroom-head push buttons within easy reach
- Make sure operating controls are designed and placed to avoid
- accidental operation and injury, use two-hand controls where necessary and shroud start buttons and pedals
- Do not let un-authorized, unqualified or untrained people use machinery – never allow children to operate or help at machines. Some workers, eg new starters, young people or those with disabilities, may be particularly at risk and need instruction, training and supervision
- Adequate training should ensure that those who use the machine are competent to use it safely. This includes ensuring they have the correct skills, knowledge and experience – sometimes formal qualifications are needed, eg for chainsaw operators
- Supervisors must also be properly trained and competent to be effective. They may need extra specific training and there are recognized courses for supervisors
- Ensure the work area around the machine is kept clean and tidy, free from obstructions or slips and trips hazards, and well lit

Dos and don'ts of machinery safety for workers

Do…

- check the machine is well maintained and fit to be used, i.e. appropriate for the job and working properly and that all the safety measures are in place – guards, isolators, locking mechanisms, emergency off switches etc
- use the machine properly and in accordance with the manufacturer's instructions
- make sure you are wearing the appropriate protective clothing and equipment required for that machine, such as safety glasses, hearing protection and safety shoes

Don't…

- use a machine or appliance that has a danger sign or tag attached to it. Danger signs should only be removed by an authorized person who is satisfied that the machine or process is now safe
- wear dangling chains, loose clothing, rings or have loose, long hair that could get caught up in moving parts
- distract people who are using machines
- remove any safeguards, even if their presence seems to make the job more difficult
- Machine guarding shall meet the requirements of OSHA
- All exposed blades shall be guarded to prevent accidental injury
- All belts and pulley's will be protected with a suitable guard to prevent accidental contact

- All table saws shall have the appropriate blade guards, anti-kickback devices and push sticks
- The GC shall be responsible for determining what equipment shall have guards, and the appropriate guard for the equipment or machine.
    - Guards shall be used and installed in accordance with manufacturers specifications

30. <u>General Safety for Miscellaneous Construction Activities:</u>

a) General:

i) Before any demolition work is commenced and also during the process of the demolition work,

a. All roads and open areas adjacent to the work site shall either be closed or suitably protected.
b. No electric cable or apparatus, which is liable to be a source of danger, shall remain electrically charged.
c. All practical steps shall be taken to prevent danger to persons employed from risk of fire or explosion or flooding. No floor, roof or other part of the building shall be so overloaded with debris or materials as to render it unsafe.
d. All persons connected with the execution of works shall wear safety helmets, safety shoe, gloves, safety belts, shields, goggles and protective appliances, safety ladders, platforms etc. to the specific requirements of the work.
e. Suitable screens, curtains (plastic mesh hessians) shall be provided. The same shall be maintained in good condition at all the times.
f. All welding works at height to have fire blankets below to protect from sparks.

ii) All necessary personal safety equipments as considered adequate by the CLIENT/CONSULTANTS shall be kept available for the use of the persons

employed at the site and maintained in condition suitable for immediate use, and the Contractor shall take adequate steps to ensure proper use of equipment by persons concerned as outlined below:

a. Workers employed on mixing asphaltic materials, cement and lime mortars shall be provided with protective footwear and protective gloves.
b. Those engaged in white washing and mixing or stacking of cement bags or any materials, which are injurious to the eyes, shall be provided with protective goggles.
c. Those engaged in welding and cutting works shall be provided and protective face and eye-shields, hand gloves etc.
d. Stone breakers shall be provided with protective goggle and protective clothing and seated as sufficiently safe intervals.
e. When workers are employed in sewers and manholes which are in use, the Contractor shall ensure that the manhole covers are opened and are ventilated at least for an hour before the workers are allowed to get into the manholes, and the manholes so opened shall be cordoned off with suitable railing and providing with warning signals or board to prevent accident to the public.
f. The Contractor shall not employ men below the age of 18 years and woman on the work of painting with products containing lead in lead in any form. Wherever men above the age of 18 years are employed on the work of lead painting, the following precautions should be taken.
    1. No paint containing lead or lead product shall be used except in the form of paste or ready-made paint.
    2. Suitable face masks shall be supplied for use by the workers when paint is applied in the form of spray or a surface having lead paint dry rubbed and scrapped.
    3. Overall shall be supplied by the Contractor to the workmen and adequate facilities shall be provided to enable the working painters to wash them on cessation to work.

iii) When the work is done near any place where there is a risk of drowning all necessary safety equipments shall be provided and kept ready for use and all necessary steps taken for prompt rescue of any person in danger and adequate provision should be made for prompt first aid treatment of all injuries likely to be sustained during the course of the work.

iv) Use of hoisting machines and tackles including their attachments, anchorage and supports shall confirm to the following standard or conditions: -

a. These shall be of good mechanical construction, should materials and adequate strength and free from patent defects and shall be kept in good working order.
b. Every rope used in hoisting or lowering materials or as means of suspension shall be of durable quality and adequate strength and free from patent defects.
c. Every crane driver or hoisting appliance operator shall be properly qualified and no person under the age of 21 years should be in charge of any hoisting machine including any scaffolding winch or give signals to the operator.
d. In case of every hoisting machine and of every chain ring hook, shackle swivel and pulley block used in hoisting or lowering or as means of suspension, the safe working load shall be ascertained by adequate means. Every hoisting machine and all gear referred to above shall be marked with the safe working load and the conditions under which it is

applicable shall be clearly indicated. No part of any machine or any gear referred to above in this paragraph shall be loaded beyond the safe working load except for the purpose of testing.

e. In case of departmental machine, the safe working load shall be notified by the CLIENT/CONSULTANTS. As regards Contractor's Machine, the Contractor shall notify the safe working load of the machine to the CLIENT/CONSULTANTS whenever he brings any machinery to site of work.

v) Motors, gears, transmission lines, electric wiring and other dangerous parts of hoisting appliances shall be provided with efficient safeguards. Hoisting appliances shall be provided with such means as to reduce to the minimum the accidental descent of the load, adequate precautions should be taken to reduce the minimum the risk of any part or parts of a suspended load becoming accidentally displaced. When workers are employed on electrical installations, which are already energized, insulting mats, wearing appeal such as gloves sleeves and boots as may be necessary shall be provided. The workers shall not wear any rings, watches and carry keys or other materials, which are good conductors of electricity.

vi) All scaffoldings, ladders and other safety devices mentioned or described herein shall be maintained in safe conditions and no scaffoldings, ladder or equipment shall be altered or removed while it is in use. Adequate washing facilities shall be provided at or near place of work. The Contractor shall indemnify the Employer against any damages whatsoever arising due to injury sustained by any person because of no provision of adequate barricades/fencing and lighting arrangements.

vii) These safety provisions shall be brought to the notice of all concerned by displaying on a notice board at a prominent place at the work spot. The person responsible for compliance of the safety code shall be named therein by the Contractor.

viii) All safety measures for constructional activities shall be as per BIS, unless and otherwise as stated.

ix) All ensure effective enforcement of the rules and regulations relating to safety precautions, the arrangements made by the Contractor shall be opened to inspection by the welfare officer of the company or CLIENT/CONSULTANTS or their representatives.

x) Notwithstanding the above clauses there is nothing in these to except the Contractor from the operations of any other ACT or rules in force in the Republic of India. The works throughout, including any temporary works, shall be carried out in such a manner as not to interfere in any way whatsoever with the traffic in any roads or footpaths at the site or in vicinity thereto or any existing works whether the property of the Employer or of a third party.

b) <u>Care in handling inflammable gas:</u>

The Contractor has to ensure all precautionary measures and exercise utmost care in handling the inflammable gas cylinders / inflammable liquids / paints etc, as required under the laws and/or as advised by the security officer of the Employers. Gas cylinders

shall be stacked in vertical positions only. They (empty and filled cylinders separate) shall be stacked in designated locations only.

c) Temporary combustible structures:

Temporary combustible structures will not be built near or around work site.

d) Precautions against fire:

No fires match boxes and lighters stoves, gas, electric series and heaters will be allowed in the factory premises. The Contractor will have to provide adequate Fire Extinguishers / Fire Buckets and drums at work site as recommended by Client/client/consultants representative. They will have to ensure all precautionary measures and exercise utmost care in handling the inflammable gas cylinders/ inflammable liquid/paints etc. as advised by CLIENT/ CONSULTANTS. Temporary combustible structures will not be built near or around the work site.

e) Explosives:

Explosives shall not be stored or used on the works or on the site by the Contractor without the permission of the Client/consultants representative in writing and then only in the manner and to the extent to which such permission is give. When explosives are required for the works they shall be stored in a special magazine to the provided at the cost of the Contractor in accordance with the Explosive Rules. The Contractor shall obtain the necessary license for the storage and the use of explosives and all operations in which or for which responsibility of the Contractor shall indemnify the Employer against any loss or damage resulting directly or indirectly.

f) Preservation of place:

The Contractor shall take requisite precautions and use his best endeavors to prevent any riotous or unlawful behavior by or amongst his workmen and others employed on the works and for the preservation of peace and protection of the inhabitants and security of property in the neighborhood of the work. In the event of the Employer requiring the maintenance of special police force at or in the vicinity of the site during the tenure of works, the expense thereof borne by the Employer shall be recoverable from the Contractor.

g) Outbreaks of infectious diseases:

The Contractor shall remove from his camp such labor and their families as refuse protective inoculation and vaccination when called upon to do so by the Client/consultants representative. Should cholera, plague or other infectious diseases break out the Contractors shall burn the huts, beddings, clothes and other belongings of or used by the infected parties and promptly erect new huts on the sites as required by Client/consultants representative failing which within the time specified in the Consultant's requisition, the work may be done by the Employer and the cost thereof recovered from the Contractor.

h) Use of intoxicants:

The sale of adent spirits or other intoxicating beverages upon the work in any of the buildings encampments or tenements owned, occupied by or within the control of the Contractor or any of his employees is forbidden and the Contractor shall exercise his influence and authority to the utmost extent to secure strict compliance with this condition.

In addition to the above, the Contractor shall abide by the safety code provision as per Indian Standard Safety Code framed from time to time.

i) Breach of safety regulations:

Breach of safety regulations will be viewed very seriously and the Contractors shall be liable for punitive action as will be recommended by the safety officer of the Employers.

- **On first instance of non compliance towards any of the safety requirements mentioned, warning would be issued to the contractor.**
- **On repetition of the non compliance the site by the contractor penalty of Rs 1000/- per noncompliance will be imposed on the contractor separately for every instance. This penalty will be deducted from running bill of the contractor.**
- **Repetition of penalty may also invite termination of the workmen or the contract.**
- **Strict action can be taken at the first instance itself based on the severity of the noncompliance.**

j) Removal of improper work and materials:

1) The client/consultant shall during the progress of the Works have power to order in writing from time to time.

   (a) The removal from the site within such time or times as may be specified in the order of any materials which in the opinion of the client/consultant are not in accordance with the Contract.

   (b) The substitution of proper and suitable materials and

   (c) The removal and proper re-execution (not withstanding any previous test thereof or Interim payment thereof) of any work which in respect of materials or workmanships not in the opinion of the client/consultant in accordance with the Contract.

2) Default of Contractor in compliance:

   In case of default on the part of the Contractor in carrying out such order the Client shall be entitled to employ and pay other persons to carry out the same and all expenses consequent thereon or incidental thereto shall be borne by the Client and shall be recoverable from him by the Client or may be deducted by the Client from any monies due or which may become due to the Contractor. Appropriate deductions may be made in the payment due to the contractor if in the opinion of the client/consultant any part of the work has not been carried out by the contractor in accordance with the contract and the specifications. Amount of such deductions will be decided by the client/consultant.

k) Work permits:

The contractors shall strictly follow HUHTAMAKI INDIA LIMITED Work Permit System requirements as applicable.

Annexure 1
Accident /Incident investigation report

Project Name :			
Sub-contractor :		**Supervisor/foreman:**	
Location of Accident or incident :			
Date of occurrence :		**Time :**	
Date of reported :		**Time :**	
Reported by :		**Reported to :**	
Type of Accident or incident	**Personal injury Equipment damage Equipment failure Property damage Fire /Explosion**	**Near miss Spill release Material loss Security theft Environment**	**Inhalation exposure Chemical Exposure Occupational illness Contamination Other (Explain)**
Name of Person affected :			
Nature of injury :			
Injured body Part :			
Occupation of person :			
Details of Incident or Accident			
Reasons for the incident or accident			

Recommendation to prevent future occurrence		
Supervisor / Site eng	**Investigated by :**	**Reviewed by :**

Annexure 2
Contractor Acceptance of HSE requirements

The Contractor shall make all necessary arrangements for safety of personnel working at site and ensure that all safety precautions in line with established industry practices are taken and Guide Lines issued by Statutory Authorities. Contractor has to agree on applicable following HSE requirements for carrying out the Job.

1. GENERAL REQUIREMENT – ☐ **Applicable** ☐ **Agreed**
   a. **Training of Contractor's Personnel** – All personnel must complete safety training at Plant.
   b. **Tool Box Meeting**: - Daily tool box meeting shall be conducted at project site.
   c. **Permit to work:** - Contractor shall start work after specific permit issued. Permit shall not be issued in case safety precautions mentioned inside permits are not complied with.
   d. **General Health and Safety Regulations** -Contractor personnel shall follow General health and site safety rules communicated during training
   e. Supervision of the work activity –
      i. Contractor to employ site supervisor's. Before employing, their qualification and experience shall be reviewed by CLIENT/CONSULTANT. At no times contractor personnel shall be left on their own at work site.
      ii. Contractor to employ one Site safety supervisor. Contractor shall provide qualification and experience certificates of Safety supervisor.
      iii. Contractor to employ qualified electrician – Electrical supervisor with license for carrying out electrical work. No other persons are allowed to work on electrical system.
      iv. It shall be responsibility of contract supervisor to ensure workers employed work in designated areas and do not loiter in other restricted areas.
      v. It is the responsibility of supervisor to ensure securing of equipment, their isolation during Lunch Time /Non-working time and at the end of each work. In no case equipment /Machinery tools shall be left in energized condition when work is not happening.

2. PERSONAL PROTECTIVE EQUIPMENT ☐ **Applicable** ☐ **Agreed**
   a. Contractor has to agree to ensure provision of standard Personal Protective equipment (Helmet / Safety Shoe / Gloves / Goggles etc.) to all contract personnel employed at site for the job. In addition to these PPE's any PPE's required by Permit to work shall be provided.

3. EQUIPMENT INSPECTION ☑ **Applicable** ☐ **Agreed**
   a. All equipment / machinery brought inside by contractor shall undergo HSE inspection at site. Equipment's cleared in the HSE inspection only shall be allowed to be used inside the plant.

4. WORK AREA ☐ **Applicable** ☐ **Agreed**
   a. CLIENT/CONSULTANT shall clearly communicate Work area / Travel Path to work site / Instruction for emergency response/Assembly point in case of emergency
   b. Barricading of work area - Contractors to provide standard barricading throughout work site.

5. STATUTORY REQUIREMENTS ☐ **Applicable** ☐ **Agreed**
   a. Following statutory requirements shall be completed and proof must be provided
      i. Labour License if applicable
      ii. Coverage of contractor's personnel under PF code
      iii. Insurance in line with workman compensation policy

iv. Adequate third party liability insurance

v. Medical fitness declaration for workers employed

b. Contractor shall abide by local laws and regulations. Statutory labour register must be maintained at site

c. All workers employed by contractor shall be above 18 years of age and no child labour at work site.

d. Contractor shall ensure working hours for person employed in line with legal regulations

6. PROVISION OF GENERAL AMENITIES - ☐ **Applicable** ☐ **Agreed**

i. Hand washing facility, Drinking Potable water facility, Toilets and Bathroom facility for contractor personnel (Men and women, Area dedicated for lunch away from work site. Contractor is responsible for the material brought at work site. This is required to be registered at the security gate.

7. SPECIFIC HSE REQUIREMENT RELATED TO ACTIVITIES

a. Fabrication Activity – ☐ **Applicable** ☐ **Not Applicable** ☐ **Agreed**

i. To the extent possible fabrication shall be done at contractor's work site. Wherever, fabrication at plant is required the same shall be carried out at an earmarked and segregated area with permit

b. **Hot works –** ☐ **Applicable** ☐ **Not Applicable** ☐ **Agreed**

i. All hot works shall require hot work permit to ensure the precautions mentioned in Hot work permits are abided by contract supervisor

ii. All hot work site shall be provided with a) barricading b) 2 Nos of 10 KG DCP extinguishers c) running Fire water hosed) Continuous supervision e) specific requirement as per permit

c. Welding Operations – ☐ **Applicable** ☐ **Not Applicable** ☐ **Agreed**

d. Welding shall be carried out by trained welder with specific PPE 's as required by permit.

i. Only Standard welding cables without joints shall be allowed for welding

ii. Welding Holders shall be provided for proper keeping of welding rods when not in use.

iii. Proper dry surface (wooden Planks) shall be provided for the wet areas.

iv. Proper availability of return earth connection shall be ensured for equipment.

v. All the welders shall be accompanied by helper identically equipped with PPE.

vi. Welding machine shall have over current relay on the welding machine

vii. Welder shall use leather gloves /Face shield / welding suit and Safety shoes.

viii. In case of surface is wet –proper dry wooden platforms shall be provided.

ix. If surface is full of water –Activity shall be stopped.

x. Supervisor at site shall ensure switching off machinery during non-work period

e. Gas Cutting Operations –

☐ **Applicable** ☐ **Not Applicable** ☐ **Agreed**

i. Gas cutting tool shall have flash back arrestor installed.

ii. Proper NRV shall be provided at both the hoses.

iii. Cylinder labelling and certificates shall be provided before their use

iv. Cylinder hoses used shall be of suitable and pressure rating.

v. All cylinders shall be used vertically and must be secured on trolley protected from sunlight.

vi. All cylinders shall have standard pressure gauge and regulator installed.

vii. Valve operating keys shall be provided on cylinder valve itself for closing of valves

viii. Personnel shall be provided with standard PPE demanded by permit
ix. Friction lighter shall be used instead of match boxes to light the torch.
x. Supervisor at site shall ensure switching off Gas cutting tools / cylinders during non work period

f. Drilling/Grinding Operation- ☐ **Applicable** ☐ **Not Applicable** ☐ **Agreed**

i. Machinery and wheels used shall be allowed only after inspection.
ii. Only grinding machinery with proper guards shall be allowed at site
iii. Electrical cabling used for grinding/drilling machinery shall be through 3 pin plug without joint
iv. Operator shall be trained not to exceed maximum operable speed on the machine
v. Personnel shall be provided with standard PPE demanded by permit.
vi. Supervisor at site shall ensure switching off electrical supply to these machines during non work period
vii. Rotating wheel used shall have expiry dates mentioned on them.

g. Vibrator machine Operation requirements

☐ **Applicable** ☐ **Not Applicable** ☐ **Agreed**

i. Hoses used shall be tested for air pressure above 5 Kg/ Cm2.
ii. Operator shall always be available for the operation of air compressor
iii. Air compressor shall have pressure relief valve installed
iv. Machine shall be installed outside bund area
v. Necessary PPE demanded by Permit shall be ensured.
vi. Necessary rest periods shall be provided to operators between works

h. Excavation Jobs ☐ **Applicable** ☐ **Not Applicable** ☐ **Agreed**

i. Shall have valid "Excavation permit "for the job.

i. Proper shoring shall be provided in case soil condition is not good and possibility of cave in (Discretion under site safety supervisor /Plant Manager)
ii. Necessary ladders and working platform shall be provided for the personnel working for excavation to come out.
iii. Provide the means of Crossing along with railings for personnel movement
iv. In case of doubt on availability of cables and pipeline –no machine excavation is permitted .Only manual excavation through shovels with insulated handle and gloves/ Safety Shoes shall be allowed. Activity shall be supervised throughout.

j. Temporary electrical Connection

☐ **Applicable** ☐ **Not Applicable** ☐ **Agreed**

i. All electrical connection shall be done by competent electrical supervisor with license
ii. All temporary electrical connections and tools shall be inspected by Plant Electrical Supervisor.
iii. Temporary connections for powers are joined to Plant electrical circuits only after ensuring power supply is cut off and LOTO requirements followed.
iv. Site distribution boxes shall be of approved type with proper cable termination.
v. From Plant electrical connection to Contractor distribution box –cabling shall be standard
vi. Provision of 30 mA ELCB shall be installed at the distribution box which shall be tested.
vii. All cable for routing shall be of double insulated with three pin plug.
viii. Proper electrical permit and Lock out and tag out mandatory while working on equipment requiring electrical isolation.

k. Work at Height-

☐ **Applicable** ☐ **Not Applicable** ☐ **Agreed**

i. Shall have signed Work at height permit.
ii. Use of aluminum ladder near hazardous area not permitted.
iii. Shall meet scaffolding standard defined in this document.
iv. All ladders and scaffolding shall be checked by supervisor before its use.

l. Work in confined space ☐ **Applicable** ☐ **Not Applicable** ☐ **Agreed**

i. Shall have valid "confined space" permit
ii. Vessel entry shall be permitted only when it is confirmed by test
   a. No availability of toxic and flammable gas inside the confined space
   b. Availability of sufficient oxygen
   c. Proper isolation of vessel "electrical, mechanical ,pneumatic ,chemical and instrumental "completed and isolation locked and tagged out
   d. Proper access through ladders inside the confined space
   e. Adequate ventilation and illumination available
   f. S/By person available outside the confined space identically equipped
   g. Supervision ensured
   h. Entry register maintained
   i. Proper escape gear provided to person entering the space
   j. Person entering the confined space if medically fit.

m. Lifting Tools and Tackles

☐ **Applicable** ☐ **Not Applicable** ☐ **Agreed**

a. Material lifting:-. Well-planned safety programme shall be implemented by contractor to ensure that all the lifting appliances and lifting gear are selected, installed, examined, tested, maintained, operated and dismantled with a view to preventing the occurrence of any accident during the activity
b. Material lifting work shall be allowed after issue of Permit to work only.
c. All lifting appliances / Tool, Tackles (Ropes, Cranes, Slings, Pulleyetc) shall be test certificate provided by competent persons.
d. All the lifting operations using moving equipments like cranes, forklifts, trailers etc shall be carried out by trained operator of machine after verifying the competency certificate. Driver's license shall be submitted
e. All the lifting operations using moving equipment like cranes, forklifts, trailers etc shall be done after ensuring the ground stability.
f. Moving equipment like cranes shall not be allowed to be left unattended during idle time. Crane boom and shall be lowered and locked. No moving equipments such as crane shall be allowed to be idled and unattended with load suspended.
g. In no case operations of crane shall be allowed near to high voltage overhead lines.
h. All these operations shall be carried out in presence of Site supervisor.
i. No person shall be allowed to remain within the radius of the boom and underneath the load while lifting/placing of the load. Area of this shall be properly barricaded with necessary cautionary signs provided.
j. In case of extreme weather all lifting and material operations shall be suspended and no lifting or material handling shall be allowed in the night.
k. Operations involving moving equipments like cranes, forklifts, trailers shall not be allowed near to excavated areas. (Sufficient distance from the edge of excavated area shall be maintained.

n. Vehicles /Phones ☐ **Applicable** ☐ **Not Applicable** ☐ **Agreed**

i. All Diesel engine driven machines shall have approved spark arrestor installed on the exhaust.
ii. No petrol driven engines shall be allowed at site
iii. Driver's license shall be submitted to CLIENT/CONSULTANT
iv. Contractor shall arrange a vehicle at project site for emergency transportation
v. Use of mobile phone spark producing gadgets such as camera /match boxes is prohibited

o. Work at extended Hours /Night

☐ **Applicable** ☐ **Not Applicable** ☐ **Agreed**

i. In case of work at extended hours is required ,permission for plant manager shall be taken
ii. Additional supervisor shall be deputed at site
iii. Proper illumination (Non Tampered) type shall be provided by competent electrical person

p. Fire Extinguisher and First aid boxes

☐ **Applicable** ☐ **Not Applicable** ☐ **Agreed**

i. Contractor to arrange 2 Nos of 10 KG DCP Fire extinguishers , 2 Nos of 4.5 Kg Co2 Extinguisher and 2 properly equipped first aid boxes
ii. 2 Nos of fire hoses and multipurpose nozzles shall also be arranged

q. HSE Communication – ☐ **Applicable** ☐ **Not Applicable** ☐ **Agreed**

i. Every 15 days –Contractor shall carry out safety competition for contractor personnel with appropriate positive recommendations.
ii. Proper signage's with banners shall be provided at work site indicating danger involved
iii. All near miss and accidents shall be reported to Plant manager by site/safety supervisor
iv. Emergency contact nos. shall be displayed at work site

ii. Dealing Non Compliance – CLIENT/CONSULTANT reserves the right to implement any disciplinary sanctions such as warning suspension of worker / Monetary sanctions / suspension of contract in case of noncompliance with HSE requirements are noticed during work activity.

r. Chemicals – ☐ **Applicable** ☐ **Not Applicable** ☐ **Agreed**

i. All chemicals brought by contractor shall require MSDS to be submitted.
ii. Labelling of chemical container shall be done
iii. Storage of chemicals shall be away from work site and suitably protected

s. Waste Management and Housekeeping ☐ **Applicable** ☐ **Not Applicable** ☐ **Agreed**

i. Contractor shall arrange the adequate number of dust bins suitable for solid /liquid waste
ii. Contractor shall ensure daily housekeeping of premises
iii. Disposal of waste shall be done in line with Plant Manager permission and in line with statutory requirement .No waste shall be burnt at plant

t. Scaffolding ☐ **Applicable** ☐ **Not Applicable** ☐ **Agreed**

i. Scaffold shall be erected, moved, dismantled, or altered only under the supervision of competent persons and by competent workmen possessing adequate experience of such work under valid permit.
ii. Inspection of all scaffolding components before erection shall be carried out .
iii. Corroded, Damaged or bent components shall not be allowed to be used.
iv. Cup-lock type scaffolding material shall be used.

v. Alternatively Steel tube with metal clamps can be used
vi. Use of Bamboo scaffolding, wooden planks & manila/ coir rope are prohibited.
vii. Scaffolding shall be tube and coupler type.
viii. Lifting of tubes shall be carried out using proper tested slings
ix. Provision of MS base Plate properly locked with scaffolding posts
x. Use of MS Scaffolding tube not spaced more than 2 m apart with tubes properly clamped
xi. Provision of working platform (900mm) with walkways
xii. Provision of proper barricaded ladder to reach to platform.
xiii. Availability of Toe guard / Mid rail / Top rails
xiv. Cross bracing of scaffolding vertically and horizontally
xv. Bracing of the scaffolding with structure for ensuring stability
xvi. Proper clamping of scaffolding posts and working platform with scaffolding members.
xvii. Working Platform –
xviii. Shall be of steel plates and jalis sufficient to withstand 4 time of working loads.
xix. Sufficient overhang for working platform shall be provided on scaffolding support on both side to take care of stability and shall be braced with metal clamps on scaffolding members .
xx. Working Platform dimensions - 1)shall be closely boarded, planked, or plated;2) at least 700 mm wide if the platform is used as a footing only 3) at least 900 mm wide if the platform is used for the handling of materials 4)at least 1100mm wide if the platform is used for the support of any higher platform 5) at least 1300mm wide if the platform is one upon which stone is dressed or roughly shaped; and 6) Two metal plates shall not have more than 25 mm gap between them.
xxi. Anchorage -Fixed anchorage shall be fixed to support the load of at least 2300 Kilograms for anchoring fall arrestor system (Vertically and horizontal life lines).
xxii. No ladder shall be over 9.0 M. in length. Landing platform shall be provided suitably. The width between the side rails in rung ladder shall not be less than 30 Cm. for 3.0 M Length ladder. Uniform step spacing of not more than 30 Cm. shall be kept.
xxiii. Erection of scaffolding is first critical phase and all person involved shall be trained on height work to communicate hazards involved and precautions required. Training records shall be maintained.
xxiv. Use of double lanyard safety belt (Full Body Harness with fall arrestor) is compulsory.
xxv. Workers are not allowed to climb without anchoring safety belt from one level to other level or on tubes of scaffold .Necessary vertical and horizontal lifelines shall be installed
xxvi. Anchorage for lifeline shall never be fixed to scaffold or its components. Also scaffold component shall not be used for lifting material using rope and pulley arrangement.
xxvii. Supervision at all times shall be ensured during this activity and in no case our person shall leave the site when work in progress
xxviii. Ensure availability of the Horizontal life line and vertical life line all along working levels
xxix. Ensure area is barricaded and safety nets are in place.
xxx. Daily Inspection of scaffolding by contractor supervisor before start of work and correcting any deviation from our requirements. Records of the same shall be maintained.
xxxi. In Case of Heavy wind or rough weather the work shall be stopped after securing the place in safe condition and communication shall be given in advance to all workers in this regard
xxxii. Picture attached indicate the CLIENT/CONSULTANT expectation about the scaffolding requirement – Picture attached is for illustration purpose only and does not indicate dimension and thickness of various components used in the design and is not to scale .In case of doubt contractor shall discuss with CLIENT/CONSULTANT about detailed specification.

Picture of Scaffolding –

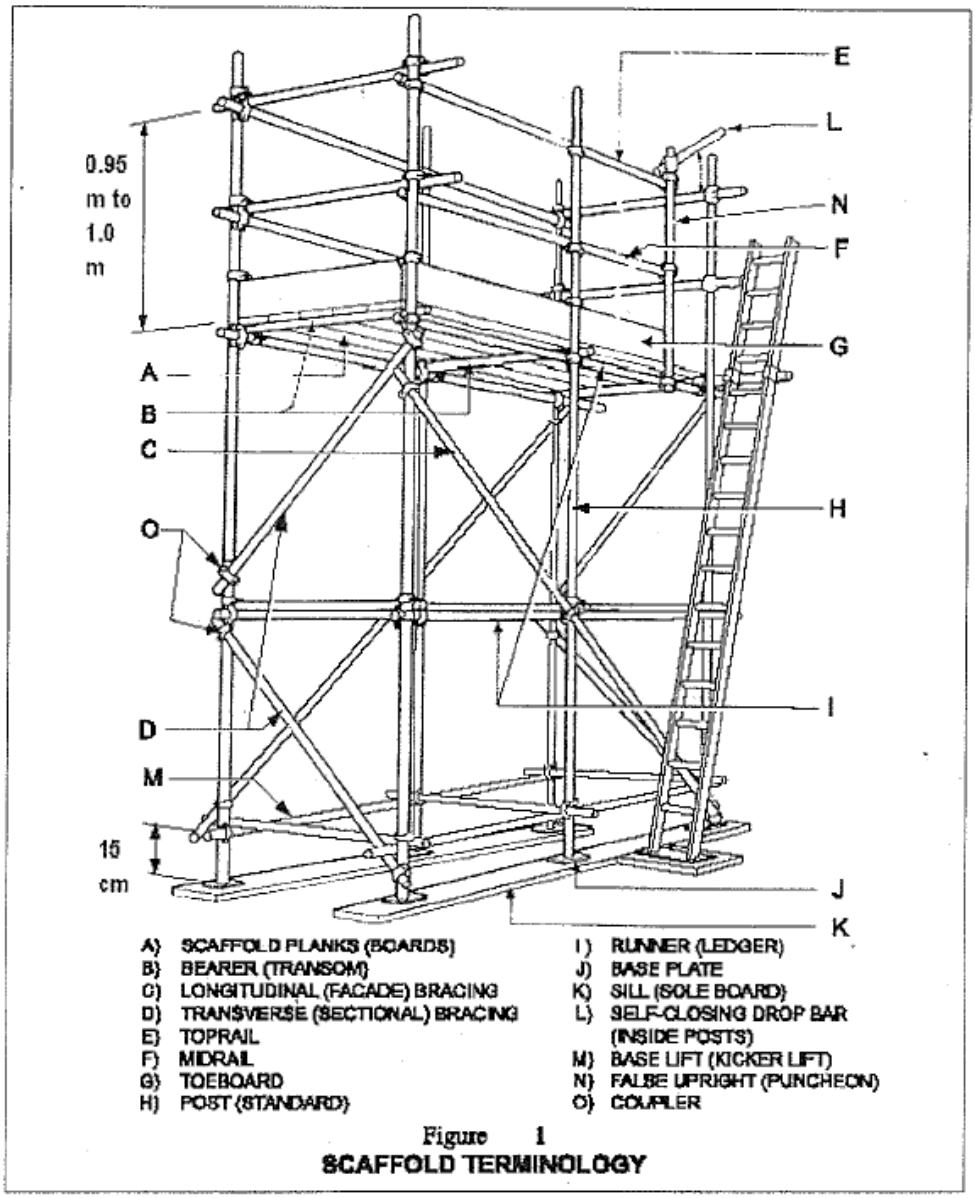


Figure 1
SCAFFOLD TERMINOLOGY

Annexure 3
Safety Induction Table

Date:
Time:
Project site:
Address:
Conducted by:

Sr. No.	Name of persons	Age	Designation	Sign
1.				
2.				
3.				
4.				
5.				
6.				
7.				
8.				
9.				
10.				

Sign of safety officer:

Annexure 4
SECTION- 10

INTERPRETATIONS OF VARIOUS TERMS IN THE CONTRACT.

In constructing these conditions, the specifications, schedule of quantities and the contract the following words shall have the meanings herein assigned to them except, e subject or context otherwise requires.

1. **Approved Equal:** Approved Equal shall mean an alternative product or service approved by the EIC as being equivalent to that specified in the Contract Documents.

2. **Basic Rate - Material:** Basic Rate shall mean the landed cost at site including all taxes, royalties, cartage, handling etc. but excluding wastage and TAXES.

3. **Contractor's Representative:** The Contractor's Representative shall mean the person or party duly appointed by the Contractor to act for and on its behalf on a day-to-day basis during the construction of the Work and the Project. Any action to be taken by the Contractor may be taken on the Contractor's behalf by the Contractor's Representative. The Contractor's Representative shall be considered a "key person" for purposes of Clause 11 of the General Terms of Contract.

4. **Consultant/Architect:** Shall mean any person or persons duly appointed by the Owner / EIC to act as "CONSULTANT/ARCHITECT" to render consultancy services in any area/field of activity connected with and arising out of the Contract under a separate agreement setting out the consultant(s) responsibilities and terms.

5. **Defect(s) Liability Period(DLP):** Defect(s) Liability Period shall be the **12-month period** after Virtual Completion and any period extended as a result of rectification of the Work/change orders, between the Virtual Completion and the Final Completion of the Work, and during which period the Contractor shall be bound to replace and/or rectify and make good all defective materials, equipment and/or workmanship which arise in the Works or come to notice subsequent to the Virtual Completion of the Works and prior to the Final Completion of the Works. Performance Bank Guarantee submitted by bidder may be amended proportionately to the extended period of defect liability phase.

6. **Drawings:** "Drawings" means all drawings, details and sketches along with the technical information therein, furnished by the Architect through the EIC to the Contractor under the Contract and any modifications of such drawings or such other drawings as may be from time to time be furnished or approved in writing by EIC. All drawings, samples, patterns, models, operation and maintenance manuals and other technical information of a like nature submitted by the Contractor and duly approved by EIC, shall also be referred as 'drawings'.

7. **Final Completion:** Final Completion will be deemed to have been achieved when at the end of the Defects Liability Period and or any extended period for rectification of defects beyond DLP. Final Completion Certificate will be issued by the EIC when all the requirements of the Contract have been met and complied with and when all the defective items of Work and defects have been replaced and/or rectified and made good as directed by and to the satisfaction of the EIC.

8. **Force Majeure:** Force Majeure are risks due to riots (other than Contractor's employees) and civil commotion (in so far as both these are uninsurable), war

(whether declared or not), invasion, act of foreign enemies, hostilities, civil war, rebellion, insurrection, military or usurped power, an act of Government, an act of God, such as lightening, unprecedented floods, cyclone and damage from aircraft.

9. **Headings:** The headings in these General Conditions of Contract shall not be deemed to be part thereof or to be taken into consideration in the interpretation or construction thereof or of the Contract.
10. **Insolvency:** The term "Insolvency" means any act of insolvency as defined by the Presidency Towns Insolvency Act or the Provincial Insolvency Act or any amending statute.
11. **Labour Rate:** As per Local Administration labour rates notified and fixed from time to time.
12. **Measurement Books:** The "measurement books" shall be defined as the books maintained during the currency of the project to record all measurements qualifying for payment. The contractor shall maintain measurement books of all work done by them. The contractor shall get the measurement books verified and the measurements certified by the EIC /Consultant/ Architect before submitting the bills for payment.
13. **Nominated Sub Contractor:** "Nominated Sub-Contractor" refers to those specialists, tradesmen and others, whose credentials as well as quotations are evaluated and approved by the EIC/Owner and then nominated for executing special works or supplying special equipment or materials. Such agencies shall be deemed to have been employed by the Contractor.
14. **Project:** Project shall mean and include the execution of the Work to be performed under this Contract plus works of all later phases necessary to complete the construction to make it habitable, according to the standards adopted by the EIC.
15. "Records and audits":

    The contractor shall keep books and records to EIC's satisfaction, in such a manner, as to enable the EIC to carry out effective technical and financial inspection and control and to have necessary reports thereon from the internal auditors of the Contractor, with liberty to the EIC to seek inspection thereof to ascertain maintenance of proper records concerning the Project. A copy of all these records must be submitted to owner after completion of the project.
16. References and Cross-References to Clause and Sub-Clause Numbers: Unless specifically stated otherwise, all references and cross-references made to clause and sub-clause numbers in these General Conditions of Contract refer to the clauses and sub-clauses of the General Conditions of Contract itself.
17. SHE Plan: "SHE plan" means Environmental, Health and Safety Plan prepared by the Contractor for implementation at site, based on and including, without limitation to various Clauses of the Conditions of Contract pertaining to Safety, Health and environment; and approved by the EIC.
18. Singular or Plural/Typographic Errors: Words in the singular also include the plural and vice versa, where the context so requires. Words implying persons include persons and corporations. Typographic or spelling errors shall not be cause to vitiate the contract.
19. Specifications:

    "Specifications" shall mean and include the specifications of work in the tender document including the Architect's / Consultant's Drawings, the Works Technical

Specifications and Priced Bill of Quantities, and any modification thereof or addition thereto.

20. Tender Documents: "Tender Documents" shall mean and include Notice Inviting Tender, Tender Form and Contract Agreement Draft, General Conditions Of Contract, Special Conditions Of Contract, Works Technical Specifications, Bill Of Quantities With Detailed Specifications, Environmental, Health & Safety (SHE) Plan, Preliminary Project Construction Schedule, Tender Drawings - Site Location, Drawings for Works, necessary for proper understanding of the job and for quoting the price.
21. Temporary Works: Temporary works mean all temporary works of every kind required, constructed and removed from site for the proper execution and completion of the works by the Contractor and the same shall be considered while quoting the price and nothing extra shall be paid by Shikshan Prasarak Mandali.
22. Terms "/", "and", "or", "and/or": The terms "/", "and, "or", "and/or" used in context with the description or enumeration of two or more items or components of work of documentation or anything similar shall mean as is relevant and applicable to the text and context.
23. Urgent Works: "Urgent works" shall mean any urgent measures which in the opinion of the EIC becomes necessary during the progress of the work to obviate any risk of accident or failure or which become necessary for security for completing the overall project within the stipulated time.
24. Vendors: "Vendors" shall mean and include all suppliers, contractors, sub-contractors, nominated sub-contractors and trade contractors engaged for same / later phase(s) of the Project, when such Vendors are in privity of Contract with the Owner. Virtual Completion: Virtual completion of the works will be deemed to have been achieved upon a Virtual Completion Certificate being issued by the EIC with concurrence of the Architect/consultant, when the Works, according to the EIC, Architect/ consultant, have been completed in every respect in conformity with the Contract Documents including rectification of defects by the contractor as mentioned below and are ready and fit for the intended purpose, complete with all systems and services having been tested and commissioned.
    a) The contractor should give intimation to EIC in writing stating that the works have been completed by them as per contract agreement and request for joint inspection of the work by EIC and contractor.
    b) Upon receiving the intimation as above, the EIC shall inspect the work jointly with the contractor and notify the defective works if any to the contractor and instruct to rectify the same acceptable to EIC.
    c) The contractor upon receiving such instructions from EIC, shall rectify the same in a time bound manner as approved by EIC, and further intimate such completion of work to EIC for a joint visit.
    d) Upon receiving such intimation from the contractor the EIC shall jointly inspect rectification works and certify their completions if the rectification works are found to be satisfactory.

SECTION- 11

SCHEDULE OF RATES (PRICE BID)

Notes to be read with SOR.

A. TECHNICAL

The item rates in the SOR shall be applicable for construction of all works.

1 Work shall be carried out as specified in Good for Construction Drawings, Technical Specifications and SOR. These are intended to be supplementary/ complimentary. In the event of contradiction/variation, the contents in SOR shall take precedence.

2 The rates in SOR shall be for completing and finishing the item in all respect ;and shall be inclusive of *inter-alia,* supply of materials, labor, scaffolding, staging, construction plant and machinery, tools, tackle and including unloading, loading, storage, carting, transportation, hoisting, laying, fabricating, fixing ,mixing, soaking, compacting, curing and all other processes required to complete the work.

3 Further to 2 above the rates shall also be inclusive of octroi, excise duty, local tax , import duty, Royalty, Royalty on excavation at site and other building materials brought from outside.

4 GST as applicable on Contract Amount shall be paid/ reimbursed by the Employer.

5 As per a recent circular from MCGM daily the working hours shall be between 6 AM to 10 PM. No work is allowed on Sundays.

6 The excavated materials shall be carted away on day-to-day basis to designated area authorized by the Competent Authority any permission for the same is under contractor's scope at no extra cost.

7 All the water proofing work for terraces, toilets, basement, lift pits, water tanks shall carry a guarantee for 10 years or as specified for water tightness.

8 Ready Mix Concrete (R M C) shall be provided from an approved source. The SOR rates for RMC items shall be inclusive of plasticizers, pumping and Boom Placer/ Tower Crane.

9 Cost Variation - Basic rate for Steel & RMC shall be considered with +/- 5 %. Variation beyond 5% reduction in cost, the benefit to be passed on to the client & above 5% client need to pay variation to the contractor.

Sr. No.	ITEM	Basic Rate	Remark
1	HCRM/ CRS reinforcement	Rs. --------/- Per M. T.	PWD SSR 22-23
2	TMT-FE-500 reinforcement	Rs. --------/- Per M. T.	PWD SSR 22-23
3	Structural Steel	Rs. ---------/- Per M. T.	PWD SSR 22-23
4	RMC (Ready Mix Concrete) M 35	Rs. ---------/- Per Cum	As per current market rate.
5	PCC (Plain cement Concrete) M 15	Rs.----------/- Per Cum	As per current market rate

10 The Contractor shall provide and set up suitable tower crane or Boom Placer for handling and conveying materials as per requirement.

11 In the Schedule for Water Supply, drainage, sanitary work:
The materials shall be of approved make and heavy quality. The item rates are for supply, laying, jointing fixing to line and level, testing and commissioning. Jointing shall be watertight. Rates for pipe items are inclusive of fittings such as check nuts, union, bend short or long, elbow, flanges to table E, nuts/bolts/washers, gasket, packing, sealant, Y, double Y, offset, nipples, and shoes. Pipes to be run on wall or soffits shall be fixed as per detail sketch.

12 For excavation over area/basement, the grading level shall be given by The Engineer.

13 Foundation, lift pit excavation depth in this region shall be with respect to grading level. Before starting to set out and construction, the contractor shall clean the site completely including removal of debris, bushes, and loose materials. This work is a part of general mobilization and shall be at his cost.

14 One total station, Theodolite, 2 leveling instruments and 1 competent surveyor shall be continuously deployed at site by contractor at his own cost.

15 Continuous competent surveyor to be at site till completion of all foundation and line out works in all respect and should be available as and when required.

16 The contractor has to construct temporary Cement Godown for minimum 500 Bags at his own cost. This godown shall be damp proof and waterproof. A proper arrangement shall be made for storage of reinforcement bars. But no storage of material would be allowed in the existing factory premises.

17 Civil work for drains, external work, septic tank, soak pit, Plain Cement Concrete (PCC) bedding and excavation for pipe laying shall be measured under relevant items in schedule.

18 For elevator shafts permissible tolerance in dimensions and plumb line is + or - 8mm.
16 Blasting at site is strictly prohibited

19 Rates to include cost for labour huts, Toilets facility, Office of consultant etc as given in tender. And shall be responsible for handling local issues related to it.

20 The contractor is binding for the circulars /notifications issued by authorities from time to time.

The free space outside the construction region can be seen in the drawing. Contractor shall plan and manage the work accordingly. More space for storage etc. if needed shall be arranged by him outside without any cost to the Employer. But no storage of material would be allowed in the existing factory premises.

B. COMMERCIAL

1. Taxes payable shall be indicated by bidders separately in their price bid/SOR.
2. Bidders must quote include all expenses in INR only.
3. Offers must be **valid for a period of 90 days from the date of bid submission.**

SECTION- 12

INSTRUCTIONS TO BIDDERS

a. No charges other than those specified in the Schedule of Rates shall be paid to you. **The detailed break up of Taxes should be given separately along with SOR.**

b. Rate should be given according to the unit and no other alternative will be considered.

c. If you are unable to offer, please return this tender to this office suitably endorsed to keep your name enlisted in our vendor database.

d. Your offer should be delivered to this office in sealed cover by 17:00 hrs. on due date of opening of bid. The tender document with each page duly signed as a token of acceptance should be submitted along with the offer.

e. The validity for the offer should be **90 days** in respect of this tender. In the absence of period of validity being mentioned in your offer, it will be assumed that your offer conforms to the validity asked in this Tender enquiry.

f. The estimated quantities are liable to change.

g. Shikshan Prasarak Mandali reserves the right to split the contract to more than one bidder.

h. Please note that `C' Form shall not be issued by Shikshan Prasarak Mandali.

i. Bids made by agents/ representatives will not be considered.

j. Shikshan Prasarak Mandali has to finalize the contract within a limited time schedule. Therefore, it may not be feasible in all cases for Shikshan Prasarak Mandali to seek clarifications in respect of incomplete offers. Prospective bidders are advised to ensure that their bids are complete in all respects and confirm to our terms & conditions and Bid Qualification Criteria of the tender. Bid not send as per Shikshan Prasarak Mandali's requirement may be rejected without seeking any clarification.

k. The bid package is non-transferable.

l. Bid package documents shall remain the property of the Company.

m. The Company shall not be responsible for any costs or expenses incurred in connection for the preparation and delivery of the tender or for any other expenses incurred in connection with such bidding.

n. The Company may reject, accept, or prefer any tenders without assigning any reason whatsoever.

o. The bidder shall quote a firm price and they shall be bound to keep this price firm without any escalation for any reason till the completion of the contract.

p. No material advance payment will be made by Shikshan Prasarak Mandali. Bidder asking for advance payment may be rejected.

q. Each tender shall be signed by a duly authorized officer & incase of a Corporation / Companies shall be sealed with the Corporation seal or otherwise appropriately executed under seal.

r. All taxes work contract tax, income tax, etc shall be applicable as per the statutory provisions and shall be included in rates.

s. TENDER must be submitted without making any additions, alternations, and as per details given in other clauses hereunder. The rate shall be filled only as per the schedule given in this Tender Document.

t. Addenda/Corrigenda to this Tender Document, if issued, must be signed, submitted along with the Tender Document. The tenderer should write clearly the revised quantities in schedule of Rates of Tender quantities when amendments of quantities are issued addenda.

u. Tenderers are advised to submit quotations based strictly on the terms and conditions and specifications contained in the Tender Documents and not be stipulate any deviations.

v. The full name, address, and telegraphic address of the Tenderers shall be written on the bottom left-hand corner of the sealed cover.

w. <u>Bidding System: -</u>

<u>A) Two Bid:-</u> Bids are to be submitted in Two Bid System. In "Two Bid System" offers are to be sealed to be submitted in triple sealed covers. The first inner cover will contain Techno-Commercial Bid having all details. This cover will clearly be super scribed with "Techno-Commercial Bid" along with tender number and item description. The second sealed inner cover will contain only the price schedule duly filled in Shikshan Prasarak Mandali Price Proforma and signed and will be clearly super scribed with "Price Bid" along with tender name/number along with soft copy of priced bid is CD. These two covers shall be put into outer cover and sealed. The outer cover should duly bear the tender number and date of closing/opening prominently underlined along with the address of this office.

x. ALL PAGES ARE TO BE INITIALLED.

All signatures in Tender Documents shall be dated, as well as, all the pages of all sections of Tender Document shall be stamped & initialed at the lower right hand corner and signed wherever required in the tender papers by the bidder or by a person holding power of attorney authorizing him to sign on behalf of the tenderer before submission of tender.

y. RATE TO BE IN FIGURES AND WORDS

The tenderer should quote in English, both in figures as well as in words the cases and Schedule of Rate of Tender submitted by the CONTRACTOR for each item and in such a way that interpolation is not possible. The amount for each item should be worked out and entered and requisite total given of all items, both in figures and in words. The tendered amount for the work shall be entered in the tender and duly signed by the Tenderer.

If some discrepancies are found between the RATES in FIGURES and WORDS or the AMOUNT shown in the tender, the following procedure shall be followed:

a) When there is difference between the rates in figures and words, the rate which is specified in words shall be taken as correct.

b) When the rate quoted by the tenderer in figures and words tally but the total amount is incorrect the unit rate quoted by the tenderer shall be taken as correct and shall be taken as the basis for calculation of the correct amount.

c) When it is not possible to ascertain the correct rate by either of above methods, Shikshan Prasarak Mandali reserves the right to take its own decision.

z. CORRECTIONS AND ERASURES

All correction (s) and alteration (s) in the entries of tender paper shall be signed in full by the TENDERER with date. No erasure or over righting is permissible.

aa. SIGNATURE OF TENDERER

The TENDER shall contain the name, residence and place of business of person or persons making the tender and shall be signed by the TENDERER with his usual signature. Partnership firms shall furnish the full names of all patterns in the tender. It should be signed in the partnership's name by all the partners or by duly authorized representatives followed by the name and designation of the person signing. Tender by a corporation shall be signed by an authorized representative, and a power of Attorney in that behalf shall accompany the tender. A copy of the constitution of the firm with names of all partners shall be furnished.

When a tenderer signs a tender in a language other than English, the total amount tendered should, in addition, be written in the same language. The signature should be attested by at least one witness.

bb. WITNESS.

Witness and sureties shall be persons of status and property and their names. Occupation and address shall be stated below their signature.

cc. DETAILS OF EXPERIENCE

The tenderer should furnish, along with his tender, details of previous experience in having successfully completed in the recent past works of this nature, together with the names of Owners, location of sites and value of contract, date of commencement and completion of work, delays if any, reasons of delay and other details along with documentary evidence (s).

dd. CLARIFICATION OF TENDER DOCUMENT: -

The Tender is required to carefully examine the Technical specifications, conditions of contract, Drawings and other details relating to WORK and given in Tender Document and fully inform himself as to all conditions and matters which may in any way affect the WORK or the cast thereof. In case the Tenderer is in doubt about the completeness or correctness of any of the contents of the Tender Document he should request in writing for an interpretation/clarification to Shikshan Prasarak Mandali in Triplicate Shikshan Prasarak Mandali will then issue interpretation/clarification to Tenderer in writing. Such clarifications and or interpretations shall form part of the specifications and Documents and shall accompany the tender which shall be submitted by tenderer within time and date as specified in invitations to tender.

Verbal clarification and information given by Shikshan Prasarak Mandali or its employee (s) or its representative shall not in any way be binding on Shikshan Prasarak Mandali.

ee. ABNORMAL RATES: -

The Tenderer is expected to quote rate for each item after careful analysis of cost involved for the performance of the completed item 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 quoted by the tenderer for any item are unusually high or unusually low, it will be sufficient cause for the rejection of the tender unless the OWNER is convinced about the reasonableness after scrutiny of the analysis for such rate (s) to be furnished by the tenderer (on demand).

ff. Award of Order:-The Order shall be awarded on the overall best bidder.

Section – 13

GENERAL CONDITIONS OF CONTRACT

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1. Interpretations

In construing these conditions, the specifications, schedule of quantities and the Contract Agreement, the following words shall have the meanings herein assigned to them except, where the subject or context otherwise requires.

(a) 'EMPLOYER/ OWNER shall mean Shikshan Prasarak Mandali having its registered office at Pune and shall include their legal representatives, Assigns, successors or managing Committee or anyone authorized by them on their behalf

(b) 'CONTRACTOR' shall mean the tenderer and shall include his/ their legal representative/s, assigns/or successors.

(c) 'ARCHITECT/ CONSULTANT shall mean those who are appointed by Employer from time to time for the design and supervision services for the said work, and their nominees.

(d) 'SITE' shall mean the site of the Contract works including any building and erections thereon and any other land (inclusively) as aforesaid allotted by the Employer for the Contractor' use

(e) 'THIS CONTRACT' shall mean the Articles of Agreement, the General Conditions, the Special Conditions, the Appendix, the Schedule of Quantities, Specifications, and other letters attached hereto and duly signed

(f) 'NOTICE IN WRITING' or 'WRITTEN NOTICE' shall mean a Notice in writing, typed or printed characters sent (unless delivered personally or otherwise Proved to have been received) by registered post to the last known private or business address or registered office of the addressee and shall be deemed to have been received when in the ordinary course of post it would have been delivered

(g) 'ACT OF INSOLVENCY' shall mean any act of insolvency as defined by the Presidency Towns Insolvency Act, or the Provincial Act or any Act amending such original

2. Scope of Contract

The Contractor shall carry out and complete the said work in every respect in accordance with this Contract and with the directions of and to the satisfaction of the Employer / Architect / Engineer-in-charge. The Architect and Engineer-in-Charge on their own may from time to time issue further drawings and/or written instructions, details, directions and explanations which are hereafter collectively referred to as "Works Instructions" in regard to:

(a) The variation or modification of the design, quality or quantity of works or the addition or omission or substitution of any work

Words importing the persons include firms and corporations.

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

(b) Any additional work within the site, instructed by The Engineer-In-Charge during the contract period including extension if any, shall be carried out by the Contractor as per BOQ rates. The Employer reserves right to reduce the scope of work in contract.

(c) Any discrepancy in the Drawings or between the Schedule of Quantities and/or Drawings and / or Specifications

(d) The removal from the site of any material brought thereon by the Contractor and the substitution of any other material, therefore.

(e) The removal and / or, re-execution of any works executed by the Contractor.

(f) The dismissal from the works of any persons employed thereupon.

(g) The opening up for inspection of any work covered up

(h) The amending and making good of any defects under clause.

The Contractor shall forthwith comply with and duly execute any work comprised in such works Instructions provided always that verbal instructions, directions and explanations given to the Contractor or his representative upon the works by the Architect and Engineer-in-charge shall, be confirmed in writing by the Contractor within seven days, and if not dissented from in writing within a further period of seven days, such shall be deemed to be "Works Instructions" within the Scope of the Contract

3. Inspection Of Site

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

The Contractor shall inspect and examine the Site and its surroundings and shall satisfy himself before submitting his tender as to the nature of the site and the quantities, nature of the work and materials necessary for the completion of the Works and the means of access to the Site the accommodation he may require and in general shall himself obtain all necessary information as to risks contingencies and other circumstances which may influence or affect his tender.

4. Sufficiency Of Tender

The Contractor shall also be deemed to have satisfied himself before tendering as to the correctness and sufficiency of his Tender for the works and of the rates and prices stated in the priced Bill of Quantities and the Schedule of Rates and Prices, which Tender rates and prices shall, except in so far as it is otherwise provided in the Contract, cover all his obligations under the Contract and all matters and things necessary for the proper execution and maintenance of the Works.

If however, during the execution of the works unfavorable physical conditions (other than weather conditions or ground water conditions) or artificial obstructions are encountered, the Contractor shall forthwith give written notice thereof to the Consultant's Representative and (if in either case) such conditions could not in the opinion of the Consultants have been reasonably foreseen by an experienced Contractor then the Employer shall pay the additional expense to which the Contractor shall have been put by reason of such conditions including the proper and reasonable expense.

5. PRICE TO BE FIRM

Unless otherwise provided for no adjustment to the Contract Price shall be made in respect of any increase or decrease after the submission of the Tender in the prevailing cost of labor of materials which result in an increase or decrease of cost to the Contractor in carrying out the Works.

6. LEADS

Rates quoted by the contractor should include all Leads and no additional claims shall be entertained against the same.

7. PRICE VARIATION

Awarded rates of the contract shall be fixed for the entire contract period & **No price** escalation shall be given to the contractor

8. AWARD OF ORDER

The Order shall be awarded to bidder evaluated on overall basis. However, it is the sole decision & authority of M/s. Shikshan Prasarak Mandali to select the contractor without disclosing the evaluations & reasoning.

9. Programme To Be Furnished

(a) Within the time stated of these Conditions, the Contractor shall, after the acceptance of his Tender, submit to the Engineer for his approval a program showing the order in which he proposes to carry out the works. The Contractor

shall whenever required by the Engineer or Engineers' Representative, also provide in writing for his information a general description of the arrangements and methods which the Contractor proposes to adopt for the execution of the works

(b) If at any time it should appear to the Engineer that the actual progress of the works does not conform to the approved program referred to in sub-clause of this Clause, the Contractor shall produce, at the request of the Engineer, a revised program showing the modifications to the approved program necessary to ensure completion of the works within the time for completion as decided and reworked to the satisfaction of the Employer

(c) The contractor shall give or provide all necessary superintendence during the execution of the Works and as long thereafter as the Consultant may consider necessary for the proper fulfilling of the Contractor's obligations under the contract. The Contractor or a competent and authorized agent or representative approved of in writing by the Consultant (which approval may at any time be withdrawn) is to be constantly on the Works and shall give his whole time to the superintendence of the same. If such approval shall be withdrawn by the Consultant the Contractor shall as soon as is practicable having regard to the requirement of replacing him as hereinafter mentioned) after receiving written notice of such withdrawal remove the agent from the Site and shall not thereafter employ him again on the Site in any capacity and shall replace him by another agent approved by the Consultant.

(d) Such authorized agent/ Engineer-In-Charge or representative shall receive on behalf of the contractor directions and instructions from the Consultant representative.

10. Drawings and Schedule of Quantities

The Copy of the Contract shall remain in the custody of the Employer. The Contractor on the signing thereof shall be furnished by the **Employer** with a copy of the priced Schedule of Quantities, one copy of each of the said drawings and the specifications and three copies of all further drawings issued during the progress of the work. The Contractor shall keep' one copy of all the Drawings on the works and Employer, Engineer-in-Charge or the Architect or his representative shall, at all reasonable-times, have access to the same. Before the issue of the Final Certificate to the Contractor, he shall forthwith return to the **Employer** all drawings and specifications, All the drawings supplied by the **Employer** will be in the form of Hardcopy

(a)Tender Drawings issued with the Bid documents give details necessary to understand the work. Good for Construction Drawings shall be released as per project requirements to match the approved construction schedule

(b)For structural steel fabrication work Shikshan Prasarak Mandali shall issue the Design Drawings. Based on these the Contractor shall prepare fabrication Drawings as per BIS conventions and get the same approved from The Engineer-In-Charge. His approval shall however not relieve the Contractor of accuracy in details and dimensions. The Fabrication work shall start after such approval.

(c)The fabrication drawings shall be in AutoCAD format. Contractor shall submit 3 hard copies and Digital files.

11. DISCREPANCIES IN DRAWINGS

The contractor shall be responsible for and shall reimburse the Employer by the actual cost incurred by the Employer in rectifying the works at site arising from

discrepancies, errors or omissions in the drawings for other particulars supplied by the contractor whether such drawings or other particulars have been approved by the consultant or not provided that such discrepancies, errors or omissions be not due to inaccurate information or particulars furnished to the contractor by the consultant, but the Employer shall be responsible for drawings and information supplied by the alterations of the work necessitated by reason of inaccurate information supplied by the consultant to contractor.

12. Contractor To Provide Everything Necessary

The Contractor shall provide everything necessary for the proper execution of the works according to the intent and meaning of the Drawings, Schedule of Quantities and Specifications taken together whether the same may or may not be particularly shown or described therein provided that the same can reasonably be inferred there from and if the Contractor finds any discrepancy in the Drawings or between the Drawings, Schedule of Quantities and Specifications, he shall immediately and in writing refer the same to the Architect who shall decide which is to be followed

13. Authorities, Notices and Patents

The Contractor shall conform to the provision of any act of the Legislature relating to the works and to the Regulations and Bye-Laws of any Authority, and of any Water, Lighting and other Companies and/or Authorities with whose system the structure is proposed to be connected and shall, before making any variations from the Drawings or Specifications that may be necessitated by so conforming, give to the Architect written notice specifying the variation proposed to be made and the reason for making it, and apply for instructions thereon. In case, the Contractor shall not within twenty days receive such instructions, he shall proceed with the work, conforming to the Provisions, Regulations or Bye-Laws in question, and any variation so necessitated shall be dealt.

The Contractor shall bring to the attention of the Architect all notices required by the said Acts, Regulations or Bye-Laws to be given to any Authority and pay to such Authority or to any Public office all fees that may be properly chargeable in respect of the works, and lodge the receipts with the Architect.

The Contractor shall indemnify the Employer and Architect against all claims in respect of patent rights, and shall defend all actions arising from such claims and shall himself pay all royalties, license fees, damages, costs and charges of all and every sort that may be legally incurred thereof

14. Setting Out Works

The Contractor shall set out the works and shall be responsible for the true and perfect setting out of the same and for the correctness of the positions, levels, dimensions, and alignment of all parts thereof. If at any time any error in this respect shall appear during the progress of the works, the Contractor shall at his own expense rectify such error if so required to the satisfaction of the Architect and the Engineer-in-Charge. The checking of any setting-out or of any line or level by the Engineer-in-charge or the Engineers representative shall not in any way relieve the contractor of his responsibility for the correctness thereof.

15. Materials and Workmanship to Conform To Description

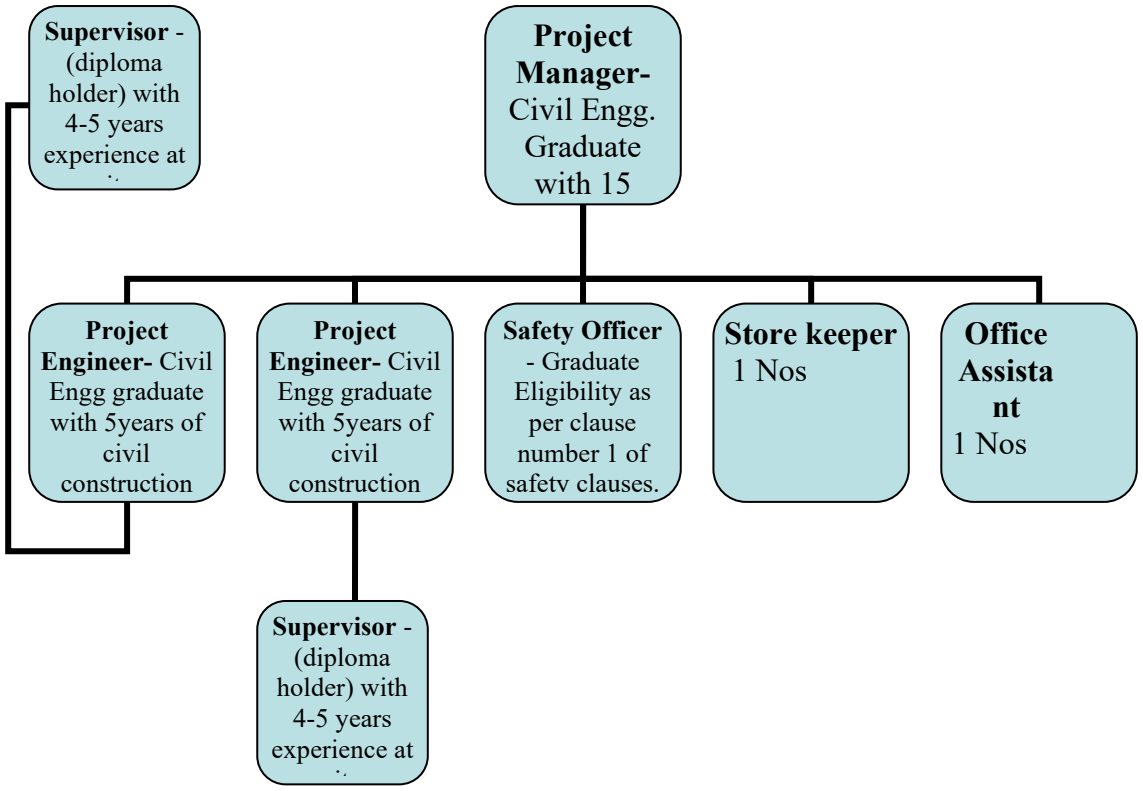
All materials and workmanship shall so far as procurable be of the respective kinds described in the Schedule of Quantities and/or Specification and in accordance with the "Works Instructions" and the Contractor shall, upon the request of the Employer/Architect, furnish him with all invoices, accounts receipts and other

vouchers to prove that the materials comply therewith. The Contractor shall at his own cost arrange for and/or carry out any test of any materials which the Architect/ the Engineer-in-Charge may require. REFER Quality Assurance Plan given in this tender.

16. Contractors Superintendence and Representative On The Works

The Contractor shall give all necessary personal superintendence during the execution of the works, and so long thereafter as the Architect or Engineer-in-Charge may consider necessary until the expiration of the "Defects Liability Period" stated in the Appendix thereto. The Contractor shall also, during the whole time the works are in progress, employ a competent representative whose name is informed to the Employer/Architect who shall be constantly in attendance at the building while the men are at work. Any directions, explanations, instructions or notices given by the Architect or Engineer-in-Charge or Employer to such representative shall be held to be given to the Contractor. Such a person shall be a qualified engineer whose qualification and experience must be made known to the Architect / Engineer-in-charge and must have the approval as per accepted **Resource Plan**.

Refer Organogram of Site staff of the contractor as below. The contractor shall deploy the same staff as mentioned in Organogram.



17. Dismissal of Workmen

The Contractor shall, on the request of the Architect or the Engineer-in-Charge or Employer, immediately dismiss from the works any person employed thereon by him who may, in the opinion of the Architect or the Engineer-In-Charge or the Employer, be incompetent or misconduct himself, and -such person shall not be again employed on the works without the permission of the Architect or Engineer-in-charge

18. Access To Works

The Architect and his representative or the Engineer-In-Charge or the Employer shall at all reasonable times have free access to the works and/or to the workshops, factories, or other places where materials are lying or from which they are being obtained and the Contractor shall give every facility to the Architect and his representative, the Engineer-In-Charge or the Employer necessary for inspections and examination and test of the materials and workmanship. Only persons authorized by the Architect, the Engineer-in-Charge or the Employer, except the Representatives of Public Authorities, shall be allowed on the works at any time

19. Engineer-In-Charge/ The Engineer

The term 'Engineer-in-Charge' shall mean the person mutually nominated by the employer and the Architect and acting under the orders of the **Employer**/Architect to inspect the works. The Contractor shall afford the Engineer-in-Charge every facilities and assistance for the inspection of the works and materials and for checking and measuring the works carried out by the Contractor. The Engineer-In-Charge or any representative of the Employer shall have power to give notice to the Contractor or his representative of non-approval of any work or materials and such work shall be suspended or the use of such material be discontinued. The work will from time to time be examined by the Architect ' the Engineer-in-Charge or the Employer but such examination shall not in any way exonerate the Contractor from the obligation to remedy any defect which may be found to exist at any stage of the work or after the same is completed. In case of Contractor not removing the rejected material nor rectifying the defective work pointed out by the Engineer-in-Charge, the Contractor will be liable to the consequences as per the Agreement. The Contactor shall honor all letters, notices issued by the Engineer-In-Charge as if they are issued by the Architect/ Engineer-In-Charge. The Engineer-In-Charge may be empowered by the Architect to issue certificates for payment and the Employer shall honor such certificates provided the Architect has obtained a written consent from the Employer or has informed the Employer in writing

20. Care Of Works

(a) From the Commencement of the Works until the date stated in the Certificate of Completion for the whole of the Contractor shall take full responsibility for the care thereof. Provided that if the Employer/Architect issues a Certificate of Completion in respect of any part of the Permanent Works the Contractor shall cease to be liable for the care of that part of the Permanent Works from the date stated in the Certificate of Completion in respect of that part and the responsibility for the care of that part shall pass to the Employer. Provided further that the Contractor shall take full responsibility for the care of any outstanding work, which he shall have undertaken to finish during the Period of Maintenance until such outstanding work is completed. In case any damage, loss or injury shall happen to the Works or to any part thereof, from any cause whatsoever, save and except the excepted risks as defined in sub-clause (b) of this Clause, while the Contractor shall be responsible for the care thereof the Contractor shall, at his own cost, repair and make good the same, so that at completion the permanent works shall be in good order and condition and in conformity in every respect with the requirements of the Contract and the Engineers instructions. In the event of any such damage, loss or injury happening from any of the excepted risks, the Contractor shall, if and to the extent required by the Engineer-in-charge and subject always to the provisions of the contract, repair and make good the same as aforesaid at the cost of the Employer. The Contractor shall also be liable for any damage to the Works occasioned by him in the course of any operations carried out by him for the purpose of completing any outstanding work or complying with his obligations.

(b) Excepted Risks

The "excepted risks" are war, hostilities (whether war be declared or not), invasion, and act of foreign enemies, rebellion, and revolution. insurrection or military or usurped power, civil war, employees of the Contractor or of his sub-contractors and arising from the conduct of Works, riot, commotion or disorder, or a cause solely due to the design of the Works or ionizing radiations or contamination by

radio-activity from any nuclear fuel or from any nuclear waste from the combustion of nuclear fuel, radioactive, toxic explosive or other hazardous properties of any explosive, nuclear assembly or nuclear component thereof, pressure waves caused by aircraft or other aerial devices traveling at sonic or supersonic speeds, or any such operation of the forces of nature are collectively referred to as "the excepted risks"

21. Assignment and Sub-Letting

(a) The whole of the works included in the Contract shall be executed by the Contractor and the Contractor shall not directly or indirectly transfer, assign or underlet the Contract or any part share thereof or interest therein without the written consent of the Employer/Architect and no undertaking shall relieve the Contractor from the full and entire responsibility of the Contract or from active superintendence of the works during their progress

(b) The Contractor shall not sub-let the whole of the Works. Except where otherwise provided by the Contract the Contractor shall not sublet any part of the Works without the prior written consent of the Employer (which shall not relieve the Contractor from any liability or obligation under the Contract and he shall be responsible for the acts defaults and neglects of any Sub-Contractor, his agents servants or workmen as fully as if they were the acts default or neglects of the Contractor his agents servants or workmen. Provided always that the provision of labour on a piece work basis, raw materials for the construction of the works, and items of Plant/Equipment for which makes are named in the Contract shall not be deemed to be a sub-letting under the clause.

(c) Assignment of Sub-Contractor obligations:
In respect of the work executed or the goods or materials supplied, in the event of a Sub-Contractor having undertaken towards the Contractor any continuing obligation extending for a period exceeding that of the Period of Maintenance under this Contract the Contractor shall at the expiration of the Period of Maintenance assign to the Employer at the Employer's request the benefit of such obligation for the unexpired duration thereof.

22. Variation Not To Vitiate Contract

No alteration, omission or variation shall vitiate this contract but in case the Architect and the Engineer-in-Charge in consultation with the Employer thinks proper at any time during the progress of the works to make any alterations in or additions to or omissions from the works or any alteration in the kind or quality of the materials to be used therein and shall give notice thereof in writing under his hand to the Contractor, the Contractor shall alter, add to or omit from as the case may require, in accordance with such notice, but the Contractor shall not do any work extra to or make any alterations or additions to or omissions from the works or any deviation from any of the provisions of the Contract, Stipulation, Specification or Contract Drawings without the previous consent in writing of the Architect and Engineer-in-Charge and the Employer jointly.

The Contractor shall carry out such variations without prejudice to the Contract as though the said variations formed part of the Contract. If in the opinion of the Contractor complying with any such variation would prevent his fulfilling any of his obligations and guarantees shall be modified by the Consultant. No such variations shall in any way vitiate or invalidate the Contract.

23. VALUATION OF VARIATION

The value (if any) of all variations shall be added to or deducted from the Contract Price as appropriate. The Consultant shall ascertain and determine this in accordance with the rates and prices prevailing in the schedule of prices so far as the same may be applicable or derived from rates for similar items in the schedule of prices or by shall be finalized by Rate Analysis. In other cases reasonable prices shall be fixed by the Consultant, which shall be the actual costs of execution to the Contractor as assessed by the Consultant increased by 15% for the Contractor's overheads and profits and shall be based on the documents and vouchers maintained and produced by the Contractor.

24. Schedule of Quantities

The schedule of Quantities, unless otherwise stated, shall be deemed to have been prepared as per mode of measurement specified in Technical Specification and Bill of Quantity attached with the Tender, Any error in description or in quantity or in omission of items from the Schedule of quantities shall not vitiate this Contract but shall be rectified and the value thereof as ascertained under Clause hereof shall be added to or deducted from the Contract Amount (as the case may be) provided that there shall be no rectification of errors in the Contractor's Schedule of Rates.

25. Sufficiency Of Schedule Of Quantities

The Contractor shall be deemed to have satisfied himself before tendering as to the correctness and sufficiency of his Tender for the works and of the prices stated in the Schedule of Quantities and / or the Schedule of Rates and Prices which rates and prices shall cover all his obligations under the Contract, and all matters and things necessary for the proper completion of the works.

26. Measurement Of Works

The PMC and the Engineer-in-Charge may from time to time, intimate to the Contractor that he requires the works to be measured and the qualified Contractor representative shall **forthwith attend to assist the** PMC or the PMC's representative in taking such measurements and calculations in consultation with the Engineer-in-Charge and to furnish all particulars or to give all assistance required by either of them.

Should the **Contractor not attend or neglect**, then the measurements taken by the PMC or approved by him in consultation with the Engineer-in-Charge shall be taken to be the correct measurements of the works. Such measurements shall be taken in accordance with the standard method of measurement of building works issued by the PMC.

Not unless the contractor is given notice in such intimations that “in the event of the contractors authorized agent not attending the site at the appointed time, the measurements will be taken Ex-Parte and the contractor will have no right to question the corrections thereon.”

The Contractor or his Agent may at the time of measurement take such notes and measurements as he may require.

The measurement and valuation in respect of the Contract shall be completed within "Period of final measurement" stated in the Appendix or if not so stated then within three months of the completion of the contract works as defined in Clause hereof.

27. MEASUREMENT BOOK

(a)Measurements of work done shall be written jointly by The Engineer-In-Charge or his representative and contractor's Engineer-In-Charge and signed. The Book shall remain in the custody of The Engineer-In-Charge

(b)Measurements of work done in a particular month shall be completed before 7th day of next month.

(c)Contractor's Bill shall be accompanied by duly signed site measurement/test certificate, material consumption of cement and steel.

28. Non-Tender Items

The Contractor shall, when ordered in writing by the Architect and with the concurrence of the Employer, perform work not covered by the specifications or included in the Bills of Quantities but forming part of the work contracted for, on the same conditions in all respect in which he agrees to do the main work. Extra work and supply of such material shall be carried out at a rate settled by written agreement between the Contractor and the Architect/ the Engineer-in-Charge with the concurrence of the Employer. The Rates of such items shall be derived on the basis of Rate analysis using the co - efficient of material and labour and the market rates of the material.

29. Status of Workmen

None of the employees of the contractor shall be construed or deemed to be the employees of Shikshan Prasarak Mandali at any time and the Contractor shall indemnify and keep indemnified Shikshan Prasarak Mandali against any claim, loss or whatsoever in this connection.

There shall never exist any employer and employee relationship between Shikshan Prasarak Mandali and the manpower engaged by Contractor. Shikshan Prasarak Mandali shall not have any responsibility to nor shall be held directly or indirectly responsible or liable for the person so employed by the contractor for performing/providing services in terms of this agreement to Shikshan Prasarak Mandali in terms of its contractual obligations hereunder.

30. Quality of Materials & Workmanship and Tests

(a) All materials and workmanship shall be of the respective kinds described in the Contract and in accordance with the Engineer's instructions and shall be subjected to tests from time to time to such other place or places as may be specified in the Contract, or at all or any of such places. The Contractor shall provide assistance instruments, machines, labor and materials as are formally required for examining, measuring and testing any work and the quality, weight or quantity of any material used and shall supply samples of materials before incorporation in the work for testing as may be selected and required by the Engineer.

(b) Cost of Samples / Shop Drawings
All samples / shop drawings / fabrication drawings shall be supplied by the Contractor at his own cost.

(c) Cost of Tests
The Cost of making any Tests shall be borne by the Contractor.

31. TESTS AND INSPECTION OF WORKS

The CONTRACTOR shall carry out the various tests as enumerated in the bidding document and as per direction of Engineer-in-charge either on field or outside laboratories concerning the execution of work and supply of the material by CONTRACTOR. All the expenses shall be borne by the CONTRACTOR and shall be considered as included in the quoted price. The inspection shall be done by following:

a) Third Party Inspection agency if nominated by the EMPLOYER for all supply items (Name of the EMPLOYER'S approved TPI agency shall be separately intimated).

b) Representative deputed by Engineer-in-charge.

c) Representative deputed by Statutory Authority.

CONTRACTOR shall give prior notice sufficiently ahead of time to the Engineer-in-charge and also to the authorities/TPI to conduct inspection/ to witness such tests.

All the tests either on the field or at outside laboratory or at any other place, concerning the execution of the work and supply of materials by the CONTRACTOR shall be carried out by the CONTRACTOR at his own cost.

The work is subject to inspection at all times by the Engineer-in-charge. The CONTRACTOR shall carry out all instructions given during inspection and shall ensure that the work is being carried out according to the technical specifications of this bidding document, the technical documents that will be furnished to him during performance of work and the relevant codes of practice furnished to him during the performance of the work.

The CONTRACTOR shall provide, for purposes of inspection, access ladders, lighting and necessary instruments at his own cost including Low Voltage (24V) lighting equipment for inspection of work. Compressed air for carrying out works shall be arranged by the CONTRACTOR at his own cost.

Any work not conforming to the execution drawings, specifications or codes shall be rejected forthwith and the CONTRACTOR shall carry out the rectifications at his own cost.

All results of inspection and test will be recorded in the inspection reports, proforma of which will be approved by the Engineer-in-charge. These reports shall form part of the Completion Documents.

For materials supplied by EMPLOYER, CONTRACTOR shall carryout the tests, if required by the Engineer-in-charge, and the cost of such tests shall be reimbursed by the EMPLOYER at actual to the CONTRACTOR on production of documentary evidence.

Inspection and acceptance of the work shall not relieve the CONTRACTOR from any of his responsibilities under this contract.

Cost towards repeat tests and inspection due to failures, repairs etc. for reasons attributable to the CONTRACTOR shall be borne by the CONTRACTOR.

Various tests as specified in specifications shall be carried out to the entire satisfaction of EMPLOYER/CONSULTANT.

32. FINAL INSPECTION

After completion of all tests as per specification the whole work will be subject to a final inspection to ensure that job has been completed as per requirement. If any defects are noticed in the work attributable to CONTRACTOR, these shall be attended by the CONTRACTOR at his own cost. As and when they are brought to his notice by Engineer In charge / EMPLOYER, by Engineer In charge / EMPLOYER shall have the right to have these defects rectified at the cost of contractor.

33. QUALITY ASSURANCE AND QUALITY CONTROL

Contractors shall refer to the Quality Assurance Plan in addition to below clauses.

Construction Quality Management is necessary to ensure that the Construction Quality meets or exceeds the intents of the technical specifications and drawings set in the Contract Documents. This is a system In which The Construction Manager (contractor) and The Engineer-In-Charge (employer/consultant) perform defined tasks independently to achieve the Objective cited above.

(a) Quality Control (QC) is regulatory process to be performed by the contractor and which includes following:

i. Specific standards are set for Construction performance, deduced or derived from the Technical Specifications/Drawings/Contract Conditions.

ii. Construction methodology and planning and detailed time schedule.

iii. Planning and deployment of appropriate resources like plant/ machinery/ manpower

iv. Systems for workmanship in process supervision, checks and corrections.

v. Testing of Construction Materials and site facilities.

vi. Quantification of work done.

vii. Meetings/workshops for safety and improvement in quality Plan

(b) The Contractor prepares Quality Plan particular to the Project and same is finalized in conjunction with Engineer-In-Charge. The Quality Plan shall comprise of

i. QC Organization defines qualifications, hierarchy, authority, and responsibility.

ii. Construction method statement.

iii. Procedure for material sample approvals.

iv. workmanship checks for work in progress.

v. Material tests-standard/frequency/tolerances

vi. Forms

vii. Procedure for interaction with Engineer-In-Charge.

viii. Bar Chart

ix. safety manual

(c) Quality Assurance (QA) includes defining criteria, applying procedures to ensure that QC system is effective. Thus the main functions of the Engineer-In-Charge are (1) to verify, vet contractor's Quality Plan and the QC system. (2) To monitor the working of QC systems. (3) Taking remedial measures in case of failures and strengthening the system

Contractor makes his quality plan in consideration with QA plan attached along with tender which comprises of:

i. QA Policy and goal.

ii. QA standards and procedure, procedure for QA/QC interface.

iii. Development of QC norms specific to the project.

iv. Organization

v. Acceptance criteria

vi. Site surveillance and checks to control and prevent non conformities.

vii. Audit of completed work

viii. Maintaining QA records.

ix. Periodic internal QA/QC audits and remedial measures as per requirement.

x. Periodic joint site visits and meetings with the Construction Manager to sort out quality related matters.

34. WORK TO BE TO THE SATISFACTION OF THE CONSULTANT

Save in so far as it is legally or physically possible the Contractor shall execute complete and maintain the Works in strict accordance with the Contract to the satisfaction of the Consultant and shall comply with and adhere strictly to the Consultants instructions and directions on any matter (whether mentioned in the Contract or not touching or concerning the Works. The Contractor shall take instructions and directions only from the Consultant Representative.

35. DOCUMENTS MUTUALLY EXPLANATORY

The several documents forming the Contract are to be taken as mutually explanatory of one another and in case of ambiguities or discrepancies the same shall be explained and. adjusted by the Consultant who shall thereupon issue to the Contractor instructions directing in what manner the work is to be carried out. Provided always that if in the opinion of the Consultant compliance with any such instruction shall involve the Contractor in any expense which by reason of any such ambiguity or discrepancy the Contractor did not and had reason not to anticipate the

Consultant shall certify and the Employer shall pay such additional sum as may be reasonable to cover such expense.

36. Inspection of Operation

The Engineer and any person authorized by him shall at all times have access to the works and to all workshops on or off the site and places where work is being prepared or from where materials, manufactured articles or machinery are being obtained for the works and the Contractor shall afford every facility for and every assistance in or in obtaining the right to such access. All works carried out off the site shall be duly brought to the notice of the Engineer.

37. Examination of work

(a) No work shall be covered up or put out of view without the approval of the Engineer or the Engineer's Representative and the Contractor shall afford full opportunity for the Engineer or the Engineer's Representative to examine and measure any work which is in view and to examine foundations about to be covered up or put out of before permanent work is placed thereon. The Contractor shall give due notice to the Engineer's Representative whenever any such work or foundation is or are ready or about to be ready for examination and the Engineer's Representative shall, without unreasonable delay, unless the considers it unnecessary and advises the Contractor accordingly, attend for the purpose of examining and measuring such works of examining such foundations.

(b) Uncovering & Making Openings

The Contractor shall uncover any part or parts of the works or make openings in or throughout the same part or parts to the satisfaction of the Engineer-in-Charge. If any such part of parts have been covered up or put off view after compliance with the requirements of sub-clause (a) of this Clause and are found to be executed in accordance with the Contract, the expenses of uncovering, making openings in or through, reinstating and making good the same shall be borne by the Employer, but in any other case all costs shall be borne by the Contractor.

38. Removal of improper Works and Material

(a) The Engineer-in-Charge shall during the progress of the works have power to order in writing from time to time

(i) The removal from the Site, within such time or times as may be specified in the order, of any materials, which in the opinion of the Employer, are not in accordance with the Contract

(ii) The substitution of proper and suitable materials and

(iii) The removal and proper re-execution, notwithstanding any previous test thereof or interim payment thereof, any work which in respect of materials or workmanship is not, in the opinion of the Engineer, in accordance with the Contract

(b) Default of Contract in compliance

In case of default on the part of the Contractor in carrying out such order, the Employer shall be entitled to employ and pay other persons to carry out the same and all expenses consequent thereon or incidental thereto shall be

recoverable from the Contractor after giving due notice in writing by the Employer, or may be deducted by the Employer from any money due or which may become due to the Contractor. Appropriate deductions may be made in the payment due to the contractor if in the opinion of the client/consultant any part of the work has not been carried out by the contractor in accordance with the contract and the specifications. The amount of such deductions will be decided by the client/consultant.

39. Suspension of Work

(a) The Contractor shall, on the written order of the Engineer, suspend the progress of the Works or any part thereof for such time or times and in such manner as the Engineer may consider necessary and shall during such suspension properly protect and secure the work, so far as is necessary in the opinion of the Engineer. The extra cost incurred by the Contractor in giving effect to the Engineer's instructions under this clause shall be borne and paid by the Employer unless such suspension is.

(i) Otherwise provided for in the Contract, or
(ii) Necessary by reason of some default on the part of the Contractor, or
(iii) Necessary by reason of climatic conditions on the site, or
(iv) necessary for the proper execution of the works or for the safety of the works or any part thereof in so far as such necessity does not arise from any act or default by the Engineer or the Employer or from any of the excepted risks defined in the clause hereof.

Provided that the Contractor shall not be entitled to recover any such extra cost unless he gives written notice of his intention to claim to the Engineer within fifteen (15) days of the Engineer-in-Charge's Order. The Engineer shall settle and determine such extra payment and / or extension of time under clause hereof to be made to the Contractor in respect of such claim as shall, in the opinion of the Engineer-in-Charge, be fair and reasonable.

(b) Suspension lasting more than 90 days.

If the progress of the works or, any part thereof is suspended on the written order of the Engineer and if permission to resume work is not given by the Engineer within a period of ninety days from the date of suspension then, unless such suspension is within paragraph (i), (ii), (iii) or (iv) of sub-clause (a) of this clause the contractor may serve a written notice on the Engineer requiring permission within twenty-eight days from the receipt thereof to proceed with the works, or that part thereof in regard to which progress is suspended and, if such permission is not granted within that time, the Contractor by a further written notice so served may, but is not bound to, elect or treat the suspension where it affects part only of the works as an omission of such part under clause hereof, or, where it affects the whole works, as an abandonment of the Contract by the Employer and shall be determined as per clause.

40. Defects during execution and after completion of works / DEFECTS LIABILITY

a. The Contractor shall complete the contract works in all respects within the Completion period as per Tender.

b. On completion of contract work, the contractor shall give a written Intimation to the Engineer-In-Charge to this effect. Joint Inspection by Employer, The Engineer-In-Charge, and contractor shall be done within 10 days of intimation and the punch list or defect list shall be prepared and signed. The defects shall be rectified within 14 days, again the rectifications work will be verified jointly.

After all the defects are rectified to the satisfaction of Employer /the Engineer-In- Charge, Acceptance report will be signed jointly.

c. Any defect, shrinkage, settlement or other faults which may appear during execution or within the **"Defects Liability Period"** (The contractor shall be responsible to make good at his own expenses every defect which may develop during this period and which in the opinion of The Engineer-In-Charge is due to defective materials /defective workmanship/erroneous construction method.) stated in the Appendix hereto, or if none stated then within 12 months after the virtual completion of the works, arising in the opinion of the Employer from materials or workmanship not in accordance with the contract, shall upon the directions in writing of the Employer, and within such reasonable time as shall be specified herein, be amended and made good by the Contractor, at his own cost unless the Architect & Engineer-in-Charge in concurrence with the Employer shall decide that he ought to be paid for such amending and making good, and in case of default the Employer may employ and pay other persons to amend and make good such defects, shrinkage, settlements or other faults, and all damages, loss and expenses consequent thereon or incidental thereto shall be made good and borne by the Contractor and such damage, loss and expenses shall be recoverable from him by the Employer or may be deducted by the Employer upon the Architect's & Engineer-in-Charge's Certificate in writing from any moneys due or that may become due to the contractor, or the Employer may in lieu of such amending and making good by the Contractor deduct from any moneys due to the Contractor a sum to be determined by the Architect and the Engineer-in-Charge in concurrence with the Employer equivalent to the cost of amending such work and in the event of the amount retained under retention clause being insufficient recover the balance from the Contractor, together with any expenses the Employer may have incurred in connection therewith.

d. Should any defective work have been done or material supplied by any sub-contractor employed on the works, who has been nominated or approved by the Architect / the Engineer-in-Charge and the Employer jointly as provided in the clause, the Contractor shall be liable to make good in the same manner as if such work or material had been done or supplied by the contractor and been subject to the provisions of this clause and the clause thereof. The Contractor shall remain liable under the provisions of this clause notwithstanding the signing by the Architect or the Engineer-in-Charge or the Employer of any Certificate or the passing of any accounts.

41. Insurance

Without limiting his obligations and responsibilities, the contractor shall insure in the name of the Employer against all loss or damage for all works under (a) below and in the joint name of the Employer and the Contractor against any loss or damage for all items under (b) below from whatever, cause arising, including riot and excepted risks and for which he is responsible under the terms of the Contract and in such manner that the Employer is covered for the period stipulated hereof and are also covered during the period of Maintenance for loss or damage arising from a cause, occurring prior to the commencement of the Period of Maintenance, and for any loss or damage occasioned by the Contractor in the course of any operations carried out by him for the Purpose of complying with his obligation under clause hereof:

a. The Works for the time being executed to the estimated current contract value thereof, or such additional such as may be specified together with the

materials for incorporation in the works at their replacement value.

b. The Constructional Plant and other things brought on to the site by the contractor to the replacement value of such constructional plant and other things.

Such insurance shall be affected with an insurer and in terms approved by the Employer and the Contractor shall, deposit with the Engineer or the Engineer's Representative the policy or policies of insurance and the receipts for payment of the current premiums. All money payable by insurers shall be received by the Employer and disbursed to the Contractor in installments.

42. LABOUR AND COMPLIANCES WITH LABOUR REGULATIONS

a. The contractor shall deploy adequate force of skilled and unskilled workers, foremen, supervisors of requisite skills to ensure quality construction as per schedule.

b. During the currency of contract, the contractor, his sub-contractors shall abide all existing or deemed statutory Labour Enactments, Rules, and Regulations as applicable.

c. The Contractor shall keep the Employer, The Engineer-In-Charge-In-Charge indemnified in case any action is taken by competent authority due to contravention of any act/rules/regulations including amendments if any.

43. Damage to Persons & Property

The Contractor shall indemnify the Employer and the Architect against all claims in respect of injuries or damage to any person or material or physical damage to any property whatsoever which may arise out of or in consequences of the execution and maintenance of the works and against claims, proceedings, damages, costs, charges and expenses whatsoever in respect of but not limited to, to include payment of Wages Act 1936 (Latest), Minimum Wages Act 1948 (Latest), Employers Liability Act 1938 (Latest), Workmen's Compensation Act 1947 (Latest), Industrial Disputes Act 1947 (Latest), Maternity Benefit Act 1961 (Latest) The Contract Labour (Regulation and Abolition Act, 1970 and any modifications thereof or of any law relating thereof in relation thereto including any compensation or damages for or with respect to

a. The permanent use of occupation of Land by the works or any-part thereof.

b. The right of the Employer to execute-the works or any part thereof on, over, under, in or through any land.

c. In case of any expenses arising from any such injury or damage to persons of employer and architects on site, the compensation shall be made by the contractor of the actual expenses without any delays which may arise out of claim filed and settled by the Insurance Company.

44. Third Party Insurance

a. Before commencing the execution of the works the Contractor, but without limiting his obligations and responsibilities under clause hereof, shall insure against his liability for any material or physical damage, Loss or injury which may occur to any property, including that of the Employer, or to any person, including any employee of the Employer, by or arising out of the execution of the Works or in the work

being carried out by the Employer, by or arising out of the referred to in provision hereof.

b. Minimum amount of Third Party Insurance

Such insurance shall be affected with an insurer and in terms approved by the Employer, and for at least the amount stated in the Appendix to the Tender. The Contractor shall deposit with the Engineer or the Engineer's Representative the policy or policies of insurance and the receipts for payment of the current premiums.

c. Provision to indemnify Employer

The terms shall include a provision whereby, in the event of any claim in respect of which the Employer would be entitled to receive indemnity under the policy being brought or made against the Contractor, the insurer will indemnify the Employer against such claims and any costs, charges and expenses in respect thereof.

45. Accident / or Injury to Workmen

(a) The Employer shall not be Liable for or in respect of any damages or compensations payable at Law in respect or in consequence of any accident or injury to any workman or other person in the employment of the Contractor or any sub-contractor.

The Contractor shall indemnity and keeps indemnified the Employer against all such damages and compensation and against all claims, proceedings, costs, and charges, whatsoever in respect thereof or relation thereto

(b) Insurance against Accident etc. to Workmen

The Contractor shall insure against such liability with an insurer approved by the Employer and shall continue such insurance during the whole of the time that any persons are employed by him on the works and shall, deposit with the Engineer or the Engineer's Representative such policy of insurance and the receipt of payment of the current premium.

Provided always that, in respect of any persons employed by any sub-Contractor, the Contractor's obligation to insure as aforesaid under this sub clause shall be satisfied if the sub-contractor shall have insured against the liability in respect of such persons in such manner that the Employer is indemnified under the policy, but the Contractor shall require such sub-contractor to deposit with the Engineer of the Engineer's Representative, such policy of insurance and the receipt for the payment of the current premium.

46. Remedy on Contractors Failure to Insure

If the Contractor fails to effect and keep in force the insurance referred to in clauses hereof, or any other insurance which he may be required to effect under the terms of the contract, then and in any such case the Employer may effect and keep in force any such insurance and pay such premium or premiums as may be necessary for that purpose and from time to time deduct the amount so paid by the Employer as aforesaid from any monies due or which may become due to the Contractor, or recover the same as a debt due from the contractor. This amount can be deducted from RA bills of contractor.

47. Commencement of Works

The Contractor shall commence the works on site within the period named in the Appendix to the Tender after the receipt by him a written order to this effect from the Engineer and shall proceed with the same with due expedition and without delay, except as may be expressly sanctioned or ordered by the Engineer. The time for commencement and completion of work shall be of the essence of the contract.

48. Possession of Site

(a) Save in so far as the Contract may prescribe, the extent of portions of the Site of which the Contractor is to be given possession from time to time and the order in which such portion shall be made available to him and, subject to any requirement in the Contract as to the order in which the Works shall be executed, the Employer will, with the Engineer's written order to commence the works, give to the Contractor possession of so much of the Site as may be required to enable the Contractor to commence and proceed with the execution of the works in accordance with the program referred to in Clause hereof, if any, and otherwise in accordance with such reasonable proposals of the Contractor as he shall, by written notice to the Engineer, make and will, from time to time as the works proceed, give to the Contractor possession of such further portions of the site as may be required to enable the Contractor to proceed with the execution of the Works with due dispatch in accordance with said program or proposals, as the case may be. If the Contractor suffers delay or incurs cost from failure on the part of the Employer to give possession in accordance with the term & of this Clause, the Engineer shall grant an extension of time for the completion of the works. In case of dispute the Employer may ask the contractor to leave the site and hand over the possession of the site. The contractor shall do so immediately.

(b) The Contractor shall bear all expenses and charges for special or temporary way leaves required by him in connection with access to the site. The price quoted by them for erection shall be deemed to have included the cost of such works, which shall be removed by the CONTRACTOR at his cost, immediately after completion of his work The Contractor shall also provide at his own cost any additional accommodation outside the Site required by him for the purpose of the Works.

49. Time for Completion

Subject to the requirement in the Contract as to completion of any sections of the works before completion of the whole, the whole of the works shall be completed, in accordance with the provisions of clause hereof, within the time stated in the Contract calculated from the last day of the period named in the Appendix to the Tender as that within which the Works are to be commenced, or such extended time as may be allowed under clause hereof.

50. Rate of Progress

If for any reason, which does not entitle the Contractor to an extension of time, the rate of progress of the works or any section is at any time, in the opinion of the Engineer, too slow to ensure completion by the prescribed time or extended time for completion, the Engineer shall so notify the Contractor in writing and the Contractor shall thereupon take such steps as are necessary and the Engineer may approve to expedite progress so as to complete the Works or such section by the prescribed time or extended time. The Contractor shall not be entitled to any additional payment for taking such steps. If, as a result of any notice given by the Engineer under this Clause, the contractor shall seek the Engineer's permission to do any work at night or

on Sundays, if locally recognized as days of rest, or their locally recognized equivalent, such permission shall not be unreasonably refused

51. Liquidated Damages for Delay

If the Contractor fails to achieve completion of the works either in whole or part within the time prescribed, then the Contractor shall pay to the Employer the sum stated in the Appendix as liquidated damages for such default for everyday or part of a day which shall elapse between the time prescribed by clause hereof and the date of certified completion of the works. The Employer may, without prejudice to any other method of recovery, deduct the amount of such damages from any monies in his hands, due or which may become due to the Contractor. The payment or deduction of such damages shall not relieve the contractor from his obligation to complete the works or from any other of his obligations and Liabilities under the contract.

52. Certification of Completion of Works

(a) When the whole of the Works have been substantially completed and have satisfactorily passed any final test that may be prescribed by the Contract, the Contractor may give a notice to that effect to the Engineer or to the Engineers Representative accompanied by an undertaking to finish any outstanding work during the period of Maintenance. Such notice and undertaking shall be in writing and shall be deemed to be a request by the Contractor for the Engineer to issue a Certificate or completion in respect of the works. The Engineer shall, within thirty days of the date of delivery of such notice either issue to the Contractor, a Certificate of Completion stating the date on which, in his opinion, the works were substantially completed in accordance with the Contract or give instructions in writing to the Contractor specifying all the work which, in the Engineer's opinion, requires to be done by the Contractor before the issue of such Certificate. The Engineer shall also notify the Contractor of any defects in the Works affecting substantial completion that may appear after such instructions and before completion of the works specified therein. The Contractor shall be entitled to receive such Certificate of Completion within twenty-one days of completion to the satisfaction of the Engineer of the works so specified and making good any defects so notified.

(b) Certification of completion by Stages

Similarly, in accordance with the procedures set out in Sub-clause (a) of this clause, the Contractor may request and the Engineer shall issue a Certificate of Completion in respect of

(i) Any section of the permanent works in respect of which a separate time for completion is provided in the Contract and
(ii) Any substantial part of the Permanent Works, which has been both, completed to the satisfaction of the Engineer and occupied or used by the Employer.

(c) If any part of the Permanent Works shall have been substantially completed and shall have satisfactorily passed any final test that may be prescribed in the Contract, the Engineer may issue a Certificate of Completion in respect of that part of the Permanent Works before completion of the whole of the works and upon the issue of such Certificate, the Contractor shall be deemed to have undertaken to complete any outstanding work in that part of the works during the Period of Maintenance.

(d) Provided always that a Certificate of Completion given in respect of any section of part of the Permanent Works before completion of the whole shall not be deemed to certify completion of any ground or surfaces requiring reinstatements unless Certificate shall expressly so state.

53. COMPLETION DOCUMENTS

The CONTRACTOR shall carry out various tests as called for in bidding document either on field or at outside approved laboratories at his own cost. All test results and related documents shall be submitted in 2 (Two) copies as part of completion documents.

The following documents in-addition to documents if specified in GCC shall be submitted in hard binder by the CONTRACTOR as a part of completion documents:

a) Test Certificate from manufacturers for all supply material.

b) Two sets of execution drawing with all corrections / alterations carried out during the execution of the work duly marked as “As Built‟ in hard and soft Autocad.

d) Field Test report for all applicable activities including NDT testing.

e) Material Inspection / Test report for supply of all material.

f) Return of surplus material, reconciliation statement for all the material issued, if any by client, etc.

g) Surrendering of Gate Passes etc.

h) All other requirements as specified in the respective specifications.

i) Any other drawing/ document/ report specified elsewhere in the Bidding Document

Note: CONTRACTOR shall be eligible to apply for issue of completion certificate only after submission of completion documents as mentioned above.

AS BUILT MARK UP - Contractor shall incorporate the changes in drawings / Isometric and submit to DADO Design Labs for certification. Quoted rates in SOR shall include all expenses for making As BUILT Mark Up.

Completion document shall contain following:

- Completion Certificate by Engineer-In-Charge
- No Demand Certificate from Contractor
- No Due Certificate from Contractor
- Site clearance Certificate
- Labour Liability Certificate
-
- Indemnity Bond on Rs. 100 stamp paper (formats of above documents are enclosed as Attachment 1)

54. Period of Maintenance/ Defect Liability

(a) Period of Maintenance
The expression "Period of Maintenance" shall mean the period of maintenance named in the Appendix to the Tender, calculated from the date of completion of the Works, certified by the Engineer in accordance with Clause hereof, or, in the event of more than one certificate having been issued by the Engineer under the said Clause, from the respective dates so certified and in relation to the period of Maintenance the expression "the Works" shall be constructed accordingly.

(b) Execution of Work of repair, etc.
To the intent that the works shall at or as soon as practicable after the expiration of the Period of Maintenance be delivered to the Employer in the condition required by the Contract, fair wear and tear excepted, to the satisfaction of the Engineer, the Contractor shall finish the work, if any, outstanding at the date of completion, after such date and shall execute all such work of repair, amendment, reconstruction, rectification and making good defects, imperfections, shrinkages or other faults as may be required of the Contractor in writing by the Engineer during the Period of Maintenance, or within fourteen days after its expiration, as a result of an inspection made by or on behalf of the Engineer prior to its expiration.

(c) Cost of execution of work of repair etc.
All such work shall be carried out by the Contractor at his own expense if the necessity thereof shall, in the opinion of the Engineer, be due to the use of materials or workmanship not in accordance with the Contract, or due to neglect or failure on the part of the Contractor to comply with any, obligations, expressed or implied, on the Contractor's part under the Contract. If, in the opinion of the Engineer, such necessity shall be due to any other cause, the value of such work shall be ascertained and paid for as if it were additional work.

(d) Remedy on Contractor's Failure to carry out work required:
If the Contractor fails to do any such work as aforesaid required by the Engineer, the Employer shall be entitled to employ and pay persons to carry out the same and if such work is work which, in the opinion of the Engineer, the Contractor was liable to do at his own expense under the Contract, then all expenses consequent thereon or incidental thereto shall be recoverable from the Contractor by the Employer, or may be deducted by the Employer from any monies due or which may become due to the Contractor.

(e) Contractor to search
The Contractor shall, if required by the Engineer in writing, search under the directions of the Engineer for the cause of any defect, imperfection or fault appearing during the progress of the works or in the period of Maintenance. Unless such defect, imperfection of fault shall be one for which the Contractor is liable under the Contract, the cost of the work carried out by the Contractor in searching as aforesaid shall be borne by the Employer. If such defect, imperfection of fault shall be one for which the Contractor is liable as aforesaid, the Cost of the work carried out in searching as aforesaid shall be borne by the Contractor and / he shall in such case repair, rectify and make good such defect, imperfection or fault at his expense in accordance with the provisions of clause hereof.

55. Payment Withheld

The Engineer may withhold or on account of subsequently discovered evidence nullify the whole or a part of any certificate to such extent as may be necessary in the opinion to protect the Employer from loss on account of

(a) Defective work not remedied.

(b) Failure of the Contractor to make payments properly to sub-contractor for materials or labour or to Contractor's employees / workmen or failure to discharge any other obligations under applicable laws.

(c) A reasonable doubt that the Contract cannot be completed in the balance time.

(d) Damage to another Contractor's or sub-contractor's work.

(e) Claims filed or reasonable evidence indicating probable filing of claims.

56. Delay and Extension of Time

If, in the opinion of the Employer, the works be delayed

(a) By force majeure or

(b) By reason of any exceptionally inclement weather or

(c) By reason of proceedings taken or threatened by or dispute with adjoining or neighboring owners or public authorities arising otherwise than through the Contractor's own default or

(d) By the works or delays of other Contractors or Tradesmen engaged or nominated by the Employer or the Architect / the Engineer-in-Charge and not referred to in the Schedule of Quantities and / or specification or

(e) By reason of "Works Instructions" as per Clause or

(f) By reason of civil commotion, local combination of workmen or strike or lockout affecting any of the building traders or

(g) in consequence of the Contractor not having received in due time necessary instructions from the Architect / the Engineer-in-Charge or the Employer for which he shall have specifically applied in writing, the Employer in consultation with the Architect / the Engineer-in-Charge shall make a fair and reasonable extension of time for completion of the Contract Works; in case of such strike or lock-out the Contractor shall, as soon as may be, give written notice thereof to the Architect, the Engineer-in-Charge and the Employer; but, the Contractor shall nevertheless constantly use his endeavors to prevent delay and shall do all that may reasonably be required to the satisfaction of the Architect / the Engineer-in-Charge and the Employer to proceed with the work.

57. Termination of Contract by the Employer

The Employer may terminate this contract by giving one-month notice.

The Employer may terminate this contract, if the Contractor being an individual or a firm commit any "act of insolvency" or shall be adjudged an insolvent or being an Incorporated Company having an order for compulsory winding up made against it or pass an effective resolution forwarding up voluntarily or subject to the supervision of

the Court and of the official Assignee of the Liquidator in such acts of insolvency or winding up shall be unable within seven days after notice to him requiring him to do so, to show to 'the reasonable satisfaction of the Architect / Employer with the concurrence of the Employer that he is able to carry out and fulfill the Contract, and to give security therefore, if so required by the Employer.

Or if the Contractor (whether an individual, firm or Incorporated Company) shall suffer execution to be issued.

Or shall suffer any payment under this Contract to be attached by or on behalf of any of the creditors of the Contractors,

Or shall assign or sub-let this Contract without the consent in writing of the Architect / the Engineer-in-Charge and the Employer first obtain,

Or shall change or encumber this Contract or any payments due or which may become due to the Contract there under;

Or if the Architect and the Engineer-in-Charge shall certify in writing the Employer that the Contractor

(a) Has abandoned the Contract, or

(b) has failed to commence the works, or has without any lawful excuse under these Conditions suspended the progress of the Works for 14 days after receiving from the Architect / the Engineer-in-Charge written notice to proceed, or

(c) Has failed to proceed with the works with such due diligence and failed to make such due progress as would enable the works to be completed within the time agreed upon, or

(d) has failed to remove materials from the site or to pull down and replace work for seven days after receiving from the Architect and the Engineer-in-Charge, written notice that the said materials or work were condemned and rejected by the Architect and the Engineer-in-Charge under these conditions, or

(e) has neglected or failed persistently to observe and perform all or any of the acts matters or things by this Contract to be observed and performed by the Contractor for seven days after written notice shall have been given to the Contractor requiring the Contractor to observe or perform the same, or

(f) has to the detriment of good workmanship or in defiance of the Architect's/ Engineer-in-Charge's and Employer's instructions to the contrary sub-let any part of the Contract, then and in any of the said cases, the Employer in consultation with the Architect / the Engineer-in-Charge may not withstanding any previous waiver after giving seven days' notice in writing to the Contractor, determine the Contract, but without hereby affecting the powers of the Architect / the Engineer-in-Charge or the obligations and liabilities of the contract, the whole of which shall continue in force-as fully as if contract had not been so determined and-as if the works subsequently executed had been executed by or on behalf of the contractor.

The Employer under advice of the Engineer-in-Charge/ Architect may enter upon and take possession of the works and all plant, tools, scaffoldings, sheds, machinery, steam and other power generation unit and materials lying upon the premises or the adjoining lands or roads, and use the same as his own property or may employ the same by means of his own persons and workmen in carrying on and completing the works or by employing any other Contractors or other person or persons to complete the works.

The Contractor shall not in any way interrupt or do any act, matter or things to prevent or hinder such other contractor or other person or persons employed for completing and finishing or using the materials and plant for the works. When the works shall be completed or as soon thereafter as convenient the Architect and the Engineer-in-Charge shall give a notice in writing to the Contractor to remove his surplus materials and plant, and should the Contractor fail to do so within a period of fourteen days after receipt thereof by him, the Employer shall sell the same by public auction, and shall give credit to the Contractor for the amount realized. The Architect and the Engineer-in-Charge shall, thereafter, ascertain and certify in writing under their hands (if anything) shall be due or payable to or by the Employer for the value of the said plant and materials so taken possession of by the Employer and the expense or loss which the Employer shall have been put to in procuring the works to be completed, and the amount if owing to the Contractor and the amount which shall be so certified shall thereupon be paid by the Employer, as the case may be, and the certificate of the Architect and the Engineer-in-Charge shall be final and conclusive between the parties.

58. Termination of Contract by the Contractor

The Contractor may terminate this contract if the payment of the amount payable by the Employer under CERTIFICATE of the Architect and the Engineer-in-Charge with interest as provided for hereinafter shall be in arrears and unpaid for forty five days after notice in writing requiring payment of the amount with interest as aforesaid shall have been given by the Contractor to the Employer, or if the Employer interferes with or obstructs the issue of such Certificate or the Employer commits any "act of insolvency", or (being and Incorporated Company) shall have an order made against him or pass an effective resolution for winding up, either compulsorily or subject to the supervision of the Court or Voluntary, or if the official Assignee or the Employer shall repudiate the Contracts or if the official Assignee or the Liquidator, in any such winding up, shall be unable within fifteen days after notice to him requiring him so to do, to show to the reasonable satisfaction of the Contractor that he is able to carry out and fulfill the Contract and to make Contractor, to give security for the same, or if the works be stopped for all payments due, and to become due there under and, if required by the three months under the order of the Employer or by any injunction or other order of any Court of Law, then and in any of the said cases the Contractor shall be at liberty to determine the Contract by notice in writing to the Employer and he shall be entitled to recover from the Employer payment for all works executed.

In arriving at the amount of such payment, the net rates contained in the Tender Agreement shall be followed.

59. Certificates and Payments

(a) Unless otherwise provided, payments shall be made at monthly intervals in accordance with the conditions set out

(b) Advances on Constructional Plant and Materials

No advances are to be made by the Employer to the Contractor in respect of Constructional Plant and Materials, the conditions of payment and repayment shall be as set out.

(c) Approval only by Maintenance Certificate

No certificate other than the Maintenance Certificate referred to in clause (d) hereof shall be deemed to constitute approval of the works.

(d) Maintenance Certificate

The Contract shall not be considered completed until a Maintenance Certificate has been signed by the Engineer-in-Charge and delivered to the Contractor stating that the Works have been completed and maintained to his satisfaction. The Maintenance Certificate shall be given by the Engineer within twenty-eight days after the expiration of the Period of Maintenance, or, if different periods of maintenance shall become applicable to different sections or parts of the works, the expiration of the latest such period, or as soon thereafter as any works ordered during such period, pursuant to clause hereof, shall have been completed to the satisfaction of the Engineer and full effect shall be given to the clause, notwithstanding any previous entry on the works or the taking possession, working or using thereof or any part thereof by' the Employer. Provided always that the issue of the Maintenance Certificate shall be preconditioned to payment to the Contractor of the second portion of retention money in accordance with the Appendix.

Cessation of Employer's Liability:

The Employer shall not be liable to the Contractor for any matter or thing arising out of or in connection with the Contract or the execution of the works, unless the Contractor has made a claim in writing in respect thereof before the giving of the Maintenance Certificate under this Clause.

60. Valuation at Date of Forfeiture

The Engineer-in-Charge shall, as soon as practicable after any such entry and expulsion by the Employer, fix and determine ex parte, or by or after reference to the parties, or after such investigation or enquiries as he may think fit to make or institute, and shall certify what amount, if any, had at the time of such entry and expulsion been reasonably earned by or would reasonably accrue to the Contractor in respect of work when actually done by him under the Contract and the value of any of the said unused or partially used materials and any Temporary Works

(a) Payment after Forfeiture

If the Employer enters and expels the Contractor under this clause, he shall not be liable to pay to the Contractor any money on account of the Contract until the expiration of the Period of Maintenance and thereafter until the costs of execution and Maintenance, damages for delay in completion, if any, and all other expenses incurred by the Employer have been ascertained and the amount thereof certified by the Engineer-in-Charge. The Contractor shall then be entitled to receive only such sum or sums, if any, as the Engineer-in-Charge may certify as payable to him upon due completion by him after deducting the said amount. If such amount shall exceed the sum which would have been payable to the Contractor on due completion by him, then the Contractor shall, upon demand, pay to the Employer the amount of such excess and it shall be deemed a debt due by the Contractor to the Employer and shall be recoverable accordingly.

61. Urgent Repairs

If by reason of any accident, or failure, or-other event occurring to in connection with the Works, or any part thereof, either during the execution of the works, or during the Period of Maintenance, any remedial or other work or repair shall, in the opinion of the Employer or the Engineer's Representative, be urgently necessary for the safety of the Works and the Contractor is unable or unwilling at once to do such work or repair, the Employer may employ and pay other persons to carry out such work or repair as the Engineer or the Engineer's Representative may consider necessary. If the work or

repair so done by the Employer is work which, in the opinion of the Engineer, the Contractor was liable to do so at his own expense under the Contract, all expenses properly incurred by the Employer in so doing shall be recoverable from the Contractor by the Employer from any monies due or which may become due to the Contractor. Provided always that the Engineer or the Engineer's Representative, as the case may be, shall, as soon after the occurrence of any emergency as may be reasonably practicable, notify the Contractor in writing.

62. Special Risks

(a) The Employer shall repay to the Contractor any increased cost of or incidental to the execution of the Works, other than such as may be attributable to the cost of construction work condemned under the provision of clause hereof, prior to the occurrence of any special risk, which is however attributable to or consequent on or the result of or in any way whatsoever connected with the said special risks, subject however to the provisions in this clause hereinafter contained in regard to outbreak of war, but the Contractor shall as soon as any such increase of cost comes to his knowledge forthwith notify the Engineer thereof in writing.

(b) Special Risks

The Special risks are war, hostilities, (whether war be declared or not), invasion, act of foreign enemies, the nuclear and pressure waves risk described in clause hereof, or insofar as it relates to the country in which the works are being or are to be executed or maintained, rebellion, revolution, insurrection, military or usurped power, civil war, or unless solely restricted to the employees of the contractor or of his sub-contractors and arising from the conduct of the works, riot, commotion or disorders.

(c) Outbreak of War

If, during the currency of the Contract, there shall be an outbreak of war, whether war is declared or not, in any part of the world which, whether financially or otherwise, materially affects the execution of the works, the Contractor shall, unless and until the Contract is terminated under the provision of this clause, continue to use his best endeavors to complete the execution of the works. Provided always that the Employer shall be entitled at any time after such outbreak of war to terminate the Contract by giving written notice to the Contractor and, upon such notice being given, this contract shall, except as to the rights of the parties under this clause and to the operation of clause hereof, terminate, but without prejudice to the rights of either party in respect of any antecedent breach thereof.

(d) Removal of Plant on termination

If the Contract is determined under the provisions of the last preceding sub-clause, the Contractor shall, with all reasonable dispatch, remove from the site all Constructional Plant, staff, workers; identify those of Sub-Contractors to do so.

63. Payment if Contract is terminated.

(a) The amounts payable in respect of any items, so far as the work or service comprised therein has been carried out or performed, and a proper proportion as certified by the Engineer in Charge in Writing of any such items, the work or service which has been partially carried out or performed.

(b) The cost of materials or goods reasonably ordered for the works which shall have been delivered to the Contractor at site or of which the Contractor is

legally liable to accept delivery for works being fabricated off site, or propriety goods ordered in both cases where due prior notice has been given to the Engineer, in writing, such materials or goods becoming the property of the Employer upon such payments being made by him.

(c) A sum to be certified by the Architect & Engineer-in-Charge in writing being the amount of any expenditure reasonably incurred by the Contractor towards, site office, site stores, fabrication yard, fencing in the expectation of completing the whole of the works insofar as such expenditure shall not have been covered by the payments in this sub-clause before mentioned.

(d) On any account, if the Contract is terminated by Employer, no liquidated damages shall be payable to the Contractor on account of profit on remaining portion of the contract or loss on account of premature termination. In such a case, the Contractor will be entitled to remove his material/equipment only after settling the account in full and final with Employer.

Provided always that against any payments due from the Employer under this sub-clause, the Employer shall be entitled to be credited with any outstanding balances due from the Contractor for advances in respect of Constructional Plant and Materials and any other sums recoverable by the Employer from the Contractor under the terms of the Contract.

64. Frustration

Payment in the event Frustration

If a war, or other circumstances outside the control of both parties, arises after the contract is made so that either party is prevented from fulfilling his contractual obligations, or under the law governing the Contract, the parties are released further performance, then the sum payable by the Employer to the Contractor respect of the work executed shall be the same as that which would have been payable under clause 62 / C.

65. Procedure for Disputes

In case of Dispute or Difference arising between Employer and the Contractor relating to any matter arising out of this contract, such disputes or differences shall be settled in accordance with the Arbitration and Conciliation Act 1996, The Arbitral tribunal shall consist of 3 Arbitrators one each to be appointed by the Employer and the Contractor. The third arbitrator shall be jointly nominated by the two Arbitrators and he hall be the presiding arbitrator. If there is no agreement about nomination of the third Arbitrator, then the third and presiding Arbitrator shall be appointed by the Indian Council of Arbitrations/ president of Institute of Engineers.

The Arbitration proceedings shall be at Mumbai and the operative language shall be English.

The decision of the Majority of Arbitrators shall be binding upon both parties. The Cost of Arbitration proceedings shall be shared equally by the parties. The expenses towards preparation and fees of Arbitrator by each party shall be borne by the parties themselves.

If the contract value is Rs 500 Lacs or less, the dispute shall be referred to a sole Arbitrator to be appointed jointly by the parties. If there is no agreement on this, the Sole Arbitrator shall be appointed by the Indian Council of Arbitration/president, Institute of engineers. Decision of the sole Arbitrator shall be binding on the parties.

Performance of the Contract shall continue during the Arbitration proceedings.

66. Safety Code

(a) General

Contractor shall submit a Safety organization structure along with the Safety plan for approval before commencing the job.

Contractor shall adhere to safe construction practice and guard against hazardous and unsafe working conditions and shall comply with Employer safety rules as set forth herein prior to start of construction, Contractor shall be furnished copies of Employer's Safety Code' for information and guidance. The contractor shall erect, display and maintain signage at different locations of the site, to show safety requirements during work, regulations regarding protective equipment, clothing and the like. **Refer to HSE and Safety clauses section given in tender.**

(b) Safety Regulations

(i) In respect of all labour, directly or indirectly employed in the work for the performance of Contractor's part of this agreement, the Contractor shall at his own expense arrange for all the safety provisions as per (i) Safety codes of C.P.W.D. & Indian Standards Institution (ii) The Electricity Act, (iii) The Mines Act, and (iv) Regulations, Rules and orders made there under and such other act as applicable

(ii) The Contractor shall observe and abide by all Fire and Safety Regulations of the Employer. Before starting construction work, Contractor shall consult Employer's safety engineer or Engineer-in-charge and provide all required precautionary measures to this effect. The Contractor must make good to the satisfaction of the Employer any loss or damage due to fire to any portion of the work done under this contract or to any of the Employer's existing property.

(iii) The contractor shall obtain necessary licenses and approvals from appropriate authority under labour enactment as required to carry out obligations under this contract including license required under The Contract Labour (Regulation and Abolition Act, 1970)

(c) First Aid and Industrial Injuries

(i) Contractor shall maintain first aid facilities for his employees and those of his Sub-contractors. He shall arrange Medical Treatment without any loss of time in the event of an accident or injury.

(ii) All critical injuries shall be reported promptly to Employer. All such injuries shall be thoroughly investigated and a copy of Contractor's report covering - cause, remedy and preventive measures (for each personal injury requiring the attention of a physician) shall be furnished to the Engineer-in-Charge in an approved format.

(iii) The contractor shall have a trained person at the site for administering first aid.

(iv) The Contractor shall have a Safety Inspector for the works

67. Setting Up of Field Laboratory

The Contractor shall set up a field laboratory at the site at his own expense to carry out the tests as per requirements. The laboratory shall be manned and operated by qualified and experienced technicians.

All required equipment as per relevant IS test procedure shall be available along with applicable IS codes. In addition to the above, the Contractor shall provide all other necessary equipment's to carry out any other field tests required by the Engineer-in-charge.

All the equipment's should be calibrated by a third party periodically and certificates should be kept in the laboratory.

The Contractor shall carry out the various mandatory tests as per BIS Specifications and the technical documents that shall be furnished to him during the performance of the work. All the tests, either on the field or outside laboratories concerning the execution of the work and supply of materials for the same shall be carried out by the Contractor at his own cost. Price quoted by the Contractor shall be deemed to include the cost of such tests and inspections.

68. Taxes

(a) The Rates in Bills of Quantities inclusive of transporting, loading, unloading , storage , security & all other charges such as toll, Octroi, local taxes, excise duty, other payments and compensations, if any in connection with the procurement and handling of materials, fabrication and execution of works or any method or process connected with the works or Temporary works. However GST shall be paid as per actual.

(b) Notwithstanding anything contained elsewhere in the contract, the Employer shall deduct at source, from the payments due to the Contractor, any taxes required to be deducted at source by law. The amounts so deducted shall be deposited by the Employer with the concerned authorities as per law. It is for the Contractor to deal with the concerned authorities directly in respect of any claim or refund relating to the above deductions and the Employer shall not be liable or responsible for any claims or payments or reimbursement in this regard.

(c) The Contractor undertakes that they shall pay all the taxes in accordance with the applicable laws as and when it becomes due and within 30 (thirty) days of making such payment shall deliver to Employer a duly certified copy / document, evidencing that the payment has been duly remitted to the appropriate authority. In case the Contractor fails to provide the Certificate, Employer reserves the right to retain /hold equivalent amount from any pending or subsequent bills/payments to the Contractor, till the Contractor provides a copy of such Certificate to Employer. In case any demand is made to Employer by any statutory authority on account of such default of the Contractor, Employer shall make the payment directly to the Statutory Authority concerned. The Contractor waives any right to claim any such amount from Employer in this regard.

69. Contractors Subordinate Staff and Their Conduct

(a) The Contractor on award of the work shall nominate and depute a qualified graduate engineer having sufficient experience in carrying out works of similar nature, as full time resident project manager of the Contractor for the work, to whom instructions for works may be given. The Contractor shall also provide to the satisfaction of the Employer/ Engineer-in-charge, sufficient and qualified staff to supervise the execution of the works, competent sub agents, foremen and leading hands including those specially qualified by previous experience to supervise the types of works comprised in the contract in such manner as shall ensure the best quality and expeditious working. At any time in the opinion of the Engineer-in-charge, any additional, qualified and experienced staff is considered necessary; they shall be employed by the Contractor without additional charge. The Contractor shall ensure to the satisfaction of the

Engineer-in-charge that his Sub-contractor's if any, shall provide competent and efficient supervision over the work entrusted to them.

(i) If any of the Contractor's agents, sub agents, assistants, foremen or any employee in the opinion of Engineer-in-charge be guilty of any misconduct or be incompetent or insufficiently qualified or negligent in the performance of their duties or that in the opinion of the Employer or the Engineer-in-charge, undesirable for administrative or any other reasons, for such person (s) to be employed on the works, then at the directions of Engineer-in-charge, the Contractor shall at once remove such persons(s) from employment at the works. The person(s) so removed from the works shall not again be employed in connection with the works without the written permission of the Engineer-in-charge. Vacancy so created shall be immediately filled at the expense of the Contractor by a qualified and competent substitute. Shall the Contractor be requested to repatriate any person removed from the works he shall do so and shall bear all costs in connection therewith.

(ii) The Contractor shall be responsible for the proper behavior of all the staff, foremen, workmen and others, and shall exercise proper degree of control over them and in particular without prejudice to the said generality the Contractor shall be bound to prohibit / prevent any employees from trespassing in anyway detrimental or prejudicial to the interest of the community or the properties or occupiers of land or properties in the neighborhood. In the event of such trespassing, the Contractor shall be responsible for all consequent claims or action for damages or injury or any other grounds whatsoever. The decision of the Engineer-in-charge upon any matter arising under this clause shall be final.

(iii) All employees of the Contractor shall be properly identified by badges of a type acceptable to the Employer, and must be worn at all times on the site.

(iv) Along with the tender, the bidder shall submit his schematic organization chart of staff to be employed at the works, along with their qualifications and experience.

(b) Sub Letting Of Work

(i) No part of the contract be transferred, assigned or sublet by the Contractor directly or indirectly to any person, firm or corporation whatsoever except as provided for in the succeeding sub clauses without the consent of the Employer.

(c) Sub-Contracting Of Works

(i) The Engineer-in-charge may give written consent to the Contractor for the execution of any part of the works/ specialized part of the works at the site, provided the Contractor submits credentials of each individual agency to the Engineer-in-charge for approval. Sub-contracting the work as a whole by the Contractor shall not be permitted. Furthermore, if it is noticed by the Employer that the Contractor has not made payments to one or any agencies working under him, without prejudice to the other conditions herein, the Employer reserves the right to make such payments directly to the concerned agency after due verification.

(d) Contractor's Liability Not Limited By Agencies To Contractors

(i) Notwithstanding any subletting with such approval as aforesaid and notwithstanding that the Engineer-in-charge shall have received copies of any sub contracts, the Contractor shall be and shall remain solely

responsible for the quality and proper expeditious execution of the works and the performance of all the conditions of the contract in all respects as if such sub contract or subletting by the Contractor had not taken place, and as if such work had been done directly by the Contractor.

(e) Employer May Terminate Sub Contracts Of Contractor

(i) If any Agency of contractor engaged upon the works at the site executes any work which in the opinion of the Engineer-in-charge is not in accordance with the contract, the Employer may by written notice to the contractor, request him to terminate such Agencies. The contractor upon the receipt of such notice shall terminate and dismiss the Agency. The Employer shall have the right to remove such Agency from the site if the Contractor fails to get the Agency immediately vacated.

(f) No Relief for Action Under This Clause

(i) Action taken by Employer under the above clauses shall not relieve the Contractor of any of his liabilities under the contract or give rise to any right or compensation, extension of time or otherwise.

(g) Contractor's Responsibility With Other Agencies

(i) Without repugnance to any other condition, it shall be the responsibility of the Contractor executing the work of civil construction to work in close cooperation and to co-ordinate in the works with the Piling, mechanical, electrical, air-conditioning, equipment, production machinery and intercommunication with other Contractors and other agencies or their authorized representatives, in providing the necessary grooves, recesses, cuts and openings etc. in wall, slabs, beams, and columns etc. and making good the same to the desired finish as per specification, for the placement of cables, conduits, air-conditioning inlets and outlets, grills and other equipment in the false ceiling and other partitions. The Contractor, before starting up the work shall in consultation, with the electrical, mechanical, equipment, inter communication, air-conditioning contractors and other agencies, prepare and put up a joint scheme, showing the necessary openings, grooves, recesses, cuts, the methods of fixing required for the works of the aforesaid, and the finishes therein, to the Engineer-in-charge and get the approval. The Contractor before finally submitting the scheme to the Engineer-in-charge shall have the written agreement of the other agencies. The Engineer-in-charge, before communicating his approval to the scheme, with any required modification shall get the final agreement of all the agencies, which shall be binding. No claim shall be entertained on account of the above.

(ii) The Contractor shall conform in all respects with the provisions of any statutory regulations, ordinance or bye laws of any local or duly constituted authorities or public bodies which may be applicable from time to time to the works or any temporary works. The Contractor shall keep the Employer indemnified against all penalties and liabilities of every kind, arising out of non-adherence to such status, ordinances, laws, rules, regulations etc.

(h) Other Agencies At Site

(i) The Contractor shall have to execute the work in such place and condition where other agencies shall also be engaged for other works such as electrical and mechanical engineering works or other works etc. No claim shall be entertained due to work being executed in the above circumstances.

(ii) 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 responsibility of the CONTRACTOR. In case of any dispute, the decision of Engineer-in-Charge shall be final and binding on the CONTRACTOR.

(i) Serving Of Notices

(i) To The Contractor

Any notice may be served on the Contractor or his duly authorized representative at the site or by registered mail directly to the postal address furnished by the Contractor at the time of tender. Proof of issue of such notice shall be conclusive of the Contractor having been duly informed of the contents therein.

(ii) To The Employer

Any notice to be given to the Employer under the terms of the contract shall be served by sending the same by Registered mail to or delivering the same at the respective site office of the Employer addressed to the Engineer-in-charge.

70. Patents, Royalties, Liens

(a) The Contractor shall indemnify the Employer from and against all claims and proceedings for or on account of infringement upon any patent, design, trade mark or name or other protected rights in respect of constructional plants, machines or materials used for or in connection with the works, temporary works therefore or any part thereof, and from and against all claims demands, proceedings, damages, costs, charges and expenses whatsoever in respect thereof or in relation thereto.

(b) Liens

(i) If at any time there shall be evidence or any lien, claim for which the Employer might have become liable, which is chargeable to the Contractor, and then the Employer may pay and discharge the same and deduct the amount so paid by him, from any amount which may be or become due to the Contractor.

71. SITE CLEANING

a) The CONTRACTOR shall clean and keep clean the work site from time to time to the satisfaction of the Engineer-in-Charge for easy access to work site and to ensure safe passage, movement and working.

b) If the work involves dismantling of any existing structure in whole or part; care shall be taken to limit the dismantling up to the exact point and/ or lines as directed by the Engineer-in-Charge and any damage caused to the existing structure beyond the said line or point shall be repaired and restored to the original condition at the cost and risk of CONTRACTOR to the satisfaction of the Engineer-in-Charge, whose decision shall be final and binding upon the CONTRACTOR.

72. ROUNDING OFF

g) All payments to and recoveries from the bill of CONTRACTOR shall be rounded off to the nearest Rupee. Wherever the amount to be paid/ recovered consists of a fraction of a Rupee (Paise), the amount shall be rounded off to the next higher rupee if the fraction consists of 50 (fifty) paise or more and if the fraction of a Rupee is less than 50 (fifty) paise, the same shall be ignored.

73. UNDERGROUND AND OVERHEAD STRUCTURES

Engineers-in-charge / EMPLOYER shall provide, to the best possible extent, details in respect of existing underground and above ground structures, overhead lines, cables, existing pipelines and utilities existing at job site to the CONTRACTOR. The CONTRACTOR shall execute the work in such a manner that the said structures, utilities, pipelines etc. are not disturbed or damaged, and shall indemnify and keep indemnified the EMPLOYER from and against any destruction thereof or damages thereto. Moreover, CONTRACTOR shall prepare drawing showing all the above stated details accurately and submit to Engineer-in-Charge. In case of any damage to Shikshan Prasarak Mandali facilities like underground cables/pipes etc during execution, contractor shall repair the same and restore it to its original form at his own cost. The rates quoted in SOR are deemed to be inclusive of the costs towards this activity.

74. WORKS CONTRACT

The entire Work covered under this Contract shall be treated as 'INDIVISIBLE WORKS CONTRACT'.

75. WORK IN MONSOON SEASON

CONTRACTOR shall submit within 15 days of award of work, to the Engineer-in Charge / EMPLOYER his contingency plan for work during monsoon clearly stating their methodology/ strategy to progress uninterruptedly during monsoon mentioning the deployment of resources viz. numbers, capacity, category of equipment and manpower on a weekly basis for approval. Time frame of work is including monsoon and no time increase will be given on account of the same.

76. INTERFERENCE WITH TRAFFIC AND ADJOINING PROPERTIES

All operations necessary for the execution of the works and for the construction of any temporary works shall so far as compliance with the requirements of the contract permits be carried on so as not to interfere unnecessarily or improperly with the public convenience or the access to use and occupation of public or private roads and footpaths or to or of properties whether in the possession of the Employer or of any other person and the contractor shall save harmless and indemnify the Employer in respect of all claims demands proceedings damages costs charges and expenses whatsoever arising out of or in relation to any such matters.

77. OPPORTUNITIES FOR OTHER CONTRACTORS

The contractor shall in accordance with the requirements of the consultant afford all reasonable opportunities for carrying out their work to any other contractor employed by the Employer and their workmen and to the workmen of the Employer and of any other duly constituted authorities who may be employed in the execution on or near the site of any contract which the Employer may enter into in connection with or ancillary to the works.

78. WATCHING AND LIGHTING

The Contractor shall in connection with the Works provide and maintain at his own cost all lights, guards, fencing and watching when and where necessary or required by the Consultant or Consultant's Representative or by any duly constituted authority for the protection of the Works or for the safety and convenience of the public and others.

79. CONTRACTOR'S ALL RISK POLICY

Before commencing the execution of the Works the Contractor shall insure against any damage, loss or injury which may occur to any property (including that of the Employer) or to any person (including any employee of the Employer)

by or arising out of the execution of the Works or Temporary Works or in the carrying out of the Contract otherwise. Contractor will not be allowed to work without submission of the same.

80. PROGRESS REPORTS AND PHOTOGRAPHS

(a) Contractor shall prepare and submit to The Engineer-In-Charge. BAR CHART during the mobilization period of all activities under this contract to meet the deadline/mile stones as required by Shikshan Prasarak Mandali. This shall be prepared in MS project. A micro planning of activities also shall be prepared showing how these milestone activities are achieved. The bar chart will be tracked on weekly basis by the contractor.

(b) Daily Progress Report (DPR) giving details of man power, staff, plant and equipment, cement consumption.

Weekly report giving details of major items of work executed, cement and steel consumed.

Monthly progress report giving details of work executed in the month, cement and steel consumed, stock position, review of construction schedule (M S Project), summary of action taken for Quality, planning of work in the next month and 8 photographs of work executed in the month.

The monthly report of the last month shall be submitted in the first week of current month.

81. ENVIRONMENT PROTECTION

(a) Contractor shall take adequate measures to reduce dust, mud, and smoke and noise nuisance to people working at site and in the neighborhood. Such measures shall inter alia include barricading the Complete Construction site by contractor without any extra cost. Temporary barricading shall be done for minimum **6.0 mt** (25ft) height using Colour coated GI sheets with proper supporting system made of structural steel and shall have wicket gate and material gate. **Security shall be provided to all gates to control the entries without any extra cost by Contractor.**

(b) Sprinkling water on excavated earth, debris, aggregate storage, application of modern construction machinery and equipment meeting statutory provisions.

(c) All the trees at site shall be thoroughly protected by guards as per requirement.

82. ROYALTY

Royalty applicable on supply of building and quarried materials to site as also on excavation work at site shall be paid by the contractor and the copies of documents showing evidence of having paid the same shall be lodged with the Employer.

83. ORDER OF PRECEDENCE

The following order of precedence shall be followed in case of any conflict between various parts of the tender specifications:

1. Commercial and General Part Addendum / Corrigendum

2. Special Conditions of Contract
3. General Conditions of Contract Technical Part
4. Drawings
5. Bill of Quantities (BOQ)
6. Scope of Work
7. Other Specifications and Standards referenced in the above Specification and Material requisition.
8. Indian Rules and Regulations.
9. Other National and International Standards. The Bidder shall bring to the notice of CONSULTANT/ EMPLOYER any such variations / conflicts between various parts of the tender and obtain approval before proceeding with such information for engineering/design.

84. DOCUMENTS TO BE MAINTAINED AT SITE:

The following registers/documents will be maintained at site by the contractor at his own cost. As per the format given by the consultant. They should be available for inspection by Consultant's representative during his site visit or as required by Consultant.

1. Work order copy
2. BOQ with final rates
3. Tender
4. Company quality and safety manual
5. Organization chart
6. Drawing register
7. Drawings new and superseded in separate folders
8. Latest tracked bar chart
9. Daily progress reports
10. Weekly progress reports
11. Monthly progress reports.
12. Hindrance register
13. Material receipt
14. Incoming Material Register
15. Material challans
16. Cement stock register
17. Sand stock register
18. Steel stock register
19. Material testing register
20. Strata testing report
21. Cement testing report
22. Sand testing report
23. Steel testing report
24. Structural steel testing report
25. Cube register
26. Pour cards
27. Other material test reports
28. Triplicate book for Memos.

85. NAME CHANGE OF COMPANY

During the course of the project, if there is any change in the name of the organization then contractor shall be informed about the same.

If there is any change the organizational or management structure including JV/ acquisition of the contractor's organization then client to be informed in advance and written acceptance on such change to be obtained.

86. BARRICADING

Contractor to provide and erect 6.0 meter / 25ft high barricading at site on all four sides of (at the proposed plot, road level on the road side & 6.0 meter above existing compound wall as per direction by Engineer-in-Charge) made of Galvalume sheet and structural steel post and runners with all the necessary excavation and foundation work in concrete as per direction of Engineer-in-Charge which would include writing and painting, arrangement for traffic diversion such as traffic signals during construction at site for day and night, glow lamps, reflective signs, marking, flags, caution tape as directed by the Engineer-in- Charge. The barricading should have provision of 2 gates 6 M wide with lockable arrangement. Maintenance for damages, painting, all incidentals, labor materials, equipments and works required to execute the job would be taken care by the contractor. The barricading shall not be removed without prior approval of Engineer-in-Charge.
(Note: - No payment shall be made for providing barricading from start of work till completion of work. The barricading provided shall remain to be the property of the contractor on completion of the work).

87. LOCAL ISSUES

During the entire course of the project if in case any issues are raised by the locals or matadis then it will be entirely contractor's responsibility to handle the same without & ensuring that the work is not hampered or disrupted due to the same issues. The client won't be responsible for any kind of financial or legal implications involved due to the same. Also, Client won't be available for any kind of assistance or aid.

88. SECURITY AT SITE

Contractor need to ensure the security at site with means of security guards, barrications, etc., at no additional cost to Client. All the responsibility of the safety & security of material, workmen, equipment, etc., at site would be of Contractor's

89. SNAKE BITE MEDICINES

Contractor need to ensure that at all time at site, sufficient & effective Snake Bite's Anti Venom Medicines & other essential requirements for same should be present at site. A trained person should be available at site at all time, whose responsibility would be to provide First Aid in case of a Snake Bite & further arrange and send for further required medical attention.

SECTION- 14

T E C H N I C A L S P E C I F I C A T I O N S

NOTE: INCASE OF ANY VARIANCE OF TECHNICAL SPECIFICATIONS WITH THE LATEST BIS CODES, RELEVANT LATEST BIS CODES SHALL BE APPLICABLE.

Scope:

This part of the specifications deals with general requirements for earthwork in excavation in different materials, site grading, filling in areas shown in drawings, back filling around foundations, plinths and approach ramps, conveyance and disposal of excess excavated soil or stacking them properly including shoring as directed by the Engineer-in-Charge and all operations covered within the intent and purpose of these specifications.

Applicable Codes:

The provisions of the latest Indian Standards listed below in addition to those mentioned in tender document, but not restricted to, shall form part of these specifications:

IS: 1200: Method of measurement of building and civil engineering Works Part 1: Earth work

IS: 1498: Classification and identification of soil for general Engineering Purposes.

IS:2720 : Method of test for soils (All Parts)

IS:2809 : Glossary of terms and symbols relating to soil engineering

IS:3764 : Safety code for excavation work

IS:4988 : Glossary of terms and classifications of earth moving Machinery (All Parts)

Drawings:
The contractor will furnish wherever in his opinion such drawings are required to show the areas to be excavated/filled, sequence of priorities etc. The Engineer-in-charge will approve the same. The contractor shall follow such drawings strictly.

Classification of earth:

For purpose of earth work, soil shall be classified as under

Loose/soft soil: Any soil which generally yields to the application of picks and shovels, phawras, rakes or any such ordinary excavating implements or organic soil, gravel, silt, sand turf, loam, clay, peat etc. fall under this category.

Soft rock / weathered rock: Any soil which generally, requires the close application of picks, or jumpers or scarifies to loosen it. Stiff clay, gravel and cobble stone etc. fall under this category.

(Note: Cobble stone is the rock fragment usually rounded or semi-rounded having maximum diameter in any one direction between 80 & 300 mm)

Mud: Mud is mixture of ordinary soft soil and water in fluid or weak solid state.

Soft/Disintegrated rock: (Not requiring blasting). This shall include the type of rock and boulders which may be quarried or split with crow-bars. Laterite and hard conglomerates also come under this category.

Hard Rock: (Requiring blasting). This shall include the type of rock or boulder which for quarrying or splitting requires the use of mechanical plant or blasting. (Note: Boulders is a rock fragment usually rounded by weathering, disintegration or abrasion by water or ice having a maximum dimension in any direction of more than 300 mm.

Hard Rock: (Requiring blasting but where blasting is prohibited) Under this category shall fall hard rocks which though normally requires blasting for their removal but blasting is prohibited and excavation has to be done by chiseling, wedging or other suitable method

General:
The contractors shall furnish all tools, plant, instruments qualified supervisory staff, labour, materials, any temporary works, consumables and everything necessary, whether or not such items are specifically stated herein, for completion of the job in accordance with the requirements of specifications.

The contractor shall carry out the survey of the site before excavation and set out properly all utility and service lines and establish levels for various works such as earthwork in excavation for grading, foundations, plinth filling, drains, cable trenches, water pipelines, culverts, retaining walls etc. These will be checked by the Engineer-in-charge or his representative and thereafter recorded plan duly signed by the contractor shall be furnished to the Engineer in charge for his approval before starting actual foundation excavations.

The excavation shall be done to correct lines and levels. This shall include where required, proper strutting & strong shoring to maintain excavation and impart safety against collapse of soil, and erection and maintenance of sand barricades around excavations with warning signs displayed during night for safety purposes. The warning signs shall be with reflectory type paints.

The rates quoted shall include for stacking of excavated material in regular heaps, bunds, rip rap with regular slopes as directed by the Engineer-in-charge within all leads and leveling the same so as to provide natural drainage. Soil excavation shall be properly stacked as directed by the Engineer-in-charge. As a rule all softer materials shall be laid along the centre of the heaps, the harder and more resistant materials, forming the casing on the sides and the top.

Clearing:
The area to be excavated/filled shall be cleared of all fences, trees, tree guard, M.S. grill above road divider and filled up earth in between road divider, plants, logs, stumps, bush, vegetation, grass, brush wood, trees and saplings of girth up to 30 cm measured at a height of 1m above ground level rubbish, slush, road, pavement structure if any required etc. and other objectionable matter. If any roots or stumps of trees are met during excavation, they shall be removed. The material so removed shall be disposed off as directed by the Engineer-in-charge. Where earth fill is intended, the area shall be cleared of all loose or soft patches, top soil containing objectionable matter/materials before filling commences. No separate payment shall be made for such clearing works.

Precious objects, Relics, Objects of Antics etc.
All gold, silver, oil, minerals, archeological and other findings of importance or other materials of any description and all previous stones, coins, treasure traces, relics, antiquities, and similar things which may be found in or upon the site shall be the property

of the corporation and the contractor shall dully preserve the same to the satisfaction of the Engineer in charge and from time to time, deliver the same to him.

Excavation for Structures:

Description:

Excavation both manual and mechanical means for structures shall consist of removal of materials for the construction of the foundations of approach structures retaining walls, head walls, and other similar structures in accordance with the requirements of this specification on the lines and dimensions shown on the drawings or as directed by the Engineer-in-charge. The work shall include all necessary sheathing, strutting, shoring, bracing, draining, pumping out of water both manual and mechanical ; proper supporting underground service lines like gas, water pipe, drainage line, electric cables, telephone cables as directed by Engineer-in-charge, and the removal of all logs, stumps, shrubs and other deleterious matter and obstructions etc. necessary for placing the foundations, trimming bottoms of excavation.

Setting out:

After the site has been cleared, the limits of excavation for foundations shall be set out true to lines, and sections as shown oft the drawing or as directed by the Engineer-in-charge. The contractor shall provide all labour, survey instruments and materials such as string, pegs, nails, bamboos, stones, lime mortar, concrete etc., required in connection with the setting out. He shall be responsible for the maintenance of bench marks and other marks and stakes as long as they are required for the work in the opinion of the Engineer-in-charge.

Excavation:

In firm soils, the sides of the trenches shall be kept vertical upto a depth of 2 metres from the bottom. For greater depths, the excavation profiles shall be widened by allowing steps of 50 cms on either side after every 2 metres from the bottom. Alternatively, the excavation can be done so as to give slope of 1:4 (1 horizontal: 4 vertical). Where the soil is soft, loose or slushy, the width of steps shall be suitably increased or sides sloped or the soil shored up as directed by the Engineer-in- Charge. It shall be the responsibility of the contractor to take complete instructions in writing from the Engineer-in-Charge regarding the stepping, sloping or shoring to be done for excavation deeper than 2 metres.

Excavation shall be taken to the width of the lowest step of footing and the sides shall be left plumb where the nature of the soil allows it. Where the nature of the soil or the depth of excavated trench/pit does not permit vertical sides, the contractor at his own expense shall put up necessary shoring, strutting and planking or cut slopes to a safe angle or both with due regard to the safety of personnel including laborers etc. and the works and to the satisfaction of the Engineer-in-charge. Non-compliance of these requirements would amount to negligence on the part of the contractor.

Excavation in hard rock in foundation should be including dressing of area and without blasting but with chipping, chiseling and cutting by jack hammer or by Pneumatic machine.

Dewatering and Protection:

All foundations shall be laid in dry condition. Where water is met with in excavation due to seepage, rain or other reasons, the contractor shall take adequate measures such as bailing, pumping, construction of diversion channels, drainage channels, bunds and any other necessary works to keep the foundation trenches/pits dry to lay foundation and to keep the green concrete/all foundations shall laid in dry protected against damage by or undermine its strength including erosion. In this regard and other details thereof, it shall be left to the choice of the contractor but subject to the approval of the Engineer-in-charge.

Approval of the Engineer-in-charge shall however, not relieve the contractor of his responsibility for the adequacy of dewatering and protection arrangements and the safety of the works.

Pumping from inside of any foundation enclosures shall be done in such a manner as to preclude the possibility for the movement of water through any freshly placed concrete. No pumping shall be permitted during the placing of concrete or for any period of at least 24 hours thereafter. Unless it is done from a suitable sump separated from the concrete work by a water tight wall or similar means.

At the discretion of the contractor and at his cost, cement grouting or other approved methods may be used to prevent or to reduce seepage and to protect the excavation area. The contractor shall take all precautions in diverting channels and in discharging the drained water so as not to cause damage to the works or to adjoining property or hindrances to moving traffic on adjoining roads.

Preparation of Foundation:
The bottom of the foundation shall be leveled both longitudinally and transversely and stepped as directed by the Engineer-in-charge. Before the footing is laid, the surface shall be slightly watered and rammed. In the event of the excavation having been made deeper that than shown on the drawing or as otherwise ordered by the Engineer-in-charge, the extra depth shall be made up with concrete, foundation shall laid in dry of the foundation grade at the cost of the contractor. Ordinary soil filling shall not be used for the purpose to bring the foundation to level as per the design. When rock or other hard strata is encountered it shall be freed of all loose and soft materials cleaned and cut to a firm surface either level, stepped or serrated as directed by the Engineer in charge.

If there are any slips or blows in the excavation these shall be removed by the contractor at his own cost.

Measurement

Will be done in Cubic meter.

Backfilling:
To the extent available, selected surplus soils from the excavation shall be used as backfill as may be directed by the Engineer in charge and after obtaining his concurrence before actually taking any action in the re-use of this excavated stuff from foundation. Fill material shall be free from clods of earth shall be broken or removed. When the excavated material is mostly rock, the boulders shall be broken into pieces not larger than 150 mm size mixed with properly graded finer materials consisting of murum or earth to fill up the voids and mixture used for filling.

If any selected fill material is required to be borrowed the contractor shall make arrangement for bringing the material from outside borrow pits. The material sources shall be subject to the prior approval of the Engineer in charge. The contractor shall make necessary access roads to such borrow areas at his own cost, if such access roads do not exist.
Backfilling of the foundation trenches/pits shall be done as soon as foundation work has been completed to the satisfaction of Engineer in charge and measured but not earlier than the full setting period of the concrete or masonry work. Backfilling shall be carried out in such a manner as not to cause undue thrust on any part of the structure. Annular space around foundations shall be back filled with coarse sand after clearing it of all debris and in layers of 200 mm. loose thickness, watered and compacted by vibratory roller to the satisfaction of the Engineer in charge and up to the original surface level. Watering,

consolidating, compacting to achieve not less than 97% Modified Proctor density conforming to relevant IS. The remaining back filling shall be done in like manner as aforesaid, using excavated earth if approved or by borrowed earth from approved source.

Measurement
Will be done in Cubic meter.

Disposal of Surplus Excavation Materials:
Item includes disposal of material outside the plot to any lead and lift. Contractor will have to take permission from government authorities for disposal outside the plot in areas assigned by the government. Works include leveling at site of disposal as per requirement of government authorities and to that satisfaction of them.

Measurement
Will be done in Cubic meter.

Measurement and Rates:
The measurement shall be generally conforming to IS:1200 Part I, unless otherwise specified. Measurement for excavation of foundation footings shall be as required for the exact width, length and depth as shown or figured on the drawings or as may be directed by the engineer in charge. If taken to a greater width, length or depth than shown or required, the extra work occasioned thereby shall be done at the contractor's expenses.

The dimensions of the trenches and pits shall be measured correct to the nearest cm. and cubical contents worked out in cubic meters, correct to two places of decimal. Measurements of filling excavated earth or sand in foundations shall be measured for the purpose of payment in cubic meter. The dimensions of the filling shall be measured correct to the nearest centimeters and cubical contents worked out in cubic meters correct to two places of decimal.

Joint measurement for levels taken for all steps like earth, murum, soft rock, hard rock should be available dully signed by contractor and engineer in charge, same to be attached along with bill.

Rate for earth work shall include the following:

(a) Excavation backfilling and disposing surplus earth to desired location as per permission taken from statutory authorities.
(b) Setting out works', profiles etc.
(c) Site clearance such as cleaning of vegetation, shrubs, brushwood etc.
(d) Leaving "Deadmen" or "Tell Tales" and their removal after measurement.
(e) Bailing/pumping out water in excavation from rains, sub soil water etc.
(f) Protection works, temporary supports for safety, by underpinning if need be to existing services, i.e. drains, water mains, cables and other utility services met within the course of excavation. Removal of electricity and / or telephone cables, posts etc. as necessary, shall be arranged by the Engineer in charge.
(g) Forming (or leaving) steps inside deep trenches and their removal:
(h) Removing slips or falls in excavation.
(i) Fencing and/or other suitable measures for protection against risk of accidents, as approved by the Engineer in charge.
(j) Excavation for insertion of planking and strutting where, required.
(k) Backfilling the trenches by selected excavated material available at site.

Measurements:-

Will be done as per IS 1200 - Part 1
Measurement to be done in Cubic meter

	Soil description
1	Soft / Lose soil is soil that can be excavated using pawdra
2	Hard / Dense soil is soil that need pixel or tikau to be used
3	Soft / Disintegrated Rock (Not Requiring Blasting) - Rock or boulders which may be quarried or split with crowbars.
4	Hard rock blasting prohibited required chiseling
5	Hard rock using blasting

	Measurement addition for working space
1	600 mm to be added on each face for working space. If there is any treatment like box type water proofing take measurement from treatment face.
2	For pre-stressing work add 1.5 M on each face
3	For depth exceeding 1 m, an allowance of 50 mm/m depth for each side of trench shall be added to the specified width.

Safety during excavation
Excavation where directed by the Engineer-in-Charge shall be securely barricaded and provided With proper caution signs, conspicuously displayed during the day and properly illuminated with red lights and/or written using fluorescent reflective paint as directed by engineer in charge during the night to avoid accident.

The Contractor shall take adequate protective measures to see that the excavation operations do not damage the adjoining structures or dislocate the services. Water supply pipes, sluice valve chambers, sewerage pipes, manholes, drainage pipes and chambers, communication cables, power supply cables etc. met within the course of excavation shall be properly supported and adequately protected, so that these services remain functional. However, if any service is damaged during excavation shall be restored in reasonable time at the cost of contractor.

Excavation shall not be carried out below the foundation level of the adjacent buildings until under pinning; shoring etc. is done as per the directions of the Engineer-in-Charge for which payment shall be made separately.

Any damages done by the contractor to any existing work shall be made good by him at his own cost. Existing drains pipes, culverts, overhead wires, water supply lines and similar services encountered during the course of execution shall be protected against damage by the contractor. The contractor shall not store material or otherwise occupy any part of the site in manner likely to hinder the operations of such services.

Blasting
Blasting is prohibited and will not be permitted under any circumstances.

Shoring:-
Where ever excavation is done close to adjoining existing structure shoring should be done as per direction of engineer in charge. This is to avoid the existing plinth filling to slide. Shoring to be done by contractor where ever required at his own cost.

CLEANING FOR AREA DEVELOPMENT

- Clearing cutting, removing including uprooting of rank vegetation, grass, brush wood, trees and
- saplings of girth up to 30 cm measured at a height of 1m above ground level and
- Disposing to area allotted by government authorities including debris of any king, brick batts, construction debris, etc
- Including taking all necessary local permission.

Measurement

Will be done in SQ Metre.

FILLING WITH GOOD EARTH OR MURUM

Scope:
This part of the specifications deals with general requirements for earthwork and filling of different materials, filling in areas shown in drawings, back filling around foundations, plinths and approach ramps, conveyance and disposal of excess soil if any or stacking them properly as directed by the Engineer-in-Charge and all operations covered within the intent and purpose of these specifications.

Applicable Codes:
The provisions of the latest Indian Standards listed below in addition to those mentioned in tender document, but not restricted to, shall form part of these specifications:

IS: 1200:	Method of measurement of building and civil engineering works Part 1: Earth work
IS: 1498:	Classification and identification of soil for general Engineering purposes.
IS:2720 :	Method of test for soils (All Parts)
IS:2809 :	Glossary of terms and symbols relating to soil engineering
IS:3764 :	Safety code for excavation work
IS:4988 :	Glossary of terms and classifications of earth moving Machinery (All Parts)

Filling in with Good Earth or Murum

The earth or murum, whenever required to be supplied by the Contractors for filling in the low lying ground and wells or in the embankment of the road, shall be dry, friable, and free from mud sludge's, vegetable matter or rotten material of any kind, or material likely to decay and of a quality to be approved by the Engineer. All big lumps or clod shall be broken before spreading the earth or murum on the ground. Testing to be done for material used for filling as per IS and approval to be taken from engineer in charge.

The filling in of wells and low-lying grounds shall be done in such layers as may be directed from time to time by the Engineer, and no fresh layer shall be allowed to be put on unless the previous one is properly spread, trimmed, leveled, and thoroughly consolidated by rammers or rollers, as the case may be, or as may be ordered by the Engineer.

The embankment shall be raised in regular layers slightly concave in section, beginning from the bottom and gradually raised to the full height, layer by layer not exceeding 230 mm. in thickness in a loose state. Each layer shall be thoroughly consolidated by watering where necessary and rolling it with an approved steam or diesel roller before the next layer is put on. The rolling and consolidation should be done to the entire satisfaction of

the Engineer and no rubble packing or metal should be laid on it until the Engineer is satisfied that the earthwork has been thoroughly consolidated and written certificate is given to them effect by the Engineer.

The rates for embankment or filling in with Contractors earth or murum shall include the cost of materials, fencing, lighting, watching haulage, spreading, leveling, watering, rolling and consolidating.

All extra filling above the required level will have to be removed by the contractor free of cost.

Compaction on Earth or Murum

1. Compaction is carried out using rolling. For ordinary consolidation of soft stone, 8 to 10 tonnes roller is good.

2. Rolling should commence at the edges and progress towards the center except in super elevated portions where it should proceed from the inner edge to outer. Each pass of the roller should uniformly overlap not less than one third of the track made in the preceding pass. The number of passes required of a roller to give good compaction of any material should also be determined by actual test at site.

3. The types of roller that can be used are pneumatic tyred, vibratory rollers etc and should be operated at the minimum speed while consolidating base and soling courses.

4. For clayey soils, sands the weight of rollers that can be used are 8 to 10 Tonnes, 20 cm will be the maximum thickness of loose material that can be compacted while 10 to 18% moisture content has to be maintained. Watering, consolidating, compacting to achieve not less than 97% Modified Proctor density conforming to relevant IS.

Tests on Earth or Murum

1. The density / moisture content of a soil needs to be determined using various tests.
2. The water content of the soil is determined by methods like oven drying, Pycnometer, sand bath methods etc.

Range of Optimum Water Content

Sand	Sandy Silt or silty sand	Silt	Clay
6 to 10%	8 to 12%	12 to 16%	14 to 20%

1. There are many field methods used for measuring compaction such as Core cutter method, Sand replacement method etc.
2. Proctor Density test is made to determine the moisture content at which the soil should be compacted to obtain the maximum dry density and the dry density likely to be achieved by compaction in the field. The dry unit weight achieved in the field using field tests are is compared with the maximum dry unit weight obtained in the standard proctor test. The dry unit weight of the order of 95% of the maximum dry unit weight of the standard proctor test needs to be achieved.
3. The methods of tests carried out for soils shall be strictly as per the IS 2720.

Frequency of compaction test

Contractor to carry one sample of 3 specimens for every 200 Sq. m for each layer.

Measurement
Will be done in Cubic Metre and initial and final levels will be duly signed by contractor and engineer in charge.

DRY RUBBLE PACKING / SOLING

Scope
Providing and laying dry rubble soling including hand packing and thoroughly consolidating, compacting using 8 to 10 tons roller filling in the voids by stone chips and 12mm thk. layer of grit on top etc complete as directed by Engineer In Charge.

(Note: The rate includes the royalty and other taxes if any) and watering the same so that no voids are left open as to avoid cement slurry to penetrate during PCC work. etc. complete.

The dry rubble packing shall consist of a layer of uniform thickness of blue trap stone rubble, or any other approved stone carefully set as close as possible on ground properly formed for the purpose. The width of the upper part of the stone shall not be more than 230 mm. or less than 150 mm. and the packing shall consist of large stones.

The interstices between the rubble stones shall be filled up with stone chips, removing the projection of the upper part of the packing with care, as not to loosen the whole; Finer gaps should be filled with grit powder of 12mm thk layer, the whole should be thoroughly rammed, watered, settled to place and including thoroughly consolidating using three wheeled 8 – 10 tones capacity roller. Rolling shall begin longitudinally at edges and shall be done with backward and forward movement with half of the roller width overlapping till entire area is rolled by rear wheel interlocking stones firmly, filling in the voids by stone chips etc. complete including all required lifting and hauling as per specifications and as directed by engineer in charge. If additional layer is required the same procedure should be followed.

Note:
- The rate includes the royalty and other taxes if any and watering the same so that no voids are left open as to avoid cement slurry to penetrate during PCC work. etc. complete.

Following Tests shall be conducted: for every 50 Cum of rubble
- **Physical tests:** i.)Density ii.)Specific Gravity iii.)Water Absorption iv.)Unconfined Crushing Strength v.)Porosity**.**
- **Chemical tests:** i) Sulphate ii.) Chloride iii.) pH value

Measurement
Will be done in Cubic Meter or Square Meter if thickness in specified.

BRICK FLAT SOLING
Providing and laying Single Brick Flat Soling of picked jhama bricks, including ramming and dressing bed to proper level and filling joints with local sand. leveling etc. complete and accepted by the Engineer.

Measurement
Will be done in Square Meter.

ANTI TERMITE TREATMENT TO SOIL (PRE-CONSTRUCTION)

SCOPE

Application of anti-termite treatment at different levels during construction. It should be done through a professional organization. 10 years guarantee to be submitted by the contractor on Rs. 100 bond paper as per format given by consultant. Treatment should be conforming to IS-6313 (part II) using chloropyrifos EC 20 Emulsion or equivalent of 1% concentration by weight for creating barrier under and all around foundation pits, wall trenches, basement excavation, backfill in immediate contact with foundation and treating the top surface of plinth filling, junction of wall & floor, along the external perimeter of building, expansion joints, surrounding of pipes, water conduits and at places as mentioned below.

Time of application

Soil treatment should start when foundation trenches and pits are ready to take mass concrete in foundations, laying of mass concrete should start when chemical emulsion has been absorbed by the soil and the surface is quite dry. Treatment should not be carried out when it is raining or when soil is wet with rain or sub-soil water. In the event of water logging of foundation, the water shall be pumped out and the chemical emulsion applied when soil is absorbent.

Treatment of column pits, wall trenches and basement excavation

The bottom surface and the sides (up to a height of about 300 mm.) of the excavations made for column pits, wall trenches and basements shall be treated with the chemical @ the rate of 5 Lit./m2 of surface area.

After the column foundations, well foundations and the retaining walls of the basement come up the back fill in immediate contact with the foundation structure shall be treated at the rate of 5 Lit./m2 of the vertical surface of the sub-structure for each side to. If water is used for ramming the earth fill, the chemical treatment shall be carried out after the ramming operation is done by dhumas the earth at 150 mm. centre close to the wall surface and supplying the chemical with the above dose. The earth is usually refilled in layers and the treatment shall be carried out in similar stages. The chemical emulsions shall be directed towards the concrete or masonry surface of the columns and walls so that the earth in contact with the surface is well treated with the chemical.

Treatment for R.C.C. framed structure

This treatment is necessary to start from the bottom of excavation for columns and plinth beams. The treatment shall start at the depth of 500 mm. below ground level. From this depth, the back fill around the columns, beams and R.C.C. basement walls shall be treated at the rate of 5 Lit. / Sq. m of the vertical surface.

Treatment of top surface of plinth filling

The top surface of the filling earth within plinth wall shall be treated with Chemical emulsion at the rate of 5 lit/m2 of the surface before the rubble soling or sub-grade is laid. If the filled earth has been well rammed and the surface does not allow the emulsion to seep through, holes up to 50 to 70 mm. deep at 150 mm. centre both-ways may be made with crow bars on the surface to facilitate saturation of the soil with the chemical emulsion.

Treatment at the junction of the wall and the floor

Special care shall be taken to establish continuity of the vertical chemical barrier of inner wall surface from ground level up to the level of the filled earth surface to achieve this a small channel 30 + 30 m. shall be made at the junction of wall and column with the floor before laying the sub-grade or rubble) and rod holes made in the channel upto the ground level 150 mm. apart and the iron rode moved backward and forward to break up the earth

and chemical emulsion poured along the channel at the rate of 5 Lit./m2 of the vertical wall or column surface so as to soak the soil right to bottom. The soil should be temped back into place after this operation.

Treatment of soil along external perimeter of building
After building is completed, provide holes in the soil with iron rods along the external perimeter of the building at intervals of about 150 mm and depth 300 mm and filling these holes with chemical emulsion at the rate of 5 Lit./m2 of the perimeter wall.

Treatment of soil surrounding pipes, wastes and conduits
When pipes wastes and conducts cater the soil inside the area of the foundation the soil surroundings the point of entry shall be loosened around each leak pipe, waste and conduct for a distant of 150 mm and to a depth of 75 mm before treatment is commenced when they enter the soil external to the foundations, they shall be similarly treated unless they start clear of the walls of the building but about 75 mm. for a distance of over 300 mm.

Treatment for expansion joints
Expansion joints at ground floor level are one of the biggest hazards for termite infestation. The soil beneath these joints shall receive special attention when the treatment mentioned in para. (d) is carried out. This treatment should be supplemented by treating through the expansion joint after the sub-base of rubble has been laid at the rate of 2 lit/m2 linear manners.

Chemical mentioned below shall be used for anti-termite treatment to be solid with the concentration mentioned below:

Name of chemical	**Proportion to mix concentration by Weight**
Chlorpyrifos emulsiflable concentrates	1.0%

This material (chemical) will have to be tested in Approved Laboratory before using on the site at contractors cost.

Measurement
Plinth area at ground floor shall be measured in square meter for all operations described above. One Plinth area measurement for all items external of the building.
There should be joint measurement sheet for daily work done and at different levels signed off by the contractor and engineer in charge. The contractor will give details of consumption on daily basis and reconciliation of the same will be done together along with the engineer in charge.

Rate
Rate shall be in “per square meter of plinth area “which include cost of all materials and labor involved in all operations described above.

Safety Precautions
1. Persons using or handling chemicals should take safety precautions.
2. The containers should be labeled and stored carefully away from reach of children. They should be kept securely closed.
3. Care should be taken to prevent skin contact with concentrates.

4. The concentrates present a fire hazard due to use of petroleum solvents. Flames should not be allowed during mixing.
5. Care should be taken while application to avoid any possible contamination of sources of drinking water.

DAMP PROOF COURSE
Scope

Providing and laying Cement Concrete Layer this shall consist of cement concrete of thickness 40 mm thick of 1:2:4 proportions or as per BOQ.

The surface of brick or stone masonry work shall be leveled and prepared before laying the cement concrete. Edge of damp proof course shall be straight, even and vertical. Side shuttering shall consist of steel forms and shall be strong and properly fixed so that it does not get disturbed during compaction and the mortar does not leak through.

The concrete mix shall be of workable consistency and shall be tamped thoroughly to make a dense mass. When the sides are removed, the surface should come out smooth without honey coming.

Continuity shall be maintained while laying the cement concrete layer and lying shall be terminated only at the predetermined location where damp proof course is to be discontinued.

There shall be no construction joints in the Damp Proof Course.

Curing

Damp proof course shall be cured for at least seven days, after which it shall be allowed to dry.

Application of Hot Bitumen

Where so directed, hot bitumen in specified quantity shall be applied over the dried up surface of cement concrete properly cleaned with brushes and finally with a piece of cloth soaked in kerosene oil. Bitumen of penetration A 90 or equivalent where used shall be heated to a temperature of 160º ± 5ºC. The hot bitumen shall be applied uniformly all over, so that no blank spaces are left anywhere. It will be paid for separately. Application of Hot bitumen at top surface should be uniform at the rate of 1.70 Kg/Sqm.

Measurement

Measurement will be done in Square meter.

EXPANSION JOINT BOARD

Scope

Providing and fixing 25 mm thickness of Pre-molded compressible filler board (Dura board HD 100) in black color, conforming to highway clause 1015 having minimum density of 100±5 Kg/m3, water absorption less than 0.09Kg/m2 and compression recovery of 93%. The product should be non-deteriorating and non-staining.

Material

Material should be of Supreme or equivalent make sample to be approved by the engineer in charge.

Procedure

- The area where the board is to be fixed should be thoroughly cleaned
- The boards are to be cut as per the thickness and fixed at the desired location using liquid bitumen by applying the same to the surface and then sticking the board to it.
- The top of the board is to be kept 10 to 15mm below the concrete surface.
- This gap is to be filled by using polysulphide sealant.

Measurement
Measurement to be done in Square Meter.

GP2 GROUTING

Scope

Grouting gap between structural steel base plates of column and RCC column pedestal and also grouting of anchor bolts with GP2 of Fosroc or equivalent make.

Application

All surfaces should be free from dirt, dust, grease, oils, and other contaminants.

Surfaces should be pre-wetted/ saturated with clean water for 4 to 6 hours; free surface water should be removed before grouting with GP2.

Mixing

Add GP2 powder to potable water in the ratio recommended for its consistency. Approximate ratios are as per below

Flow able Grout: Water/25kg grout bag 4.25 L
Plastic Grout: Water/25kg grout bag 3.25 L

-Manual mixing is not at all recommended. Use mechanical mixer like paddle or revolving drum type. Full 5 minutes mixing to get homogeneous consistency is required. Fluid grout should be placed within 20/30 minutes. In gelled material no further addition of water is allowed and should be discarded.

Placement
Pouring head should be used for base plate grouting. For holding down bolt in 10 cm and above diameter hole or grout bed exceeding 80 mm thickness well graded clean aggregate from 5 mm to 15 mm in saturated surface dry condition may be used along with grout up to 25 to 30% of grout weight.
Edge finish/Curing
Plastic grout may be used for edge finish. Exposed edges after 8 hours of grouting should be kept under steel plate up to 24 hours and then normal curing with wet hessian or ponding may be carried out.

Measurement
Measurement will be done in KG and contractor to maintain consumption records. All records to be dully signed by the engineer in charge.

BONDING COAT EPOXY

Scope

Bonding coat Epoxy between old & new concrete surface and steel column Including sprinkling sand where ever required using epoxy as per manufactures specification and as per direction of engineer in charge. Complete.

Measurement

- Measurement to be done in Square Meter.

Low density polyethylene sheets (LDPE sheets)

Scope

Providing & laying in position Low density polyethylene sheets (LDPE sheets) impermeable membrane of specified 150 micron of approved make & quality with necessary pressure adhesive tapes or with serrated joints made by an electric iron rod complete directed & instructed by Engineer/ Owner. (Minimum lap of sheets shall be 300 mm unless noted otherwise).

Measurement

Measurement to be done in Square Meter.

Cement Mortar Injection

Scope

Supplying & providing injection of cement mortar 'with approved waterproofing grouting compound at construction joints in concrete under pressure through nozzles along the joint including installation of 12 / 18 mm dia threaded nozzles in concrete , grouting, sealing the nozzles etc. all complete as per drawing , specification and direction of engineer.

Measurement

Measurement to be done in Kg.

RE-BARRING OF STEEL BARS

Scope

Fixing of tor steel bars by cutting the bars to required size & then inserting in pre drilled holes and fixing the same by using specified chemical as per specified in BOQ.

Drilling of holes

The diameter of hole should be diameter of bar Plus 2mm i.e. If you want to grout 10mm diameter bar you have to drill 12mm diameter hole. The depth of holes should be minimum 150mm deep or as specified in the drawing.

Cleaning of holes

The drilled holes have to be cleaned using electrical blower and vacuum cleaner and all loose dust should be removed from the holes.

Grouting bars using Epoxy

Epoxy resin of Araldite, Sunanda chemicals, or similar make can be used make should be approved by the engineer in charge before buying.

Mixing

The proportion of hardener to resin should be as per the specification given by the supplier. The resin and hardener shall be thoroughly mixed before in the dry filler. The

mixed ready to use adhesive shall not contain lumps and should be of a uniform color. Weight of 1 kg. Or less hand mixing shall be sufficient. For quantities in excess of 1 the use of mechanical mixer is recommended.

Fixing
The bars are dipped into the epoxy Mix up to the depth of the holes and the bars are inserted into these holes care should be taken that the epoxy dose not flow reverse outside the hole.
The bars are allowed to settle for 12 hours and should not be disturbed .After 12 hours further work can be done.

Grouting bars using HILTI Chemicals
All procedures are same only HILTI chemical as specified in the drawing is to be used and chemical is to be used as per HILTI specification.

Measurement
Measurement will be done in per numbers.

STRUCTURAL STEEL

Material Specification

Scope
Providing, fabrication and fixing of steel work in M.S. angles channel, Pipes. box section, R.S. beams, flats, plates , insert plates, etc. as per details at any height including all labor and material with hoisting in position, fixing with bolts and nuts or by welding, scaffolding, applying two coat of zinc chromate primer and two coat synthetic enamel paint etc. complete as directed by engineer in charge.

General requirements relating to supply of structural steel shall conform to IS 8910.

All finished materials shall be well and cleanly rolled to the dimensions, sections and masses specified. The finished material shall be reasonably free from surface flaws; laminations; rough/ jagged and imperfect edges and all other harmful defects.

Minor surface defects may be removed by the manufacturer/supplier by grinding provided the thickness is not reduced locally by more than 4 percent below the minimum specified thickness.

Material quality
Only TATA, SAIL or JINDAL steel to be used for structural steel work no re rolled steel will be allowed.

Testing of material
The structural steel each lot should be tested for all chemical and physical tests from external government approved laboratory apart from the test certificates received for the vendor. The cost for sample preparation and testing to be included in the rates quoted no extra payment will be done for the same
Rivets and bolts needs to be tested for slip test.

Testing frequency
Testing to be carried out for every truck load for all different material received three numbers of each material received to be tested for both Physical and chemical test form a NABL certified laboratory

Rivets and bolts needs to be tested for each lot received at site.

Rivets
Rivets shall be made from rivet bars of mild steel as per IS 1148.

Bolts
These are of two types namely turned and fitted bolts and black bolts. Turned & fitted bolts are turned to exact diameter in automatic lathe. For these bolts, whether reamed or drilled bolts, the same unit stresses are allowed as for rivets. In case of black bolts which are not finished to exact sizes, a lower working stress other than for turned bolts is adopted. They shall conform to IS 1367 – Technical supply conditions for threaded steel fasteners.

Electrodes
The electrodes required for metal arc welding shall be covered electrodes and shall conform to IS 814. Make to be Advani, Essar only.

Laying Out
A figure of the steel structure to be fabricated shall be drawn on a level platform to full scale. This may be done in full or in parts, as shown on drawings or as directed by the Engineer-in-Charge. Steel tape shall be used for measurements.

Fabrication using rivets and bolts
Fabrication shall generally be done as specified in IS 800. In major works or where so specified, shop drawings giving complete information for the fabrication of the component parts of the structure including the location, type, size, length and details or rivets, bolts or welds, shall be prepared in advance of the actual fabrication and approved by the Engineer-in-charge. The drawings shall indicate the shop and field rivets, bolts and welds. The steel members shall be distinctly marked or stenciled with paint with the identification marks as given in the shop drawings.

Great accuracy shall be observed in the fabrication of various members, so that these can be assembled without being unduly packed, strained or forced into position and when built up, shall be true and free from twist, kinks, buckles or open joints.

Wooden or metal sheet templates shall be made to correspond to each member, and position of rivet holes shall be marked accurately on them and holes drilled. The templates shall then be laid on the steel members, and holes for riveting and bolting marked on them. The ends of the steel members shall also be marked for cutting as per required dimensions. The base of steel columns and the positions of anchor bolts shall be carefully set out at the required location.

The steel section shall be straight or to be straightened or flattened by pressure unless required to be of curvilinear form and shall free from twists. These shall be cut square either by shearing or sawing to correct length and measured by steel tape. No tow pieces shall be welded or joined to make up for the required length of member.

Making Holes
Holes through more than one thickness of materials for members, such as compound stanchion and girder flanges shall, where possible, be drilled after the members are assembled and tightly clamped or bolted together. Punching may be permitted before assembly, provided the holes are punched 3mm less in diameter than the required size and reamed after assembly to the full diameter. The thickness of material punched shall be not greater than 16 mm.

Rivet Holes
The diameter for rivets and black bolts holes shall be taken as the nominal diameter of a rivet/ black bolts plus 1.5 mm for rivets/ bolts of nominal diameter less than or equal to 25

mm" and 2.0 mm for rivets of nominal diameter exceeding 25 mm, unless specified otherwise. Holes for turned and fitted bolts shall be drilled or reamed large by 0.2 to 8 mm depending upon the dia. of bolts.

Holes shall have their axis perpendicular to the surface bored through. The drilling or reaming shall be free from burrs, and the holes shall be clean and accurate. Holes for rivets and bolts shall not be formed by gas cutting process. Holes for counter sunk bolts shall be made in such a manner that their heads sit flush with the surface after fixing.

Assembly
Before making holes in individual members, for fabrication and steel work intended to be riveted or bolted together shall be assembled and clamped properly and tightly so as to ensure close abutting, or lapping of the surfaces of the different members. All stiffeners shall be fixed (or placed) tightly both at top and bottom without being drawn or caulked. The abutting joints shall be cut or dressed true and straight, and fitted close together.

Web plates of girders, which have no cover flange plates, shall have their ends flush with the tops of angles unless otherwise required. The web plate when spliced, shall have clearance of not more than 5mm. The erection clearance of cleated ends of members connecting steel to steel shall preferably be not greater than 1.5 mm. The erection clearance at the ends of beams without web cleats shall not be more than 3 mm at each end but where for practical reasons, greater clearance is necessary, seating designed suitably shall be provided.

Column splices and butt joints of struts and compression members requiring contact for stress Transmission shall be accurately, machined and close butted over the whole section. In column caps and bases, the ends of shafts together with the attached gussets, angles, channels etc. after riveting together shall be accurately machined so that the parts connected, butt against each other over the entire surfaces of contact. Connecting angles or channels shall be fabricated and placed in position with great accuracy so that they are not unduly reduced in thickness by machining.

The ends of all bearing stiffeners shall be machined or grounded to fit tightly both at top and bottom.

Riveting:
Rivets shall be used, where slip under load has to be avoided.

Preliminaries before Riveting:-
Members to be riveted shall have all parts firmly placed and held together before and during riveting, and special care shall be taken in this respect for all single riveted connections. For multiple riveted connections, a service bolt shall be provided in every third or fourth hole.

Process of Riveting
The riveting shall be carried out by using machines of the steady pressure type. However, where such facilities are not available hand riveting may be permitted by the Engineer-in-charge. The rivets shall be heated red hot, care being taken to control the temperature of heating so as not to burn the steel. Rivets of diameter less than10mm may be driven cold. Rivets shall be finished neat with heads full and of equal size. The heads shall be central on shanks and shall grip the assembled members firmly.

All loose, burnt, or badly formed rivets with eccentric or deficient heads shall be cut out and replaced. In cutting out rivets, care shall be taken so as not to injure the assembled members. Caulking and recapping shall not be permitted.

For testing rivets, a hammer weighing approx. 0.25 kg shall be used and both heads of the rivet (Specially the machine head) shall be tapped. When so tested, the rivets shall not give a hollow sound and a jar where so specified, other tests shall be carried out to ensure the soundness of rivets. All rivets heads shall be painted with approved steel primer paint within a week of their fixing.

Bolting

The nominal length of the bolt shall be the distance from the underside of the head to the further end of the shank. The nominal diameter of the bolt shall be the diameter at the shank above the screwed threads. Bolts, nuts and washers shall be thoroughly cleaned and dipped in double boiled linseed oil, before use. All bolts heads and nuts shall be hexagonal unless specified otherwise. The screwed threads shall conform to IS 1363 and the threaded surface shall not be tapered. The bolts shall be of such length as to project at least two clear threads beyond the nuts when fixed in position, and these shall fit in the holes without any shake. The nuts shall fit in the threaded ends of bolts properly.

Where necessary, washers shall be tapered or otherwise suitably shaped to give the heads and nuts of bolts a satisfactory bearing. The threaded portion of each bolt shall project through the nut at least two thread. In all cases where the full bearing area of the bolt is to be developed, the bolt shall be provided with a washer of sufficient thickness under the nuts to avoid any threaded portion of the bolt being within the thickness of the parts bolted together.

Where there is a risk of the nuts being removed or becoming loose due to vibrations or reversal of stresses, these shall be secured from slackening by the use of lock nut, spring washers as directed by the Engineer-in-charge.

Erection

Steel members shall be hoisted and erected in position carefully, without any damage to itself, other structures and equipment and injury to workmen. The method of hoisting and erection proposed to be adopted by the contractor shall be got approved from the Engineer-in-charge in advance. The contractor however shall be fully responsible for the work being carried out in a safe and proper manner without unduly stressing the various members and proper equipment such as derricks, lifting tackles, winches, ropes etc. shall be used.

The work of erection may be done in suitable units as may be directed by the Engineer- in charge.

Fabricated members shall be lifted at such points so as to avoid deformation or excessive stress in members. The structure or part of it placed in position shall be secured against over-turning or collapse by suitable means. During execution, the steel members shall be securely bolted or otherwise fastened when necessary temporarily braced to provide for all loads including those due to erection equipments and its operation to be carried safely by structure during erection. The steel members shall be placed in proper position as per approved drawing, final riveting or permanent bolting shall be done only after proper alignment has been checked and confirmed.

Trusses shall be lifted only at nodes. The trusses above 10 m in span shall not be lifted by slinging at two mid points of rafters, which shall be temporary braced by a wooden member of a suitable section. After the trusses are placed in position, purlins and wind bracings shall be fixed as soon as possible.

The end of the truss which faces the prevailing winds shall be fixed with holding down bolts, and the other end kept free to move. In case of trusses of spans upto 10m the free end of the truss shall be laid on lead sheet or steel plate as per design, and the holes for holding down bolts shall be made in the form of oblong slots so as to permit the free

movements of the truss end. For larger spans the truss shall be provided with proper bearing as per design.

Columns and stanchions shall be erected truly vertical with the necessary cross bracing etc. and the base shall be properly fixed with the foundation concrete by means of anchor bolts etc. as per drawing.

Anchor bolts to be placed in the concrete foundation should be held in position with a wooden template. At the time of concreting anchor bolt locations shall be provided with suitable timber mould or pipe sleeve to allow for adjustment which shall be removed after initial setting of concrete. The spaces left around anchor bolts shall be linked to a stopping channel in the concrete leading to the side of the pedestal and on the underside of the base plate to allow the spaces being grouted up after the base plate is fixed in the position along with the column footing. Grouting shall be of cement mortar 1:3 (1 cement: 3 coarse sand) or as specified.

Bedding of Column, Stanchions etc
Bedding shall not be carried out until the steel work has been finally leveled, plumbed and connected together. The stanchion shall be supported on steel wedges and adjusted to make the column plumb. For multi storied buildings, the bedding shall not be done until sufficient number of bottom lengths of stanchions have been properly lined, leveled and plumbed and sufficient floor beams are fixed in position. The base plates shall be wedged clear of the bases by M.S. wedges and adjusted where necessary to plumb the columns. The gap between the plate and RCC should be grouted using GP2.

Welded Joints
Welding shall generally be done by electric arc process as per IS 816 and IS 823. The electric arc method is usually adopted and is economical. Where electricity for public is not available generators shall be arranged by the contractor at his own cost unless otherwise specified. Gas welding shall only by resorted to using oxyacetylene flame with specific approval of the Engineer-in-charge. Gas welding shall not be permitted for structural steel work Gas welding required heating of the members to be welded along with the welding rod and is likely to create temperature stresses in the welded members. Precautions shall therefore be taken to avoid distortion of the members due to these temperature stresses.

The work shall be done as shown in the shop drawings which should clearly indicate various details of the joint to be welded, type of welds, shop and site welds as well as the types of electrodes to be used. Symbol for welding on plans and shops drawings shall be according to IS 813. As far as possible every effort shall be made to limit the welding that must be done after the structure is erected so as to avoid the improper welding that is likely to be done due to heights and difficult positions on scaffolding etc. apart from the aspect of economy. The maximum diameter of electrodes for welding work shall be as per IS 814. Joint surfaces which are to be welded together shall be free from loose mill scale, rust, paint, grease or other foreign matter, which adversely affect the quality of weld and workmanship.

Precautions
All operation connected with welding and cutting equipment shall conform to the safety requirements given in IS 818 for safety requirements and Health provision in Electric and gas welding and cutting operations.

Inspection
Inspection and testing of welds shall be as per IS 822.

Assembly
Before welding is commenced, the members to be welded shall first be brought together and firmly clamped or tack welded to be held in position. This temporary connection has to

be strong enough to hold the parts accurately in place without any disturbance. Tack welds located in places where final welds will be made later shall conform to the final weld in quality and shall be cleaned off slag before final weld is made.

Erection
While erecting a welded structure adequate means shall be employed for temporary fastening the members together and bracing the frame work until the joints are welded. Such means shall consists of applying of erection bolts, tack welding or other positive devices imparting sufficient strength and stiffness to resist all temporary loads and lateral forces including wind. Owing to the small number of bolts ordinarily employed for joints which are to be welded, the temporary support of heavy girders carrying columns shall be specially attended.

Different members which shall be fillet welded, shall be brought into as close contact as possible. The gap due to faulty workmanship or incorrect fit if any shall not exceed. 1.5 mm if gap exceeds 1.5 mm or more occurs locally the size of fillet weld shall be increased at such position by an amount equal to the width of the gap.

Cleaning
In the workshop of the contractor: blast cleaning with sand of grit.
On site, when plant is in normal operation: blast cleaning is not admitted unless if method of blasting is dust free. The production of lubricants cannot admit that sand dust or grid dust is absorbed in the product.

Alternative cleaning methods should be applied (water cleaning or hydro jetting, wire rushing, disc sanding, Needle hammering)

On all blasted surfaces shall a primer coating been applied and this within a maximum delay of 4 to 6 hours after blasting. During blasting and until the primer is applied the relative humidity shall not exceed 85 %.

Special requirement for pipes, flanges: the interior of the pipes shall be free of any sand or grid or other foreign matters after applying of the primer on the exterior of the pipes. In practices, the contractor shall take measures to avoid the entrance of any sand or grid or other foreign matters in the interior of the pipes during blasting.

Painting
All surfaces which are to be painted, oiled or otherwise treated shall be dry and thoroughly cleaned to remove all loose scale and loose rust. Surfaces not in contact but inaccessible after shop assembly, shall receive the full specified protective treatment before assembly. This does not apply to the interior of sealed hollow sections. Part to be encased in concrete shall not be painted or oiled.

Two coat of zinc chromate primer and two coat synthetic enamel paint.

Paint make should be of Asian paints or Berger or equivalent. Make to be approved by Engineer in charge before purchasing by contractor.

Measurement:
Measurement will be in KG or MT. Unit weight of members to be taken from IS steel table only.

Rate will be including procurement, welding, bolting, riveting, Erecting and painting complete.

FOUNDATION BOLTS

Scope

Providing and Fixing of Foundation Bolts and nuts in RCC column / pedestal / beam at any level including maintaining the accuracy towards line, level & position including making and using the template etc. complete as directed by Engineer In Charge. (Contractor will take due care for its threads and rusting by applying grease and cotton waste.

Material

All foundation bolts to be made of Mild steel plain bars the steel should confirm to the latest edition of IS: 432 Part 1. Grade of steel minimum 5.8 to maximum 8.8 of any diameter at any and all level including making treads and bends.

Treading and bending

The bolts should be treaded and bended in work shop as per the drawing and details provided.

Care should be taken to the treads are greased and covered using plastic and does not get damaged

Bolts

They shall conform to IS 1367 – Technical supply conditions for threaded steel fasteners.

Fitting of bolts

The bolts should be fitted as per pre-fabricated templates made of structural steel. The bolts once positioned needs to be welded to the main steel of the foundation pedestal.

Care should be taken during concreting for displacement of any bolt. Re checking of all the bolts to be done after concreting. The upper treaded portion to be cleaned thoroughly for any spills of concrete.

Fixing of Foundation Bolts and nuts in RCC column / pedestal / beam at any level should include maintaining the accuracy towards line, level & position including making and using the template etc. complete as directed by Engineer In Charge.

Rate to include providing and fixing of template in MS steel as per structural steel.

Measurement

Measurement to be taken in KG. Rate to include providing and fixing complete.

Testing

3 bolts of each diameter to be tested for both physical and chemical test from NABL certified laboratory.

STEEL REINFORCEMENT

BENDING OF REINFORCEMENT

Scope

Providing and fixing in position HYSD steel conforming to IS : 432 / 1786 reinforcement of any dia. and grade Fe 500 or FE 500 D for all RCC members as per detailed drawings and schedules including cutting, bending, hooking the bars binding with wires as required including all lead and lift etc. complete. (Binding wire shall be of 1.6 mm diameter or 16 SWG Annealed wire) soft drawn, annealed with chair supports including cost of transporting, decoiling and straightening of bars as per specifications. Including welding of bars where ever required. Binding wire shall not be measured for payment)

No re rolled steel will be allowed for construction.

Note:- Reinforcement for all heights. All reinforcement should be free of dust

Material

HIGH YIELD STRENGTH DEFORMED BARS (TOR)

The High Yield Strength Deformed Bars (Tor) to be used in reinforced concrete work shall be of tested quality and shall comply with the requirements of Indian Standard Specification No. IS: 1139 or 1786 as amended from time to time. If the result of the test made in accordance with the provisions of the IS does not comply with the specifications the Consultants will reject the lot or lots from which the sample or samples were taken and the same shall not be used in the works, but, shall be removed there from and the work already executed with such powers may be ordered to be demolished. All other requirements for these reinforcement bars shall be same as these mentioned for mild steel reinforcement from approved source.

Reinforcing steel shall conform accurately to the dimensions shown on relevant drawings and Only TATA or SAIL material to be used. No re rolled steel would be allowed. HYSD steel conforming to IS: 432 / 1786 reinforcement of any dia. and grade Fe 500 of FE 500 D for all RCC members to be used.

Bars shall be bent cold to the specified shape and dimensions or as directed by the Engineer-in-charge using a proper bar bender, operated by hand or power to attain proper radii of bends. Bars shall not be bent or straightened in a manner that will injure the material. Bars beat during transport or handling shall be straightened before being used on work; they shall not be heated to facilitate bending. Unless otherwise specified, a U type hook at the end of each bar shall invariably be provided. The hook shall be of required as specified in IRC code of practices. In case of deformed or bars which are not round, the diameter shall be taken as the diameter of a circle having an equivalent effective area. The deformed bar shall have standard L hooks when under tension. The hook shall be suitably encased with adequate concrete cover to prevent any splitting of the concrete.

Before cutting and bending a full scale sketch shall be drawn on a leveled platform and lengths measured before cutting.

Testing of material

The structural steel each lot should be tested for all chemical and physical tests from external government approved laboratory apart from the test certificates received for the vendor. The cost for testing to be included in the rates quoted no extra payment will be done for the same

Testing frequency

Testing to be carried out for every truck load for all different diameter of steel received 3 nos of each bars to be tested for both physical and chemical test from NABL certified laboratory.

PLACING OF REINFORCEMENT

All reinforcing bars shall be accurately placed in the exact position shown on the drawings, and shall be securely held in position during placing of concrete by annealed binding wire not less than 1.6 mm diameter or 16 SWG Annealed wire and conforming to IS: 280, and by using stays, concrete blocks of same strength of concrete or metal chairs, spacers, metal hangers, supporting wires or other approved devices at sufficiently close intervals.

Bars will not be allowed to sag between supports nor displaced during concreting or any other operation over the work. All devices used for positioning shall be of non-corrodible material Wooden and metal supports will not extend to the surface of concrete, except where shown on the drawings. Placing bars on layers of freshly laid concrete as the work progresses for adjusting bar spacing will not be allowed. Pieces of broken stone, brick or wooden blocks shall not be used. Layers of bars shall be separated by spacer bars, precast concrete blocks of same strength of concrete or other approved devices only.

Reinforcement after being placed in position shall be maintained in a clear condition until completely embedded in concrete. Special care shall be exercised to prevent any displacement of reinforcement in concrete already placed.

To protect reinforcement from corrosion, concrete cover shall be provided as indicated on the drawings. All bars protruding from concrete to which other bars are to be spliced and which are likely to be exposed for an indefinite period shall be protected by a thick coat of neat cement slurry.

In the case of columns and walls, vertical bars shall be kept in normal position with timber templates having slots accurately cut in for bar position. Such templates shall be removed after the concreting has progressed up to a level just below them.

Bars crossing each other, where required, shall be secured by annealed binding wire of size not less than 1 mm and conforming to IS in such a manner that they do not slip over each other at the time of fixing and concreting. As far as possible, bars of full length shall be used. In case this is not possible, overlapping of bars shall be done as directed by the Engineer-in-Charge. Overlapping bars shall be bound with annealed steel wire, not less than 1 mm thickness twisted tight. The overlaps shall be staggered for different bars and located at points along the span where neither shear nor bending moment is maximum. However at any section not more than 50% of bar shall be spliced for FE-415 / 500 grade bar and not more than 25% for Fe-240 grade bars.

WELDING OF BARS

When permitted or specified on the drawings, joints of reinforcement bars shall be butt-welded so as to transmit their full strength. Welded joints shall preferably be located at points where the reinforcement steel will not be subject to more than 75 percent of the maximum permissible stresses and the welded joints should be staggered such that, at any one section, not more than 20 percent of the rods are welded. Only electric arc welding using a process which excludes air from the molten metal and conforms to any or all other special provisions for the work will be accepted. Suitable means shall be provided for holding the bars securely in position during welding. It must be ensured that no voids are left in welding and when welding is done in 2 or 3 stages, the previous surfaces shall be cleaned properly. Ends of the bars shall be cleaned of all loose scale, rust, grease, paint and other foreign matter before welding. Only competent welders shall be employed on the work.

The M.S electrodes used for welding shall conform to IS: 814.

Welded pieces of reinforcement shall be tested. Specimens shall be taken from the actual site and their number and the frequency of tests shall be as directed by the Engineer-in-charge.

Tolerances on Placing of Reinforcement

Unless otherwise specified by engineer-in-charge, the reinforcement shall be placed within the following tolerances:

Details	tolerance
for effective depth 200 mm or less	+- 10 mm
for effective depth more than 200 mm	+- 15 mm

Tolerance for Cover
Unless specified otherwise, actual concrete cover should not deviate from the required nominal cover by + 10mm and – 0 mm

MEASUREMENT FOR PAYMENT
Reinforcement shall be measured in length, separately for different diameters, as actually used in the work including overlaps. From the length so measured the weight of reinforcement shall be calculated in tones as per IS. Lengths shall also include hooks at end. Wastage, avoidable overlaps, couplings, welded joints and annealed steel wire for binding shall not be measured and cost of these items shall be deemed to be included in the rates for reinforcement.
Measurement will be taken in MT.

RATE
Rate for reinforcement shall include cost of all steel, its bending, placing, binding and fixing in position as shown on the drawings and as directed by the Engineer-in-charge. It shall also include cost of all devices for keeping reinforcement in approved position, cost of jointing as per approved method, and tests to be carried out. Rate would be per KG or MT.

FLOORING
Scope
Providing and laying M 25 grade or as specified in BOQ Concrete vacuum dewater flooring including adding floor top hardener of nitoflor hard top (Fosroc) or equivalent including topping @ 5 kg/Sq. m including vibration with a poker vibrator and finished with screed board vibrator , vacuum dewatering process and finally finished by floating, brooming with wire brush etc. complete as per specifications and directions of Engineer-in-charge. Curing, machine cut grooves size = 25mm d x 3mm w (Panel Size = 4m x 3m) and its fill with PU sealant Fosroc Make/ Equivalent brand etc. complete. As directed by engineer in charge. The surface tolerance should not exceed 3 mm in three meter length measured by straight edges in any direction complete as per specifications and directions of Engineer-in-charge.

Vacuum Dewatered Flooring (VDF/ Tremix Flooring):
Concrete in specified proportions of mix shall be laid in alternate bays or approved dimensions. The top surface will be finished as specified after surface vibration and shall be leveled. Immediately after surface vibration, a filter pad consisting of two layers shall be placed upon the surface of the wet concrete such that the bottom layer acts as filter and upper layer acts as water duct. Place a tight plastic sheet over the filter pad projecting slightly outside on all sides as the top cover to produce air-tight seal. Connect suction hose to a vacuum pump to extract the excess of water and to compact the concrete. Finish the surface by power floating and trowelling to achieve level, wear resistant floor with minimum dusting. The concrete surface shall be power trowelled at least twice to ensure wear resistance, sealing of capillary pores to reduce permeability and dusting.
Grade should be M 25 Concrete vacuum dewater flooring including adding of nitoflor hard top (Fosroc or equivalent) including topping @ 5 kg/Sq.m including vibration with a poker vibrator and finished with screed board vibrator , vacuum dewatering process and finally finished by floating, brooming with wire brush etc. complete as per specifications and directions of Engineer-in-charge. curing, machine cut grooves size = 25mm d x 3mm w (Panel Size = 4m x 3m) and its fill with PU sealant Fosroc Make/ Equivalent brand)etc.

complete. As directed by engineer in charge. The surface tolerance should not exceed 3 mm in three meter length measured by straight edges in any direction complete as per specifications and directions of Engineer-in-charge.

Consolidating
Vibrating screeds with truss assemblies shall be used to strike off and straightedge the concrete and to provide consolidation. Its use shall be limited to concrete with slump less than 75mm.

Jointing and edging tools
In order to make neat rounded edges next to the forms, edgers shall be used. Use a 3mm radius edger wherever edging is specified for joints subject to regular vehicular traffic. A larger radius will produce a joint that becomes rough and difficult to maintain.

Grooving:
In order to create a weakened section, the groove depth should be about one –fourth of the slab thickness.

25mm deep for a 100mm slab

37.5mm deep for a 150mm slab

Revolving disk floats shall be used to float low slump concrete or slab toppings. They are also used for additional compacting or floating following normal floating operations when the slab is stiff enough to support the machine without damage to the flatness of the slab.

Sequence of steps in making a slab on grade

1. Site Preparation

2. Placing Concrete

3. Finishing concrete

A. Prepare the sub grade	A. Deliver concrete to proper locations(s)	A. Bull float OR use straightedge.
B. Establish grades (elevations)	B. Spread or distribute concrete	B. WAIT for bleed water to disappear.
C. Set edge forms, temporary bulkheads, and screed guides.	C. Vibrate concrete	C. Edge and joint as needed.
D. Install vapor barrier, if any	D. Strike off	D. Float
E. Install reinforcement, if any	(Sometimes 2C and 2D are combined in a single operation)	E. Trowel, if required.
F. Get tools and materials ready		F. Saw joints as needed
		G. Cure

Subgrade Preparation
Slabs on ground are supported by the subgrade on which they are cast. Subgrades should provide uniform support throughout. There should not be any hard spots or soft spots. If the subgrade is not uniform, a subbase of sand, gravel, crushed stone, or other granular material should be used over it.

All sub bases or subgrade material should be compacted to uniform bearing capacity, and to meet any specific requirements.

Dampen sub grade or sub base before concrete is deposited ONLY if needed to prevent plastic shrinkage or other severe problems. There should be no standing water.

Under severe drying conditions that threaten plastic shrinkage cracking, water can be sprinkled on the subgrade before concreting. However, there should be no free water standing on the subgrade when concrete is placed, nor should there be any muddy or soft spots.

Compaction around buried pipes:

Electrical conduit and pipes should be covered with at least 50mm of sub base so that they do not cause cracking by restraining slab shrinkage or reducing slab thickness. Metal, rigid plastic or wax-impregnated cardboard ducts with watertight joints are recommended for heating ducts. The backfill material should be compacted in layers so that it will not settle and cause the slab to crack.

Placement sequence:

Concrete floors shall be constructed in long strips starting at one side of the floor. Alternate long lanes shall be cast

Two sides of each panel should be left open for at least 2 days to allow expansion to occur.

Reinforcement must be located at or (preferably) above mid-depth of the slab. The best position depends on the design concept and weather exposure, but it must not be allowed below mid-depth.

If it is to be a working joint that is expected to open and provide relief for drying shrinkage, it is best to discontinue all steel at the joint.

Isolation joints used to separate the slab from walls, footings, columns, and other rigid structures, are made with asphalt-impregnated sheets or other suitable joint materials.

The metal keyed joint form is not recommended for slabs subject to heavy wheel traffic.

Here are some of the important dos and don’ts of placing concrete in flatwork:

1. DO deposit the concrete as close to its final location in the slab as possible. The less you have to move it, the better.
2. DO start by depositing concrete in a corner and work away from the corner.
3. If a slab is on a slope, DO start at the low end and work uphill.
4. DO deposit concrete into (instead of away from) previously deposited concrete.
5. DON’T move concrete horizontally with a vibrator. That is a sure way of causing segregation.
6. DON’T vibrate high slump (more than 5 in.) concrete in slabs on grade.
7. DON’T let concrete for slabs drop from a chute or bucket (free fall) more than about 2 ft if the slump is more than 4 in. Limit the drop to about 3 ft when slump is less than 4 in.
8. DO use the proper tools to move concrete horizontally. These tools are square nose shovels or come alongs. Do not use garden tools.

Vibrating (consolidating) the concrete

Surface vibration for consolidating slabs upto 6 in.thick shall be done provided they are unreinforced or contain only light mesh. Low- frequency vibrating screeds – 3000 to 6000 vibrations per minute – are the most common means.

- ✓ DON't use a vibrator to move concrete horizontally ("run the concrete) because the coarse aggregates will separate from the mortar.
- ✓ DON'T leave a vibrator in the concrete too long (over vibrate) in concrete mixes which have a slump of more than about 3 in. If in doubt about the adequacy of compaction, it is generally better to vibrate more in stiffer mixes (slump less than 3.) because the danger of over vibrating stiff mixes is small.

Trowelling

Trowelling follows immediately after floating, and no trowelling should ever be done unless the surface has first been floated.

Joints in a floor on grade

Isolation joints permit the slab to move up or down (very slightly) relative to walls, columns or footings. Contraction (control) joints permit slabs to shrink without excessive cracking between joints. Construction joints are stopping places for a day's work

Isolation joint material must be compressible and thick enough to permit such movement. Joint material ½ in. thick is commonly used. In freeze-thaw regions, caulking may be required for long term joint maintenance.

Isolation joints are made of performed asphalt impregnated fiber sheeting or similar materials. It is important that the joint filler extend the full depth of the joint and not protrude above it. There should be no concrete-to-concrete contact

Isolation joints around column – should be either circular or diamond shaped. If no isolation joints are used around columns, or if the corners of the isolation joint do not meet the contraction joints, radial cracking may occur.

Contraction joints

Contraction joints should be placed on or straddling column lines, with intermediate joints between column lines to keep the maximum distance between joints at 24 to 36 times the slab thickness. The resulting panels should be as nearly square as practical, dividing a large floor area into relatively small panels.

Avoid elongated and L-shaped panels. Never make the long side more than 11/2 times as long as the short side.

The edge forms or bulkheads for slab-on-grade construction joints are generally keyed for 6 in. or thicker slabs so that the slab will have a tongue-and-groove joint after concrete has been cast on both sides.

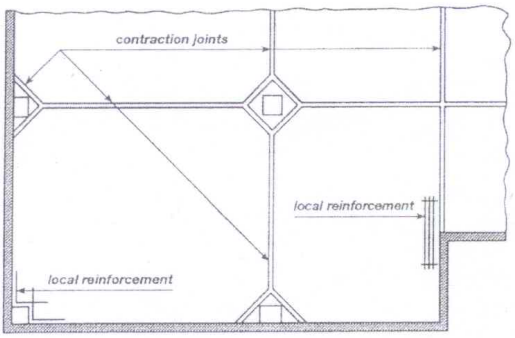
If construction joints occur where neither a contraction joint nor an isolation joint is wanted, tie bars or welded wire fabric may be used across the joint.

When to saw – Joints should be sawed as soon as the concrete is hard enough not to be torn or damaged by the blade, but before random cracks can form in the concrete slab. With wet cut saws, usually this condition occurs from 4 to 12 hr after finishing is complete, although sawing as late as 24 hr may be successful under some conditions.

Sawing techniques require a wait of 4 hours or more and a saw cut one –fourth the depth of the slab in order to get a good contraction joint.

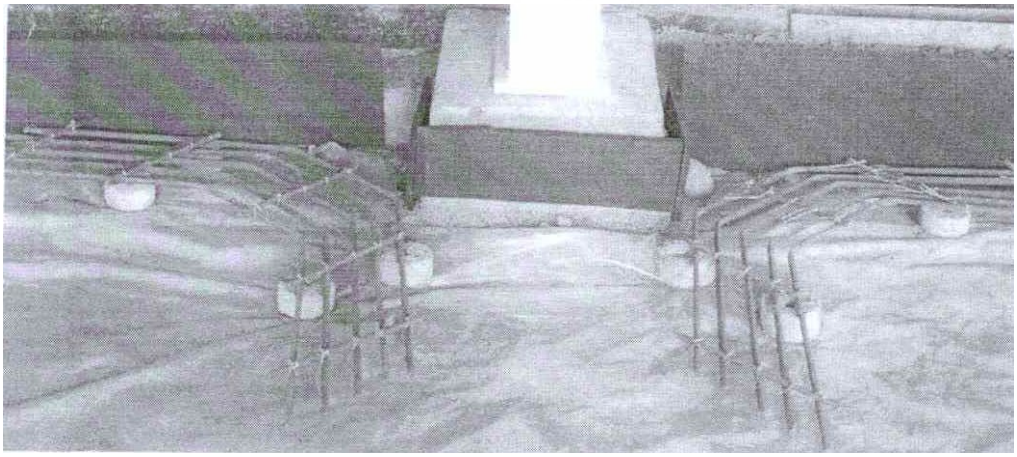
Joint Details

Contraction Joint

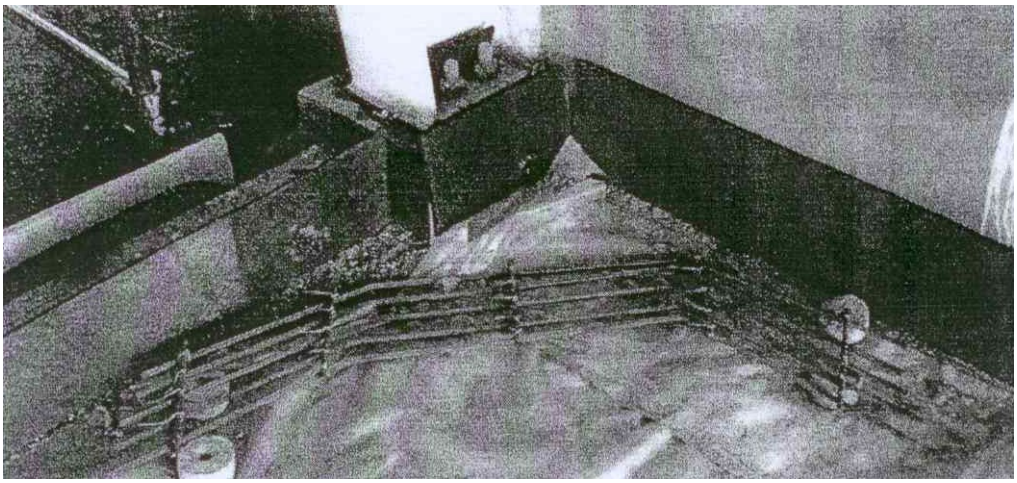


Column – Floor Joint Details

Two State Constructions : Cc

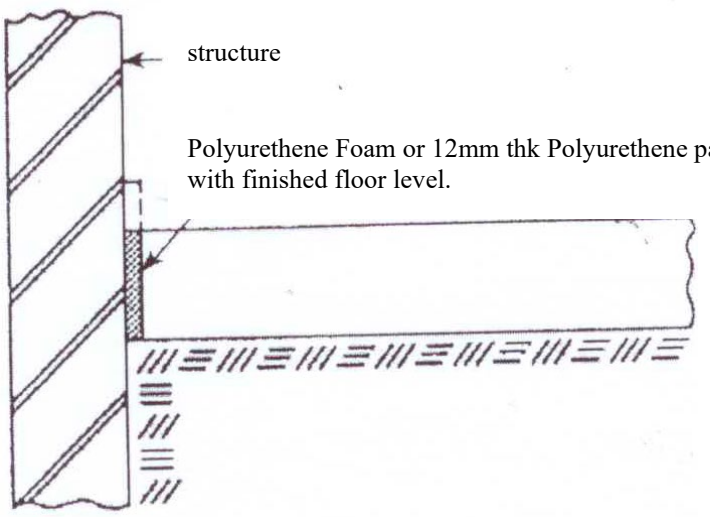


One Stage Construction: Column Isolation & Auxiliary Reinforcement.



Column Isolation & Auxiliary Reinforcement at Column in Corners.

Insulation Joint



Polyurethene Foam : 12mm Thickness & 10mm above Floor level.

Curing:
Concrete should be kept continuously moist for 7 days unless otherwise specified. To avoid crazing and cracking do not allow the concrete surface to become dry during this period.

Ponding – Although seldom used, one of the best methods of curing concrete is to cover the concrete with water

Erect sunshades in hot weather to keep the sun from overheating the concrete surface.

To keep shrinkage to a minimum, apply the following rules:

1. Use the stiffest mix that can be handled and consolidated satisfactorily.
2. Reduce the water demand (total amount of water) of the mix by these practices:
    - Use the largest maximum size of aggregate that is practical.
    - Keep aggregate and cement temperatures low.
    - Use aggregates free of clay and other fines.
    - Plan for the shortest possible travel time between ready mix plant and the job.

Other factors to consider besides shrinkage that influence the amount of curling in a slab included:

- High water tables or wet subgrades – Will cause slab curling because they increase the moisture differential across the slab thickness.
- Slab thickness – thin slabs will curl more than thicker slabs when joint spacing is 15 to 20ft. With joint spacing greater than this range, vertical curling is the same for thin or thick slabs.
- Concrete modulus of elasticity E (*a measure of concrete stiffness)* – Concretes with a low modulus curl less than high-modulus concretes. Lower strength concretes have a lower E and thus curl less.

- Vapor barriers – Avoid if possible. If vapor barriers are necessary they should be covered with a layer of compactable fill. A fill thickness of 2 to 3 in. is common, although some authorities recommend as much as 6 in. to protect the vapor barrier from concrete truck traffic and to maintain a level subgrade.

The amount of bleeding is affected mostly by:

1. Slump – High slump concrete will bleed more than low slump concrete if the slump is caused by excess water and not by admixtures.
2. Air- entrainment – Non-air-entrained concrete will bleed more than air-entrained concrete.
3. Aggregate gradation – Concrete made with gap –graded aggregate or with coarse sands which do not have much material finer than a No.50 mesh sieve will bleed more than concrete made with a sand which has enough fine material.
4. Too little cementitious material in the mix.

The surface should not be damaged by the finishing operations. However, it is usually best to avoid excessive bleeding by adjusting the concrete mix before it is delivered.

Causes of random cracks are due to poor joints.ie.

a. Joints too far apart
b. Sawed or grooved joints not installed soon enough and /or deep enough
c. No contraction joints at re-entrant corners
d. Inadequate isolation joints at walls, columns, footings etc.

Concretes made with small aggregates and overly wet concrete mixes will need closer joint spacings.

Incomplete bond between the topping and base slab in two-course floors shall be avoided. Several precautions can be taken during construction to assure bond between the topping and base slab.

1. Clean the surface of the base slab, removing all dirt, grease, plaster, etc. Use stiff wire brushes or abrasive blast new slabs if necessary. If the base slab is old, mechanical roughening should be used.
2. The surface of the base slab should be slightly damp – not wet
3. Apply a coating of sand-cement grout using a stiff bristle broom.
4. Place the topping before the grout coat dries.

Map cracking and crazing

Fine hairline map cracks occur mostly on troweled surfaces. Like most of the other cracks that occur in concrete, map cracks are caused by shrinkage.

Precautions to avoid map cracking:

Water brought to the surface during floating should be allowed to evaporate before continuing finishing operations. Also water should not be sprinkled on the surface to make finishing easier.

Delayed curing or lack of curing can cause map cracking, particularly if rapid drying of the concrete is likely. Avoid it

Wide map cracks may mean that aggregate are reacting chemically with the alkalies in the cement resulting in alkali-aggregate (or alkali-silica) reactivity.

Shrinkage-compensating concrete slabs

To take advantage of the expansion, enough steel reinforcement is used in the top half of the slab to resist the expansion and prestress of concrete to a low level.

Reinforcement should be at least 0.15 percent by cross sectional area, located in the top half of the slab.

Measurement for industrial flooring

Measurement to done in Cu M if one item taken with all above details. OR Sq m if thickness specified.

If separate item given than concreting can be taken in Cu m

Vacuumed Dewatering can be taken in Sq m.

Cutting and filling poly sulphide sealant can be taken in Rmt.

CEMENT CONCRETE WORKS

These specifications cover the requirements of plain, reinforced and pre-stressed concrete for use in various components of structures.

For all items of concrete in any portion of the structure or its associated works controlled concrete shall be used unless otherwise specified. Normal / ordinary concrete mix as shown on the drawing or as directed by the Engineer-in-charge may be used.

The provisions of the latest revisions of the following I.S Codes shall form a part of this specification to the extent they are relevant.

IS-226	Specification for structural steel (standard quality).
IS-269	Specification for ordinary and low heat Portland cement
IS-280	Specification for mild steel wire for general engineering purpose.
IS-303	Plywood for general purposes.
IS-383	Specification for coarse and fine aggregate.
IS-432	
(All Parts)	Specifications for mild steel and medium tensile steel bars and hard-drawn steel wire for concrete reinforcement.
	Part-I – Mild steel and medium tensile bars.
	Part-II – Hard drawn steel wire.
IS-455	Specification for portland blast furnace slag cement.
IS-456	Code of practice for plain and reinforced concrete (IS:456-2000)
IS-460	Specification for test sieves.
IS-516	Methods of test for strength of concrete.
IS-650	Standard sand for testing of cement.
IS-1139	Hot rolled mild steel, medium tensile steel and HYSD bars for concrete reinforcement.
IS-1199	Sampling and analysis of concrete.
IS-1200	Method of measurement of building works.
IS-1343	Code of practice for prestressed concrete.
IS-1489	Specification for portland pozzo-lana cement.
IS-1542	Sand for plaster.
IS-1566	Specification for hard-drawn steel wire fabric
IS-1732	Dimensions for round & square steel bars for structural & general engineering purposes.
IS-1785	Plain hard drawn steel wire for prestressed concrete (Part-I) Cold drawn stress-relieved wire.
IS-1786	Specification for high strength deformed steel bars & wires for concrete reinforcement.
IS-1791	Batch type concrete mixers.
IS-2062	Specification for structural steel (fusion welding quality)

IS-2386	
(All Parts)	Method of test for aggregates for concrete.
IS-2502	Code of practice for bending and fixing of bars for concrete reinforcement
IS-2505	Immersion type concrete vibrators.
IS-2506	Screed board concrete vibrators.
IS-2722	Specification for portable swing weigh batcher (single and double bucket type).
IS-2751	Code of practice for welding of M.S. bars.
IS-2911	Code of practice for design and construction of pile foundation (Part-I & IV).
IS-3366	Pan vibrators
IS-3370	
(All Parts)	Code of practice for concrete structure for the storage of liquids.
IS-3558	Code of practice for the use of immersion vibrators for consolidating concrete.
IS-4656	Form vibrators for concrete.
IS-5525	Recommendation for detailing of reinforcement in reinforced concrete works.
IS-5640	Method of test for determining aggregate impact value of soft, coarse aggregate.
IS-5816	Method of test for splitting tensile strength of concrete cylinder.
IS-6006	Uncoated stress relieved strand for prestressed concrete.
IS-6461	Cement concrete: glossary of terms.
IS-8041	Specifications for rapid hardening portland cement.
IS-8043	Specifications for hydrophobic portland cement.
IS-8112	Specifications for high strength ordinary portland cement.
IS-9103	Admixtures for concrete.

OTHER CODES AND SPECIFICATIONS

Other IS codes pertaining to the items of cement concrete work in structural work not listed above shall also be deemed to come under the purview of this clause. All Indian Roads Congress Standards, specifications and codes of practice also come under this purview.

GRADE OF CONCRETE

CONTROLLED CONCRETE

For controlled concrete, design of the mix shall be carried out for the respective target strength and in its production all necessary precautions shall be taken to ensure that the required works cube strength is attained and maintained.

The controlled concrete grades are designated as M 20, M 25, M 30, M 35, M 40, M 45 and M 50 and as per the technology used for such designation in IRC codes of practice.

ORDINARY CONCRETE (Concrete Grades M:15 & below)

In case of ordinary / nominal grade concrete, mix is required to be arrived at by preliminary tests, proportions of cement, fine aggregates and coarse aggregates are specified by mass.

In the designation of a concrete mix, letter 'M' refers to the mix and the number to the specified 28 days works cube compressive strength of that mix on 150 mm cubes, expressed in N/mm^2.

MATERIAL SPECIFICATION

CEMENT

Cement to be used for RCC work shall comply in every respect with the requirements of the IS: 8112 and IS 12269 for 43 grade and 53 grade cement respectively for ordinary Portland cement as issued and amended for time to time by the ISI. Portland pozzolana cement (PPC - as per IS 1489 latest) and Portland slag cement (PSC - as per IS 455 latest) shall be used for all works other than RCC like masonry, plastering, waterproofing, tiling, external and internal grade concrete etc. with prior written approval from the structural consultant and the engineer in charge. Use of blended cement as per latest IS 456 shall be permitted with the prior approval of the Engineer In charge. It shall be of a make and quality approved by the Consultant. The Contractor shall maintain a proper and efficient storage shed for the cement on the work. The storage of different grades and types of cement should be clearly earmarked. The cement of different grades and types shall in no case be allowed to be intermixed during the stage of storage or actual use on the site. He will also maintain a record of the cement received and used on the work.

Cement which has remained in bulk storage at the mill for more than 6 months or which has remained in bags at the dealers storage for over 3 months, or which has been stored at project site for more than 3 months shall be re-tested before use. Cement shall also be rejected if it fails to conform to any of the requirements of these specifications. Different type, grade and company of cement should not be mixed

Testing frequency

Cement testing to be done once for every batch of procurement.

FINE AGGREGATES

Fine aggregates shall consist of natural sand, manufactured sand or an approved combination thereof and shall conform to IS: 383. The grading zone of sand proposed for use shall be supplied by the contractor and got approved by the Engineer-in-Charge.

The sand shall be siliceous material, sharp, hard, strong and durable and shall be free from adherent coatings, clay, dust, alkali, organic material, deleterious matter, lumps, etc.

Either natural or manufactured sand shall be prepared for use by such screening or washing, or both, as necessary, to remove all objectionable foreign matter. Natural sand shall be washed, unless specific written authority is given by the Engineer-in-charge to use sand that meets specifications and standards of cleanliness without washing. The cost of screening and washing must be borne by the contractor. The fine aggregate shall be taken from a source approved by the Engineer-in-charge.

All lots should be tested at site for Silt content and if found above the require limit that is maximum 3% by weight and maximum 8% by volume then the same will be rejected.

Testing frequency

Silt test to be done for every truck load received at site.

COARSE AGGREGATES

Coarse aggregate to be used on works shall consist of hard blue basalt stone free from deleterious substances and shall contain no soft or elongated pieces. The Contractor shall obtain the coarse aggregate from a source approved by the Consultant. It will be from a source approved by the Engineer in charge. Coarse aggregate shall conform to IS: 383.

All coarse aggregate shall be stored on the works in such a manner as to prevent the intrusion of foreign matter.

If it is considered necessary, the Consultant may order it to be washed and screened at the Contractor's expenses.

The coarse aggregate shall be classified as under:

Aggregate No.1 - The whole of the aggregate to be retained on 4.75mm mesh screen and pass through 20mm mesh screen.

Aggregate No.2 - The whole of the aggregate to be retained on 20mm mesh screen and pass through 40mm mesh screen.

Size of Coarse Aggregates

Following shall be the maximum nominal size of coarse aggregate for the different items of work if not specified in the item of works or their respective specifications:

Sr. No.	Item of Construction	Max. Nominal Size of Coarse Aggregate
(i)	RCC well steining concrete, RCC well curb & RCC piles in plum concrete	40 mm
(ii)	Well cap or pile cap, solid type piers, abutments and wing walls, and, footing of open foundation and general items of work in bridge and building construction.	20 mm
(iii)	RCC works in girders, deck slab, wearing coat, kerbs, light posts, ballast walls, approach slab etc. and piers, returns, wing walls and retaining walls.	20 mm
(iv)	RCC bearings, shells and other thin walled members and in zones of congestion.	20 mm
(v)	For any other item of construction not covered by items (i) to (iv)	As specified in the drawings or as desired by the Engineer-in-Charge.

For heavily reinforced concrete members as in the case of ribs of main beams, the nominal maximum size of aggregate shall usually be restricted to 5 mm less than the minimum lateral clear distance between the main bars, or 5 mm less than the minimum cover to the reinforcement, whichever is smaller.

Testing frequency

Gradation test to be done in start and whenever required if the visually gradation is different or is the source of raw material or query has changed. The teat frequency can be decided by the engineer in charge.

WATER

The water shall be clean, free from oil, acid, alkali, organic or other deleterious substances and shall conform to IS 456 (as revised). The quantity of water added to the materials for making concrete shall be properly under control and must be measured and used in the desired water-cement ratio to be determined by the Consultant. Water used mixing and curing shall be free from injurious amounts of deleterious material. PH value of water shall not be less than 6. Potable water generally considered satisfactory for mixing and curing concrete. Water shall be got tested before use in concrete and curing. The cost for the same shall be borne by the contractor. Permissible limits for solid shall be as below:

PERMISSIBLE LIMIT FOR SOLIDS

	Tested as per	**Permissible limit max.**
Organic	IS : 3025 (Pt.18)	200 mg/lit.
Inorganic	IS : 3025 (Pt. 18)	3000 mg/lit.
Sulphates (as SO3)	IS : 3025 (Pt. 28)	400 mg./lit.
Chlorides (as C1)	IS : 3025 (Pt. 32)	2000 mg. lit. for concrete work not containing embedded steel and 500 mg./lit. for pre-stressed /reinforced concrete work.
Suspended matter	IS : 3025 (Pt. 7)	2000 mg / lit

Testing frequency

Once in the start of the project or if the is change of water source or there is doubt of contamination.

ADMIXTURES

No materials other than essential ingredients i.e., cement, aggregate and water, shall ordinarily by used in the manufacture of concrete or mortar. But the Engineer-in-Charge may permit the use of approved admixtures for improving the workability of the concrete, if so specified on satisfactory evidence that its use does not in any way adversely affect the properties of concrete particularly its strength, volume changes, durability and has no deleterious effect on the reinforcement. Admixture where allowed shall conform to relevant IS: 9103.

Polycalk CP 293 Sunanda or equivalent chemicals to be added as add mixture in concrete for all reinforced concrete works dosage as per manufactures specification

Testing frequency

Usually supplier's certificate is sufficient but chloride content in admixture shall be independently tested for each batch before acceptance.

STEEL REINFORCEMENT

Reinforcing steel shall be clean and free from loose mill scales, dust, loose rust and coats of paints, oil, grease or other coatings which may impair or reduce bond.

1. Fe 240 - Mild steel shall conform to the latest edition of IS: 432 Part 1.
2. Fe 415 & Fe-500 high strength deformed bars shall conform to IS: 1786, TMT bars conforming to IS: 1786 shall only be used.
3. Structural steel sections and plates shall conform IS: 226 and IS: 2062.
4. Rerolled steel will not be allowed.
5. Only standard brands like TATA and SAIL should be used.

STORAGE OF MATERIALS

Cement

The contractor shall make arrangements to the satisfaction of the Engineer-in- Charge for the storage of cement to prevent deterioration due to moisture and/or intrusion of foreign matter. Bulk cement shall be stored in approved water-proof bin or silo. Bagged cement shall be stored in a suitable weather tight warehouse in a manner to provide easy access for identification and inspection of each consignment. Stored cement shall meet the test requirements as per IS-269 at any time after storage, when a retest is ordered by the Engineer-in-Charge. Each consignment shall be stacked separately with the date of receipt flagged on it, not more than 12 bags being stacked in height, the bags being arranged with headers and stretchers. Normally consignments shall be used in the order of receipt at site unless otherwise directed. In the case of large concrete pours the Engineer-in- Charge will decide on the batch of cement to be used taking into consideration the quantity of cement with particular reference to the concerned concrete pours. Any additional work in handling and storage of cement contingent upon this requirement shall be to the contractors' account and no extra claim will be entertained. Cement shall be protected from closure to moisture in transit, in storage at the works and until it enters the concrete mixers. The contractor shall keep accurate records of the deliveries of the cement and of its use in the work.

Aggregates

Coarse and fine aggregates shall be stacked separately in such manner as to prevent contamination by foreign materials. All aggregates shall be stored on concrete or masonry platforms, each size shall be kept separate with wooden, steel, concrete, or masonry bulk heads, or shall be stored in separate stacks, taking care to prevent the materials at the edges of the stock piles from getting intermixed. Stacks of fine and coarse aggregates shall be kept sufficiently apart. The aggregates shall be stored in easily measurable stacks of suitable heights as may be directed by the Engineer- in-Charge.

Reinforcing Steel

Reinforcing steel shall not be stored directly on the ground. These shall be stored under cover and shall be protected from rusting, oil, grease and distortions as directed by the Engineer-in-Charge.

High Tensile steel

The high tensile shall be stored in humidity controlled godowns and shall not be stored for long period. The procurement of H.T. steel shall be made just before actual use and shall be stacked on wooden platform.

SHUTTERING

All centering, formwork and temporary works shall be constructed according to duly approved drawings and specification. The design criteria and loading for these works shall be as per American Concrete Institute relevant specifications.

As soon as practicable after the acceptance of his tender the contractor shall submit a scheme showing the order of the procedure and methods by which he proposed to carry out the work together with such details as are necessary to demonstrate the adequacy, stability and safety of the methods which the contractor propose to adopt.

The approval to the general scheme of centering as well as design criteria and loading shall be obtained in good time to facilitate all preparatory work. Any delay on this account shall be the responsibility of the contractor.

Notwithstanding the approval given to the design criteria and loading and the general scheme for the centering, the entire responsibility for the satisfactory execution of the centering and all temporary works shall rest with the contractor and he shall be liable to pay all claims and compensation arising from any loss or damage to life and property due to any deficiency, failure or malfunctioning of the centering or all the temporary works.

Reuse of Forms etc

Forms required to be used more than once shall be maintained in serviceable conditions and shall be thoroughly cleaned and repaired before reuse. Where metal sheets are used for lining forms the sheets shall be placed and maintained in the forms with minimum amount of wrinkles, lumps or other imperfections. All forms shall be checked for shape and strength before reuse.

Maximum repetition allowed for water proof marine ply wood shuttering would be 10 times. This number is subjective and may be reduced or increased as per the condition which would be reviewed by the engineer in charge or clients representative.

Material

In general, all shuttering and formwork to be used shall be water proof ply wood shuttering, unless otherwise stipulated. All props used to be MS props. MS pipes, couplers and H frames where ever required.

Designing of shuttering system

Contractor shall prepare, before commencement of actual work, design and drawings for formwork and get them approved by the Owner's Representative. The form work shall conform to the shapes, lines and dimensions as shown on the drawings within the allowable tolerances.

Erection and removal of forms

I. Before placing concrete the surface of all forms shall be covered with suitable non staining form releasing agents such as raw linseed oil so as to prevent sticking of concrete and to facilitate removal of forms.

II. The form releasing agent shall cover the forms fully and evenly without excess over drip. Care shall be taken on the surface of the construction joints and on reinforcement bars. Special care shall be taken to cover thoroughly the form strips for narrow grooves, so as to prevent swelling of the forms and the consequent damage to concrete prior to or during removal of forms.

III. Immediately before concrete is placed care shall be taken to see that all forms are in proper alignment and the supports and fixtures are properly secured and tightened.

IV. Where forms for continuous surfaces are placed in successive units, the forms shall lap and fit tightly over the completed surface so as to prevent leakage of cement slurry from the fresh concrete and to maintain accurate alignment of the surface.

V. Forms shall be left in place until their removal is authorized and shall then be removed with care so as to avoid injury to concrete.

VI. Removal of forms shall never be started until the concrete is thoroughly set and hardened adequately to carry its own weight, besides the live load which is likely to come on the work during construction. The length of time for which the forms shall remain in place shall be decided by the engineer-in-charge, with reference to weather conditions, shape and position of the structure of structural member and nature and amount of dead and live loads. In normal circumstances and where ordinary Portland cement is used forms can be allowed to be struck as under :

A	Beam sides, walls, unloaded columns	after	24 hours
B	Slabs and arches (props left under)	after	4 days
C	Props to slabs and arches	after	10 days
D	Beam soffit (props left under)	after	8 days
E	Props to beams	after	21 days
F	Beam concrete (sides)	after	2 days

Note: - Time shall be measured from last batch concrete in respect to the structural member under consideration.
In no case shall forms be removed until there is an assurance that removal can be accomplished without damaging the concrete surface. Heavy loads shall not be permitted until after the concrete has reached its design strength. The forms shall be removed with great caution and without jerking the structure.

Settlement of Formwork and Camber

Due to various reasons such as closure of form joints, shrinkage of timber, dead load deflection, elastic shortening of form members formwork deflection or settlement may occur. The members of the formwork must be rigid enough to prevent excessive deflections the usual acceptable limit being 1/500 of the spans of the formwork. In the absence of any specified camber on the drawings, soffit of all beams more than 5 m in span and other than prestressed concrete beams shall be laid to a camber the amount of which midspan shall not be less than 1/500 of the span of the structure. The profile of soffit shall be parabolic.

Mock-Ups

The method for pouring difficult zones of concrete will be pre-studied on mock-ups. Mock-ups will be particularly necessary for the following:

i) Zones around penetrations and openings.

ii) Behind anchorages of prestressed members.

iii) Dome and hell in general requiring single and double forms.

iv) Various zones of large thickness for studying placement temperatures in relation to internal temperature build ups.

Work involved in mock-up pours will be paid for at the rates entered under relevant items of work. Materials which are of free supply as mentioned in this document, such as steel, embedment, etc. will also be supplied free for mock-up pours. Sampling and testing of all samples will be done by the contractor. Unsuccessful mock-ups may have to be repeated in full or in part as required by the engineer.

Tolerance

All works will be carried out true to the lines, levels, and grades shown on the drawings and within the tolerances specified below. The contractor shall establish, erect and maintain in an undisturbed condition until final completion and acceptance of the project control points and bench marks necessary and adequate to establish these tolerances.

Departure from established alignment of all elements	:	30 mm
Departure from established grades	:	10 mm
Variation from plumb or specified	:	12 mm in 3 m. (If exposed)
Batter in lines and surface of	:	(25 mm in 3m. if
Back filled columns, piers, walls and in arises)		
Variation from level or indicated	:	12 mm in 3 m (If exposed)
Grade in slabs, beams, horizontal and railing offsets	:	25 mm in 3 m. (If backfilled)
Variation in cross sectional dimensions of columns,		
Piers, slabs, walls, beams and similar parts.	:	6 mm plus 12 mm
Variation in slab thickness	:	-3 mm plus 6 mm
Footings / Plan dimensions	:	-15 mm plus 30 mm
placement of eccentricity	:	-2% of
footing which in the direction of misplacement and		
not exceeding 30 mm.		
Reduction in thickness	:	-5% of specified
Thickness variation in size and locations of slabs, well	:	-12 mm.
Openings		
Pre stressed concrete cables	:	will be laid such
that their profile is a smooth curve unless otherwise specified.		

The alignment tolerances shall be as under.

Member with a depth of up to 200 mm	:	+/- d/40
200 – 1000 mm	:	+/- 5 mm
more than 1000 mm	:	+/- 10 mm
Tolerance in direction of width of member the level of tendon		
Up to 200 mm wide	:	+/- 5 mm
200 – 1000 mm wide	:	+/- 10 mm
Slabs and beams of more than 1000 mm width	:	+/- 20 mm

Tendon extensions will be measured up to 1 mm accuracy. The total prestressing force applied to a beam shall not vary more than +3% from the design force specified and measured in terms of the total elongations of all the tendons in that members.

In the case of slabs this variations shall be measured and restricted over a range of 5 consecutive tendons.

The contractor shall be entirely responsible for the sufficiency and efficiency of the shuttering and for the safe removal of the same. The shuttering shall be designed and arrange so that it will not settle or deflect under the load of concrete plant and workmen and can be removed without causing any damage to the concrete. All stuttering design will have to be got approved by the engineer in charge.

Joints shall be tight enough to prevent leakage of liquid and fines from the concrete and shutter shall be lined as may be necessary to provide the desired concrete surface.

Folding wedges if used for final adjustments shall be nailed together and to the struts or battens to prevent loosening during vibration. All chambers and radius trips, liners and cores shall be provided where necessary. All shutters shall be fixed to the proper lines and trued up immediately before depositing the concrete.

Before any concrete is placed all shavings and other harmful matter shall be removed from inside the shuttering. No concrete shall be deposited until the shuttering is inspected and approved.

The formwork shall be so designed and erected that the forms for slabs and sides of the beam, columns and wall are independent of soffit of beams and can be removed without any strain to the concrete already placed or affecting the remaining, formwork. No prop shall be removed without the approval of the Owner's & Consultant's Representative. If formwork is erected with full height of the column, one side shall be left open and built-up in sections as placing of concrete progress. Wedges, spacer bolts, clamps or other suitable means shall be provided to allow adjustment and alignment of the formwork and to allow it to be removed gradually without jarring the concrete.

In general, all shuttering and formwork to be used shall be wrought, unless otherwise stipulated.

Wrought formwork used for work shall be wooden form work lined with plywood or metal plates without indentation or "Anchor Board" shuttering or equivalent approval by Owner's Representative.

Unwrought Formwork: Wooden plank used for this type of Formwork shall be available from the saw mill. When this type of formwork is used, the concrete surfaces after the removal of formwork shall be plastered only where necessary, as required by Owner's Representative.

Plywood shuttering material shall be used where an especially good finish is required. Re-use of plywood shuttering will be undertaken if allowed by the Owner's & Consultant's Representative.

The formwork shall be so constructed that it is rigid enough to remain free from any bulging, sagging or any movement during the placing of the concrete, and can be subsequently without damaging concrete. The formwork shall be sufficiently watertight to prevent loss of liquid from the concrete. All formwork shall be fixed to proper elevation. No concreting shall be undertaken by the contractor until the level, size, suitability etc. is approved by Owner's Representative.

If it is desired by the Owner's Representative, the Contractor shall prepare, before commencement of actual work, design and drawings for formwork and get them approved by the Owner's Representative. The form work shall conform to the shapes, lines and dimensions as shown on the drawings within the allowable tolerances.

Note:

Tolerances apply to concrete dimensions only, not to positioning of vertical reinforcing steel or dowels.

The forms shall have smooth even surface and be sufficiently strong, to carry without deformation the dead weight of the green concrete, working load, wind load and also the side pressure exerted by the green concrete. As far as practicable, clamps shall be used to hold the forms together. Where use of nails is unavoidable minimum number of nails shall be used and these shall be left projecting so that they can be easily withdrawn.

The form work shall be strong enough to withstand the effect of vibrations practically without any deflection, bulging, distortion or loosening of its components.

All horizontal forms shall be designed and constructed to withstand the dead load of the green concrete, reinforcement equipment, material, embedment and a minimum live load of 200 kg/sq. meter.

When forms appear to be unsatisfactory factory building in any way, either before or during the placing of concrete, the work shall be stopped until the defects have been corrected as per the instructions of the Owner's & Consultant's Representative.

All comers and agents shall be formed with 45 deg. moldings, to form chamfers or fillets on the finished concrete wherever required. The standard dimensions of chamfers and fillets, unless otherwise detailed or specified shall be 25 x 25 mm. For heavier work chamfers or fillets shall be 50 x 50 mm. Care shall be exercised to ensure accurate moldings. The diagonal face of the moldings shall be planned or surfaced to the same texture as the forms to which it is attached.

Before reuse, all forms shall be thoroughly scrapped, cleaned, examined and when necessary repaired and retreated before resetting. Formwork shall not be reused, if declared unfit or un-serviceable by the Owner's & Consultant's Representative.

Staging/scaffolding shall be properly planned and designed by the Contractor. The contractor shall get it reviewed by Owner's & Consultant's Representative before commencement of work. Double scaffolding sufficiently strong so as to withstand all loads likely to come upon it and having two sets of vertical supports, shall be provided. Where two sets of supports are not possible, the inner end of the horizontal scaffolding member shall rest in a hole provided in the header course only. Only one header for each member shall be left out. Such holes however shall not be allowed in pillars under one meter in

width or immediately near the skewbacks of arches. The following measures shall be considered while designing and erecting of scaffolding/stating.

- Sufficient sills or under pinning in addition to base plates shall be provided particularly where scaffoldings are erected on soft grounds.
- Adjustable bases to compensate for uneven ground shall be used.
- Proper anchoring of scaffolding/staging at reasonable materials shall be provided in each case with the main structure wherever available.
- Horizontal braces shall be provided to prevent the scaffolding/staging from rocking.
- Diagonal braces shall be provided continuously from bottom to top between two adjacent rows of uprights.
- The scaffolding/staging shall be checked at every stage for plumb line.
- Wherever the scaffolding/staging is found to be out of plumb line, it shall be dismantled and re-erected fresh and effort shall not be made to bring it in plumb with a physical force.
- All nuts and bolts shall be properly tightened.
- Proper and effective supervision of the erection work shall be ensured by the Contractor.
- Erection work of a scaffolding/staging under no circumstances shall be left totally to semi-skilled or skilled workmen and shall rather be carried out in the presence of a technically qualified Civil Engineer of the Contractor.
- Wherever steel tubes are used care shall be taken that all the clamps/ couplings are firmly tightened so as to avoid any slippage.

Wooden forms for reinforced cement concrete shall be at least 25 mm. thick. All rubbish shall be removed from the interior of the forms and the surface of formwork to come in contact with concrete shall be cleaned and thoroughly treated with approved oil, soft soap, or emulsion. The oil shall be applied before the reinforcement is placed, and care shall be taken that no oil comes in contact with steel while it is being placed in position. The joints of forms shall be made watertight by plugging them with good clay and jute or by other approved means before applying oil. The form shall be so fixed that only slight marks are visible on the surface of the concrete after stripping the forms.

No plugs, bolts, ties or any appliances whatsoever for supporting, the shuttering shall be fixed permanently in the structure, nor be placed temporarily in such a manner that damage to the structure would result from their removal at the time of striking the forms and supports.

No forms shall be removed or staging struck until it is safe to do so and approved by Owner's Representative. All vertical-centering members shall be sufficiently braced with stiff members. Bamboo shall not be used as bracing members.

All formwork shall be removed without shock or vibration and without damaging the new concrete. The side forms shall be so fixed that while removing them the supporting forms and posts are not disturbed to any extent. In no circumstances, should the supporting forms be struck until the concrete reaches strength of at least twice the stress to which the concrete may be subjected at the time of striking. Under normal conditions, the periods shown below are the minimum, which should be allowed between the placing of the concrete and the removal of the forms.

Formwork shall be cambered as described below, unless otherwise shown or specified. Deflection reading of various elements shall be taken as directed.

Type of Member	**Compression steel as percentage of tensile steel**	**Camber co-efficient K.**
Simple Span	0 50%	0.066 0.037
Continuous or restricted span	0	0.032
Cantilever Span	50% 0 50%	0.50 0.020 0.046

$$\text{Camber (in inches)} = \frac{K' L}{D}$$

Where K = Camber co-efficient
L = Length of member in ft.
D = Depth of member in ft.

Special note:-
No binding wire will be used to support the form work by tying to the reinforcement.
No steel bars spacer (katta) to be used for beams side.

Measurement for form work:-

Form Work IS 1200 Part 5

Sr. No.	**Description**
	Unit
1	Form work shall be measured in Square Meter
2	Raking or circular cutting and rounded or moulded edges shall be measured in running meters.
3	Moulded stopping should be measured in numbers
	Measurement
1	No deductions shall be made for each of opening up to 0.4 Square Meter
2	No deduction shall be made for any opening/cutouts when slip form technique is used.
3	Formwork to secondary beams shall be measured up to the sides of main beams, but no deduction shall be made from the formwork of the main beam where the secondary beam intersects it. Formwork to beam shall be measured up to sides of column, but no deduction shall be made from the formwork to stanchion or column casings at intersections of beam.

CONTROLLED CONCRETE

Addition of anti-corrosive add mixture

Polycalk CP 293 Sunanda chemicals to be added as add mixture in concrete for all reinforced concrete works dosage as per manufactures specification

Concrete mix shall be designed for 33% higher strength than the grade of concrete specified. The proportions for ingredients chosen shall be such that concrete has adequate workability for conditions prevailing on the work in question and can be properly compacted with the means available.

Except where it can be shown to the satisfaction of the Engineer-in-Charge that a supply of properly graded aggregate of uniform quality can be maintained till the completion of work, grading of aggregate should be strictly controlled. The different sizes shall be stocked in separate stock piles. Required quantity of material shall be stock-piled several hours, preferably a day, before use. Grading of coarse and fine aggregate shall be checked as frequently as possible, frequency for a given job being determined by the Engineer-in-charge to ensure that the suppliers are maintaining the uniform grading as approved for samples used in the design mix.

The quantity of both cement and aggregate shall be determined by weight. Water shall either be measured by volume in calibrated tanks or weighed. All measuring equipment shall be maintained in a clean and serviceable condition. Their accuracy shall be periodically checked.

It is most important to keep the specified water-cement ratio constant and at its correct value. To this end, the moisture content in both fine and coarse aggregates shall be determined by the Engineer-in-charge according to the weather conditions. The amount of mixing water shall then be adjusted to compensate for variations in the moisture content. For the determination of moisture content in the aggregates, IS: 2386 (Part III) shall be referred to. Suitable adjustments shall also be made in the weights of aggregates to allow for the variation in weights of aggregates due to variation in their moisture content.

The minimum cement and maximum water cement ratio and minimum grade of concrete is given below:-

For bridges with pre-stressed concrete / RCC decking or those with individual spans greater than 30 mtrs. Or those that are built with innovative design / construction.

[Ref: Table: 5 of IS-456-2000]

Sr. No.	**Exposure**	**Plain Concrete**			**Reinforced Concrete**		
		Minimum Cement Content Kg/m3	**Maximum Free Water-Cement Ratio**	**Min. Grade of Concrete**	**Minimum Cement Content Kg/m3**	**Maximum Free Water-Cement Ratio**	**Min. Grade of Concrete**
1	2	3	4	5	6	7	8
1	Mild	220	0.60	-	300	0.55	M-20
2	Moderate	240	0.60	M-15	300	0.50	M-25
3	Severe	250	0.50	M-20	320	0.45	M-30
4	Very Severe	260	0.45	M-20	340	0.45	M-35
5	Extreme	280	0.40	M-25	360	0.40	M-40

Adjustments to Minimum Cement Contents for Aggregates other than 20 mm Nominal Maximum Size [Ref : Table:6 of IS-456-2000]

Sr. No.	Nominal Maximum Aggregate Size (mm)	Adjustment to minimum Cement Content in above table (kg/m3)
(1)	(2)	(3)
1	10	+ 40
2	20	0
3	40	-30

Limits of Chloride Content of Concrete
[Ref: Table: 7 of IS-456-2000]

Sr. No.	Type or Use of Concrete	Maximum Total Acid Soluble Chloride Content expressed as kg/m3 of Concrete
1	Concrete containing metal and steam cured at elevated temperature and pre-stressed concrete	0.4
2	Reinforced concrete or plain concrete containing embedded metal	0.6
3	Concrete not containing embedded metal or any material requiring protection from chloride	3.0

Condition of Exposure:

1. Severe - Marine Environment:

   Alternate wetting and drying due to sea spray, alternate wetting and drying combined with seezing, buried in soil (having corrosive effect); members in contact with water where the velocity of flow and the bed material are likely to cause corrosion of concrete.
2. Moderate - Condition other than ‘severe’

   a) The minimum cement content is based on 20 mm size aggregates. For larger size aggregates, it may be reduced suitably by not more than 10%. Similarly for smaller size aggregates, it may be suitably increased, but not more than 10%.

   b) The cement content shall not exceed 540 kg/cu.m. of concrete.
3. Ordinary / Nominal Concrete:

The ordinary/ nominal concrete mix shall also be specified by mass. Proportioning of sand shall be as per its dry volume and in case it is damp, allowance for 'bulking' shall be made as per IS : 2386 (Part III).

Ingredients required for nominal mix concrete containing one 50 Kg. bag of cement for different proportions of mix shall be as given in Table below.

MIX DESIGN

Controlled concrete shall be based on a mix design carried out in a laboratory, approved by Consultant & Client, and shall conform to IS 456-2000. The requirements of sampling and testing shall be as given in these specifications.

- As the guarantor of quality of concrete used in the construction, the Contractor

shall carry out the mix design and the mix so designed (not the method of design) shall be approved by the Employer within the limitation of parameters and other stimulations laid down by IS:456-2000.

- The mix shall be designed to produce the grade of concrete having the required workability and a characteristic strength not less than appropriate value given in Table I below. The target mean strength of concrete mix should be equal to the characteristic strength plus 1.65 times the standard deviation.
- Mix design done earlier not prior to one year may be considered adequate for later work provided there is no change in source and quality of the materials.

Table for Grades of Concrete

Group	Grade Designation	Specified Characteristic
		Compressive Strength of 150 mm Cube at 28 days in N/mm2
(1)	(2)	(3)
	M 10	10
Ordinary Concrete	M 15 M 20	15 20
	M 25	25
	M 30	30
	M 35	35
Standard Concrete	M 40 M 45	40 45
	M 50	50
	M 55	55
	M 60	60
	M 65	65
High Strength	M 70	70
	M 75	75
	M 80	80

Notes:

1. In the designation of the concrete mix M refers to the mix and the number to the specified compressive strength of 150 mm size cube at 28 days, expressed in N/mm2.
2. For concrete of compressive strength greater than M 55, design parameters given in the standard may not be applicable and the values may be obtained from specialized literatures and experimental results.
3. No extra charges will be paid to contractor to carry out the tests.

Standard Deviation

The standard deviation for each grade of concrete shall be calculated separately.

Standard deviation based on test strength of sample.

a. Number of test results of samples – The total number of test strength of samples required to constitute an acceptable record for calculation of standard deviation shall not be less than 30. Attempt should be made to obtain the 30 samples, as

early as possible, when a mix is used for the first time.

b. In case of significant changes in concrete – When significant changes are made in the production of concrete batches (for example changes in materials used, mix design, equipment or technical control), the standard deviation value shall be separately calculated for such batches of concrete.

c. Standard deviation to be brought up to date – The calculation of the standard deviation shall be brought up to date after every change of mix design.

Assumed Standard Deviation

Where sufficient test results for a particular grade of concrete are not available, the value of standard deviation given in Table II may be assumed for design of mix in the first instance. As soon as the results of the samples are available, actual calculated standard deviation shall be used and the mix design properly. However, when adequate past records for a similar grade exist and justify to the designer a value of standard deviation different from that shown in Table II, it shall be permissible to use that value.

Assumed Standard Deviation

Grade of Concrete	Assumed Standard Deviation
M 10 M 15	3.5
M 20 M 25	4.0
M 30	5.0
M 35	
M 40	
M 45	
M 50	

Note:
The above values correspond to the site control having proper storage of cement; weigh batching of all materials; controlled addition of water; regular checking of all materials; aggregate gradings and moisture content; and periodical checking of workability and strength. Where there is deviation from the above, the values given in the above Table shall be increased by 1 N/mm2.

Specimen

Test specimens shall be cubes whose sizes shall be as given below.

Minimum size of Coarse Aggregate	Size of specimen cubes in cms.
Not exceeding 20 mm	10 x 10 x 10
Greater than 20 mm but not exceeding 40 mm	15 x 15 x 15

Sampling of Concrete

Samples for concrete for test specimens shall be taken at the mixer or in the case of ready mixed concrete from the transportation vehicle during discharge. The sample of concrete from which test specimens are made shall be representative of the entire batch. Such samples shall be obtained by repeatedly passing a scoop or pail through the discharging

stream of concrete, stacking the sampling operation until the entire batch is discharged. The sample thus obtained shall be transported to the place of moulding of specimen, and to counteract segregation, the concrete shall be mixed with a shovel until it is uniform in appearance. The location in the work of the batch of concrete thus sampled shall be noted for further reference. In the case of paving concrete, samples may be taken from the batch immediately after deposition on the sub-grade. At least five samples shall be taken from different positions of the pile and these samples shall be thoroughly mixed before being used to form the test specimens.

Preparation of Test Specimens

The interior surfaces of the mould and base plate shall be lightly oiled before the concrete is placed in the mould. From the samples of concrete obtained, the test specimen shall be immediately molded by one of the following methods.

a. When the job concrete is compacted by ordinary methods, the 1st specimen shall be molded by placing the test concrete in the mould in layers, each approximately one-third of the volume of the mould. In placing each scoopful of concrete, the scoop shall be moved around the top edge of the mould as the concrete there slides from it, in order to ensure a uniform distribution of concrete within the mould. Each layer shall be rodded 25 times with a 16 mm rod, 60 cm in length, bullet pointed at the lower end. The strokes shall be distributed in a uniform manner over the cross section of the mould and shall penetrate into the underlying layer. The bottom layer shall be rodded throughout its depth. After the top layer has been rodded, the surface of the concrete shall be struck off with a trowel and covered with a glass plate at least 6.5 mm thick or a machined metal plate. The whole process of moulding shall be carried out in such a manner as to preclude the alteration of the water cement ratio of the concrete, by loss of water either by leakage from the bottom or overflow from the top of the mould.

b. When the job concrete is placed by vibration and the consistency of the concrete is such that the 1st specimen cannot be properly molded by hand Roding as directed under (a) above, the specimens shall be vibrated to give a compaction corresponding to that of the job concrete. The fresh concrete shall be placed in the mould in two layers, each approximately half the volume of the mould. In placing each scoopful of concrete, the scoop shall be moved around the top edge of the mould as the concrete there slides from it, in order to ensure a symmetrical distribution of concrete within the mould. Either internal or external vibrators may be used. The vibration of each layer shall not be continued longer than is necessary to secure the required density. Internal vibrators shall be of appropriate size and shall penetrate only the layer to be compacted. In compacting the first layer, the vibrators shall not be allowed to rest on the bottom of the mould. In placing the concrete for the top layer, the mould shall be filled to the extent that there will be no mortar loss during vibration. After vibrating the second layer, enough concrete shall be added to bring the level above the top of the mould. The surface of the concrete shall then be struck off with a trowel and covered with a glass or steel plate as specified under (a) above. The whole process of moulding shall be carried out in such a manner as to preclude the alteration of the water cement ratio of the concrete, by loss of water either by leakage from the bottom or overflow from the top of the mould.

Method of Testing

The tests shall be made at the age of the concrete corresponding to that for which the strengths are specified. Compression tests shall be made immediately upon removal of the concrete test specimens from the curing tank i.e. the test specimens shall be loaded in damp condition. The dimensions of the test specimens shall be measured in millimetres accurate to 0.5 mm.

The metal bearing plates of the testing machine shall be placed in contact with the ends of the test specimens. Cushioning materials shall not be used. In the case of cubes, the test specimen shall be placed in the machine in such a manner that the load is applied to the sides of the specimen as cast. An adjustable bearing block shall be used to transmit the load to the test specimen. The size of the bearing block shall be the same or slightly larger than that of the test specimen. The upper or lower section of the bearing block shall be kept in motion as the head of the testing machine is brought to a bearing on the test specimen.

The load shall be applied axially without shock at the rate of approximately 140 kg/sq.cm. per minute. The total load indicated by the testing machine at failure of the test specimen shall be recorded and the unit compressive strength calculated in kg/sq.cm. using the area computed from the measured dimensions of the test specimen. The type of failure and appearance of the concrete shall be noted.

Standard of Acceptance
The standard of acceptance shall be as described below:

Three test specimens shall be made for each age at which tests are required. The average of strength of the three specimens may be accepted as the compressive strength of concrete, provided the difference between the maximum and minimum strengths of the three specimens does not exceed 15% of the average strength. If the difference exceeds 15% of the average strength, repeat tests shall be made unless the minimum strength is greater, than the strength specified.

In order to get a relatively quicker idea of the quality of concrete, compressive strength tests at 7 days may be carried out in addition to 28 days compressive strength tests. For this purpose, the values given in Table above may be taken for general guidance in the case of concrete made with ordinary Portland cement. In all cases, the 28 days compressive strength specified in Table above shall alone be the criterion for acceptance or rejection of the concrete. If, however, from tests carried out in a particular job over a reasonably long period, it has been established to the satisfaction of the Engineer –in-charge that a suitable ratio between 28 days compressive strength and the 7 days compressive strength exists, the compressive strength at 7 days may be accepted, and the Engineer-in-charge may suitably relax the frequency of 28 days compressive strength specified provided the expected strength values at the specified early age are consistently met.

If the average strength of the sample concrete is less than the specified strength, the work for that day shall be accepted at reduced rate, provided the average strength of sample concrete is not less than 75% of the specified strength. The Engineer-in-charge shall determine the reduced rate and the quantity of the day's work for which the rate is to be reduced. If the strength of sample concrete is less than 75% of the minimum specified strength after 28 days, the Engineer-in-charge shall reject the defective portion of the work done during the day along with the other concrete work structurally affected by the defective portions and get it dismantled.

Six cubes shall be made for a test and 3 out of these shall be tested after 7 days. If the 7 days test gives the specified compressive strength, no further test shall be necessary. In case the 7 days test is not satisfactory, the remaining 3 cubes shall be tested after 28 days. The result of the 28 days test shall be taken into account while reducing the rate of rejecting the concrete represented by the sample. The result of the test conducted by the approved testing laboratory shall be taken as final and binding on the Contractor.

For Use of PPC cement or fly Ash in concrete 3 extra cubes have to be taken for 56 days test.

Testing of Concrete

Whenever required by the Consultant & client the Contractor shall prepare required number of concrete cubes for testing the compression strength of concrete used for the various items of work.

For every big pour of concreting particularly for slab twelve cubes are to be taken. Out of these three cubes will be tested on 3rd day, three on 7th day, three on 14th day and balance three on 28th day.

The moulds should be perfect cubes of 150mm resting on a flat iron plate. The base plate and the sides should be polished smooth and sufficiently oiled to prevent the concrete from sticking. The concrete in the moulds shall be placed in 3 layers, compacting each layer 35 times uniformly with a 16mm dia bar 600mm long, bullet pointed at the lower end. The test specimen covered with sack cloth for 24 hours, after which the specimen should be removed and placed under heap of wet sand or in water tank till the date of test.

Such cubes will be sent for testing to any other approved materials testing laboratory as directed by the Consultant and the cost of such cubes and tests and transport of cubes will have to be borne by the Contractor.

The code of practice to be preferred shall be the Indian Standard Code of Practice for plain and reinforced cement concrete for General Building Construction (Revised) No. I.S. 456 as issued and amended from time to time by the Indian Standard Institution. In the event of unsatisfactory results of the tests, the Contractors shall be required to take such measures as will be directed by the Consultant free of cost to the Clients. One set of 12 cubes of every slab and one set of 6 cubes for columns on different floors will be taken.

STRENGTH REQUIREMENT OF CONCRETE

Grade of Concrete	**Compressive Works Test Strength in N/Sq. mm on 150 mm Cubes after Testing Conducted in accordance with IS : 456**	
	Min. at 7 days	**Min. at 28 days**
M 10	7	10
M 15	10	15
M 20	13.5	20
M 25	17	25
M 30	20	30
M 35	23.5	35

Number of sample to be taken in concreting for compressive strength test

Quantity of concrete in Cum	**Number of samples**
1 – 5	1
6-15	2
16-30	3
31-50	4
5 1 and above	4 plus one additional sample for - each additional 50 m3 or part thereof

Other test to be done

Test	Frequency
Concrete impermeability	1 sample / 1000 m3
RCPT	1 sample / 1000 m3
ISAT	1 sample / 1000 m3

PROPORTION OF NOMINAL MIX CONCRETE

Grade of Concrete	Total quantity of dry aggregates by mass per 50 Kg. of cement, to be taken as the sum of the individual masses of fine & coarse aggregates, (Kg.), Max.	Proportion of fine aggregate to-coarse aggregate by mass.	Qty. of water per 50 Kg. of cement Max. (Ltrs.)
M-7.5	625	Generally 1:2 for fine aggregate to coarse aggregate by volume but subject to a upper limit of 1:1 ½ and a lower limit 1.2 ½	45
M-10	480		34
M-15	330		32

Note No. 1: The proportions of the aggregates shall be adjusted from upper limit to lower limit progressively as the grading of the fine aggregates becomes finer and the maximum size of coarse aggregate becomes larger.

Note No. 2: The amount of water should be kept minimum required for proper workability. The quantity given in Col. 4 is not to be exceeded.

Example For an average grading of fine aggregate (that is Zone the proportions shall be 1:1 ½ , 1:2 and 1:3, for maximum size of aggregates 10 mm, 20 mm and 40 mm respectively.

Note No. 3: A mix leaner than M 10 may be used for non-structural parts if specified on the drawing or provided in the contract. In such case grading of aggregates shall be as specified in the contract or on the drawings. Other requirements for mixing, placing and curing shall be the same as specified in this section.

Quantity of Water

The quantity of water shall be just sufficient to produce a dense concrete of required workability and strength for the job. An accurate and strict control shall be kept on the quantity of mixing water.

In the case of reinforced concrete work, workability shall be such that the concrete surrounds and properly grips, all reinforcements. The degree of consistency, which shall depend upon the nature of work and the methods of vibration of concrete, shall be determined by regular slump tests. The slump shall be adopted for different types of works shall be as per IS 456, cl. No. 7, pg no. 17.

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Sr. No.	Type of Work	Where Vibrators are Used	Where Vibrators are not Used
i)	Mass Concrete in RCC Foundations, Footings and Retaining Walls	25 mm to 40mm	80 mm
ii)	Beams, Slabs & Columns Simply Reinforced	35 mm to 40 mm	100 – 120 mm
iii)	Thin RCC Section or Section with Congested Steel	40 mm to 50 mm	125 – 150 mm

Note: With use of ordinary concrete the slump requirement specified above would not be applicable.

MIXING CONCRETE

For manufacturing concrete, automatic mixer (mini/mobile batching plant) with a minimum output capacity of 8 cum per hour and having minimum / single batching size of 0.35 cum with the production capacity of approximately 20 batches per hour shall only be used. There should be two mixers including standby should be provided. The feeding of the concrete ingredients like sand, grit, aggregate and cement may be done manually, but gauges for that should be installed on it, either dial gauge or digital only. It should also have the same kind of arrangements for water flow and admixture dose on it or separately. All those gauges should be clearly indicative, measurable from the one place.

The calibrations of all the gauges shall have to be done at least once a month or at the frequency as directed by Engineer in charge.

All those accessories shall be mandatory and shall be kept in first class working conditions and so maintained throughout the construction. Mixing shall be continued till materials are uniformly distributed and a uniform colour of the entire mass is obtained and each individual particle of the coarse aggregate shows a complete coating of mortar containing its proportionate amount of cement. In no case shall the mixing be done for less than 2 minutes after all ingredients have been put into the mixer. Hand mixing of concrete is not permissible. For mixes lower than M-10, machine mixing may be permitted only under exceptional circumstances with the permission of the engineer in charge in advance. In hand mixing quantity of cement shall be increased by 10% above that specified above but the cost of increased cement quantity shall be borne by the contractor. Mixers, which have been out of use for more than 30 minutes, shall be thoroughly cleaned before putting in a new batch. Unless otherwise agreed to by the engineer in charge, the first batch of concrete from the mixer shall contain only two thirds of the normal quantity of coarse aggregates. The mixing plant shall be thoroughly cleaned before changing from one type of cement to another.

TRANSPORT, PLACING AND COMPACTION OF CONCRETE

The method of transporting and placing concrete shall be approved by the Engineer-in-charge. Concrete shall be transported and placed such that no contamination, segregation or loss of its constituent materials takes place.

All formwork and reinforcement contained in it shall be cleaned and made free from standing water or dust, immediately before placing of concrete.

No concrete shall be placed in any part of the structure until the approval of the Engineer-in-charge has been obtained in writing.

If concreting is not started within 24 hours of the approval being given, it shall have to be obtained again from the Engineer-in-charge. Concreting shall then proceed continuously over the area between construction joints. Fresh concrete shall not be placed against concrete which has been in position for more than 30 minutes unless it is ensured that there vibration limit of the earlier concrete is not crossed or a proper construction joint is formed.

Concrete when deposited shall have a temperature of not less than 5 deg. C and not more than 40^0 C unless otherwise specified. It shall be compacted in its final position within 30 minutes of its discharge from the mixer unless carried in properly designed agitators, operating continuously, in when this time shall be within 1 hour of the addition of cement to the mix and within 30 minutes of its discharge from the agitator, except where otherwise agreed to by the Engineer-in-charge, concrete shall be deposited in horizontal layers to a compacted depth of not more than 0.45 m when internal vibrators are used and not exceeding 0.30 m in all other cases.

Unless otherwise agreed to by the Engineer-in-charge, concrete shall not be dropped into place from a height exceeding 1.5 metres. When trunking or chutes are used, they shall be kept clean and used in such a way as to avoid segregation.

When concrete is conveyed by chute, the plant shall be of such size and design as to ensure practically continuous flow. Slope of the chute shall be so adjusted that the concrete flows without the use of an excessive quantity of water and without any segregation of its ingredients. The angle of chute from ground should not be less than 45 deg. The delivery end of the chute shall be as close as possible to the point of deposit. The chute shall be thoroughly flushed with water before and after each working period and the water used for this purpose shall be discharged outside the formwork.

When concreting has to be resumed on a surface which has hardened, it shall be roughened, swept clean, thoroughly wetted and covered with a layer of neat cement grout. This shall be followed by a 10 mm thick layer of mortar composed of cement and sand in the same ratio as in the concrete mix itself. This 10 mm layer of mortar shall be freshly mixed and placed immediately before placing of new concrete. A layer of bond coat to be applied on old surface as directed by engineer incharge.

Where concrete has not fully hardened, all laitance shall be removed by scrubbing the wet surface with wire or bristle brushes, care being taken to avoid dislodgement of any particles of coarse aggregate. The surface shall then be thoroughly wetted, all free water removed, and then coated with neat cement grout. The first layer of concrete to be placed on this surface shall not exceed 150 mm in thickness, and shall be well rammed against old work, particular attention being given to comers and close spots.

All concrete shall be compacted to produce a dense homogeneous mass with the assistance of vibrators, unless otherwise permitted by the Engineer-in-charge for exceptional cases, such as concrete under water, where vibrators cannot be used. Sufficient vibrators, in serviceable condition, shall be kept at site so that spare equipment is always available in the event of breakdowns.

The performance requirements of vibrators shall conform to relevant IS Codes. Vibration shall not be applied through reinforcement, and where vibrators of the immersion type are used, contact with reinforcement and all inserts shall be avoided as far as practicable.

CONCRETING UNDER WATER

When it is necessary to deposit concrete under water, the methods, equipment, materials and proportions of the mix to be used shall be got approved from the Engineer-in-charge before any work is started. Such concrete shall not be considered as 'Controlled Concrete'.

Concrete shall not be placed in water having temperature below 5^0C. The temperature of the concrete, when deposited, shall be not less than 16^0C., not more than 40^0C.

While carrying out mix design. It shall be considered that Concrete shall contain 10 per cent more cement than that required for the same mix placed in the dry. The materials shall be so proportioned as to produce a concrete having a slump of not less than 100 mm. and not more than 180 mm. The slump shall be tested as per latest IS: 516.

Coffer-dams or forms shall be sufficiently tight to ensure still water conditions if practicable, and in any case to reduce the flow of water to less than 3 metres per minute through the space into which concrete is to be deposited. Coffer-dams or forms in still water shall be sufficiently tight to prevent loss of mortar through the joints in the wells. Pumping shall not be done while concrete is being placed, or until 24 hours thereafter.

Concrete shall be deposited continuously until it has been brought to the required height. While depositing, the top surface shall always be kept as nearly level as possible and formation of seams avoided. For depositing concrete any one of the following methods may be used:

Tremie

When concrete is to be deposited under water by means of tremie, the top section of the tremie shall be a hopper large enough to hold one full batch of the mix or the entire contents of the transporting bucket if any. The tremie pipe shall not be less than 200mm in diameter, and shall be large enough to allow a free flow of concrete and strong enough to withstand the external pressure of the water in which it is suspended, even if a partial vacuum develops inside the pipe. Preferably, flanged steel pipe of adequate strength for the job shall be used. A separate lifting device shall be provided for each tremie pipe with its hopper at the upper end. Unless the lower end of the pipe is equipped with an approved automatic check valve, the upper end of the pipe shall be plugged with a wadding of gunny sacking or other approved material before delivering the concrete to the tremie pipe through the hopper, so that when the concrete is forced down from the hopper to the pipe it will force the plug (and along withit any water in the pipe) down the pipe and out of the bottom end, thus establishing a continuous stream of concrete. It will be necessary to raise slowly the tremie in order to allow a uniform flow of concrete, but it shall not be emptied so that water enters above the concrete in the pipe. At all times after the placing of concrete is started and until all the required quantity has been placed, the lower end of the tremie pipe shall be kept below the top surface of the plastic concrete. This will cause the concrete to build up from below instead of flowing out over the surface, and thus avoid formation of layers of laitance. If the charge in the tremie is lost while depositing, the tremie shall be raised above the concrete surface, and unless sealed by a check valve it shall be re-plugged at the top end, as at the beginning, before refilling for depositing further concrete.

Drop Bottom Bucket

The top of the bucket shall be closed. The bottom doors shall move freely downward and outward when tripped. The bucket shall be filled completely and lowered slowly to avoid backwash. It shall not be dumped until it rests on the surface upon which the concrete is to be deposited and when discharged shall be withdrawn slowly until well above the concrete.

To minimize the formation of laitance, great care shall be exercised not to disturb the concrete as far as possible while it is being deposited.

CURING OF CONCRETE

PROTECTION AND WATER CURING

Immediately after compaction, concrete shall be protected against harmful effects of weather, including rain, running water, shocks, vibration, traffic, rapid temperature changes and premature drying out. It shall be covered with wet sacking, Hessian or other similar absorbent material approved by the Engineer-in-charge soon after the initial set, and shall be kept continuously wet for a period of not less than 21 days from the date of placement. Masonry work over the foundation concrete may be started after 48 hours of its laying but the curing of concrete shall be continued for a minimum period of 21 days.

STEAM CURING

Where steam curing is adopted it shall be ensured that it is done in a suitable enclosure to contain the live steam in order to minimize moisture and heat losses. The initial application of the steam shall be from two to four hours after the final placement of concrete to allow the initial set of the concrete to take place.

Where retarders are used, the waiting period before application of the steam shall be increased from four to six hours.

The steam shall beat 100% relative humidity to prevent loss of moisture and to provide excess moisture for proper hydration of the cement. The application of steam shall not be directly on the concrete, and the ambient air temperature shall increase at a rate not exceeding 5 deg. cent. per hour until a maximum temperature of 60 deg. cent. to 70 deg. cent. is reached. The maximum temperature shall be maintained until the concrete has reached the desired strength.

When steam curing is discontinued the ambient air temperature shall not drop at a rate exceeding 5 deg. centigrade per hour until a temperature of about 10 deg. cent. above the temperature of the air to which the concrete will be exposed, has been reached.

WORKING IN EXTREME WEATHER

When depositing concrete in very hot weather, precautions shall be taken so that the temperature of wet concrete does not exceed 38 deg. C while placing. This shall be achieved by stacking aggregate under sheds and keeping it moist using cold water or crushed or flaked ice if specified and permitted by the Engineer, reducing the time between mixing and placing to the minimum, cooling formwork by sprinkling water on the exterior, starting curing before the concrete dries out and restricting concreting, as far as possible, to mornings and evenings.

During hot weather and rains the concrete shall be covered with tarpaulin and transported and placed in the forms and consolidated to final state. Commencement of concrete pours shall be avoided during heavy rains, storms and high winds.

FINISHING

Immediately after the removal of forms, all exposed bars or bolts passing through the reinforced cement concrete member and used for shuttering or any other purpose shall be cut inside the reinforced cement concrete member to a depth of at least 25 mm below the surface of the concrete and the resulting holes be closed by cement mortar. All fins caused by form joints shall be broken. All cavities produced by the removal of form ties, all holes and depressions, honey-comb spots, broken edges or corners and all other defects

shall be thoroughly cleaned, saturated with water and carefully pointed and rendered true with mortar of cement and fine aggregate mixed in the proportions used in the grade of concrete that is being finished of as dry a consistency as is possible to use. Considerable pressure shall be applied in filling and pointing to ensure thorough filling in all voids. Surfaces which have been filled/pointed shall be kept moist for a period of twenty-four hours. Any repair and rectification of defective work is to be undertaken and carried out as directed by the Engineer-in-charge.

If soft pockets/honey-combs, in the opinion of the Engineer-in-charge, are of such an extent or character as to affect the strength of the structure materially or to endanger the life of the steel reinforcement, he may declare the concrete defective and require the removal and replacement of the portions of the structure affected.

All construction and expansion joints in the completed work shall be left carefully tooled and free from any mortar and concrete. Expansion joint filler shall be left closed for its full length with clean and true edges.

CONSTRUCTION JOINTS

Concreting shall be carried out continuously upto the construction joints, the position and details of which shall be as shown on approved drawings or as directed by the Engineer-in-charge. Such joints shall, however, be kept to the minimum.

For a vertical construction joint, a stopping board shall be fixed previously at the pre-determined position and shall be properly stayed for sufficient lateral rigidity to prevent its displacement or bulging when concrete is compacted against it. Concreting shall be continued right up to the board. The board shall not be removed before the expiry of the specified period for removal of vertical forms.

Before resuming work at a construction joint where the concrete has not yet fully hardened, all laitance shall be removed thoroughly, care being taken to avoid dislodgement of coarse aggregates.

When work has to be resumed on a surface which has hardened, the surface shall be thoroughly hacked, swept clean, wetted and covered with a layer of neat cement grout. The neat cement grout shall be followed by a 13 mm thick layer of mortar mixed in the same proportion as in the concrete and concreting resumed immediately thereafter. The first batch of concrete shall be rammed against the old work to avoid formation of any soft pockets, particular attention being paid to corners and close spots.

In all cases, the position and detailed arrangement of all construction joints shall be predetermined and got approved by the Engineer-in-charge.

Measurement of Concrete works

All concrete quantity to be measure in Cubic Meter Shuttering included. Id shuttering is separate it should be measure in Square Meter.

Concrete works IS 1200 Part 2	
Sr. No.	**Description**
	Unit
1	Concrete works to be measured in Cubic meter
	Finishing surface
1	Hacking or making rough surface should be included in description

	Measurement
1	No deduction for the following
a	Ends of dissimilar materials for example, beams, posts, girders, rafters, purlins, trusses, corbels and steps up to 500 square centimeter in cross-section;
b	Opening up to 0.1 square meter
c	Volume occupied by reinforcement
d	Volume occupied by pipes, conduits, sheathing, etc, not exceeding 100 square centimeter each in cross-sectional area or as specified
e	Small voids not exceeding 40 square centimeter each in cross-section
2	Columns shall be measured from top of column base to underside of first floor slab and subsequently from top of floor slab to underside of floor slab above.
3	For Flat slab flare of column shall be included with column for measurement.
4	Beams shall be measured from face to face of columns and shall include haunches, if any, between columns and beams. The depth of beams shall be measured from bottom of slab to bottom of the beam except in case of inverted beam where it shall be measured from top of slab to top of beam.
5	CHAJJA shall be measured inclusive of bearing. When CHAJJA is combined with lintel, beam or slab, it shall be measured as clear projection.
6	Forming Cavity in Wall shall be measured in square meter.
7	Concrete Casing to Beams and Steel Stanchions should be measured in cum and no deduction for beams
8	Boxed stanchions or girders, in which case boxed portion only shall be deducted.
9	Concrete in channel shall be measured in cubic meters. Volume of channel shall be deducted from the concrete. Where shape of cross-section is round, elliptical or oval, area of section shall be taken as three-fourth of the width at top, multiplied by average depth at center.
	Pre-stressing concrete works
1	Grouting work is measured in Running meter
2	Strands is measured in Kilo grams

REPAIR OF CONCRETE WORK

All repair work will be done using Epoxy Mortar and Epoxy grouting as per the seriousness of the defect.

Concrete with satisfactory test results by with otherwise minor defects shall only be considered unsatisfactory.

Repair of concrete shall be made by skilled workmen. Repairs shall be made as soon as practicable after removal of forms and in a manner to meet the requirements for the finish specified for the particular location.

The extent of repair shall be decided upon by the Engineer-in-charge. The cost of repairs of defective areas shall be borne by the contractor. The Engineer-in-charge may adopt at his discretion any other method of repairing like epoxy grouts or guniting etc., which will be carried out by the contractor at his cost as per the specifications supplied by the Engineer.

Epoxy mortar

Epoxy mortar with quarts sand and SUNEPOXY 358 or approved equivalent brand including applying bonding coat of epoxy with hardener formulations in required proportion (as per manufacturers recommendations) in layers of built up thickness of 20& 40 mm, etc. complete. Epoxy mortar shall be applied in wet on wet condition. i.e. epoxy mortar should be applied when bond coat is wet.

Epoxy grouting repair work

Injecting approved low viscosity epoxy grout SUNEPOXY 358 or approved equivalent brand with viscosity at 400-500 CP, into concrete at slab, beams, columns etc. by suitable gun/ pump at required pressures drilling and inserting 12mm dia brass grouting multi perforated nipples upto 30mm to 40mm depth, using M Seal around the nipple cutting of nipples after curing, cleaning etc. complete.

NOTE: - Concrete shall be ready mix concrete RMC if mentioned in the BOQ & accordingly price to be quoted. Use of mechanical vibrator shall be made for all R.C.C. work wherever directed. All joints and gaps in the form work shall be covered with water proof papers as directed and full water proofing paper shall be used for casting the terrace/floor slabs and sanitary blocks at every floor. Precast cement mortar (1:2) cover blocks or approved plastic cover blocks shall be used for all RCC members as directed. Providing of cutouts for manholes, vent pipes, extra shuttering for sumps and haunch portions for which nothing extra will be paid. All sharp internal corners of walls, R.C.C. columns etc. which are likely to be broken are to be rectified with no extra cost. The rates of R.C.C. items are for floor height as per drawing including two stage shuttering. Please refer the drawing prior to quote.

PLUM CONCRETE

Providing and laying plum concrete (1:5:10) with 150 mm to 200mm graded rubble stone (not exceeding 35% by volume of concrete) and using 40 mm maximum size graded stone aggregates including consolidation, finishing, curing etc complete as per direction of engineer in charge and standard specifications

Measurement

To be measured in Cubic Meter as per standard practice.

SPECIFICATION FOR R.C.C. BORED CAST IN SITU PILES

Scope of work

Providing drilling with tripod winch machine and concreting bored Cast-in-situ M 25 grade R.C.C. pile of various diameter in position as per specifications in all kinds of soil including cost of boring using drilling mud and bentonite to stabilize the bore and flushing the bore of excess mud with freshly prepared drilling fluid by using pumps prior to placing concrete by tremie pipe in one continuous operation. including the cost of all materials and labor for placing of concrete and also including the cost of mobilization and hire charges of all equipment necessary for boring, welding of reinforcement cage as necessary and lowering of reinforcement cage, preparation and placing of concrete, including the cost of concrete but excluding the cost of reinforcement and labor for bending binding etc. as per drawing and technical Specifications and removal of excavated earth with all lifts and lead Etc. Complete as directed by engineer in charge.

Rates to include

1. Rate should include cost of providing and placing of concrete in bore-hole with the help of a tremie pipe
2. Rate Should include mixing of admixture in concrete as per requirement and IS codes
3. Rate Should include providing and placing of lean concrete of at least 1.0 m above the bottom of Pile Cap.
4. Rates are including fabrication, driving and removing of temporary liners upto 6 m as per requirement of site condition and bentonite clay required to stabilize soil
5. Pile tops will be chipped off to remove laitance and concrete above cut-off level. Including Labor for breaking head of cast in situ bored pile / pre-cast driven pile including repairing of pile head, straightening and bending of pile bars. The debris generated after dismantling the pile will be initially stacked at a place designated by client in the premises and thereafter disposed off from site by the contractor. Contractor to take into account for the same while quoting for the items
6. No payment whatsoever will be made separately on account of chiseling at the bearing rock and contractors in their own interest are requested to take into account the variations of the bores etc. while quoting for the items in case of all piling work.
7. Rate should include mobilization of machine to site, machine transfer from one point to other, setting out and alignment of machine at every point.
8. Rate should include removal of mud/sludge/slurry/liquid earth obtained during piling work from the working site and disposal of the same beyond the KMC/Municipal or any suitable area with conformity of Municipal Corporation Rules using tanker including loading and unloading the same with pump, clearing the site complete in all respect as per direction of the Engineer-in-charge.
9. Rates to include testing of concrete as IS code
10. Rate should include clean the bore-hole and make the bore – hole ready for placing steel cage
11. The rates shall include the cost of complete work including Pile Layout, mix design, site laboratory equipment, all necessary testing of concrete
12. Contractor to give as built coordinates for the casted pile

The contractors shall provide necessary materials, plant etc. required for driving. The tube or tubes for driving shall be in exact position perpendicular and plumb while being driven. Cast iron sheets, if provided shall be of approved size and quality at bottom. In the event of the shoe being broken during driving, the same shall have to be replaced without any extra cost. The tube shall be driven by two-ton hammer up to refusal.

After the tube is finally driven as above, the reinforcement bars as per design tied together to form a hexagon with 25mm diameter M.S. bars helically bound as stirrups at 75 to 150mm c/c at centers, shall be bent and lowered in wards to fix into the shoe below. The reinforcement bars shall project at least 600 mm. above ground level or above the top of finished concrete pile level whichever is higher. The exposed bar and any wastage shall not be paid. Pile from bottom of shoe up to bottom of pile cap shall be paid for in running meters. The records shall be kept with reference to a fixed bench mark in the form of reduced levels. The entries must be signed by the Contractors.

The tube shall be filled with cement concrete in the proportion as per drawing. The concrete shall be Ready Mix concrete as per mixed design and proper water cement ratio shall be maintained. The concrete shall be thoroughly consolidated to the entire satisfaction of the Engineer.

Excess concrete should be removed from site at once. The top of piles should be finished properly, neatly leveled and finished on all sides.

General

This specification covers Reinforced Cement Concrete bored cast in-situ piles including all related items of work like chipping off a small length at the top, load test on a single and/or groups of piles taking cores for ascertaining strength of concrete in pile etc. The relevant clauses of the specifications for 'Concrete Plain and Reinforced' as per relevant IS Codes, fall within the scope of this specifications.

Extent of contractor's services

The work to be provided for by the Contractor, unless otherwise specified, shall include but not be limited to the following:

a) Furnish all labour, supervision, services, materials, piling equipment, tools, plants, transportation etc. required for the work for pile foundations confirming to the detailed drawings or as may be specified, including all surveying and setting out arrangements necessary for fixing correct locations of piles, etc.

b) The identification plan showing the proposed sequence of piling will be prepared on the basis of the basic plan furnished by the Engineer, and the same approved from the competent authority before commencing pile work.

c) Submit in prescribed form detailed daily report of piling work done in prescribed form giving all information as required by the engineer in charge.

d) Furnish details of the pile boring and casting equipment giving all salient dimensions and loads.

e) Carry out load tests to the satisfaction of the engineer in charge including casting and dismantling of test caps, if done and submit the test results in prescribed data sheet in pursuance to provision under clause of IS codes.

f) Make necessary earthwork, all approaches, roads, etc for movement of the equipment, excavation and cleaning up of the works area.

g) Maintain the Piling Records as per formats prescribed by client or its representative

h) In case it is subsequently noted that the pile has deviated from the tolerance permitted as per IS, any additional expenses due to resulting consequences would be debited from the contractor's dues and any checks/clearance done on behalf of client or their representative would not absolve the contractor.

Work provided by others

No work under this specification will be provided by any agency other than the contractor unless specifically mentioned otherwise elsewhere in the contract.

Codes and specifications applicable

All IS Codes pertaining to the items of piling work, concrete and reinforcement and not listed above shall also deem to come under the purview of this clause. The provisions of special conditions of contract, those specified on the execution drawings or other specifications issued in writing by the engineer in charge shall also form part of these specifications.

Conformity with designs

The contractor will prepare check list in approved proforma which will be called "Pile Installation Card". At each important stage of the work as decided by the engineer in charge for correctness and conformity with the design, specifications and drawings, before allowing the next phase of the work to commence. These intermediate checks and approvals by the engineer in charge will not, however, absolve the contractor from his total responsibility to execute the work as per the specifications and drawings and to remove any/or

Rectify all work which is defective or inaccurate.

Soil data

The information as to the bore hole log details and soil investigation report, are given in good faith and general guidance only. The Employer will not be responsible for any discrepancy or inaccuracies therein and shall not entertain any claim whatsoever from the contractor on the basis of the same.

Other data

Nothing contained in this Contract document or these specifications shall relieve the contractor from the responsibility of obtaining the approval from the engineer in charge, the pile installation procedure to be followed by him. During the execution of the work should any error or inconsistency appear in any of his contract documents, the contractors shall not proceed with the work before obtaining instruction/clarifications from the engineer in charge.

MATERIALS

General

Material such as Steel, Cement and RMC / Concrete will be contractor scope. All materials whether incorporated in the works or used temporarily for executing will be of the best approved quality conforming to the IS Code and specifications.

Concrete & Reinforcement

The relevant clauses in the Specifications for concrete, plain, and reinforced, enclosed are applicable. If no specific specifications are enclosed, the IS Codes are deemed to form part of this specification.

PILE SHOES & SHELLS

a) Pile Shoes

Pile shoes, where used, should be manufactured out of best quality cast Iron or steel with proper treatment, the composition and thickness of the material being of special importance where they are likely to be in contact with harmful chemicals and organic materials causing deterioration in service. The shell tubes which are to be left in place should also receive similar consideration in selection.

(b) Shells

Temporary steel casing used in the lined bored piles, shall be straight and shall have sufficient wall thickness and strength to withstand without damage, distortion, etc. during driving and to resist harmful distortions and buckling due to soil pressures developed during installation of the pile or adjacent piles. Where screwed joints are used to connect successive lengths of casing pipes, the thickness of the casing wall shall not be less than 16 mm.

DRILLING MUD (BENTONITE)

(a) General

Drilling mud corresponding to basic properties given IS codes shall be used to keep the sides of the bore holes established. Mud shall have THIXOTROPIC properties i.e. gel forming property. The drilling mud shall have such properties as to permit the formation of filter cake on the sides of the bore holes, the thickness of which would depend on the nature of the subsoil deposit. Sodium based bentonites have ideal properties suitable for use as drilling mud. Bentonite MTC must be submitted to clients representative for approvals.

(b) Specifications/ Properties

The suspension used for boring work shall satisfy the following requirements:

Fresh sodium based bentonite shall have –

a) The liquid limit shall be more than 300% when tested in accordance with IS codes and less than 450%.

b) The PH value of 5% bentonic suspension shall be between 8 and 11.5.

c) The free water standing after 24 hours of 10% suspension of 100 cc shall be only a thin veil of water.

d) Sand content of bentonite powder shall not be more than 7%.

e) The marsh viscosity of 5% suspension when tested by mash concrete should be around 37 sec.

f) The 10 minute gel strength of fresh 5% bentonite should be between 10 to 75 kg/Sq.mt.

g) The density of the bentonite solution should be above 1.11.

(c) Reuse

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

(d) Disposal

The drilling mud shall not get spread outside the working area and shall not create any hindrance to moving traffic and shall be suitably disposed off without causing any nuisance to the surrounding area in a manner approved by the Engineer-in-charge.

STORAGE OF MATERIALS

(a) General

The relevant clauses pertaining to 'storage of materials' under specification for 'Concrete Plain and Reinforced' and prestressed as per IS codes will apply.

(b) Cast Iron or steel shoes and shells

All cast iron or steel shoes and shells will be painted with two coats of anti-corrosive paint or smeared with protective layer of grease and kept stored in weatherproof sheds, in such a manner that they remain off the ground, on sturdy racks and enable quick and easy inspection.

INSTALLATION

All installation requirements for bored pile shall be in accordance with IS codes and as supplemented or modified herein or by other best possible standards to the satisfaction of the Engineer in charge where the specific requirements mentioned in this section of the specification wherever not have covered fully in all aspects.

GENERAL

The tenderer shall furnish complete information about the type of piles offered with sketches of pile sections showing method of driving the casing or boring as the case may be, details and availability of driving equipment. The tenderer is supplied with bore hole logs or any other data indicating the nature of the soil strata expected at the site. All piles will have to be bored to the required founding level as shown on the drawings or as decided by the Engineer in charge.

TYPE OF PILE

(i) Type

All piles shall be bored cast in-situ concrete piles reinforced as per design requirements.

For any type of pile adopted and in spite of different methods of installations, concreting, etc. the load carrying capacity of single and group of piles shall not be less than the design loads indicated on the drawings.

(ii) Diameter

The casing/boring shall be of such diameter as to give the necessary specified nominal diameter of the concrete pile. In general, the measurement of the diameter of the pile shall be as follows:

a) For cast in-situ bored piles, employing temporary casing withdrawn during the placing of the concrete, the nominal diameter shall be the outside diameter of the temporary casing.

b) For cast in-situ bored piles with permanent liner, the nominal diameter shall be the inside diameter of the permanent casing left in place.

c) For partly lined or unlined bored cast in-situ piles using drilling mud, the nominal diameter shall be the inside diameter of the guide liners (temporary or permanent).

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

e) The Contractor may, however, be required to demonstrate to the Engineer in charge, if so called for by him, that the diameter of the bore hole for its full length is not less than the nominal diameter specified and this may be done by lowering a guide ring having a diameter equal to the nominal diameter of the pile into the bore hole before concreting the pile or lowering the reinforcement cage.

IDENTIFICATION OF PILE

A plan showing clearly the designation of all piles by identification system shall be filed with the Engineer in charge before installation of piles is started, if so desired by the Engineer in charge.

PILING SEQUENCE

The piles shall be installed in such a sequence that the carrying capacity of previously installed piles is not reduced or there is no appreciable upheaval of ground causing unusual soil resistance to rest of the pile driving or the soil is not flowing out laterally during driving operation. The Engineer in charge shall review on the sequence of the groups of piles that the contractor proposes to follow for construction and the Contractor shall have to follow this sequence.

WORKMANSHIP & CONSTRUCTION OF PILES

(a) General

1. Piles shall be constructed by acceptable method which leaves their strength unimpaired and which develops and retains the required bearing resistance. Equipment and the method of construction of the pile shall be such that the pile is installed in its proper position and alignment and truly vertical.

2. Pile construction shall be carried out by using standard bored piling process. Piles shall be cased with mild steel liner of required thickness which shall be provided up to depth shown on the detailed working drawing supplied by the Engineer in charge.

3. For uncased piling for boring beyond the depth of M.S. casing shall be done using bentonite slurry to prevent the subsoil from caving. This shall be of approved quality

and standards as prescribed under detailed specification for pile foundation work given in the document. The boring shall start from the level as indicated in the drawings.

4. Further, for all types of bored piles including the use of open-end casing, the tenderer shall submit, in view of sub-soil water being present in the bore hole, particulars of concrete placement method so as to reduce to a minimum, the contact of fresh concrete with ground water. It is imperative that the bore hole shall exclude an sub-soil material before placement of reinforcement and concrete inside the casing or bore hole. Details of the concrete placing equipment and / or any other process intended to be used by the tenderer for such conditions, shall be fully described.

5. The reinforcements of the pile should project out, above the top level of the pile by a minimum length of 600 mm or as specified, to be later or bent and embedded in the pile cap concrete.

   Concrete shall be placed and compacted at least up to 1 meter above the cut-off level & to comply to IS 2911.

6. To construct the pile cap, the ground will be excavated to expose the top portion of the piles, which will be dismantled neatly up to the cut-off level, removing all cracked, loose and unsound concrete. The top surfaces of the piles will be kept rough and treated by keeping wet and application of near cement coat, before concreting of pile cap to ensure bond with the pile cap concrete in which they will be ultimately embedded. In case any pile is to be rebuilt, it will done by contractor at his own cost.

7. In case, the casing is directed to be removed, care shall be taken to ensure that there is no gap left in the concrete of the pile and that the reinforcement are not displaced.

QUALITY CONTROL

The contractor shall submit a work methodology statement for approval of the consultant.

The contractor shall maintain quality control for all items of work including materials and every stage as may be directed by the Engineer, to ensure compliance with contract specifications and shall maintain and submit to the Engineer, records of the same. The quality control requirements stipulated under the specifications for 'Concrete Reinforced and Plain' will apply wherever relevant. In addition, the requirements will include but not be limited to the following:

a)	Location and Plumb	:	Control survey for accuracy in plan plumb and check for verticality.
b)	Slump	:	Slump to be 150mm 180mm at pouring point.
c)	Boring	:	Prevention of any cave-in of subsoil
d)	Casting of Piles	:	Check inside casing of boring as the case may be, reinforcement cage, concrete mix, placing, consolidation
f)	Load tests	:	As prescribed under these documents if any

CONCRETE IN PILES

(a) General

This shall conform to the specification for 'Cement Concrete - Plain and Reinforced' as per IS Codes to the extent it has been referred to or applicable for this purpose. The concrete shall be as per design mix specified and of approved quality. The entire depth of the pile shall be concreted in one operation without stoppage. All concreting operation for piles shall be carried out during day time only. Exposed portions of piles shall be cured for at least 10 days from the date of casting. When installing the piles in groups, sufficient time shall be allowed for freshly poured concrete in pile to set before installing adjacent piles. The Engineer in consultation with the Contractor shall determine the installation sequence and time schedule to ensure that freshly concreted piles are not damaged due to installation of adjacent piles.

(b) Materials

Unless otherwise called for on the drawings or in the bills of quantities, the concrete shall be of grade as specified in design and drawing. In case of alkaline water sulphate resistant cement as directed by the Engineer in charge may be used. All materials to be conforming to IS codes.

(c) Volume Check

Concreting shall start as soon as possible after driving the closed end pile tube or completion of boring. Concrete shall be so placed as to fill the entire volume of the hole without segregation and formation of voids caused by faulty consolidation or entrapped air. The volume of concrete placed shall be observed in the initially cast piles and the average figure obtained shall be used to check whether there is undue deviation in concrete consumption and if so the same shall be brought to the notice of the Engineer without further work on piling.

(d) Consistency

Where the concrete is cast in place in an open-end tube, its consistency shall be suitable to the method of compaction employed in the formation of piles. If necessary, concrete shall be as dry as possible to minimize shrinkage and the possibility of cement being washed down by flow of subsoil water if any while casing is withdrawn. Plasticizing agents may be used by the contractor to improve the workability but the Engineer may be furnished with proof that the proposed plasticizing agent has no adverse effects on the hardened concrete of reinforcement. Care shall be taken against segregation of concrete while passing through the reinforcement cage, and against inflow of soil and water during withdrawal of the tube, if such method is adopted, by maintaining sufficient head of concrete inside the tube. The extraction of casing shall not cause any shearing or necking of the poured concrete thereby reducing the capacity of the piles.

If it becomes necessary to place concrete through water, this should be done with special equipment and necessary precaution in conforming to specification as may be got approved by the Engineer. Slump of concrete shall range as per IS codes depending on the manner of concreting.

(e) Testing

Concrete testing should be done as stated below in concrete specification.

(f) Acceptance

The Engineer reserves the right to reject any pile of deficient concrete strength. Such rejected piles shall be replaced by the contractor at his own cost who shall also bear the additional costs of widening the pile caps resulting from the grouping of the piles as a result of replacement of piles. The Engineer also reserves the right to order a change in the mix design and/or water cement ratio to obtain the specified strength of workability if so considered necessary during execution.

REINFORCEMENT IN PILES

Reinforcement (HYSD TMT Bars) conforming to IS codes suitable for cement concrete as per standards specifications for reinforcement concrete for general building work shall be applicable for this specification to the extent it has been referred to or applicable. Reinforcement used in cast-in-situ piles shall be made up into cages sufficiently well wired or span welded to withstand handling without damage. The bars shall be so spaced as not to offer obstruction in placing concrete. Care shall be taken to preserve correct cover and alignment of reinforcement throughout the operation of placing the concrete. Any distortion or displacement of reinforcement during the compaction of concrete or while extracting the tube shall be avoided.

Joints in longitudinal reinforcement bars, if unavoidable, shall be made by lapping and the laps shall be tack-welded to prevent distortions of the reinforcement cage. The lap length of longitudinal bars beyond the pile cut-off level shall be as shown on the drawings.

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

Concrete cover over all reinforcement including lateral helical reinforcement shall be 50 mm unless otherwise specified or shown on the drawings.

Care shall be taken to preserve the correct cover and alignment of reinforcement free from any twist, throughout the whole operation of placing the reinforcement in the bore hole and placing the concrete.

DOWELS

The contractor shall provide necessary dowels as directed by the Engineer if so required.

INSPECTION

For cast-in-situ, bored piles, the contractor shall get the Engineer bore hole inspected by engineer for proper plumb, location, compaction of founding surface, pressure of water and other requisites. The diameter of the hole may also be checked in the case of bentonite slurry bored piles by lowering a guide ring through the depth of the hole. The depth of the bore hole shall be measured by means of a chain to which a plumb bob weighing not less than 250 gm is attached. The contractor shall provide all the equipment required for the above inspection and he shall co-ordinate this work with the Engineer in charge. Concreting shall start only after the Engineer has approved the bore hole. All facilities, equipment and labour required for inspection by the Engineer mentioned above shall be provided by the Contractor promptly and free of cost.

RECORD OF INSTALLATION OF PILES

A joint record shall be maintained by the Contractor in a proforma approved by the Engineer, of the entire penetration for every pile and the behavior of such pile during its entire process of construction as per IS codes. These records shall be submitted to the

Engineer in charge regularly as the job progresses. Any sudden change in the rate of penetration which cannot be ascribed to the nature of the ground or any deviation from the designed location, alignment or load carrying capacity of any pile or any upheaval or subsidence noticed on any pile driven under this contract or already existing, during construction of other piles, shall be promptly reported to the Engineer in charge and adequate corrective measures shall be taken free of any charge as may be decided by the Engineer in charge. The records of such additional borings or other subsurface information that were obtained during the process of installation shall also be filed with the Engineer in charge.

TEST PILE

The contractor may have to construct test piles, and ascertain the load carrying capacity by test, if desired by the Engineer in charge, before he starts systematic piling operation at locations indicated. For this purpose, the pile construction process shall be the same as in usual piling process to be followed on this job.

PILE CAPACITY, QUALITY AND TOLERANCES

(a) Working Load on Piles

General arrangement of pile foundation and its details are given in the tender for general information.

The capacity of the piles in place shall be verified by conducting "Routine Load Tests" on working pile as described hereinafter.

For bored piles, the characteristics, thickness and inclination of the sub-soil strata underlying the pile points shall be taken into account for estimating the extent of settlement of the pile due to consolidation of the soil below, while evaluating the allowable load on pile.

The contractor shall submit his findings on the allowable carrying capacity of a single pile from the load test. This shall then be reviewed by the Engineer and the allowable carrying capacity of each pile and group of piles shall be decided by him in consultation with the allowable load on the piles shall be final. The tender drawings have been prepared on the basis of the assumed pile carrying capacity as indicated therein. The layout and number of piles and the size and details of the pile caps may have to be revised if the decided allowable loads on each single pile in a group differ from the above value and the Contractor shall have to do the work according to the revised design and drawings at no extra cost or expenses to the Employer.

If the load test results indicate that the piles, already constructed are deficient in load carrying capacity, such manner as may be approved by the Engineer, at no extra cost to the Employer.

(b) Quality

The contractors shall guarantee the full cross section of the pile for its entire length and also guarantee against the occurrence of necking or wasting, bulging, spilling of pile shaft concrete and similar defects, which will impair the strength and durability of the pile.

(c) Tolerances

The pile shall be installed truly vertically as per the detail design as required within the following permissible tolerances.

- The position of the pile at the level of the bottom of the pile cap shall not vary more than 75 mm in any direction from the positions specified in the drawings.
- The alignment of the pile shall not vary by more than 2% (about 1 degree) from the vertical axis or the specified batter.
- The above two allowances, however, shall not be cumulative.

(d) Defective Piles

Piles that are defective or where the deviation in alignment of the tube or base is more than that tolerance specified, shall be pulled out or left in place as per the directions of the Engineer-in-charge. Additional pile shall be driven to replace them and/or the pile cap shall be redesigned and built at no extra cost to the Employer. In case the pile/ casing cannot be removed. It shall be cut out as may be directed by the Engineer-in-charge. Voids resulting from rejected borings or extraction of the pile or casing shall be filled with gravel or sand unless other piles are installed in such voids. The contractor shall also not be paid for any expenses incurred by him, in extracting and rejected pile/ casing and refilling if so required.

IDLE PERIOD

The phasing of construction and movement of plant shall be done as may be directed by the Engineer. The phasing may involve some extra movement of the plant or some idle period during test pile operation etc., but the contractor will not be entitled for any claim due to this reason and all rates quoted by him shall include the same. However, during the testing of piles and other holdups, pile driving operation may be allowed on other piles, if considered acceptable and if so decided by the Engineer-in-charge with a view to minimize idle time. If due to change in loading elevation or any other alternations, modifications become necessary contractor will not be entitled to any claim whatsoever, for such modifications in the pile layout, during the progress of work including claims for any idle labour or tools and plant on that account.

TESTING ACCEPTANCE CRITERIA

Static Load Test;

(i) General:

In order to determine the carrying capacity of pile, static load tests shall be undertaken by the contractor on single pile as indicated on drawings. Piles to be tested shall be cast in situ at least 30 days before loading, before any load test is made, the proposed arrangement of the structure and kentledge to be used in making the load test shall have to be approved by the Engineer-in-charge. All load test shall be made under the supervision of the Engineer-in-charge. All responsibilities for conducting the test safely and properly shall rest with the contractor.

(ii) Preparation of Pile Head for Test:

The pile head shall be chipped of carefully till sound concrete is met with and the reinforcement shall either be cut off for initial test or bent sideways and the top shall be capped by means of a suitably RCC cap. A bearing plate may be embedded on the top to receive the loading jack.

(iii) Procedure for Load Testing :

The test shall be carried out by applying a series of vertical load increments on the pile, the load increments shall be equal to about 20% of the estimated working load on the pile.

The test load may be applied by means of hydraulic jack with pressure gauges, with remote pumps acting against rolled steel joints or suitable load frame obtaining reaction from:

a. Kentledge heavier than the required test load, placed on a platform supported clear of test pile. Any existing structure of suitable construction may be used as a kentledge. The center of gravity of the kentledge shall also be concentric with the pile axis.

OR

b. Tension piles or suitable anchors. The center to center distance between the test piles and the anchor piles shall be a minimum of five times the diameter of the test pile. Working piles shall not be used as anchor piles.

The reaction to be made available for the test shall be at least 25% more than the final test load proposed to be applied.

The settlement shall be recorded at least with three dial gauges for single piles and four dial gauges for group of test piles and positioned at equal distances along the periphery of the pile and held normally by detum bars resting on immovable supporters at least 5 x D (subject to a maximum 2.5 m) away from the test pile periphery where D is the diameter of the test pile shaft.

Each stage of loading shall be maintained till the rate of movement of the pile top is less than 0.1 mm per hour in sandy soils and 0.02 mm per hour in clayey soils. For this purpose, the soil met with at the tip of the pile shall be considered. The estimated safe working load on the pile shall be kept in position for at least 24 hours and during this period settlement readings shall be recorded every hour.

Each stage of application of the load increment shall be smooth and free from jerks, time and settlement observations shall be made at the commencement and completion of the load increment. Settlement observations shall be made when each increment of load had been maintained for at least 15 minutes.

The loading shall continue for the specified load for the type of test in question or failure of the pile, should this occur earlier.

After the proposed working load had been applied and from each increment thereafter, the test load shall remain in place until there is no settlement in two hours period. The total test load shall remain in place until settlement does not exceed 1/2 of a millimeter in 48 hours.

The total test load shall be removed in decrements not exceeding 1/5 of the total test load. The rebound shall be recorded after each decrement is effected and the final rebound shall be recorded, 24 hours after the entire test load had been removed.

A complete record in triplicate shall be filled with the Engineer or the loads and readings obtained, duly verified and countersigned by the Engineer.

(iv) Costs :

The tested piles will be used as usual foundation piles if it is a routine test and no extra payment shall be made except for load test on this pile.

Tenderer shall include cost of all materials, accessories and labour including construction of pile top loading platform and dismantling the same, for the load test.

(v) Acceptance Criteria;

1. For Routine Load Tests:

The tests shall be considered as successful, provided that -

(a) The total settlement at the full test load of 1.5 times the proposed design load for the pile is not more than 12 mm.

(b) The net settlement on removal of entire test load is not more than 6 mm.

(c) Load settlement curve shall not indicate failure of the pile within the above range of settlement.

2. Cyclic Load Test :

Cyclic load test may have to be carried on the test pile if directed by the Engineer. This load test shall be carried out as per IS codes. Loading shall be continued till, there is no marked progressive settlement of the pile. The rate quoted for pile foundation shall be inclusive of such test.

3. Lateral Load Test :

(i) Procedure for Load Test :

a) This test shall be conducted as far as possible at the cut off level of the piles. In case of pile groups the test shall be conducted after providing caps such that the required condition of actual use fulfilled.

b) The test may be conducted by introducing a hydraulic jack, with gauge between two piles or pile groups under test or the reaction may be suitable obtained otherwise these tests may also be done by applying lateral pull by a suitable set up. If it is conducted by jack located between two piles or groups, the full load imposed by the jack shall be taken as the lateral resistance of each pile or group. The loading should be applied in increments of about 20% of the estimated safe load.

c) After applying each increment of load, the next increment of load shall be applied after the rate of 0.1 mm / hr in sandy soil and 0.02 mm per hour in clayey soil or two hour whichever is earlier.

d) Displacements shall be measured by using at least two dial gauge spaced at 30 cm and kept horizontally one above the other on each pile. Where it is not possible to locate one of the dial gauges in the line of jack axis, then the two dial gauges may be kept at a distance of 30 cm at a suitable location from similar triangles.

(ii) Acceptance Criteria:

The safe lateral load on a pile shall be taken as the least of the following:

(a) Fifty percent of the final load at which total displacement increases to 12 mm.

(b) The load at which the displacement is equal to 5 mm.

(c) Load corresponding to any other displacement specified and dictated by performance requirements.

4. Pull out Test :

Pull out tests may be carried out in special cases, if required to determine friction and ensure that the construction method and equipment used by the contractor produces sound piles of desired depth and specifications.

(i) Procedure for pull out test :

(a) Uplift force on the piles may preferably be applied with hydraulic jacks with calibrated gauges and using suitable set up of approved by the Engineer.

(b) The test pile shall have adequate steel reinforcement to withstand pulling loads. Additional reinforcement may be provided in the pile for this purpose.

(c) Pull out loads shall be applied without shock by suitable mechanical means, in stages of 2½ tonnes until a peak value of frictional resistance is reached. A graph of pull out force and corresponding rise of pile top shall be plotted.

(ii) Acceptance Criteria:

For initial load, tests, the load applied shall be two times the estimated safe load on the pile. The safe load shall be taken as the least of the following :

(a) One half the load at which the displacement is 12 mm or corresponding to the specified displacement.

(b) One half the load at which the load displacement curve shows a clear break.

Routine test load shall be carried out to 1.5 time the allowable load, pull out load in the pile or the load corresponding to 12 mm, pull whichever is earlier.

(iii) Defective Piles:

In case it is observed that the piles cast are not sound and there is doubt about compactness of concrete, reduction in diameter, exposure of steel, undesirable information or any other flaws which the Engineer-in-charge considered improper, the contractor shall modify or improve his method of construction and ensure by casting and constructing further piles at his own cost before he is permitted to go ahead with the construction.

PILE CUT OFF, EXCAVATION AND CLEAN-UP :

(i) Pile Cut off:

(a) All piles shall be concreted to a level 1 meter above the specified pile cut off. For piles cast by tremie method, in bentonite established bore holes, this level of concreting above pile cut off elevation shall be not less than 1 meter.

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

(c) Piles shall be cut off at level and true to elevation shown or specified on the drawings. Care shall be taken not to damage the reinforcement or the concrete below cut off elevation during such stripping operations.

(d) Where stripping has been done to a level lower than the specified cut off elevation to obtain dense and sound concrete, the Contractor shall built up the pile up to cut off elevation at his own cost.

(ii) Excavation:

(a) Excavation by the Contractor for pile cut off shall be done to the depth specified on the drawings. These excavations shall be co-ordinate with the Engineer-in-charge, so that they will remain open for a minimum possible time and the pile cap concrete is placed as soon as possible thereafter.

(b) Any additional excavation carried out due to pile stripping being required to be carried out below the cut off elevation to obtain dense concrete and the backfilling of all such excavation shall be done by the contractor at hi own cost.

(iii) Clean up:

(a) Upon completion of the pilling work, all casing equipment, construction tools, protective coverings and debris resulting from the piling operations shall be removed from the works site with the permission of the Engineer- in-charge.

(b) All excavated material and left over drilling mud shall be disposed off as may directed by the Engineer-in-charge away from the site and the cost of all such cleanup operations shall be included by the contractor in his rates for piling work and no separate payment will be made for the same.

RATES AND MEASUREMENTS

Rates :

The rate for the item of installation of piles shall include the cost of all materials consumed in the work or incidental to it as well as testing of materials, including the cost of plants and equipment, labour, supervision, transport, taxes, insurances, royalties and revenue expenses, securities and safety measures, approach roads & its maintenance, power, fuel, lubricants, services, preliminary and enabling works, camps, stores etc. and overheads and profits etc. complete.

The rate shall include the entire cost of boring for cast-in-situ bored pile supplying and installing concrete above cut off level as specified and subsequently dismantling and removing the same. The specifications cover the supply of material complete the pilling work. Should there be any details of construction or materials, which have not been referred to in the specifications or in the Bill of Quantities and drawings but the necessary for which may be implied or inferred there from, to which are usual or essential to the completion of the work in the trades, the same shall be contractor in the Bill of Quantities.

Measurements:

(a) Will be in running meter

(b) For the purpose of measurements Length of pile for payment shall be measured up to bottom of the Pile Cap for each diameter of the pile installed in position as per these specifications. Measurement of length for payment will be done by lowering down a tape with a heavy weight attached at the end, through the hole left by driving, before the reinforcement cage is lowered and concreting commences.

(c) Reinforcement placed in the pile shall be paid for separately

(d) Payment for load tests shall be made only for those tests ordered by the Engineer and the payment shall be made only for the completed load test provided the pile tested passes the load test, otherwise the cost shall be borne by the contractor.

BORING AND FILLING WORK FOR CAST-IN-SITU PILES

(a) All Cast-in-situ piles are to be made by driving hollow tubes or heavy steel pipes and then withdrawing them, or by boring and filling the holes formed with concrete accordingly as per site conditions and instructions of engineer in-charge.

(b) Built-up-piles also to be made up to cut-off level using bond as per clearance from engineer-in-charge.

(c) Any reinforcement used should me made up into cages sufficiently well wired; the bars should be openly spaced, and the lateral ties should not be close than 0.15 meters. The reinforcement should also be exposed for a sufficient distance to permit it to be adequately bonded into the pile cap.

(d) Before placing the concrete the holes should be inspected by lowering a light for any undesirable materials or water

General

Piles shall be driven by a pile driver, suitable for the type and size of the piles, geological conditions and construction environment, and in such a manner as to cause no public nuisance, such as noise, to the third party.

The method for construction joint of piles shall be submitted in writing to the engineer and shall be subject for approval by the structural consultant.

Records shall be kept during the piling operation and these shall be submitted to the engineer.

Piles shall be driven vertically and at the exact locations indicated in the drawings, and pile driving shall be continuous without interruption to avoid deviation of pile head.

Caps and other suitable materials shall be used as a cushion to protect the head of piles.

Toward the end of driving the amount of penetration shall be measured for each pole as directed by the engineer.

Should it be difficult to drive any pile up to the specified depth, the contractor shall carry out such pilling word in accordance with the instructions of the engineer.

Method and equipment of pile driving to be employed for construction works shall be subject to approval of the engineer prior to execution.

When driving a group of piles, driving shall begin from the center and gradually moved outward.

When eccentric error exceeds 10 cm when a pile is damaged or creaked during piling operation, it shall be reported to the engineer, and the pile shall be replaced or an additional pile shall be driven.

Field Joining of Piles

- Field joining of piles shall be carried out by arc welding.
- Welders shall have not less than 6 months continuous experience in welding of pile, and shall be qualified.
- Are welding rods shall be standard items specified
- Welding rods shall be completely dry prior to use.
- The welding surface of parent metal shall be carefully cleaned of slag, moisture, dust, rust, oil, paint or other foreign matter.
- The root face of steel pipe pile shall be 2mm,
- Welding shall be performed carefully by selecting welding current and welding speed which ensure complete penetration of welding rood to avoid cracks in any portion of the weld.
- Welding shall not be performed when the parent metal is wet from rainfall or when strong winds are blowing. However, when the portion to be welded in suitable protected, welding may be performed upon approval of the engineer.
- If harmful defects or cracks have been found in the weld, the deposited metal shall be carefully chipped off and the affected part shall be re-welded and then inspected by the engineer.

MASONARY WORK

Scope

Providing and constructing Ist class brick work with minimum 35 Kg/ Sqm compressive strength in 1:4 cement mortar including mixing non shrink additive like cebex 100 / Intraplast N200, sunplex, (full size brick) using sand screened through 4.75mm sieve including casting 100mm thick M20 Grade RCC patli with 3 tor 8mm dia. main bars and 6 dia. rings at 150 c/c at a vertical interval of 1m, ensuring that no joint thickness is more than 12mm thick including curing, double scaffolding, raking out joints, prewetting of bricks, keying in existing brick work, applying hack-aid-plast of Sunanda Specialty Coating Pvt. Ltd. at the junction of RCC and brick masonry etc. complete. As directed by the engineer in charge

Material Specification

CEMENT:

Portland pozzolana cement (PPC - as per IS 1489 latest) and Portland slag cement (PSC - as per IS 455 latest) shall be used for all works masonry, plastering, waterproofing, tiling, external and internal grade concrete etc. with prior written approval from the structural consultant and the engineer in charge. Use of blended cement as per latest IS 456 shall be permitted with the prior approval of the Engineer In charge. It shall be of a make and quality approved by the Consultant. The Contractor shall maintain a proper and efficient storage shed for the cement on the work. The storage of different grades and types of cement should be clearly earmarked. The cement of different grades and types shall in no case be allowed to be intermixed during the stage of storage or actual use on the site. He will also maintain a record of the cement received and used on the work.

Cement which has remained in bulk storage at the mill for more than 6 months or which has remained in bags at the dealers storage for over 3 months, or which has been stored at project site for more than 3 months shall be re-tested before use. Cement shall also be rejected if it fails to conform to any of the requirements of these specifications. Different type, grade and company of cement should not be mixed

FINE AGGREGATES

Fine aggregates shall consist of natural sand, manufactured sand or an approved combination thereof and shall conform to IS: 383. The grading zone of sand proposed for use shall be supplied by the contractor and got approved by the Engineer-in-Charge. Sand screened through 4.75mm sieve.

The sand shall be siliceous material, sharp, hard, strong and durable and shall be free from adherent coatings, clay, dust, alkali, organic material, deleterious matter, lumps, etc.

Either natural or manufactured sand shall be prepared for use by such screening or washing, or both, as necessary, to remove all objectionable foreign matter. Natural sand shall be washed, unless specific written authority is given by the Engineer-in-charge to use sand that meets specifications and standards of cleanliness without washing. The cost of screening and washing must be borne by the contractor. The fine aggregate shall be taken from a source approved by the Engineer-in-charge.

All lots should be tested at site for Silt content and if found above the require limit that is maximum 3% by weight and maximum 8% by volume then the same will be rejected.

CEMENT MORTAR:

The cement mortar for all masonry work whether it be of brick or concrete blocks or basalt or for plaster the Portland Pozzolana cement or Portland slag cement shall be used confirming to IS 1489 (Part I) and IS 455 (latest) respectively. The cement and sand to be used for cement mortar shall be carefully gauged in suitably sized boxed thoroughly mixed in a dry state on a clean MS tray and mixed again after the addition of the requisite quantity as can readily be used up and mortar which has particularly set shall under no circumstances be reused by being mixed with additional materials or water. The proportion of Cement and sand should be as per specified in BOQ.

Quality of Bricks

Bricks should have a bearing strength of 35 Kg/Sq.cm. at least as required by I.S.S.1077 (latest).

Bricks shall be whole, sound, well burnt, and free from cracks, to ring when struck and not to crack or break when soaked in water and to be uniform in size.

They shall be of the best description obtainable in the market and of the best quality and color. Brick shall be procured from a source as approved by the Consultant, preferably with approved mark of manufacturers, and shall conform to the requirements of Indian Standard Specifications as amended from time to time. No bricks shall absorb more water than one fifth of its own weight when dry. For soaking of bricks before use, IS: 2212 (latest) shall be followed, No broken bricks shall be used except as closers.

Test of Bricks

Following test should be carried on bricks

1. Compressive strength test
2. Water absorption test
3. Efflorescence test
4. Dimension

Above test to be carried out for each lot of bricks or 1 set for every 10000 bricks

Workmanship

The contractor should apply coat of hack-aid-Plast of Sunanda Specialty Coating Pvt. Ltd. Or equivalent at the junction of RCC and brick masonry. The whole of the brickwork shall be built in plumb and in such bond as the Consultant may direct, and shall be carried out in a thoroughly workman like manner and to the entire satisfaction of the Consultant. Brick on edge layers shall be provided where directed.

For every 1 meter height of the brick wall of all thickness one horizontal RCC patli beam shall be provided with reinforcement as 2 number 10 mm diameter bars with 8mm diameter C ring @ 200 C/C.

A good bond must be preserved throughout the work both laterally and transversely. The course shall be kept perfectly horizontal and in plumb. The bricks shall be laid with the frogs facing upwards. The vertical joints shall break joint with course below and above, but they shall be directly over and another in alternate course to prevent the necessity of bats. All bed joints should be perpendicular to the pressure upon them, i.e. horizontal in vertical walls, radial in arches and at right angles to the slope in battering walls.

The joints are not to exceed 10mm in thickness and are to be full of mortar close, well finished up and neatly struck. The work shall be kept wet while in progress to the entire satisfaction of the Consultant till the mortar is properly set.

On Sundays and other holidays when the work is stopped the top of all unfinished masonry shall be kept flooded with water and laborers shall be employed for the purpose. The Consultant shall be at liberty to water the work at the Contractor's expenses should the Contractor fail to do so to the Consultant's satisfaction.

As a rule the whole of the masonry work shall be carried out at one uniform level throughout but where breaks are unavoidable the joint shall be made in good long steps so as to prevent cracks arising between the new and old work. All junctions of walls shall be formed at the time the walls are being built and cross walls shall be carefully bonded into the main walls. All joints in brick masonry shall be raked but to a depth of at least 12mm before the mortar has set.

English bond to be used throughout in walling. In arching such bond shall be used as directed by Engineer.

No part of the wall during its construction shall rise more than one metre above the general construction level. Parts of wall left at different levels shall be raked back at an angle of 45 degrees or less with the horizontal. Toothing shall not be permitted as an alternative to raking back. For half brick partition to be keyed into main walls, indents shall be left in the main walls.

In other respects, the work should comply with the general specification for brick work as per relevant IS code.

Addition of additives to Mortar

Use of Cebex- 100 / Intraplast N200 Sunplex as Non shrink additive in mortar as per manufacture specification is to be added and details of consumption and empty bags to be handed over to engineer in charge for verification.

Care shall be taken to keep the prep ends properly aligned within following maximum permissible tolerances:

a) Deviation from vertical within a storey shall not exceed 6 mm per 3 m height.
b) Deviation in verticality in total height of any wall of building more than one storey in height shall not exceed 12.5 mm.
c) Deviation from position shown on plan of any brick work shall not exceed 12.5 mm.
d) Relative displacement between load bearing wall in adjacent storeys intended to be vertical alignments shall not exceed 6 mm.
e) A set of tools comprising of wooden straight edge, masonic spirit levels, square, 1 metre rule line and plumb shall be kept on the site of work for every 3 masons for proper check during the progress of work.

Rate

The rate shall include the following:

a) Raking out joints or finishing joints flush as the work proceeds;
b) Preparing tops of existing walls and the like for raising further new brick work.
c) Rough cutting and waste for forming gables, splays at eaves and the like.
d) Leaving holes for pipes up to 150 mm dia. and encasing hold fasts etc.
e) Rough cutting and waste for brick work curved in plan and for backing to stone or other types of facing.

f) Embedding in ends of beams, joists, slabs, lintels, sills, trusses etc.
g) Bedding wall plates, lintels, sills, roof tiles, corrugated sheets, etc. in or on walls if not covered in respective items and
h) Leaving chases of section not exceeding 50 cm in girth or 350 sq cm in cross-section.
i) Brick on edge courses, cut brick corners
j) including casting 100mm thick M20 Grade RCC patli with 3 tor 8mm dia. main bars and 6 dia. rings at 150 c/c at a vertical interval of 1m
k) Including curing, double scaffolding, prewetting of bricks, keying in existing brick work, applying hack-aid-plast of Sunanda Specialty Coating Pvt. Ltd. or equivalent at the junction of RCC and brick masonry etc. complete. as directed by the engineer in charge.

Note:-

To close necessary Structural Members (For filling the gaps of beam webs at staircase) Vertical Brick Bats to be used along with cement mortar and then fixing Chicken Mesh along entire width and keeping 6 inches extra at top & bottom to fold, and making ready for plaster.

Measurement:-

Brick work IS 1200 Part 3

Sr. No.	Description
	Unit
1	230 mm brick work in cubic metre
2	single brick work in square metre
3	Honey combed brick work in square metre
4	Fair cutting exceeding 10 centimeter in width or girth in splayed angles, weatherings, cornices, quoins, etc measured in square metre
5	Fair cutting not exceeding 10 centimeter in width or girth, such as in splays and chamfers, shall be measured in running metres, stating width/girth.
6	Circular fair cutting shall be measured in square metre
7	Brick edgings, as to roads shall be measured in running metres
8	Filleting in mortar, as in flashings on roofs, shall be described and measured in running metres
9	Broken glass coping laid along with brickwork shall be measured in square metre
10	Damp-proof course shall be measured in square metre
11	Encasing in brick work in Cubic metre
	Measurement
	No deduction for the following

a	Ends of dissimilar materials (joists, beams, lintels, posts, girders, rafters, purlins, trusses, corbels, steps, etc); up to 0.1 square metre in section
b	Opening up to 0.1 square metre area
c	Wall plates, bed plates, and bearing of slabs, CHAJJAS and the like, where thickness does not exceed 10 centimeter and bearing does not extend over the full thickness of wall
d	Cement concrete blocks as for hold fasts and holding down bolts
e	Iron fixtures, such as wall ties, pipes up to 300 mm diameter and hold fasts for doors and windows
f	Chases of section not exceeding 50 centimeter in girth
	Brick work in arches
1	Should include centering for span up to 2m above 2m centering should be different
	Encasing using brick
1	Volume occupied by joists shall not be deducted except in case of boxed stanchions or girders in which case box portion only shall be deducted.
2	Extra labour in cutting and fitting brickwork around steel joists, stanchions, girders, etc, shall be measured separately in square metres of finished surfaces
	Cutting opening
1	Cutting openings exceeding 0.1 square metre in area in walls one brick thick and less shall be measured in square metres and in walls exceeding one brick thick shall be measured in cubic metres.
	Making Holes
	Measured in per Cm of depth classified as
	Holes not exceeding 400 square centimeter in area;
	Holes exceeding 400 square centimeter and not exceeding O.1 square metre in area.
	Toothing and bonding
1	Where new walls are bonded to existing walls, an item of labor and material in cutting, tooting and bonding shall be measured in square metres of vertical face in contact with new work only.

115mm thick Ist class brick work to be measured in Square Meters.

Scaffolding

MS scaffolding using pipe and MS planks to be used no bamboo scaffolding will be permitted. All scaffolding should be double scaffolding. Contractor should not take any support form masonry and avoid holes in masonry work.

Openings in Masonary
Cutting breaking and making of pocket in brick masonry of required size template and finishing the edges and making good by plaster etc. complete

Measurement
In numbers if Cross Sectional Area if mentioned.

Brick work with Flyash brick

Making Brick work with flyash brick in 1:4 cement mortar using sand screened through 4.75mm sieve including casting 100mm height & thickness as of the masonary work, M20 Grade RCC patli with 3 tor 8mm dia. main bars and 6 dia. rings at 150 c/c at a vertical interval of 1m, ensuring that no joint thickness is more than 12mm thick including curing, double scaffolding, raking out joints, prewetting of bricks, keying in existing brick work, applying hack-aid-plast at the junction of RCC and brick masonry etc. complete.

Measurement
In Cubic Meters

PLASTER WORK

Scope of work: Providing and applying internal and external Cement sand plaster on masonry work, concrete surfaces. Etc. including adding cebex 100 / Intraplast N200, sunplex as per manufacture specification internally to surfaces finished up to any height including all lead and lifts including providing and fixing 200mm width chicken mesh over joints between brick work & concrete including scaffolding, hacking concrete surfaces curing complete.

MATERIAL SPECIFICATION

CEMENT:

Portland pozzolana cement (PPC - as per IS 1489 latest) and Portland slag cement (PSC - as per IS 455 latest) shall be used for all works masonry, plastering, waterproofing, tiling, external and internal grade concrete etc. with prior written approval from the structural consultant and the engineer in charge. Use of blended cement as per latest IS 456 shall be permitted with the prior approval of the Engineer In charge. It shall be of a make and quality approved by the Consultant. The Contractor shall maintain a proper and efficient storage shed for the cement on the work. The storage of different grades and types of cement should be clearly earmarked. The cement of different grades and types shall in no case be allowed to be intermixed during the stage of storage or actual use on the site. He will also maintain a record of the cement received and used on the work.

Cement which has remained in bulk storage at the mill for more than 6 months or which has remained in bags at the dealers storage for over 3 months, or which has been stored at project site for more than 3 months shall be re-tested before use. Cement shall also be rejected if it fails to conform to any of the requirements of these specifications. Different type, grade and company of cement should not be mixed

FINE AGGREGATES

Fine aggregates shall consist of natural sand, manufactured sand or an approved combination thereof and shall conform to IS: 383. The grading zone of sand proposed for use shall be supplied by the contractor and got approved by the Engineer-in-Charge.

The sand shall be siliceous material, sharp, hard, strong and durable and shall be free from adherent coatings, clay, dust, alkali, organic material, deleterious matter, lumps, etc.

Either natural or manufactured sand shall be prepared for use by such screening or washing, or both, as necessary, to remove all objectionable foreign matter. Natural sand shall be washed, unless specific written authority is given by the Engineer-in-charge to use sand that meets specifications and standards of cleanliness without washing. The cost of screening and washing must be borne by the contractor. The fine aggregate shall be taken from a source approved by the Engineer-in-charge.

All lots should be tested at site for Silt content and if found above the require limit that is maximum 3% by weight and maximum 8% by volume then the same will be rejected.

Grading of Sand for use in Plaster

IS Sieve Designation	Percentage passing by mass
10 mm	100
4.75 mm	95 to 100
2.36 mm	95 to 100

Preparation

All stone and brick masonry shall be thoroughly wetted and raked out to a depth of at least 20 mm each and walls washed and wetted before plastering is done.

Projecting burrs of mortar formed due to the gaps at joints in shuttering shall be removed. The surface shall be scrubbed clean with wire brushes. In addition concrete surfaces to be plastered shall be pock marked with a pointed tool, at spacing of not more than 5 cm. Centres, the pock being made not less than 3 mm deep. This is to ensure a proper key for the plaster. The mortar shall be washed off and surface, cleaned off all oil, grease etc. and well wetted before the plaster is applied.

Mortar preparation

Mortar should be mixed in MS trays and the Proportion should be as per specified in the BOQ.

Addition of non-shrink additive

Use of Cebex- 100 / Intraplast N200 or Sunplex of equivalent as Non shrink additive in mortar as per manufacture specification is to be added and details of consumption and empty bags to be handed over to engineer in charge for verification.

Application of plaster

Ceiling plaster shall be completed before commencement of wall plaster.

Plastering shall be started from the top and worked down towards the floor. All putlog holes shall be properly filled in advance of the plastering as the scaffolding is being taken down. To ensure even thickness and a true surface, plaster about 15 × 15 cm shall be first applied, horizontally and vertically, at not more than 2 metres intervals over the entire surface to serve as gauges. The surfaces of these gauged areas shall be truly in the plane of the finished plaster surface. The mortar shall then be laid on the wall, between the gauges with trowel. The mortar shall be applied in a uniform surface slightly more than the specified thickness. This shall be brought to a true surface, by working a wooden straight edge reaching across the gauges, with small upward and sideways movements at a time. Finally the surface shall be finished off true with trowel or wooden float according as a

smooth or a sandy granular texture is required. Excessive troweling or over working the float shall be avoided.

All corners, arises, angles and junctions shall be truly vertical or horizontal as the case may be and shall be carefully finished. Rounding or chamfering corners, arises, provision of grooves at junctions etc. where required shall be done without any extra payment. Such rounding, chamfering or grooving shall be carried out with proper templates or battens to the sizes required.

When suspending work at the end of the day, the plaster shall be left, cut clean to line both horizontally and vertically. When recommencing the plastering, the edge of the old work shall be scrapped cleaned and wetted with cement slurry 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 wall and not nearer than 15 cm to any corners or arises. It shall not be closed on the body of the features such as plasters, bands and cornices, nor at the corners of arises. Horizontal joints in plaster work shall not also occur on parapet tops and copings as these invariably lead to leakages. The plastering and finishing shall be completed within half an hour of adding water to the dry mortar.

No portion of the surface shall be left out initially to be patched up later on. The plastering and finishing shall be completed within half an hour of adding water to the dry mortar.

Finish

The plaster shall be finished to a true and plumb surface and to the proper degree of smoothness as required. The work shall be tested frequently as the work proceeds with a true straight edge not less than 2.5 m long and with plumb bobs. All horizontal lines and surfaces shall be tested with a level and all jambs and corners with a plumb bob as the work proceeds.

Curing

Curing shall be started as soon as the plaster has hardened sufficiently not to be damaged when watered. The plaster shall be kept wet for a period of at least 7 days. During this period, it shall be suitably protected from all damages at the contractor's expense by such means as the Engineer-in-Charge may approve. The dates on which the plastering is done shall be legibly marked on the various sections plastered so that curing for the specified period thereafter can be watched.

Test

The plaster shall be finished to a true and plumb surface and to the proper degree of smoothness as required. The work shall be tested frequently as the work proceeds with a true straight edge not less than 2.5 m long and with plumb bobs. All horizontal lines and surfaces shall be tested with a level and all jambs and corners with a plumb bob as the work proceeds.

Defects

Any cracks which appear in the surface and all portions which sound hollow when tapped, or are found to be soft or otherwise defective, shall be cut out in rectangular shape and redone as directed by the Engineer-in-Charge.

To prevent surface cracks appearing between junctions of column/beam and walls, 300 mm on all sides wide chicken wire mesh or fiber mesh should be fixed with U nails 150 mm centre to centre before plastering the junction of brick work and RCC. The plastering of walls and beam/column in one vertical plane should be carried out in one go. The cost of the same to be included in the rate for plaster.

Internal plaster

Internal plaster should be 12 to 15 MM thick. All stone and brick masonry shall be thoroughly wetted and raked out to a depth of at least 20 mm each and walls washed and wetted before plastering is done. Including adding cebex 100 / Intraplast N200, sunplex as per manufacture specification finished up to any height including all lead and lifts including providing and fixing 200mm width chicken mesh over joints between brick work & concrete.

Render with a mortar of specified parts of cement and fine sand the proportion of cement to sand should be as per specified in BOQ of specified thickness and rough but do not beat. Float or set with a thin coat 3 mm of Portland cement and polished well immediately with a trowel or flat board. The cement mortar to be used within 30 minutes after it leaves the mixing board or mill. Before work is started patches of plaster 150 x 150 mm. should be put on about 3 meters apart as gauges. By this means an even thickness is ensured. Cement plaster must be in even squares or stripe. Care shall be taken to keep the whole surface thoroughly wetted for at least a week. The finishing surface should be as specified and as directed. Further finish on the plaster to be applied separately as per drawing in separate item.

External Plaster

Providing and applying sand faced plaster 20mm thick in two coats using approved screened river sand in all positions including base coat of 12mm thick in C.M. 1:4 including adding cebex 100 / Intraplast N200, sunplex as per manufacture specification, approved brand of waterproofing compound at 1kg per cement bag and curing the same for not less than one day and keeping the surface of base coat rough to receive the sand faced treatment and top coat of 8mm thick in C.M.1:3 including adding cebex 100 / Intraplast N200, sunplex using waterproofing compound @ 2 kg. per cement bag finishing the surface by taking out grains and curing for minimum 10 days including double scaffolding in such a manner that no holes are cut in masonry item, hacking the concrete surfaces all lead and lift etc. complete. (The item is inclusive of making groves and design, watta at the junction of wall & chajja with cement slurry finish & drip mould at chajja soffit)

All stone and brick masonry surface to be plastered shall be thoroughly wetted for at least 6 hours in case of brick masonry and the joints shall be raked out to a depth of at least 20 mm. before plastering.

The first coat of cement mortar in the proportion as specified in item shall be applied uniformly all over the surface to be plastered to a thickness of 12 mm in C.M. 1:4. with a trowel and flat board in exact plumb. This coat shall be allowed to rest for not less than half an hour. Indentations shall then be made in the form of waves by a wire broom over the surface to form a key for the second coat. The plastered surface shall be allowed to cure for at least four days. First coat will be with addition of water proofing compound in proportion as specified below.

The second coat of cement mortar shall be applied in the proportion of as specified in item using clean and screened through a mesh of not less than 1.5 mm. and not more than or 3 mm. equal size to a uniform thickness of 6.5 mm by trowel and flat board in exact plumb. Waterproofing compound to be added as per as specified below.

Note: - this would be including adding cebex 100 / Intraplast N200, sunplex as per manufacture specification, approved brand of waterproofing compound at 1kg per cement bag and curing the same for not less than one day and keeping the surface of base coat rough to receive the sand faced treatment and top coat of 8mm thick in C.M.1:3 including adding cebex 100 / Intraplast N200, sunplex using waterproofing compound @ 2 kg. per cement bag finishing the surface by taking out grains and curing for minimum 10 days including double scaffolding in such a manner that no holes are cut in masonry item, hacking the concrete surfaces all lead and lift etc. complete.

The item is inclusive of making groves and design, watta at the junction of wall & chajja with cement slurry finish & drip mould at chajja soffit.

The top surface can either be finished using sponge or cork piece to give uniform granular texture or “dubba” plaster can be done on the same by applying layer of cement slurry on the plaster surface and using machine to spray fine sand to give uniform texture.

Care shall be taken to keep the whole surface thoroughly wetted for at least a week.

Cement plaster for the ceiling of roof slabs, staircase soffits

Providing plain cement plaster for the ceiling of roof slabs, staircase soffits with 6 mm thick cement mortar 1:3 including adding cebex 100 / Intraplast N200, sunplex as per manufacture specification including hacking and preparing the surface, scaffolding, finishing, curing making design and drip mould all complete as per drawings and specifications and as directed by the Engineer.

Repairs to plaster

Providing repairs to plaster of thickness 12 mm to 20 mm in cement mortar 1:4 in patches of area 2.5 sq. meters and under, including cutting the patch in proper shape, raking out joints and preparing and plastering the surface of the walls complete, including disposal of rubbish to the dumping ground within 50 meters lead: including applying one coat of Hack aid plast chemical of Sunanda make or equivalent bonding agent. Including scaffolding etc. complete as per direction of engineer in charge

Waterproofing treatment with 12mm thk. 1:2 c.m. plaster

Waterproofing treatment to the drain and tank with 12mm thk. 1:2 c.m. plaster with a floating coat of neat cement with addition of water proofing compound of sunanda make or equivalent as per manufactures instruction Complete. As directed by engineer in charge.

Water Proofing Compound

Integral cement water proofing compound conforming to IS 2645 and of approved brand and manufacture, enlisted by the Engineer-in-Charge from time to time shall be used.

The contractor shall bring the materials to the site in their original packing. The containers will be opened and the material mixed with dry cement in the proportion by weight, recommended by the manufacturers or as specifically described in the description of the item. Care shall be taken in mixing, to see that the water proofing material gets well and integrally mixed with the cement and does not run out separately when water is added.

Neat cement finishes plastering (Drains, walls, etc.)

During internal plastering when the plaster has been brought to a true surface with the wooden straight edge it shall be uniformly treated over its entire area with a paste of neat cement and rubbed smooth, so that the whole surface is covered with neat cement coating. The quantity of cement applied for floating coat shall be 1 kg per sqm. Smooth finishing shall be completed with trowel immediately and in no case later than half an hour of adding water to the plaster mix.

Waterproofing chemical to be added in proportion described in vendor specification.

Scaffolding

MS scaffolding using pipe and MS planks to be used no bamboo scaffolding will be permitted. All scaffolding should be double scaffolding. Contractor should not take any support form masonry and avoid holes in masonry work.

Measurement:

Plaster and pointing work IS 1200 Part 12

Sr. No.	Description
	Unit
1	All works will be measured in Square Metre
2	Cutting to edges shall be measured separately in running metres
	Measurement
1	No deduction shall be made for ends of joists, beams, posts, etc, and openings not exceeding 0.5 Square Metre each and no addition shall be made for reveals, jambs, soffits, sills, etc, of these openings nor for finish to plaster around ends of joists, beams, posts, etc.
2	Deductions for openings exceeding 0.5 Square Metre till 3 Square Metre
	When both faces of wall are plastered with same plaster, deduction shall be made for one face only.
	When two faces of wall are plastered with different types of plaster or if one face is plastered and the other pointed, deduction shall be made from the plaster or pointing on the side on which width of reveals is less than that on the other side but no deduction shall be made on the other side. Where widths of reveals on both faces of wall are equal, deduction of 50 percent of area of opening on each face shall be made from areas of plaster and/or pointing as the case may be.
	When only one face is plastered and the other face is not, full deduction shall be made from plaster if width of reveal on plastered side is less than that on unplastered side but if widths of reveal on both sides are equal or width of reveal on plastered side is more, no deduction shall be made.
	When width of door frame is equal to thickness of wall or is projecting beyond thickness of wall, full deduction for opening shall be made from each plastered face of the wall.
3	In case of openings of area above 3 Square Metre each, deduction shall be made for opening on each face but jambs, soffits and sills shall be measured.
4	Ceilings shall be measured between walls or Partitions and dimensions before plastering shall be taken. Width covered by cornices or coves, if any, shall be deducted.
5	Soffits of stairs shall be measured as plastering on ceilings.
6	Pointing on honey-comb work shall be described and measured in square metres on the basis of overall superficial area without deducting openings.

GYPSUM PLASTER

Stucco plaster

Providing and applying 13 mm thick internal plaster in gypsum (Stucco plaster) of approved make with neat smooth finish at all heights and locations including making

groves, Dhars and corners complete as per drawings and specifications and as directed by the Engineer.

Scope

Providing and application of 13mm thick Gypsum plaster to cement plastered wall or block work directly.

Preparation works

After the plaster is completed and curing period is over and the plaster has fully dried Gypsum has to be done over the surface.

Remove all the loose plastered material and make surface clean from all foreign matter.

To ensure even thickness and a true surface, plaster about 15 × 15 cm shall be first applied, horizontally and vertically, at not more than 2 metres intervals over the entire surface to serve as gauges. Connect the vertical gauges to making straight line over which the Aluminium patti can be moved at one level.

Material

Only India Gypsum material to be used or equivalent after approval of client

Mixing

Premixed light weight plasters essentially consist of retarded hemihydrate gypsum plaster and light weight aggregate which are characterized by low density, high thermal insulation and sound absorption properties. Other additions may be incorporated to impart desired properties. The physical and chemical requirements shall conform to IS 2547 (Pt. II).

The minimum recommended water-premixed plaster ratio is 1:2 as per standard practice or as recommended by the manufacturers.

Scaffolding

MS scaffolding using pipe and MS planks to be used no bamboo scaffolding will be permitted. All scaffolding should be double scaffolding. Contractor should not take any support form masonry and avoid holes in masonry work.

Application

The mortar shall be applied in a uniform surface slightly more than the specified thickness. This shall be brought to a true surface, by working a Aluminium straight edge reaching across the gauges, with small upward and sideways movements at a time. Surface should be made smooth and in line and level.

All corners to be made round or in right angle as per the details in drawings.

Curing

No curing should be done on the Gypsum plastered surface.

Cleaning

All material that has dropped during the work should be cleaned and thrown away as directed by the engineer in charge.

Measurement

Gypsum plaster work to be measured in square meter. Rules as per plastering to be applied.

Rates should be including making of groves as per requirement along windows, over skirting etc.

Molding and design will be paid separately in RM

PAINTING WORK

Scope

Providing and painting of surface with various paints as per approved color including surface preparation.

For all painting works brand of Asian paints, Louis burger or equivalent to be used. Contractor to take approval from client or client's representative for brand and color shade before placing order.

Measurement

All painting work to be measured in Square Meter.

Rates to include scaffolding cost, material and labor cost.

WHITE WASHING WITH SLAKED LIME

Preparation of Surface

Before new work is white washed, the surface shall be thoroughly brushed free from mortar droppings and foreign matter. In case of old work, all loose particles and scales shall be scrapped off and holes in plaster as well as patches of less than 50 cm area shall be filled up with mortar of the same mix. Where so specifically ordered by the Engineer-in-Charge, the entire surface of old white wash shall be thoroughly removed by scrapping and this shall be paid for separately. Where efflorescence is observed the deposits may be brushed clean and washed. The surface shall then be allowed to dry for at least 48 hours before white washing is done.

Preparation of Lime Wash

The lime wash shall be prepared from fresh stone white lime (Narnaul or Dehradun quality).

The lime shall be thoroughly slaked on the spot, mixed and stirred with sufficient water to make a thin cream. This shall be allowed to stand for a period of 24 hours and then shall be screened through a clean coarse cloth. 40 gm of gum dissolved in hot water, shall be added to each 10 cubic decimeter of the cream. The approximate quantity of water to be added in making the cream will be 5 liters of water to one kg of lime.

Indigo (Neel) up to 3 gm per kg of lime dissolved in water shall then be added and stirred well.

Water shall then be added at the rate of about 5 liters per kg. of lime to produce a milky solution.

Color can be changed by addition of color pigments as per requirement in this case Indigo (Neel) need not be added.

Application

The white wash shall be applied with moonj brushes to the specified number of coats. The operation for each coat shall consist of a stroke of the brush given from the top

downwards, another from the bottom upwards over the first stroke, and similarly one stroke horizontally from the right and another from the left before it dries.

Each coat shall be allowed to dry before the next one is applied. Further each coat shall be inspected and approved by the Engineer-in-Charge before the subsequent coat is applied. No portion of the surface shall be left out initially to be patched up later on.

For new work, three or more coats shall be applied till the surface presents a smooth and uniform finish through which the plaster does not show. The finished dry surface shall not show any signs of cracking and peeling nor shall it come off readily on the hand when rubbed.

For old work, after the surface has been prepared a coat of white wash shall be applied over the patches and repairs. Then a single coat or two or more coats of white wash as stipulated in the description of the item shall be applied over the entire surface. The white washed surface should present a uniform finish through which the plaster patches do not appear. The washing on ceiling should be done prior to that on walls.

Protective Measures

Doors, windows, floors, articles of furniture etc. and such other parts of the building not to be white washed, shall be protected from being splashed upon. Splashing and droppings, if any shall be removed by the contractor at his own cost and the surfaces cleaned. Damages if any to furniture or fitting and fixtures shall be recoverable from the contractor.

Note

Satna lime wash shall be used as a base coat where so specified. The specifications for 'white washing with lime' shall apply except that Satna or Katni quality lime shall be used in place of Narnaul or Dehradun quality lime and the wash will be mixed to a thicker consistency.

EXTERIOR PAINTING ON WALL

Material

The paint shall be acrylic smooth exterior paint of approved brand and manufacture (Apex ultima or equivalent). This paint shall be brought to the site of work by the contractor in its original containers in sealed condition. The material shall be brought in at a time in adequate quantities to suffice for the whole work or at least a fortnight's work. The materials shall be kept in the joint custody of the contractor and the Engineer-in-Charge. The empty containers shall not be removed from the site of work till the relevant item of work has been completed and permission obtained from the Engineer-in-Charge.

Preparation of Surface

For new work, the surface shall be thoroughly cleaned off all mortar dropping, dirt dust, algae, fungus or moth, grease and other foreign matter of brushing and washing, pitting in plaster shall make good, surface imperfections such as cracks, holes etc. should be repaired using white cement. The prepared surface shall have received the approval of the Engineer in charge after inspection before painting is commenced.

Application Base coat of Primer

Primer coat should be applied as per details given in manufacture's specification

Painting

Before pouring into smaller containers for use, the paint shall be stirred thoroughly in its container, when applying also the paint shall be continuously stirred in the smaller containers so that its consistency is kept uniform. Dilution ratio of paint with potable water

can be altered taking into consideration the nature of surface climate and as per recommended dilution given by manufacturer. In all cases, the manufacturer's instructions & directions of the Engineer-in-charge shall be followed meticulously.

The lids of paint drums shall be kept tightly closed when not in use as by exposure to atmosphere the paint may thicken and also be kept safe from dust.

Paint shall be applied with a brush on the cleaned and smooth surface. Horizontal strokes shall be given, First and vertical strokes shall be applied immediately afterwards. This entire operation will constitute one coat. The surface shall be finished as uniformly as possible leaving no brush marks.

VARNISHING

Ordinary copal varnish or superior quality spray varnish shall be used. The work includes sizing of transparent wood filler.

Varnish (conforming to IS 347 for the finishing and undercoats shall be of the approved manufacturer.

Varnishing on New Surfaces

Preparation of Surface

New wood work to be varnished shall have been finished smooth with a carpenter's plane. Knots shall be cut to a slight depth. Cracks and holes shall be cleaned of dust. The knots, cracks etc. shall then be filled in with wood putty made as follows: On a piece of wood say 20 x 15 cm face and on the side where cross grains appear, a small quantity of glue size shall be poured and the surface scraped with the edge of a fine carpenter's chisel. Very fine wood powder shall be mixed with the glue and the stiff paste thus formed shall be used for the filling.

The fillings when dry shall be rubbed down with a carpenter's file and then the entire surface shall be rubbed down perfectly smooth with medium grained and fine sand papers and wiped with dry clean cloth so that it presents uniform appearance. In no case shall sand papers be rubbed across the grains, as in this case even the finest marks will be visible when the varnishing is applied.

Sizing or Transparent Wood Filler Coat:

The surface shall then be treated with either glue sizing or with transparent wood filler coat as stipulated in the description of item.

Sizing:

When sizing is stipulated, an application of thin clean size shall be applied hot on the surface. When dry, the surface shall be rubbed down smooth with sand paper and cleaned. It shall then

be given another application of glue size nearly cold. The sized wood work shall again be rubbed down smoothly with fine sand paper and cleaned. The surface shall be perfectly dry and all dust shall be removed not only from the surface but also from the edges and joints before varnishing is commenced. If the wood work is to be stained, the staining colour shall be mixed with the second coat of the size which must be applied evenly and quickly keeping the colour on the flow. Any joining up with work already dry will show badly. The object of application of the glue size is to seal the pores in wood to prevent absorption of the oil in the varnish.

Glue sizing is inadvisable on floors, table tops and other horizontal surfaces likely to carry wet.

Household utensils which are likely to disturb the size coatings and thus expose bare wood.

Where glue sizing is omitted to be done the rate for the work shall be suitably reduced.

Transparent Wood Filler Coat:

Where instead of glue sizing, transparent wood filler application is stipulated in the item, then the surface prepared as described in 13.37.2.1 shall be given as application of the filler with brush or rag in such a way that the filler fills up all the pores and indentations and levels up the surface. It shall be allowed to dry for 24 hours. Then it shall be cut and rubbed with emery paper so that the surface of the wood is laid bare, with the filler only in the pores and crevices of the wood.

Application of Varnish:

The number of coats to be applied shall be as stipulated in the description of the item. The undercoat shall be with a flatting varnish. This dries hard and brittle and when cut and rubbed down to produce a smooth surface enhances the gloss of the finishing varnish. The top coat shall be given with stipulated brand of finishing varnish.

The varnish shall be applied liberally with a full brush and spread evenly with short light strokes to avoid frothing. If the work is vertical the varnish shall be crossed and re-crossed and then laid off, latter being finished on the upstrokes so that varnish, as it sets, flows down and eliminates brush marks, the above process will constitute one coat. If the surface is horizontal, varnish shall be worked in every direction, with light quick strokes and finish in one definite direction so that it will set without showing brush marks, in handling and applying varnish care should be taken to avoid forming froth or air bubbles.

Brushes and containers shall be kept scrupulously clean.

Rubbing down and flatting the surface shall be done after each coat except the final coat with fine sand paper.

The work shall be allowed to dry away from droughts and damp air. The finished surface shall then present a uniform appearance and fine glossy surface free from streaks, blister etc.

Any varnish left over in the small container shall not be poured back into the stock tin, as it will render the latter unfit for use.

Special fine haired varnishing brushes shall be used and not ordinary Paint brushes. Brushes shall be well worn and perfectly clean.

LUSTURE PAINT

Materials

Lusture paint of approved brand and manufacture shall be used. The primer where used as on new work shall be lusture primer as described in manufacture specification. These shall be of the same manufacture as Lusture paint. The Lusture shall be as prescribed with thinner in a manner recommended by the manufacturer. Only sufficient quantity of paint required for day's work shall be prepared.

The Paint and primer shall be brought by the contractor in sealed tins in sufficient quantities at a time to suffice for a fortnight's work, and the same shall be kept in the joint custody of the contractor and the Engineer-in-Charge. The empty tins shall not be

removed from the site of work, till this item of work has been completed and passed by the Engineer-in-Charge.

Preparation of the Surface

For new work the surface shall be thoroughly cleaned of dust, old white or color wash by washing and scrubbing. The surface shall then be allowed to dry for at least 48 hours. It shall then be sand papered to give a smooth and even surface. Any unevenness shall be made good by applying Lambi putty on the entire surface including filling up the undulations and then sand papering the same after it is dry.

In the case of old work, all loose pieces and scales shall be removed by sand papering. The surface shall be cleaned of all grease, dirt etc.

Application

Priming Coat:

The priming coat shall be with Lusture primer same make as of paint, as required by the vendor specification.

Note: If the wall surface plaster has not dried completely, cement primer shall be applied before painting the walls.

Lusture Coat

For new work, after the primer coat has dried for at least 48 hours, the surface shall be lightly sand papered to make it smooth for receiving the paint, taking care not to rub out the priming coat. All loose particles shall be dusted off after rubbing. One coat of Primer properly diluted with thinner or as stipulated by the manufacturer) shall be applied with brushes in horizontal strokes followed immediately by vertical ones which together constitute one coat.

The subsequent coats shall be applied in the same way. Two or more coats of Lusture as are found necessary shall be applied over the primer coat to obtain an even shade. A time interval of at least 24 hours shall be allowed between successive coats to permit proper drying of the preceding coat. After application of final paint roller brush should be used to get even surface and remove all brush marks.

15 cm double bristled paint brushes shall be used. After each day's work, brushes shall be thoroughly washed in hot water with soap solution and hung down to dry.

HOT APPLIED THERMOPLASTIC ROAD MARKING

Providing and applying 2.5 mm thick 100 mm wide marking strips (retro reflective) of specified shade/ color using hot thermoplastic material by fully/ semi-automatic thermoplastic paint applicator machine fitted with profile shoe, glass beads dispenser, propane tank heater and profile shoe heater, driven by experienced operator on road surface including cost of material, labour,T&P, cleaning the road surface of all dirt, seals, oil, grease and foreign material etc. complete as per direction of Engineer-in-charge and accordance with applicable specifications.

a) The thermoplastic material shall be homogenously composed of aggregate, pigment, resins and glass reflector zing beads.
b) The thermoplastic compound shall be screeded / extruded on to the pavement surface in a molten state by suitable machine capable of controlled preparation and laying with surface application of glass beads at a specific rate. Upon cooling to ambient pavement temperature, it shall produce an adherent pavement marking of specified thickness and width and capable of resisting deformation by traffic.

c) The thermoplastic material shall conform to ASTM D36/BS-3262-(Part I).
d) The material shall meet the requirements of these specifications for a period of one year. The thermoplastic material must also melt uniformly with no evidence of skins or un melted particles for the one year storage period. Any material not meeting the above requirements shall be replaced by the manufacturer/supplier/Contractor.

Marking:

Each container of the thermoplastic material shall be clearly and indelibly marked with the following information:

1. The name, trade mark or other means of identification of manufacturer.

2. Batch number

3. Date of manufacture

4. Color (White or yellow)

5. Maximum application temperature and maximum safe heating temperature.

Sampling and Testing:

The thermoplastic material shall be sampled and tested in accordance with the appropriate ASTM/BS method. The Contractor shall furnish to the Engineer-in-Charge a copy of certified test reports from the manufacturers of the thermoplastic material showing results of all tests specified herein and shall certify that the material meets all requirements of this Specification.

Preparation

The material shall be melted in accordance with the manufacturer's instructions in a heater fitted with a mechanical stirrer to give a smooth consistency to the thermoplastic material to void local overheating. The temperature of the mass shall be within the range specified by the manufacturer, and shall on no account be allowed to exceed the maximum temperature stated by the manufacturer. The molten material should be used as expeditiously as possible and for thermoplastic material which has natural binders or is otherwise sensitive to prolonged healing, the material shall not be maintained in a molten condition for more than 4 hours.

After transfer to the laying equipment, the material shall be maintained within the temperature range specified by the manufacturer for achieving the desired consistency for laying.

Properties of Finished Road Marking

a) The stripe shall not be slippery when wet.
b) The marking shall not lift from the pavement in freezing weather.
c) After application and proper drying, the stripe shall show no appreciable deformation or discoloration under traffic and under road temperatures up to 60oC.
d) The marking shall not deteriorate by contact with sodium chloride, calcium chloride or oil drippings from traffic.
e) The stripe or marking shall maintain its original dimensions and position. Cold ductility of the material shall be such as to permit normal movement with the road surface without chopping or cracking.
f) The color of yellow marking shall conform to IS Color No. 356 as given in IS 164.

Application

Marking shall be done by fully /semi-automatic paint applicator machine fitted with profile shoe, glass beads dispenser, propane tank heater and profile shoe heater, driven by experienced operator as specified in item. For locations where painting cannot be done by machine, approved manual methods shall be used with prior approval of the Engineer-in-charge. The Contractor shall maintain control over traffic while painting operations are in progress so as to cause minimum inconvenience to traffic compatible with protecting the workmen.

The thermoplastic material shall be applied hot either by screeding or extrusion process. After transfer to the laying apparatus, the material shall be laid at a temperature within the range specified by the manufacturer or otherwise directed by the Engineer-in-Charge for the particular method of laying being used. The paint shall be applied using a screed or extrusion machine.

The pavement temperature shall not be less than 10oC during application. All surfaces to be marked shall be thoroughly cleaned of all dust, dirt, grease, oil and all other foreign matter before application of the paint.

Thermoplastic paint shall be applied in intermittent or continuous lines of uniform thickness of at least 2.5 mm unless specified otherwise. Where arrows or letters are to be provided, thermoplastic compound may be hand-sprayed.

The minimum thickness specified is exclusive of surface applied glass beads.

The finished lines shall be free from ruggedness on sides and ends and be parallel to the general alignment of the carriageway. The upper surface of the lines shall be level, uniform and free from streaks

Paint Items Summary-

1. **Synthetic enamel paint** - Providing and applying first single coat of approved primer and two coats of synthetic enamel paint/flat oil paint of an approved make and color as per manufacturers specifications to surfaces, at all height and locations as directed including scaffolding, cleaning and preparing surfaces for painting by any approved means etc. complete as directed by Engineer-in-charge.

2. **Luster paint-** Providing and applying first single coat of approved primer and two coats of Luster paint of an approved make and color as per manufacturers specifications to surfaces , at all height and locations as directed including scaffolding, cleaning and preparing surfaces for painting by any approved means etc. complete as directed by Engineer-in-charge.

3. **Exterior weather proof coat-** Providing and applying first single coat of approved primer and two coats of exterior weather proof coat like apex ultima or equivalent paint to walls including preparation of surface, of an approved make and color as per manufacturers specifications to surfaces , at all height and locations as directed including scaffolding, cleaning and preparing surfaces for painting by any approved means etc. complete as directed by Engineer-in-charge.

4. **Retro reflective marking strips -** Providing and applying 2.5 mm thick 100 mm wide marking strips (retro reflective) of specified shade/ color using hot thermoplastic material by fully/ semi-automatic thermoplastic paint applicator machine fitted with profile shoe, glass beads dispenser, propane tank heater and profile shoe heater, driven by experienced operator on road surface including cost of material, labour,T&P, cleaning the road surface of all dirt, seals, oil, grease and foreign material etc. complete as per direction of Engineer-in-charge and accordance with applicable specifications.

5. **White/color wash-** Providing and applying three coats of White/color wash to any surface with lime wash prepared from quick lime of best quality by adding blue/color pigments and glue of approved color, quality in required quantities at all height and locations as directed including scaffolding, cleaning and preparing surfaces for painting with broom, coir and sand paper if necessary or by any other approved means etc. complete as directed by Engineer-in-charge.

Measurement painting works

Sr. No.	Description	
	Unit	
1	All works will be measured in Square metres	
2	Painting of structural steel in weight or Square metres	
3	Painting work up to 10 centimeter in width or in girth and not in conjunction with similar painted work shall be measured in running metres and shall include cutting to line where so required.	
4	Cutting to line, where not included in the item, shall be measured separately in running metres.	
5	Small articles up to 0.1 Square metres of painted surface, where not in conjunction with similar painted work, shall be enumerated.	
6	Painting on eaves-gutters, rain-water pipes, soil and ventilating pipes and steel poles shall be measured in running metres stating the size or girth. Fittings, such as bends, shoes, branches, heads, etc, shall be included in the length.	
7	Painting in repair work up to 1 Square metres shall be in numbers	
8	Varnish, tarring, preservative treatment, polishing in Square metres	
9	Letters and figures in numbers	
	Measurement	
1	No deduction shall be made for openings not exceeding 0.5 Square metres each, and no addition shall be made for painting to beading, molding, edges, jambs, soffits, sills, etc, of such openings.	
2	Flag staffs, chimneys, aerial masts (not latticed), water tanks, flood light towers, over-head electric masts, spires and the like requiring special scaffolding shall be measured separately stating the size, height and average girth.	
	Multiplying factor	
		Factor
1	Paneled or framed and braced or ledged and battened or edged, battened and braced joinery (for each side)	1.3
2	Flush joinery, Flush shutter (for each side)	1.2
3	Fully glazed or gauzed (for each side)	0.8
4	Partly paneled and partly glazed or gauzed joinery (for each side)	1
5	Fully ventilated or louvered joinery (for each side)	1.8

6	Weather boarding (for each side)	1.2
7	Wood shingle roofing (for each side)	1.1
8	Boarding with cover fillets and match boarding (for each side)	1.05
9	Tile and slate battening no deduction to be made for open spaces and supporting members shall not be measured separately (for painting all over)	0.8
10	Trellis (or JAFFRI) work one-way or two way no deduction to be made for open spaces and supporting members shall not be measured separately (for painting all over)	2
11	Guard bars, balustrades. gates, gratings, grills, expanded metal and railings no deduction to be made for open spaces and supporting members shall not be measured separately (for painting all over)	1
12	Gates and open palisade fencing including standards, races, rails, stays, etc no deduction to be made for open spaces and supporting members shall not be measured separately (for painting all over)	1
13	Carved or enriched work (for each side)	2
14	Steel roller shutters measured size of opening (top cover shall be measured separately) (for each side)	1.1
15	Plain sheet steel doors and windows (for each side)	1.1
16	Fully glazed or gauzed steel doors and windows (for each side)	0.5
17	Partly paneled and partly glazed or gauzed steel doors (for each side)	0.8
18	Collapsible gate (for painting all over)	1.5
19	**Increase in quantity for building finishes**	
a	External walls of plain brickwork faced with recessed, raised or weather stuck pointing 20 percent	
b	Sand face plaster with up to 4 mm size 50 percent	
c	Rough cast plaster with stone aggregate up to 10 mm 100 percent	
d	Pebble dash finish beyond 10 mm 275 percent	
e	Sponge finished plaster 25 percent	
20	**Increase in quantity for RCC Jallis**	
a	for painting of one side 100 percent	
b	for painting of one side and inside (that is through the thickness) 150 percent	
c	for painting of both sides and inside (that is through the thickness) 200 percent	

INDIAN PATENT STONE

The Indian patent stone flooring to be 38 mm. in thickness and shall consist of cement concrete mixed in the proportion of 1:2:3 (with 12 mm chips only). It shall be laid as directed in bays of suitable size and to required slope and neatly finished smooth in any colour with lines drawn as per design and as directed. No dry cement shall be allowed to be used for finishing the surface. False marks of 300 mm X 300 mm to be prepared by using strings on top as required. The surface shall be kept well-watered after it is dry for a period of 8 days. The measurement of the work shall be the actual superficial area of the pavement.

TILE FLOORING IN GENERAL

1. Tiles of same batch to be used for one area tiles for different batches should not be mixed
2. Cut pieces and start tiles should be exactly as per the drawing
3. Only first quality tiles to be used
4. All level marking to be checked by engineer in charge.
5. Design and color of tiles and samples to be got approved by the client and engineer in charge
6. Water proofing chemical to be added in mortar of toilet flooring tiles.
7. Molding, half or full and chamfering should be included in the rates quoted for tread and door and window frames and urinal partition.
8. Treads should have 3 nos. groves.
9. Urinal slabs should have both sides polished and molding throughout.

CERAMIC / VITRIFIED FLOORING

Tiles shall conform to Table 12 of IS 15622 -2006 (Tiles with water absorption E ≤ 0.08 per cent.

Thickness shall be as per BOQ normal 8mm thick. It includes the profiles on the visible face and on the rear side. Manufacturer/supplier and party shall choose the work size of tiles in order to allow a nominal joint width up to 1mm for floor tiles. The joint in case of spacer lug tile shall be as per spacer. The tiles shall conform to table10 of IS 15622 with water absorption 3 to 6% (Group BII).

The top surface of the tiles shall be glazed. Glaze shall be either glossy or matt as specified. The underside of the tiles shall not have glaze on more than 5% of the area in order that the tile may adhere properly to the base. The edges of the tiles shall be preferably free from glaze. However, any glaze if unavoidable, shall be permissible on only upto 50 per cent of the surface area of the edges.

Test on tiles to be carried as per list of test attached at the end of specification.

Preparation of Surface and Lying

Base concrete or the RCC slab on which the tiles are to be laid shall be cleaned, wetted and mopped. The bedding for the tile shall be with cement mortar 1:4 (1 cement : 4 coarse sand) or as specified. The average thickness of the bedding shall be 25 mm or as specified while the thickness under any portion of the tiles shall not be less than 10 mm.

Mortar shall be spread, tamped and corrected to proper levels and allowed to harden sufficiently to offer a fairly rigid cushion for the tiles to be set and to enable the mason to place wooden plank across and squat on it.

Over this mortar bedding neat grey cement slurry of honey like consistency shall be spread at the rate of 3.3 kg of cement per square metre over an area upto one square metre. Tiles shall be soaked in water washed clean and shall be fixed in this grout one after another, each tile gently being tapped with a wooden mallet till it is properly bedded and in level with the adjoining tiles. The joints shall be kept as thin as possible and in straight lines or to suit the required pattern.

The surface of the flooring during lying shall be frequently checked with a straight edge about 2 m long, so as to obtain a true surface with the required slope. In bath, toilet W.C. kitchen and Balcony / verandah flooring, suitable tile drop or as shown in drawing will be given in addition to required slope to avoid spread of water. Further tile drop will also be provided near floor trap.

Where full size tiles cannot be fixed these shall be cut (sawn) to the required size, and their edge rubbed smooth to ensure straight and true joints. Tiles which are fixed in the floor adjoining the wall shall enter not less than 10 mm under the plaster, skirting or dado.

After tiles have been laid surplus cement slurry shall be cleaned off.

Pointing and Finishing

The joints shall be cleaned off the grey cement slurry with wire/coir brush or trowel to a depth of 2 mm to 3 mm and all dust and loose mortar removed. Joints shall then be flush pointed with white cement added with pigment if required to match the color of tiles. Where spacer lug tiles are provided, the half the depth of joint shall be filled with polysulphide or as specified on top with under filling with cement grout without the lugs remaining exposed. The floor shall then be kept wet for 7 days. After curing, the surface shall be washed and finished clean. The finished floor shall not sound hollow when tapped with a wooden mallet.

Measurement

To be measured in square Meter.

CERAMIC / VITRIFIED TILE DADO AND SKIRTING

The tiles shall be of approved make and shall generally conform to IS 15622. The tiles shall be pressed ceramic covered by a glaze thoroughly matured and fitted to the body. The tiles shall be sound, true to shape, flat and free from flaws and other manufacturing defects affecting their utility. The top surface of the tiles shall be glazed. The underside of the tiles shall not have glaze on more than 5% of the area in order that the tile may adhere properly to the base. The edges of the tiles shall be free from glaze, however, any glaze if unavoidable shall be permissible on only upto 50 per cent of the surface area of edges.

The glaze shall be free from welts, chips, craze, specks, crawlings or other imperfections detracting from the appearance when viewed from a distance of one metre. The glaze shall be either glossy or matt as specified. The glaze shall be white in colour except in the case of coloured tiles when colours shall be specified by the Engineer-in-Charge. There may be more than one colour on a tile.

The thickness of the tiles shall be 8 mm or as specified.

The dimensions of fittings associated with the glazed tiles namely cover base, round edge tile, angles corner cups, ridge and legs, cornices and capping beads shall be of the shape and dimensions as required and the thickness of fittings shall be the same as the thickness of tiles given above.

Preparation of Surfaces

The joints shall be raked out to a depth of at least 15 mm in masonry walls. In case of concrete walls, the surface shall be hacked and roughened with wire brushes. The surface shall be cleaned thoroughly, washed with water and kept wet before skirting is commenced.

Laying

12 mm thick plaster of cement mortar 1:3 (1 cement : 3 coarse sand) mix of as specified shall be applied and allowed to harden. The plaster shall be roughened with wire brushes or by scratching diagonal at closed intervals. If the wall is already plastered than the above mortar need not be done.

The tiles should be soaked in water, washed clean, and a coat of cement slurry applied liberally at the back of tiles and set in the bedding mortar. The tiles shall be tamped and corrected to proper plane and lines. The tiles shall be set in the required pattern and jointed. The joints shall be as fine as possible. Top of skirting or dado shall be truly horizontal and joints truly vertical except where otherwise indicated. Odd size/cut size of tile shall be adjusted at bottom to take care of slope of the flooring. Skirting and dado shall rest on the top of the flooring. Where full size tiles cannot be fixed these shall be cut (sawn) to the required size and their edges rubbed smooth. Skirting /dado shall not project from the finished “surface of wall” by more than the tile thickness, undulations if any shall be adjusted in wall.

Curing and Finishing

The joints shall be cleaned off the grey cement grout with wire/coir brush or trowel to a depth of 2 mm to 3 mm and all dust and loose mortar removed. Joints shall then be flush pointed with white cement added with pigments if required to match the colour of tiles. The work shall then be kept wet for 7 days.

After curing, the surface shall be washed and finished clean. The finished work shall not sound hollow when tapped with a wooden mallet.

Measurement

Dado work to be measured in square Meter

Skirting can be measured in Square meter and Running meter if thickness is specified.

KOTA STONE FLOORING

Kota Stone Slabs

The slabs shall be of selected quality, hard, sound, dense and homogeneous in texture free from cracks, decay, weathering and flaws. They shall be hand or machine cut to the requisite thickness. They shall be of the colour indicated in the drawings or as instructed by the Engineer-in-Charge.

The slabs shall have the top (exposed) face polished before being brought to site, unless otherwise specified. The slabs shall conform to the size required. Before starting the work the contractor shall get the samples of slabs approved by the Engineer-in-Charge.

Dressing

Every slab shall be cut to the required size and shape and fine chisel dressed on the sides to the full depth so that a straight edge laid along the side of the stone shall be in full

contact with it. The sides (edges) shall be table rubbed with coarse sand or machine rubbed before paving. All angles and edges of the slabs shall be true, square and free from chippings and the surface shall be true and plane.

The thickness of the slab after it is dressed shall be 20, 25, 30 or 40 mm as specified in the description of the item. Tolerance of ±2 mm shall be allowed for the thickness. In respect of length and breadth of slabs Tolerance of ± 5 mm for hand cut slabs and ± 2 mm for machine cut slabs shall be allowed. If specified in BOQ, it would be polished machine cut kota stone flooring 25 mm thick of size 600 x 600 (approx.).

Preparation of Surface and Lying

The specification shall be as described in marble fixing except that the edges of the slabs to be jointed shall be buttered with grey cement, with admixture of pigment to match the shade of the slab. The thickness of the joints should be minimum as possible. In any location, it shall not exceed 1 mm. C.M 1:4 including cement float, filling joints with cement slurry, curing, rubbing, polishing (The polishing should be mirror polish), cleaning, all lead & lift etc complete. As per drawing and as directed by engineer in charge

Polishing and Finishing

The specifications shall be as described in Marble flooring except that

1. First polishing with coarse grade carborundum stone shall not be done
2. Cement slurry with or without pigment shall not be applied on the surface before polishing.

Measurement

Measured in square Meter

KOTA STONE IN RISERS OF STEPS, SKIRTING AND DADO

All specification same as Kota flooring except

- Thickness of the slabs shall be 25 mm or as specified in the description of the item
- Cement mortar 1:3 (1 cement : 3 coarse sand) or other mix as specified in the description of the item
- Filling joints with neat cement slurry, rubbing, polishing, including making three groves on the edge of tread.
- Making nosing with Half molding on the front face of tread, 3 groves on edge all lead & lift etc complete. As per drawing and as directed by engineer in charge.

GRANITE FLOORING

Machine cut, mirror polished Black Granite 18-20mm thick

MATERIAL

Granite Stone Slabs :

The slabs shall be of selected quality, hard, sound, dense and homogeneous in texture free from cracks, decay, weathering and flaws. They shall be machine cut to the requisite thickness. They shall be of the colour indicated in the drawings or as per approved sample by the Engineer-in-charge.

The slabs shall be of minimum size 900mm x 900mm and have the top (exposed) face polished before being brought to site, unless otherwise specified. The slabs shall conform to

the size required. Before starting the work the contractor shall get the samples of slabs approved by the Engineer-in-charge. If required the contactor should arranged a visit for the representative of Engineer-in-Charge/Consultant to the granite quarry to approve the sample of stone. The contractor should deliver the stone at site only after getting approval of the stone.

DRESSING:

Every slab shall be cut to the required size and shape and machine cut and table rubbed on the sides to the full depth so that a straight edge laid along the side of the stone shall be in full contact with it. The sides (edges) shall be table rubbed with machine edges of the slabs shall be true, square and free from chippings and the surface shall be true and plane. The polishing should be mirror polish.

The thickness of the slab after it is rubbed shall be 18-20 mm.

PREPARATION OF SURFACE AND LAYING:

Base concrete of R.C.C. slab on which the slabs are to be laid shall be cleaned, wetted and mopped. The bedding for the slabs shall be with cement mortar 1:3 (1 cement: 3 coarse sand) or 1:4 (1 cement: 4 coarse sand) as specified in BOQ, as the 12 mm thick under layer of leveling coarse.

The slabs shall be laid in the following manner.

Mortar of the specified mix shall be spread under the area of each slab, roughly to the average thickness specified in the item. The slab shall be washed clean before laying.

It shall be laid on top, pressed, tapped with wooden mallet and brought to level with the adjoining slabs. It shall be lifted and laid aside. The top surface of the mortar shall be corrected by adding fresh mortar at hollows.

The slab to be paved shall then be lowered gently back in position and tapped with wooden mallet till it is properly bedded in level with and close to the adjoining slabs with as fine a joint as possible. Subsequent slabs shall be laid in the same manner. After each slab has been laid, surplus cement on the surface of the slabs shall be cleaned off. The flooring shall be cured for a minimum period of seven days. The surface of the flooring as laid shall be true to levels and slopes as instructed by the Engineer-in-charge.

The finished surface shall be kept protected appropriately till commissioning of the building (Sample of granite stone shall be got approved by Engineer-in-Charge) after laying of granite. **(Nothing extra shall be paid in this account).**

The top surface of the granite flooring shall be treated with two or more coats of stain proof penetrating shield treatment on the top surface of granite floor surface Method of Applying Water based stone sealer:

- Thoroughly clean the surface, free of any coating, wax, grease and dust particles
- Mask surface not intended to be treated
- Apply the sealer over entire area for 15-20 minutes for an even penetration. Remove excess sealer by wiping, entire area with clean and dry trowel.
- Wait for 30 to 40 min and apply second coat.
- Start wiping excess sealer entire area 15-20 min after final application with clean dry notched trowel.

- To remove residue, reapply thin coat, dwell it for 2 to 3 minutes. Clean with dry notched trowel.
- Full cure 24-72 hrs. Foot traffic allowed after 6 to 8 hrs.
- Due care shall be taken to match the grains of slabs which shall be selected judiciously having uniform pattern of Veins/ Streaks or as per drawing and directed by Engineer-in-charge.
- The slabs shall be matched as shown in drawings or as instructed by the Engineer-in-charge.
- Slabs, which are fixed in the floor adjoining the wall, shall enter not less than 12 mm under the plaster skirting or dado. The junction between wall plaster and floor shall be finished neatly and without waviness.
- The surface of existing floor shall be hacked, cleaned, washed and kept wet before flooring is commenced.
- The granite slabs shall be of selected quality, hard sound, dense and homogeneous in texture, free from cracks, decay weathering and flaws.
- The granite stone slabs shall be machine cut with minimum size of 900mm x 900 mm and machine polished of 18-20mm thickness and of approved quality and size, free from flakes and shall be of uniform colour, with straight edges and an even surface.
- The stone slabs shall be laid in level or in slopes and as directed with invisible joints firmly bedded in cement mortar 1:4, 15mm thick.
- All angles and edges of slabs shall be true, square and free from chipping and the surface shall be true and plane.
- Slight unevenness at the meeting edges of slabs shall be removed by fine chiseling.
- The surface then shall be ground evenly with machine fitted with fine grade grit block.
- The next day floor shall be wiped with a moist rag and dried with a soft cloth and finished clean.
- Wherever required the wall surface shall be cut uniformly to requisite depth to accommodate stone face shall have uniform projection from the finished face of wall as per drawings or as directed by Engineer-in-charge.
- The concrete wall shall be hacked and roughened with wire brushes.
- Masonry walls shall have joints racked at least 15mm deep.
- The surface shall be thoroughly cleaned, washed and kept wet.
- The laying details shall be as per approved architectural drawings and as per the directions of EIC.
- The floor shall not sound hollow when tapped with a wooden mallet.

MEASUREMENT:

Measurements shall be taken in square meter correct to two places of decimal from wall face to wall face. No deduction in measurement shall be made for opening up to 0.20 sqm and nothing extra shall be allowed for forming such openings. For any opening exceeding 0.20 sqm in area, deduction in measurements for the full opening shall be made in such cases.

RATE:

The rate shall include the cost of all materials and labour involved in all the operations described above including the cost of granite stone with wastage if any, cost of cement mortar

bed, cost of adhesive, cost of jointing with white cement including pigment, cost of pre-treatment and post-treatment of stone bed, protection of top surface of stone, rubbing and polishing, cartage of material, lifts and all taxes like, GST/VAT/Service Tax, Excise duty, Octroi etc. as applicable.

For Pantry counter-

- 600mm wide counter with top finished in 19mm thick approved shade and sample pre-polished granite slab
- laid on 25mm thick one side polished Cuddapah on a bed of cement mortar 1:4, 25mm thick,
- Cuddapah stones shall be properly anchored and grouted into walls.
- The supports to be in 19mm thick both sides polished Cuddapah verticals @ 600mm c/c or as directed.
- Providing and fixing, 100mm high front facia and 150mm high band above the counter top of same shade granite.
- All exposed surfaces of platform to be finished in same granite slab. Exposed edges to be half round bull nosed with mirror polished. Including making cutout for Sink and basin.

MEASUREMENT:

Measurements shall be taken in square meter

MARBLE, GRANITE, KOTA STONE DOOR AND WINDOW FRAMING

All specification same as marble flooring, dado and skirting except

- Minimum thickness of the slabs for Granite ad Kota stone shall be 25 mm and for marble thickness will be 18mm or as specified in the description of the item
- Cement mortar 1:3 (1 cement : 3 coarse sand) 12 mm (average) thick or other mix as specified in the description of the item as backing coat in approved adhesives, leveling, smooth cement plastering along the sides to match the existing surface in cement mortar, filling the joints with pigment mixed with cement, cleaning, finishing, curing etc complete as directed by Engineer In Charge.

Molding half round, chamfering or full round as per drawing should be included in the rate quoted.

CEILLING WORKS

Modular Ceiling Systems

- Providing and fixing Modular Ceiling Systems with Mineral Fiber Board Tegular Edge Ceiling Tiles as per following specifications. Rate to include all fastening accessories with approved finishes.
- Ceiling tiles shall be approved make Micro look Edge tiles, of size 600mm x 600mm, of approved shade and color.
- Tile shall render a NRC level of 0.5-0.6. Suspension system shall be manufacturer specific double rotary stitched (Trulok or equivalent) Silhouette reveal profile grid system with 15mm wide flanges incorporating 3 or 6mm central reveal of all white color.

- Silhouette main runners and cross tees to have mitred ends and (Birds' mouth or equivalent) profiled notches to provide cruciform junctions.
- Installation to comprise of main runners spaced at 1200mm centers securely fixed to the structural soffit by approved hangers at 1200mm maximum centers and not more than 150mm from spliced joints.
- The last hanger at the end of each main runner should not be greater than 600mm from the adjacent wall.
- Flush fitting 1200mm long cross tees to be interlocked between main runners at 600mm centers to form 1200mm x 600mm modules.
- Cut cross tees longer than 600mm require independent support. 600mm x 600mm modules to be formed by fitting 600mm long flush fitting cross tees centrally between the 1200mm cross tees.
- 1200mm cross tees to have central (Birds' mouth or equivalent) notches to facilitate flush fitting of 600mm cross tees.
- Perimeter trim to be (Trulok or equivalent) manufacturer specific sized wall angle of approved color, secured to walls at 450mm maximum centers.

MEASUREMENT:

- Measurements shall be taken in square meter

Metal Tile Grid Tile Suspended Ceiling

- Providing and Fixing 600X600 Metal Tile Grid Tile Suspended Ceiling on 24mm T-Grid suspension system.
- Panels shall be of Size 600mm X 600mm made out of 0.5 mm thick GI. Non woven acoustic pad pasted on the back side with appropriate adhesive.
- Tile will be manufactured on advanced equipment which includes several leveling and one stage manufacturing.
- The tile end shall be raised upward by 10 mm and bend outward to lay the tile in frame work.
- Grid system for fixing ceiling tiles shall comprise of T-grid suspension system.
- The 24mm main Tee runner shall be suspended at an interval of 1200mm centre to centre.
- The 1200mm cross tee shall be attached between two main runners at every 600 mm and further 600mm cross Tee shall be interconnected between two 1200 mm cross Tees.

MEASUREMENT:

- Measurements shall be taken in square meter

Trap door in the false ceiling

- Providing and fixing Trap door in the false ceiling for HVAC in Aluminum Composite Panel 4mm thick 0.50 PVDF
- inclusive of Aluminum tabular Section for runner frame work (38mm x 25mm) which would be anodized in color shade matching the shade of the ACP and also along with the grid false ceiling and with lockable arrangement and stainless steel hinges.
- The rate to be inclusive of all the necessary supports from ceiling etc. complete.

MEASUREMENT:

- Measurements shall be taken in square meter

Gypsum False Ceiling

- Providing and fixing Gypsum False Ceiling of India Gypsum make using moisture resistant board which includes Gypsteel® ULTRA CRP surface ribbed perimeter channels (having one flange of 20mm and another flange of 30mm and a web of 27mm) along the perimeter of ceiling, screw fixed to brick wall/partition with the help of nylon sleeves and screws, at 610mm centers.
- Then suspending Gypsteel® ULTRA CRP surface ribbed intermediate channels of size 45mm (with two flanges of 15mm each) from the soffit at 1220mm centers with Gypsteel ULTRA CRP surface ribbed ceiling angle of width 25mmx10mm fixed to soffit with GI cleat and steel expansion fasteners(Mfg by Saint Gobain Gyproc).
- Then Gypsteel® ULTRA CRP surface ribbed Ceiling section of having web of 51.5mm and two flanges of 26mm each with lips of 10.5mm are then fixed to the Gypsteel® ULTRA intermediate channel with the help of connecting clip and in direction perpendicular to the Gypsteel® ULTRA intermediate channel at 457mm centers.
- Single layer of 12.5mm tapered edge moisture resistant Gypboard® Plain (conforming to IS 2095 part 1 1996) is then screw fixed to ceiling section with 25mm drywall screws at 230mm centers.
- Screw fixing is done mechanically either with screw driver or drilling machine with suitable attachment.
- Finally tapered edges of the Gyp boards are to be jointed and finished so as to have a flush look which includes filling and finishing with jointing compound, joint paper tape and two coats of dry wall top coat suitable for Gypboard (as per recommended practice of BPB India gypsum) etc complete as per the recommended practices of India Gypsum.
- Rate to be include all kinds of profiles and cut outs required for light fixtures, Speakers, Smoke detector, trap doors and AC grill in the ceiling. All steel sections to be marked with "GYPSTEEL ULTRA" which is a registered trademark of BPB IGL and hologram.
- Rate to be inclusive of shadow profile at the junction of Wall and ceiling.

MEASUREMENT:

- Measurements shall be taken in square meter

ELEVATION TREATMENT

Aluminum Composite Panel Cladding

- Supply, Fabrication & Erection of Aluminum Composite Panel Cladding by using 4mm thick 0.50 PVDF Coated Kynar 500Core &
- Aluminum tabular Section for runner frame work (38mm x 25mm), Dow Croning 789 weather silicone (25mm x 25mm x 1.5mm) clit angel, Backer Rod, Double Side adhesive tape and other hardware etc.
- Rate are including double H frame scaffolding, all mullions required, fixtures and fitting, anchor fastener, welding etc. complete

Note - GA drawing to be approved by consultant

MEASUREMENT:

- Measurements shall be taken in square meter

Aluminum extruded profile "Z" Louvers

- Design, fabricate, supply and installation of Aluminum extruded profile "Z" Louvers of approved size, integrated with brackets of alloy 6063 T6 in super Durable powder coating finish in metallic or solid colors minimum 35 microns, SS 316 screws and fasteners.
- The design at wind load of 210 kg/sq.mtr, to accommodate the building movements, thermal expansion and seismic movements.
- The support system to be designed without causing any failure at 1.5 times designed wind pressure.
- Includes interface details such as fire seal, flashing, sealants, extruded capping, insulations, brackets and any sub frame as required.
- All exposed aluminum extrusion shall be in PVDF finish & Color to architect's selection.

Note - GA drawing to be approved by consultant

MEASUREMENT:

- Measurements shall be taken in square meter

Structural Glass Glazing

- Providing & Installing Structural Glass Glazing: Systems: Semi-Unitized with 6 mm St. Gobin or equivalent Tough Glass
- Supply, fabrication & Installation of Semi-Unitized Anodized Aluminum Extruded Sections using following material.

Mullion : 56mm x 63mm x 2mm

Transom : 56mm x 63mm x 2mm

Sash Frame : 38mm x 25mm x 2.5mm

M.S. Slotted bracket (Hot Dip Galvanized / SS screw) , 10mm x 100mm Anchor fastener, Nut Bolts, Double Sided Tape, Dow Croning 789 weather Silicone, 995 Structural Silicone & other necessary hardware.

Note - GA drawing to be approved by consultant

MEASUREMENT:

- Measurements shall be taken in square meter.

WATER PROOFING

BOX TYPE WATER PROOFING

Preparation of Surface

The Water Proofing Treatment over the lean concrete / leveling course surface should adhere to the surface firmly, the surface of leveling course should be roughened properly when the concrete is still green. In case the surface is not made rough before the concrete is set, the work of water proofing should not be executed till proper key is provided for the base layer of Cement Mortar 1:3.

Blending Cement/Water with Water Proofing Compound

The required quantity of cement bags to be used for a particular portion of work should be emptied on a dry platform. Water proofing compound bearing ISI mark and conforming to IS 2645 should then be mixed properly with the cement. The quantity of water proofing compound to be mixed should be as prescribed by the manufacturer but not exceeding 3% by weight of cement. The quantity of cement and water proofing compound thus mixed should be thoroughly blended and the blended cement should again be packed in bags.

For the water proofing compound in liquid form, the blending is to be done with water. This can be done by taking the just required quantity of water to be mixed in the particular batch of dry cement mortar.

The required quantity of water thus collected per batch of dry cement mortar to be prepared should be mixed with liquid water proofing compound from sealed tins with ISI mark. The water thus mixed with water proofing compound shall be thoroughly stirred so that the water is blended with water proofing compound properly.

Rough Shahabad stone slabs to be used for this item shall be in thickness of minimum 20 mm. Larger size of stone slabs i.e. 550 mm x 550 mm or 550 mm x 850 mm shall be used to minimize the number of joints.

Preparation of Cement Slurry

Cement slurry shall be prepared by using 2.2 kg of blended cement per sqm. area. Each time only that much quantity shall be prepared which can be covered on the surface, and the surface in turn would be covered with 20 mm thick cement mortar base within half an hour. Slurry prepared and remained unused for more than half an hour shall be totally rejected.

Preparation of Cement Mortar

Cement mortar 1:3 (1 blended cement: 3 coarse sand) shall be prepared with cement/ water duly blended. Only that much quantity of cement mortar which can be consumed within half an hour, shall be prepared. Any cement mortar that is prepared and remains unused for more than half an hour shall not be used in the work and shall be rejected.

Laying Water Proofing Course

Before laying the base course of cement mortar 1:3, the lean concrete surface shall be cleaned neatly with water. Cement slurry and other compound as per waterproofing agency's specifications prepared shall be applied only on the area of the concrete surface that can be covered with the cement mortar (1:3) base course within half an hour, but confirming to IS: 2645-1975. The cement slurry should cover every spot of the surface and no place shall remain uncovered. Just after the application of cement slurry on the surface, the cement mortar prepared should be used for laying the base course. Base Course should be laid to a perfect level with wooden / Aluminium straight edge of at least 2 mtrs. long. The top surface of cement mortar should be finished neatly and later

scratched when green with a suitable instrument before the base course dries and gets hard that is just before the base course takes up initial set.

When the 20 mm thick base course is just getting set the cement slurry should be spread over the base course upto the area that shall be covered with just two to three stone slabs. The cement slurry shall be spread in such a way that the area of base course to be covered immediately shall be covered with slurry without any gap or dry spots. Immediately on applying cement slurry on the base course the rough Shahabad stone slab shall be laid over the base course and pressed gently so that the air gap can be removed. The slurry applied on the surface which gets spread when the stone slab is pressed shall get accumulated in the joints of adjacent stone slabs and if any gap still remains between the stone slabs the same should also be filled with additional quantity of cement slurry. For laying the stone slabs in perfect level, two stone slabs at adjacent concerns/ends shall be fixed firmly to the required level and a string stretched over the two slabs, the intermediate slabs shall then be set to the level of the string.

After filling all the joints of the rough Shahabad Stone Slabs with cement slurry the area of stone slab shall be laid with cement mortar 1:3. The surface of stone slabs shall be cleaned and lightly watered. Cement mortar 1: 3 prepared shall be used for laying this course. For laying this course 20 mm high wooden strips shall be used and the top surface shall be finished smooth without using additional cement or slurry.

After laying 3rd course and before the mortar layer takes the initial set, Stone aggregate of 10 mm to 12 mm nominal size shall be uniformly spread and lightly pressed into the finished surface @ 8 cudm./sqm. The aggregates shall not be embedded totally inside the mortar and shall be visible on the top surface.

In cases where slope is to be provided for the water proofing layer, grading with additional cement concrete/cement mortar shall be provided and then the water proofing layer shall be laid on the graded surface.

After completion of floor slab & side walls, treatment of waterproof layer shall be continued along the outer surface of the walls. Up to a height of 60cm above adjacent ground level, complete as directed. Thus, treatment to carry 10 years guarantee Refilling outside the wall shall be filled with soft earth by the contractors and water proofing with soft earth by the contractors and water proofing of side walls shall not be damaged. The total thickness of the treatment shall be 65mm to 75mm for floors, & 45mm to 65mm for walls. Including final finished to wall water proofing by 12 mm thick plaster with smooth cement finish on top etc complete as directed.

Curing

Immediately after completing the fourth layer, arrangements shall be made for the top RCC slab as quickly as possible and in the meantime till the top slab is casted the water proofing treatment shall be kept wet continuously. In case the concreting of slab gets delayed for more than 2 weeks the curing can be stopped after 14 days.

Measurement

Measured in square Meter

WATER PROOFING IN SUNKEN PORTION OF WC, BATH KITCHEN AND LIKE WISE

Before the Water Proofing Treatment

Before the water proofing treatment, the internal plaster of ceiling and walls of WC block leaving the portion for dado/skirting should be completed. Grooving / chasing for doing the concealed work of GI/CI pipes/Electrical conduits should be completed. Cleaning to be done in the depressed / sunken portion of WC, bath, and likewise of all debris, extra mortar sticking to the vertical and horizontal surface etc. Necessary holes for ‘P’ trap / Nahani trap/Water escape pipe etc should be completed.

Preparing Surface and Fixing Pipes and Fittings

Before the water proofing treatment work, proper key in the concrete surface should be provided. The depressed/sunken portion should be hacked by a hacking tool, after the concrete slab is cast and when this concrete is still green.

The vertical surfaces of the depressed /sunken portion should be hacked with a hacking tool just after the shuttering is removed. In case of old work, the water proofing treatment on such surfaces shall be permitted after making proper spatter dash key. Fixing the 'P' trap in position and all other pipes work including the water escape pipe shall be fixed properly and the holes should be plugged carefully before taking up the water proofing work.

1st Course

Cement duly blended with water proofing compound as per manufacture specification shall be used for preparing the cement slurry. The consistency of the slurry should be such that 4.4 kg. of blended cement with water proofing compound is used per sq. metre area of surface to be treated. The slurry should be started from the vertical faces towards the bottom of the floor as Particular care should be taken to see that the slurry is applied to corners without leaving any gap.

1st layer to be cured for 3 days by ponding

2nd Course

20 mm thick cement plaster as base coat with cement mortar 1:4 (1 blended cement : 4 coarse sand with addition of Water proofing chemical as per vendors specification) shall be evenly applied over the concrete surface taking particular care to see that all the corners and joints are properly packed

Laying Brick Bat Coba

Brick bat of size 25 mm to 115 mm out of well burnt bricks shall be used for the purpose of brickbat coba. The brick bats shall be properly dampened for six hours before laying.

Brick bats shall be laid to required slope/gradient over the base coat of mortar leaving 15-25 mm gap between two bats. Cement mortar 1:5 (1 blended cement: 5 coarse sand with addition of Water proofing chemical as per vendors specification) shall be poured over the brick bats and joints filled properly. Under no circumstances dry brick bats should be laid over the base coat.

2nd brick bat course to be cured for 3 days. Brick batt Koba of height 300 mm to be done.

3rd Course

Immediately on applying the blended cement slurry on the surface to be treated cement plaster 12 mm thick in CM 1:4 (1 blended cement: 4 coarse sand with addition of Water proofing chemical as per vendors specification) shall be applied both on vertical and horizontal surfaces taking particular care to complete the entire depressed/ sunken portion of WC within a day so that the plaster can be done without any joint. Junctions shall be properly rounded. Including applying bonding coat of "hack-aid-plast" at the junction of old plaster and new plaster, and to the existing R.C.C. members like slabs, beams, finishing the surface with neat cement float with addition of water proofing compound

The surfaces of the plaster shall be made plain by cement and water proof chemical slurry and cured for a week. On completion of the curing period both horizontal and vertical surfaces shall be cleaned properly and gently and allowed to dry.

Water test to be carried by pounding for 7 days. Test to be shown to the Engineer in charge and signed off by both contractor and Engineer In charge if found satisfactory.

Including two legged scaffolding, curing etc. complete. The water proofing to be extended 1 m above the floor level on walls and payment will be made only as per area of floor.

Measurement

Measured in square Meter

INDIAN PATENT STONE OVER CHAJJA

The Indian patent stone flooring to be 38 mm. in thickness including laying small brick bats at the junction of wall & chajja , curing by ponding, scaffolding etc. and shall consist of cement concrete mixed in the proportion of 1:2:3 with addition of water proofing compound as per vendor's specification (with 12 mm chips only). It shall be laid as directed in bays of suitable size and to required slope and neatly finished smooth in any colour with lines drawn as per design and as directed. No dry cement shall be allowed to be used for finishing the surface. False marks of 300 mm X 300 mm to be prepared by using strings on top as required. The surface shall be kept well watered after it is dry for a period of 8 days.

Measurement

Measured in square Meter

BRICK BATT WATER PROOFING OVER TERRACE

Preparing Surface and Fixing Pipes and Fittings

Before the water proofing treatment work, proper key in the concrete surface should be provided. The top portion of the slab should be hacked by a hacking tool, after the concrete slab is cast and when this concrete is still green. Including cleaning and removing dust, dirt, patches of concrete mortar, brick bats etc also removing fine dust using industrial vacuum cleaner.

Providing and Laying of Slurry for First Layer

The consistency of the slurry should be such as to cover the desired area by using 2.75 kg of blended cement per sqm of area. On deciding the correct quantity of water required per sqm. area the required quantity of slurry should be prepared which can be applied over the desired surface within half an hour of mixing with water proofing compound as per manufacturer specifications to be added to cement slurry

Application

Depending upon the area of surface that has to be covered, the required quantity of slurry should be prepared using 2.75 kg. blended cement + water per sqm. area to be covered, taking particular care to see that only that much quantity of slurry shall be prepared which can be used within half an hour of preparation i.e. before the initial setting time of cement.

The prepared slurry shall be applied over the dampened surface with brushes very carefully, including the joints between the floor slab and the parapet wall, holes on the surfaces, joints of pipes, masonry/concrete etc.

The application of the slurry should continue up to a height of 300 mm on the parapet wall and also the groove. The slurry should also be applied up to a height of 150 mm over pipe projections etc.

Laying Base Coat 20 mm thick

Immediately after the application of slurry and when the application is still green, 20 mm thick cement plaster as base coat with cement mortar 1:4 (1 blended cement : 4 coarse sand with addition of Water proofing chemical as per vendors specification) shall be evenly applied over the concrete surface taking particular care to see that all the corners and joints are properly packed and the application of the base coat shall be continued up to a height of 300 mm over the parapet wall.

Laying Brick Bat Coba

Brick bat of size 25 mm to 115 mm out of well burnt bricks shall be used for the purpose of brick bat coba. The brick bats shall be properly dampened for six hours before laying. Brick bats shall be laid to required slope/gradient over the base coat of mortar leaving 15-25 mm gap between two bats. Cement mortar 1:3 (1 blended cement: 3 coarse sand with addition of Water proofing chemical as per vendors specification) shall be poured over the brick bats and joints filled properly. Under no circumstances dry brick bats should be laid over the base coat.

The haunches/gola at the junction of parapet wall and the roof shall be formed only with brick bat coba. coba is to be laid on the subsequent day, cement slurry prepared as per first layer shall applied over the top surface of the base coat, then only the brick bat coba shall be laid. Average thickness to be of 200 mm.

Finishing coat

Immediately on applying the blended cement slurry on the surface to be treated cement plaster 12 mm thick in CM 1:4 (1 blended cement: 4 coarse sand with addition of Water proofing chemical as per vendors specification) shall be applied both on vertical and horizontal surfaces. Hack- aid-plast should be applied at the junction of old IPS & new IPS etc. Junctions shall be properly rounded.

The surfaces of the plaster shall be made plain by cement and water proof chemical slurry.

The finished surface shall be allowed to dry for a while and then pattern of 300 mm x 300 mm groove, 8 mm deep shall be made over the entire surface.

Water test to be carried by pounding for 7 days. Test to be shown to the Engineer in charge and signed off by both contractor and Engineer In charge if found satisfactory.

Measurement

Measured in square Meter

TWO LAYER WATER PROOFING FOR VERTICAL OF TANK WALLS AND DRAIN PITS

After surface preparation

Cement duly blended with water proofing compound as per manufacture specification shall be used for preparing the cement slurry. The consistency of the slurry should be such that 4.4 kg. of blended cement with water proofing compound is used per sq. metre area of surface to be treated. The slurry should be started from the vertical faces towards the bottom of the floor as Particular care should be taken to see that the slurry is applied to corners without leaving any gap.

Repeat the procedure for second layer

Water test to be carried by pounding for 7 days. Test to be shown to the Engineer in charge and signed off by both contractor and Engineer In charge if found satisfactory.

Measurement

Measured in square Meter

PROVIDING WATER STOPS

Water stops conforming to IS 12200 for construction/expansion joints should be fabrication from a plastic compound, the basic resin of which shall be polyvinyl chloride. The compound shall contain additional resin/ plasticizer inhibitors or other materials such that when the materials are compounded it shall meet the requirement given in IS 15058.

PVC water stops

- Approved make 150 mm X 6 mm wide
- Serrated with central bulb complete as directed & instructed by Consultant.

Measurement

- To be taken in Running Meter

Type of Joints for which Water Bars are provided

The water bars are provided only for the movement of joints in a water retaining structure.

Different types of movement joints are as described below:

Complete Contraction Joint:

This is a movement joint with deliberate discontinuity both in concrete as well as the reinforcement but no initial gap is maintained between the concrete on either side of the joint.

This joint is intended to accommodate the contraction of the concrete.

Partial Contraction Joint:

This is a movement joint with deliberate discontinuity in concrete but no water bar is provided and no discontinuity is provided in steel. No initial gap is maintained between the concrete on either side of joint.

Expansion Joint:

This is also a movement joint with complete discontinuity in both reinforcement and concrete. It is intended to accommodate either expansion or contraction of the structure. In general such joint requires the provision of an initial gap between the adjoining parts of the structure which accommodates expansion or contraction of the structure.

Types and Performance of Water Bars

Water bars are performed strips of impermeable material which are embedded in the concrete during construction so as to span across the joints and provide a permanent water tight seal during the whole range of joint movement.

Plastic such as polyvinyl chloride PVC or Natural synthetic rubber should be used.

These bars comprise of central longitudinal hollow tube with thin walls and stiff wings of about 150 mm width. Natural synthetic rubber and plastics have very considerable advantage in handling, splicing and in making intersections.

The strip water bars described as above, while placing in position has to be passed through the end shutter of the first placed concrete with the result the shuttering at this point should be perfectly water tight otherwise cement slurry may escape from the concrete being laid and will ultimately weaken the structure. Therefore to avoid the above problem one can prefer moulded type of water bar.

The design of the moulded water bar with several projections need to be passed through the end shutter while placing the same in position. Another main advantage of this water bar is that since it occupies bigger proportion of the thickness of the joint it would lengthen the shortest alternative water path through the concrete.

It is important to ensure proper compaction of concrete around the water bar. Proper cover to all the reinforcement shall be maintained. Sometimes to increase the bond the holes are provided in the copper water bars but in the long run it proves to be disadvantageous as it shortens the path of water through concrete. Water bars should be placed at the centre of the wall or if it is to be provided away from the centre its distance from either face of the wall shall not be less than half of the width of water bar or as specified/directed by the Engineer-in-charge.

Measurement

To be taken in Running Meter

MS PVC COATED RUNGS

- size 300x150mm for UG Sumps and OH Tank
- including placing 150mm inside concrete (while doing form work),
- aligning during concreting,
- Grouting the junction if required, cleaning etc.

Measurement

- To be taken as per unit number

Note:- All water proofing work to have guarantee of 10 years and to be provided by contractor on 100 Rupees bond paper as per the format submitted by Consultant or as given in tender.

WOOD WORKS

Classification of wood
Teak Wood (Tectona Grandis)
It is of outstanding merit in retention of shape and durability. The heart wood is one of the most naturally durable woods of the world. It usually remains immune to white ant attack and insect attack for very long periods. It is, however, not always immune from fungus attack (rot). Taken as a whole, good quality teak is very durable, it is relatively easy to saw and work. It can be furnished to a fare surface and takes polish well. It is generally used for making furniture and all important timber construction.

Superior Class Teak Wood such as Balarsha, Malabar and Dandeli :
Individual hard and sound knot shall not be more than 12 mm in diameter and the aggregate area of all the knots shall not exceed one half per cent of the area of the piece. It shall be close grained.

Deodar Wood (Cedrus Deodars)
It is the strongest of the Indian conifers. Its weight and strength is 20% per cent less than teak. It is easy to saw and works to a smooth finish. It is not, however, a suitable wood for polish or paint work as the oil in the wood and especially near knots, always seeps through such finishes and discolours them. It is used for house building, furniture and other construction work. It is also suitable for beams, floors, boards, posts, window frames and light furniture etc.

Sal Wood (Shoera Robusta)
Sal is about 30 per cent heavier than teak, 50 per cent harder, and about 20 to 30 per cent stronger. In shock resistance it is about 45 per cent above teak. Its heart wood is a naturally durable wood, and usually remains immune to attack by white ants and fungi for a long period, while its sapwood is very perishable and should not be used. Well dried sal is not a really easy wood to saw and work. It is a rough constructional wood than a carpentry timber. No individual hard and sound knot shall exceed 25 mm in diameter and the aggregate area of all the knots shall not exceed 1% of the area of the piece. It can be used for a variety of purposes, such as for beams, rafters, flooring, piles, bridging, tool handles, picker arms and tent pegs, etc.

Kail Wood (Pinus Roxburghie)

Kail Wood is not a very durable wood. But it is easy to saw and work and usually very popular in workshops. It can be brought to a fine smooth surface, but is more suitable for paint and enamel finishes than for polish work. It is useful for joinery works, constructional work, light furniture and house fitments.

PANELLING MATERIAL

Timber
Timber panels shall be preferably made of timber of larger width. The minimum width and thickness of a panel shall be 150 mm and 15 mm respectively. When made from more than one piece, the pieces shall be joined with a continuous tongue and groove joint, glued together and reinforced with metal dowels. The grains of timber panels shall run along the longer dimensions of the panels. The panels shall be designed such that no single panel exceeds 0.5 square metre in area.

Plywood /Plywood Boards
Plywood boards are formed by gluing and pressing three or more layers of veneers with the grains of adjacent veneers running at right angles to each other. The veneers shall be either rotary cut or sliced and shall be sufficiently smooth to permit an even spread of glue. Face veneers may be either decorative on both sides or one side commercial and the other decorative. Plywood shall be of BWP grade or BWR grade as per IS 303.

Adhesive:
Adhesive used for bonding BWP grade of plywood boards shall be BWP type synthetic resins conforming to IS 848.

The thickness of all veneers shall be uniform, within a tolerance of ± 5 per cent. Corresponding veneers on either side of the centre one shall be of the same thickness and species. The requirements of thickness and core veneers shall be as follows:

a) In 3 ply boards upto 5 mm thick. The combined thickness of the face veneers shall not exceed twice the thickness of centre ply.
b) In multiply boards, the thickness of any veneer shall not be more than thrice the thickness of any other veneer.
c) The sum of the thickness of the veneers in one direction shall approximate to the sum of the thickness of the veneers at right angle to them and shall not be greater than 1.5 times this sum except for 3 ply as specified in (a).

Thickness:
Plywood boards are available in thickness ranging from 3 to 25 mm. Tolerance in thickness shall be ± 10% for board's up to and including 5 mm; ± 7% for boards from 6 to 9 mm and ± 5% for boards above 9 mm thickness. The boards shall be of uniform thickness and the surfaces of the boards shall be sanded to a smooth finish.

Moisture content of the plywood boards when tested in accordance with IS 1734 (Part 1) shall not be less than 5 per cent and not more than 15 per cent.

Testing:
One sample for every 100 sqm or part thereof shall be taken and testing done as per IS 303. However, testing may not be done if the total requirement of plywood boards is less than 30 sqm. All the samples tested shall meet the requirements of physical and mechanical properties of plywood boards specified in Appendix D of Chapter 9.

FLUSH DOOR SHUTTERS
Flush door shutters shall have a solid core and may be of the decorative or non-decorative

(Paintable type as per IS 2202 (Part I). Nominal thickness of shutters may be 25, 30 or 38 mm. Thickness and type of shutters shall be as specified.

Width and height of the shutters shall be as shown in the drawings or as indicated by the Engineer in - Charge. All four edges of the shutters shall be square. The shutter shall be free from twist or warp in its plane. The moisture content in timbers used in the manufacture of flush door shutters shall be not more than 12 per cent when tested according to IS 1708.

Core

The core of the flush door shutters shall be a block board having wooden strips held in a frame constructed of stiles and rails. Block Board Door Shutters should be thermo pressed. Each stile and rail shall be a single piece without any joint. The width of the stiles and rails including lipping, where provided shall not be less than 45 mm and not more than 75 mm. The width of each wooden strip shall not exceed 30 mm. Stiles, rails and wooden strips forming the core of a shutter shall be of equal and uniform thickness. Wooden strips shall be parallel to the stiles.

End joints of the pieces of wooden strips of small lengths shall be staggered. In a shutter, stiles and rails shall be of one species of timber. Wooden strips shall also be of one species only but it may or may not be of the same species as that of the stiles and rails. Any species of timber may be used for core of flush door. However, any non-coniferous (Hard wood) timber shall be used for stiles, rails and lipping.

Face Panel

The face panel shall be formed by gluing, by the hot-press process on both faces of the core, either plywood or cross-bands and face veneers. The thickness of the cross bands as such or in the plywood shall be between 1.0 mm and 3.0 mm. The thickness of the face veneers as such or in the plywood shall be between 0.5 mm and 1.5 mm for commercial veneers and between 0.4 mm and 1.0 mm decorative veneers, provided that the combined thickness of both is not less than 2.2 mm. The direction of the veneers adjacent to the core shall be at right angles to the direction of the wooden strips. Finished faces shall be sanded to smooth even texture. Commercial face veneers shall conform to marine grade plywood and decorative face veneers shall conform to type I decorative plywood in IS 1328.

Lipping

Lipping, where specified, shall be provided internally on all edges of the shutters. Lipping shall be done with battens of first class hardwood or as specified of depth not less than 25 mm. For double leaved shutters, depth of the lipping at meeting of stiles shall be not less than 35 mm. Joints shall not be permitted in the lipping. Standard 12mm thick teak wood external lipping as per IS:2202 and finished in approved melamine polish to be provided.

Rebating

In the case of double leaves shutters the meeting of stiles shall be rebated by 8 mm to 10 mm. The rebating shall be either splayed or square type as shown in drawing where lipping is provided. The depth of lipping at the meeting of stiles shall not be less than 30 mm.

Laminate

If required 1.5mm thick laminate finished on both sides as per drawing or BOQ to be provided.

Opening for Glazing

When required by the purchaser opening for glazing shall be provided and unless otherwise specified the opening for glazing shall be 250 mm in height and 150 mm or 200

mm in width unless directed otherwise. The bottom of the opening shall be at a height of 1.4 m from the bottom of the shutter. Opening for glazing shall be lipped internally with wooden batten of width not less than 25 mm. Opening for glazing shall be provided where specified or shown in the drawing.

Venetian Opening
Where specified the height of the venetian opening shall be 350 mm from the bottom of the shutter. The width of the opening shall be as directed but shall provide for a clear space of 75 mm between the edge of the door and venetian opening but in no case the opening shall extend beyond the stiles of the shutter. The top edge of the opening shall be lipped internally with wooden battens of width not less than 25 mm. Venetian opening shall be provided where specified or shown in the drawing.

Tolerance
Tolerance on width and height shall be + 3 mm and tolerance on nominal thickness shall be ± 1.2 mm. The thickness of the door shutter shall be uniform throughout with a permissible variation of not more than 0.8 mm when measured at any two points.

Adhesive
Adhesive used for bonding various components of flush door shutters namely, core, core frame, lipping, cross-bands, face veneers, plywood etc. and for bonding plywood shall conform to BWP type, phenol formaldehyde synthetic resin adhesive conforming to IS 848.

Tests
Samples of flush door shutters shall be subjected to the following tests:

(a) End Immersion Test
(b) Knife Test
(c) Glue Adhesion Test

Fixing of Shutters
For side hung shutters of height upto 1.2 m, each leaf shall be hung on two hinges at quarter points and for shutter of height more than 1.2 m, each leaf shall be hung on three hinges one at the centre and the other two at 200 mm from the top and bottom of the shutters. Top hung and bottom hung shutters shall be hung on two hinges fixed at quarter points of top rail or bottom rail. Centre hung shutter shall be suspended on a suitable pivot in the centre of the frame. Size and type of hinges and pivots shall be as specified. Flap of hinges shall be neatly counter sunk into the recesses cut to the exact dimensions of flap. Screws for fixing the hinges shall be screwed in with screw driver and not hammered in. Unless otherwise specified, shutters of height more than 1.2 mm shall be hung on butt hinges of size 100 mm and for all other shutters of lesser height butt hinges of size 75 mm shall be used. For shutter of more than 40 mm thickness butt hinges of size 125 × 90 × 4 mm shall be used. Continuous (piano) hinges shall be used for fixing cup-board shutters where specified.

Fittings
Fittings shall be provided as per schedule of fittings decided by Engineer-in-Charge.. Cost of providing and fixing shutter shall include cost of hinges and necessary screws for fixing the same. All other fittings shall be Included in rate.

Paneling
Material:
This paneling shall be decorative or non-decorative (Paintable) type as per design

and thickness specified by the Engineer-in-Charge, of 2nd class teak wood, FPT-1 or graded wood pre-laminated particle board or as specified in item.

Ornamental Work:
The ornamental wood work shall be painted on the back with priming coat of approved wood primer before fixing the same to the grounds with screws, which shall be sunk into the wood work and their tops covered with putty. The ornamental work shall be made true and accurate to the dimensions shown in the working drawings. The fixing shall be done true to lines and levels. The planks for wall lining shall be tongued and grooved, unless otherwise specified.

HOLD FASTS
These shall be made from SS flat 40 × 5 mm size conforming to IS 7196 without any burns or dents. 5 cm length of S.S. flat at one end shall be bent at right angle and one hole 11 mm dia shall be made in it for fixing to wooden frame with 10 mm dia nut bolt. The bolt head shall be sunk into the wooden frame, 10 mm deep and plugged with wooden plug. At the other end 10 cm length of the hold fast flat shall be forked and bent of length as specified at right angle in opposite direction and embedded in cement concrete block of size 30 x 10 x 15 cm of mix 1:3:6 (1 cement : 3 coarse sand : 6 graded stone aggregate, 20 mm nominal size) or as specified.

Measurement:-
Hold fast is to be included in the frame no extra will be paid for hold fast.

All fixtures to be in SS make.

Glass Panels:
Glass paneling (Glazing) shall be done in the shutters of doors, windows and ventilators of bath, WC and Lavatories shall be provided with frosted glass the weight of which shall be not less than 10 kg/sqm. Frosted glass panes shall be fixed with frosted face on the inside. Glass panels shall be fixed by providing a thin layer of putty conforming to IS 419 applied between glass pane and all along the length of the rebate and also between glass panes and wooden beading.

Putty can be prepared by mixing one part of white lead with three parts of finely powdered chalk and then adding boiled linseed oil to the mixture to form a stiff paste and adding varnish to the paste at the rate of 1 litre of varnish to 18 kg of paste. Fixing of glass panes without beading shall not be permitted. Glazing shall be done after the shutters have been primed and prepared for painting, so that wood may not draw oil out of putty.

Fittings
Fittings shall be provided as per schedule of fittings decided by Engineer-in-Charge.
Cost of providing and fixing shutter shall include cost of hinges and necessary screws for fixing the same and all other fittings shall be included.

All fixtures to be in SS make & if at all mentioned in BOQ & design, then of mild steel brass, Aluminium or as specified. Some mild steel fittings may have components of cast iron. These shall be well made, reasonably smooth, and free from sharp edges and corners, flaws and other defects. Screw holes shall be counter sunk to suit the head of specified wood screws. These shall be of the following types according to the material used.

Mild Steel Fittings: These shall be bright finish black stone enameled or copper oxidized (black finish), nickel chromium plated or as specified.

Brass Fittings: These shall be finished bright satin finish or nickel chromium plated or copper oxidized or as specified.

Aluminium Fittings: These shall be anodized to natural matt finish or dyed anodic coating not less than grade AC 10 of IS 1868.

All fixtures to be in SS make, unless otherwise specified in BOQ.

The fittings generally used for different type of doors and windows are indicated in drawing. The fittings to be actually provided in a particular work shall, however, be decided by the Engineer-in-Charge.

Screws used for fittings shall be of the same metal, and finish as the fittings. However, chromium plated brass screws or stainless steel screws shall be used for fixing Aluminium fittings. These shall be of the size as indicated in respective drawings.

Fittings shall be fixed in proper position as shown in the drawings or as directed by the Engineer-in- Charge. These shall be truly vertical or horizontal as the case may be. Screws shall be driven home with screw driver and not hammered in. Recesses shall be cut to the exact size and depth for the counter sunk of hinges.

All doors should have the following fittings:

1. Tower bolt
2. Door mortise latch
3. Door stopper
4. Handle in and out
5. Cylindrical latch if required
6. All lock to have 3 keys
7. Hinges (as per design & BOQ)
8. External Door Closer

Universal Hydraulic Door Closer
These shall generally conform to IS Specifications for door closers (Hydraulically regulated) IS 3564.

The door closers may be polished or painted and finished with lacquer to desired color. Aluminium alloy door closer shall be anodized and the anodic coating shall not be less than grade AC 15 of IS 1868. All dents, burrs and sharp edges shall be removed from various components and they shall be pickled, scrubbed and rinsed to remove grease, rust, scale or any other foreign elements. After pickling, all the M.S. parts shall be given phosphating treatment in accordance with IS 3618.

Door closure size as per door

Designation of closers	Mass of the door (kg)	Width of the door (mm)	Remarks
1	Up to 35	Up to 700	For light doors such as double leaved and toilet doors.
2	36 to 60	701 to 850	Interior doors, such as of bed rooms, kitchen and store
3	61 to 80	851 to 1000	Main doors in a building, such as entrance doors

Performance Requirements:

After being fitted in its position when the door is opened through 90°, the same should swing back to angle of 20° ± 5° with nominal speed but thereafter, the speed should get automatically retarded and in case of doors with latches, it should be so regulated that in its final position the door smoothly negotiates with the latch.

MINIMUM SPECIFICATION OF BLOCK BOARD DOORS

- 38mm thick Solid core Block Board Door Shutters Single leaf panel swing door & Double leaf panel swing door
- thermo pressed
- with 12mm thick teak wood external lipping as per IS:2202
- Finished in approved melamine polish with 1.5mm thick laminate finished on both sides.
- Hardware to include like Hinges, Handle, Locks, Ex. Door Closer etc, as per design.
- All fixtures to be in SS make.
- With Vision panel of approved size.
- All finishes needs to be approved by consultant.

Measurement

Measurement to be done in Sqm.

HMPS DOOR

- Made with 18 g pressed steel section frame and shutter with 18 g GI sheets in box type construction
- Accessories-
    - bearing/ butt hinges,
    - aldrop,
    - tower bolts,
    - handle for pull - push,
    - lock key.
- Doors are given One coat of Zinc Each Epoxy primer(Auto finish paint) & two coats of Auto finish Paint.
- Rotated with 180° open able lever handle with lock from both sides Including handles and latches and door closure.
- Drawing needs to be approved by consultant.
- If Single leaf panel swing door of size 1.2 X 2.1 then DORMA PHCR 1000 Panic bar with 1 point locking with external trim to be provided as per BOQ & drawing
- If Double leaf panel swing door 1.5 X 2.1 then DORMA PHCR 1000 Panic bar with 3 point locking with external trim to be provided as per BOQ & drawing

Measurement

Measurement to be done in Numbers.

ALUMINIUM WORKS

Aluminium Sections

Aluminium sections used for fixed/openable windows, ventilators, partitions, frame work & doors etc. shall be suitable for use to meet architectural designs to relevant works and shall be subject to approval of the Engineer-in-Charge for technical, structural, functional and visual considerations. The aluminium extruded sections shall conform to IS 733 and IS 1285 for chemical composition and mechanical properties. The stainless steel screws shall be of grade AISI 304.

The permissible dimensional tolerances of the extruded sections shall be as per IS 6477 and shall be such as not to impair the proper and smooth functioning/operation and appearance of door and windows.

Aluminium glazed doors, windows etc. shall be of sizes, sections and details as shown in the drawings. The details shown in the drawings may be varied slightly to suit the standards adopted by the manufacturers of the Aluminium work, with the approval of Engineer-in-Charge. Before proceeding with any fabrication work, the contractor shall prepare and submit, complete fabrication and installation drawings for each type of glazing doors, windows, ventilators and partition etc. for the approval of the Engineer-in-Charge. If the sections are varied, the contractor shall obtain prior approval of Engineer-in- Charge and nothing extra shall be paid on this account.

Anodising

Standard Aluminium extrusion sections are manufactured in various sizes and shapes in wide range of solid and hollow profiles with different functional shapes for architectural, structural glazing, curtain walls, doors, window & ventilators and various other purposes. The anodizing of these products is required to be done before the fabrication work by anodizing/electro coating plants which ensures uniform coating in uniform colour and shades. The extrusions are anodized up to 30 micron in different colours. The anodized extrusions are tested regularly under strict quality control adhering to Indian Standard.

Thickness: The thickness of the finished coating measured by micron meter shall not be less than 50 micron nor more than 120 micron at any point.

Performance Requirements for the Finish

(i) Surface appearance: The finish on significant surfaces shall show no scratches when illuminated and is examined at an oblique angle, no blisters, craters; pinholes or scratches shall be visible from a distance of about 1 m. There shall not be any visible variation in the colour of finished surfaces of different sections and between the colours of different surfaces of same section.

(ii) Adhesion: When a coated test piece is tested using a spacing of 2 mm between each of the six parallel cuts (the cut is made through the full depth of powder coating so that metal surface is visible) and a piece of adhesive tape, approximately 25 mm x 150 mm approved by the Engineer-in-Charge is applied firmly to the cut area and then removed rapidly by pulling at right angles to the test area, no pieces of the finish other than debris from the cutting operation shall be removed from the surface of the finish.

Protection of Anodizing Finish:

It is mandatory that all aluminium members shall be wrapped with self-adhesive non-staining PVC tape, approved by Engineer-in-Charge.

Measurement:

All the aluminium sections including snap beading fixed in place shall be measured in running meter along the outer periphery of composite section correct to a millimeter. The weight calculated on the basis of actual average (average of five samples) weight of composite section in kilogram correct to the second place of decimal shall be taken for payment. (Weight shall be taken after anodizing). The weight of cleat shall be added for payment. Neither any deduction nor anything extra shall be paid for skew cuts.

Rate:

The rate shall include the cost of all the materials, labours involved in all the operations as described in nomenclature of item and particular specification.

DOOR, WINDOWS AND VENTILATOR SHUTTERS

Material, fabrication and dimensions of aluminium doors, windows and ventilators manufactured from extruded aluminium alloy sections of standard sizes and designs complete with fittings, ready for being fixed into the building shall be as per IS 1948.

Material

Aluminium alloy extruded sections used in the manufacture of extruded window sections shall conform to IS 733. Hollow aluminium alloy sections used shall conform to IS 1285.

Glass Panes

Glass panes shall weigh at least 7.5 kg/m2 and shall be free from flaws, specks or bubbles. All panes shall have properly squared corners and straight edges.

Screws

Screws threads of machine screws used in the fabrication of aluminium doors, windows and ventilators shall conform to IS 1362.

Fabrication

Frames: Frames shall be square and flat, the corners of the frame being fabricated to a true right angle. Both the fixed and opening frames shall be constructed of sections which have been cut to length, mitered and welded at the corners. Where hollow sections are used with welded joints, argon-arc welding or flash butt welding shall be employed (gas welding or brazing not to be done). Subdividing bars of units shall be tenoned and riveted into the frame.

Finish

Aluminium doors, windows and ventilators may be supplied in either matt, scratch-brush or polished finish. They may, additionally, also be anodized, if so required by the Engineer-in-charge. If colour anodizing is to be done then only approved light-fast shades should be used. A thick layer of clear transparent lacquer based on methacrylates or cellulose butyrate, shall be applied on aluminium doors, windows and ventilators by the supplier to protect the surface from wet cement during installation. This lacquer coating shall be removed after installation is completed.

Three track Aluminium window

- Three track Aluminium window of extruded modular and anodized Aluminium sections of approved make and of

- size 92 mm x 45.5 mm x 1.5 mm thk (wt 1.659 kg/Rm) for bottom and
- 92 mm x 31.75 mm x 1.3 mm thk. (wt 0.933 kg/Rm) for top and
- sides mounted on anodized Aluminium rectangular frame of size 100mm x 40mm x 1.3mm.(Wt 0.976 kg/m)
- The shutter comprising of bearing bottom and top of size 40mm x 18 mm x 1.25 mm thk (wt. 0.417 Kg/Rm)
- Interlocking section of size 40mm x 26.7 mm x 1.10 mm thk. (Wt. 0.469 kg./Rm) and
- hand sides of 40mm x 18mm x 1.25 mm thk (wt. 0.417kg/Rm) with
- 5 mm thick plain / frosted / tinted glass fixed in shutter including
- approved quality neoprene gasket, fixtures, fastenings and
- Accessories like PVC rollers, PVC weep holes, locks, handles etc. complete as directed by Engineer In Charge.

(Note: anodic film must not be less than 15 microns i.e. AC-15 as per IS, the anodizing must be scaleted by keeping the anodized section in boiling de-anodized water for a period of one hour)

Four track Aluminium window

- Four track aluminum window of extruded modular and anodized aluminum sections of approved make and of
- size 122.2 mm x 45.5 mm x 1.3 mm thk (wt 1.829 kg/Rm) for bottom and
- 122.2 mm x 31.75 mm x 1.2 mm thk. (wt 1.093 kg/Rm) for top and
- sides mounted on anodized aluminum rectangular frame of size 127mm x 25.4mm x 1.3mm(1.052 kg/m)
- The shutter comprising of bearing bottom and top of size 40mm x 18 mm x 1.25 mm thk (wt. 0.417 Kg/Rm)
- Interlocking section of size 40mm x 26.7 mm x 1.10 mm thk. (Wt. 0469 kg./Rm) and
- hand sides of 40mm x 18mm x 1.25 mm thk (wt. 0.417kg/Rm) with
- 5 mm thick plain / frosted / tinted glass fixed in shutter including
- approved quality neoprene gasket, fixtures, fastenings and
- Accessories like PVC rollers, PVC weep holes, locks, handles etc. complete as directed by Engineer In Charge.

(Note: anodic film must not be less than 15 microns i.e. AC-15 as per IS, the anodizing must be scaleted by keeping the anodized section in boiling de-anodized water for a period of one hour)

Aluminium louvered window

- Aluminium louvered window with anodized Aluminium frame of approved make and of
- size 40mm x 20mm x 2.0mm (wt. 0.605 kg/Rm) including
- adjustable Aluminium frame,

- 4 to 6mm thk. frosted glass,
- Fixtures and fastenings etc. complete as directed by Engineer In Charge.

FITTINGS

Stainless Steel Friction Stay

The stainless steel friction stays of make approved by the Engineer-in-Charge shall be used. The SS friction stays shall be of grade AISI-304 and of sizes specified in nomenclature of item.

Lockable Handles

The lockable handle shall be of make approved by the Engineer-in-Charge and of required colour to match the colour of powder coated /anodized aluminium window sections.

Tubular Handle

The tubular handle bar shall be aluminium polyester powder coated minimum 50 micron to require colour/anodized AC 15. Outer dia of tube shall be 32 mm, tube thickness 3.0 mm and centre to centre length 2115 mm + 5 mm.

ROLLING SHUTTER

- Supplying and fixing rolling shutters of approved make, made of required size M.S. laths interlocked together through their entire length and jointed together at the end by end locks mounted on specially designed pipe shaft with brackets, side guides and arrangements, for inside and outside locking with push and pull operation complete
- Including ball bearing, the cost of providing and fixing necessary 27.5 cm long wire springs grade Nos2 and 80 x 1.25 mm M.S. laths with 1.25 mm thick top cover.
- Including motorized device shaft and crank operation 1.2 M above FFL for operating rolling shutters etc. complete. including painting primer 2 coats with zinc chromate and 2 coats of synthetic enamel paint complete as directed by engineer in charge

AUTOMATIC BI PARTING SLIDING DOORS

- Providing & fixing Automatic sliding door system of ht 2200 mm with front mounted Automatic runner of length 4000 mm so as to provide clear passage gap of 2000 mm to have 2 individual runner mounted 12 mm clear toughened glass sliding shutters.
- Automatic system to be of DORMA ES-200 or equivalent.
- Easy automatic bi parting sliding door operator, modular design i/c Microprocessor control, self-learning with adjustable parameters for opening & closing speed, hold open time & opening & closing force, reversing when obstruction is en-countered.
- Class of protection IP 20.
- The system to made operative only on UPS power supply 230v,50/60Hz.
- Operator length 4000 mm with shutter opening passage of 2000 mm with clear min ht of 2050 mm. Max. weight per leaf = 2 x 85 Kg (for Bi-parting doors). Operator body finish : Silver Anodized finish.

- Accessories light Barriers, pair of radars, Battery pack floor guide etc all complete with fixing of operator & glass by authorized DORMA agency or equivalent.
- System to include 5 years warranty on motors & 1 year on accessories

Measurement

Rolling shutter in Sqm & Motors in Nos.

KERB STONE

- Providing and laying at or near ground level factory made kerb stone of M- 25 grade cement concrete in position to the required line, level and curvature, jointed with cement mortar 1:3 (1 cement: 3 coarse sand),
- including making joints with or without grooves (thickness of joints except at sharp curve shall not to more than 5mm),
- including making drainage opening wherever required complete etc. as per direction of Engineer-in-charge
- Length of finished kerb edging shall be measured for payment.
- Size:- 300mmx150mmx450mm

Measurement

Measurement to be done in running meters.

PAVING BLOCKS

- Paver blocks-Supplying and installing 80 mm thick M40 Grade pre-cast concrete hydraulically pressed uni-regular machine made inter locking paving blocks of approved design & color,
- Including transportation of the blocks to the site, preparation of surface including supplying and filling with dry river sand/crushed dry aggregate to 50mm thick, leveling and compacting with plate vibrator and
- laying of the inter locking paving blocks with sand binding and
- final compaction with plate vibrator of 3 tonne capacity finishing the surface including cutting of blocks at the edges including all labor, material, etc. complete

Measurement

Measurement to be done in Sqm.

PRECAST GRATING

- Providing and fixing Precast grating to take 40 T load thickness as per manufacturers specification with slots for water drainage with necessary provision for lifting lugs,
- Aligning and fixing in position with cement mortar 1:3 (1 cement, 3 sand) etc., complete as per specifications, drawings and as directed by Engineer In charge.
- Prior approval on the design of grating to be taken for engineer in charge

Measurement

Measurement to be done in Running Meter.

C I COVERS

Circular

- 600 mm dia C.I. cover
- with locking arrangement etc.
- heavy duty 40 T load capacity cover

Measurement

Measurement to be done in Per Unit Number.

MS MANHOLE COVER

- Providing, and fixing MS manhole cover including frame in angle section with locking arrangement
- including grouting frame in RCC etc. complete as directed by engineer in charge
- Weight not less than 15 kg per frame

Measurement

Measurement to be done in Per Unit Number.

CUTTING OF CONSTRUCTION JOINTS CONCRETE

- Cutting of construction joints in concrete pavement by mechanical means within 10 to16 hrs. of casting of bay / slab as directed.
- Size of joints 25 mm deep & 6 mm wide. etc. complete as directed by Engineer-in-charge

Measurement

Measurement to be done in running meters.

DRESSING OF C.C.PAVEMENT

- Dressing of C.C. pavement, dummy, transverse, longitudinal & expansion joints with hot rubberized sealing compound or equivalent confirming to IS 1834-1984 after proper cleaning with compressed air,
- applying required primer &
- Providing a layer of lime powder over hot sealing compound etc. complete as directed.
- Sealing joints 25 mm deep & 6 mm wide.

Measurement

Measurement to be done in running meters.

CONVEX MIRROR

- Providing and installation of new convex mirror and pole.
- Including foundation work.
- Rate shall include for the supply and installation of 50mm dia.
- Tubular galvanized steel post.
- Height of post between 2100 and 2500 mm.
- 80 cm diameter mirror

Measurement

Measurement to be done in Per Unit Number.

LANDSCAPING

All landscaping lawn plantation and trees work should include free maintenance for 3 months

Garden Earth Work

- Filling Red Hill Earth & Cow Dung Manure mixing in 2:1 proportion,
- watering to the depth of 1" three times,
- weeding after every watering before plantation of the grass,
- leveling & rolling after proper compaction

Measurement

Measurement to be done in Cum.

Korean carpet lawn

- Planting Korean carpet lawn in tiles of 300 X 300 mm.
- planting of good quality lawn suckers by dibbling method in staggered fashion at specified intervals
- Watering and proper mowing etc. maintaining for 3 month after completion of plantation and replacement of casualties till 3 month.

Measurement

Measurement to be done in Sqm.

Palspam lawn

- Providing and laying Palspam lawn.
- Planting of good quality lawn suckers by dibbling method in staggered fashion at specified intervals including transport & unloading.
- Watering and proper mowing etc. maintaining for 3 month after completion of plantation and replacement of casualties till 3 month. Complete as directed by engineer in charge

Measurement

Measurement to be done in Sqm.

Phosphalum Saint Agustin grass

- Planting Phosphalum Saint Agustin grass at 50mm c/c
- planting of good quality lawn suckers by dibbling method in staggered fashion at specified intervals
- Watering and proper mowing etc. maintaining for 3 month after completion of plantation and replacement of casualties till 3 month.

Measurement

Measurement to be done in Sqm.

Plantation, Shrubs, Shrubbery

- Planting well grown, healthy, bushy shrubs as per specified variety and sizes in drawing,
- Planting at desired location and specified distances, as per drawing

- Maintaining for 3 month after completion of plantation and replacement of casualties till 3 month.

Acalypha Red - 1.5 Ft.
Acalypha Green - 1.5 Ft.
Coleus height 9”to12”
Golden Duranta / Duranta repens height 9”to12”
Euphorbia caracasana / Burgundy leaves
Ixora Duffi
Coleomena
Golden Diosma

Measurement

Measurement to be done in per Number.

Planting trees

- Excavate pits as per size required according to the tree
- Filling of Red Hill Earth, Cow Dung Manure & good earth from excavated pit in mix 2:1:1 proportion the excavated pits,
- Watering & providing well grown trees with minimum average girth of 2" and minimum height of 10' above finished level after plantation of specified variety , at desired location & at specified distances as per drawing.
- Achieving finished grade level.
- Planting the tree with appropriate anchoring, leveling the top soil surface as specified after plantation, staking to balance the tree.
- Preparation of tree basin, watering
- Maintaining for 3 month after completion of plantation and replacement of casualties till 3 month.

Delonix regia / Gulmohar 4' height
Foxtail palm 10' to 12' height
Plumeria rubra (Temple tree Red flowers) - 4' height
Cestrum nocturnum / Raat Rani - 4' height
Bougainvillea glabra / Purple Single Flowers

Measurement

Measurement to be done in per Number.

Flowering Pot

- Flower Bed with soil and flowering shrubs
- Size of Pot 3' length and 1'6" wide

Measurement

Measurement to be done in per Number.

DISMANTELLING AND DEMOLITION

TERMINOLOGY

(i) **Dismantling:** The term 'Dismantling' implies carefully separating the parts without damage and removing. This may consist of dismantling one or more parts of the building as specified or shown on the drawings.

(ii) **Demolition:** The term 'Demolition' implies breaking up. This shall consist of demolishing whole or part of work including all relevant items as specified or shown on the drawings.

All materials obtained from dismantling or demolition shall be the property of the client otherwise specified and shall be kept in safe custody until they are handed over to the Engineer - Charge/ authorized representative.

The demolition shall always be well planned before hand and shall generally be done in reverse order of the one in which the structure was constructed. The operations shall be got approved from the Engineer-in-Charge before starting the work.

Due care shall be taken to maintain the safety measures prescribed in IS 4130.

Necessary propping, shoring and or under pinning shall be provided to ensure the safety of the adjoining work or property before dismantling and demolishing is taken up and the work shall be carried out in such a way that no damage is caused to the adjoining work or property. Wherever specified, temporary enclosures or partitions and necessary scaffolding with suitable double scaffolding and proper cloth covering shall also be provided, as directed by the Engineer-in-Charge.

Necessary precautions shall be taken to keep noise and dust nuisance to the minimum. All work needs to be done under the direction of Engineer-in-Charge. Helmets, goggle, safety belts etc. should be used whenever required and as directed by the Engineer-in-Charge.

The demolition work shall be proceeded with in such a way that it causes the least damage and nuisance to the adjoining building and the public.

Dismantling shall be done in a systematic manner. All materials which are likely to be damaged by dropping from a height or by demolishing roofs, masonry etc. shall be carefully removed first. Chisels and cuters may be used carefully as directed. The dismantled articles shall be removed manually or otherwise, lowered to the ground (and not thrown) and then properly stacked as directed by the Engineer-in-Charge.

Where existing fixing is done by nails, screws, bolts, rivets, etc., dismantling shall be done by taking out the fixing with proper tools and not by tearing or ripping off.

The contractor shall maintain/disconnect existing services, whether temporary or permanent, where required by the Engineer-in-Charge.

No demolition work should be carried out at night especially when the building or structure to be demolished is in an inhabited area.

Screens shall be placed where necessary to prevent injuries due to falling pieces.

Water may be used to reduce dust while tearing down plaster from brick work.

Safety belts shall be used by labourers while working at higher level to prevent falling from the structure.

First-aid equipment shall be got available at all demolition works of any magnitude.

All material / debris needs to be disposed outside the plot to area allocated by the government authorities including taking approvals for them.

Demolition of RCC members using diamond saw cutter and mechanical and pneumatic breakers

- Cutting and breaking of RCC members using diamond saw cutter and mechanical and pneumatic breakers without damaging the existing structure breaking of existing RCC cutting the reinforcement steel using cutters first break, cut and separate the joint and then proceed further separating the same from existing structure, of any thickness including all finishes in workman like manner without disturbing the adjoining structure, including necessary scaffolding, propping, Bracing etc. covering of the Machine.
- The debris to be disposed outside the plant as directed by engg in charge etc.
- The reinforcement cut will be separated from the concrete and should be ghanded over to client.
- Contractor will have to take permission from government authorities for disposal of the debris
- Outside the plot in areas assigned by the authority for the same no extra payment will be given for the disposal activity.

Measurement

Measurement to be done in per Cum.

Demolition of Brick / Block masonry

- Dismantling existing brick / block masonry of any thickness including plastering and all other finishes, including wall tiles, stones, marbles etc in workman like manner manually or by mechanical means including stacking of serviceable material at desired place as per instruction of engineer in charge.
- Including necessary scaffolding, covering the machines disposing debris outside the plot with prior permission from government authorities at no extra cost as directed by engineer in charge etc. complete.

Measurement

Measurement to be done in per Cum.

Demolition of rubble soling

- Breaking, Demolition and carting away, existing rubble soling of any thickness by mechanical means including stacking of material at desired place
- Disposing the debris outside the plot with prior permission from government authorities at no extra cost as directed by engineer in charge etc. complete.

Demolition of fencing, post, barbed wire, poles, etc

- Dismantling and disposing fencing, post, barbed wire, poles, clips nails and associated hardware. stacking including all earth work and dismantling of concrete

etc. in base of and carting off at location allotted and with prior permission from government authorities at no extra cost

Measurement

Measurement to be done in per Sqm.

General Mode of Measurement for Demolition:

Demolition and dismantling IS 1200 Part 18	
Sr. No.	**Description**
	Unit
1	Demolition of wall brick work reinforced brick work should be taken in Cubic metres
2	Demolition of stone masonry should be taken in Cubic metres
3	Cleaning of brick and stalking the same should be in Numbers
4	Removing and cutting of reinforcement should be measured in KG
5	Removing of roofing should be taken in Cubic metres
6	Removing of ceiling should be taken in Square metres
7	Removing of flooring should be taken in Cubic metres
8	Concrete paving shall be measured in square metres stating their thickness
9	Partitions or light walls of lath and plaster, trellis work (JAFFARI), expanded metal, thin concrete or terra-cotta slabs and other similar materials, including framework, if any, shall be measured in square metres stating the thickness.
10	wooden ballies shall be measured in running metres.
11	All other woodwork under 40 cm2 in section shall be measured in running metres and average 40 cm2 and over in cubic meter
12	Door and windows should be measured in numbers
13	Post RCC struct should be measured in Running Meter
14	Fencing removal should be measured in Square metres
15	Glazing removal should be measured in Square metres
16	Pipes should be measured in Running Meter if joints special fitting are required to be removed it should be measured in Numbers

17	W/C cisterns, urinals should be measured in numbers
18	Man hole and inspection chambers should be measured in numbers
	Measurement
	Demolition and separating and disposal up to 100m is included above 100m lead should be extra
	Thickness of brick work is excluding brick work
	Honey combed brick work should be measured as solid
	Removal of door frames will be included in removal of doors and windows item

GALVANIZED CHAIN LINK FENCING

Material
Galvanized Chain Link Fencing of 10 gauge G.I. Mesh, sizes 50 x 50 mm diamond pattern.

Fixing :
GI chain link shall be stretched and fixed in specified width, strengthening with 2 mm dia wire or nuts bolts & washers as required. Fixed 75 mm below finished ground level / coping, including providing and erecting ISA 65x65x6 angle posts @ 2.5m C/C with cross support at every 6th pole & at corners and 2 nos 6mm dia MS bars at top and bottom with necessary U hooks, nuts and bolts, washers, total height of fencing @ 2.1m above ground including embedding the angle post in concrete block of 0.45m x 0.45m x 0.6m of cement concrete M15 grade including necessary excavation, and cleaning, preparing the surface, applying one coat of red oxide zinc chromate primer and two coats of Synthetic Enamel paint of approved manufacture, brand, color, shade etc. complete as directed by Engineer In Charge. (first coat of synthetic enamel paint after fabrication and second coat after erection including touching up the primer coat). Gate with locking arrangement in Chain link fencing could be provided as per requirement but to be quoted separately.

Measurements:
The length and width shall be measured correct to a cm. The area shall be calculated in square metres, correct to two places of decimal.

G.I. CRIMPED WIRE MESH

- G.I. crimped wire mesh of required openings of size 25 mm x25 mm or of any size with main and cross wires of 10 gauge approved type
- Including fixing of wire gauge to M.S. frame works by welding and fixing the same by anchor fastener or concrete nails or welding the same to Steel as per drawing
- Painting the same with 2 coats of primer and 2 coats of synthetic enamel paint. As per direction of engineer in charge. Complete.

Measurement
Measurement to be done in per Sqm.

BOLT AND FASTENERS

MS foundation bolt

- MS foundation bolt of grade of steel minimum 5.8 to maximum 8.8 of any diameter at any and all level including making treads and bends as per drawing and specification completed as directed by engineer in charge.
- Note rate is including providing and fixing of template in MS steel.

Foundation Bolts and nuts in RCC column / pedestal / beam

- Foundation Bolts and nuts in RCC column / pedestal / beam at any level including maintaining the accuracy towards line, level & position including making and using the template etc. complete as directed by Engineer In Charge.
- Contractor will take due care for its threads and rusting by applying grease and cotton waste.

Mechanical Anchor Fasteners

- Mechanical Anchor Fasteners of Hilti Make or equivalent confirming to IS 1367 (Part 3) at required locations and level including drilling the hole, cleaning and anchoring the bolt as per manufacturers specifications etc. complete as directed by Engineer In Charge.

Chemical Anchor Fasteners

- Chemical Anchor Fasteners of Hilti Make or equivalent confirming to IS 1367 (Part 3) at required locations and level including drilling the hole, cleaning with blow pump and anchoring the bolt with chemical as per manufacturers specifications etc. complete as directed by Engineer In Charge.

CEMENT CONCRETE PAVEMENT (UNDER ORDINARY CONDITIONS)

Concrete is same as above

Compaction of Concrete

Compaction shall be carried out by electrically (or) diesel operated needle and screed vibrators as stipulated hereafter. Needle vibrator should be used all over the area for obtaining initial compaction of concrete. These should be of diameter not less than 4.5 cm. If the vibrator are pneumatic the pressure must not be below 4 kg/sq.cm. If electrically operated, they should have a minimum frequency of 3500 impulses per minute.

There should be at least three needle vibrators working in any bay. A vibrating screed consisting of a steel or timber section weighing not less than 15 kg. per metre with a tamping edge of not less than 7 cm width and having a vibrator mounted thereon shall follow needle vibrators to obtain full compaction. The face of the wooden tamping edge of the screed shall be lined with M.S. Plate rigidly fixed by means of counter sunk screw. Where screed vibrators are used for compaction, a standby unit shall always be maintained ready for use, should the other one go out of order. Where electrically driven vibrators are employed, a standby diesel pneumatic unit shall be kept ready for use in case of power failure. At the discretion of the Engineer-in-Charge, for compaction at edges and joints, vibrators may be supplemented by hand tamping and rodding for securing satisfactory results. Under no circumstances, honey combing of concrete at joints or elsewhere shall be permitted.

When using screed vibrator for compaction it should not be dragged over the concrete. During the initial passes it shall be lifted to the adjacent forward position in short steps, subsequently, it shall be slowly slided over the surface with its axis slightly tilted away from the direction of sliding and the operation repeated until a close, dense surface is obtained.

Concreting shall be carried out in one operation between the expansion joints and construction joints without any break at the dummy joints.

Concrete shall be deposited on the base as near the joints as possible without touching them.

It shall then be shoveled against the sides, maintaining equal pressure and deposited approx. 50 mm higher than the depth of the joints, care being taken that it is worked well around the joints. The concrete shall not be dumped from the bucket directly upon or against the joints.

Workmen shall not be allowed to walk on freshly laid concrete and proper cat walk shall be provided with independent supports beyond concreting bays.

Finishing of Concrete

During compaction, any low or high spots shall be made up by adding or removing concrete.

After longitudinal floating has been completed but while concrete is still plastic, the slab surface shall be tested for trueness with a 3 m straight edge. Any depressions or high spots showing departure from the true surface shall be immediately rectified. High spots shall be cut down and refinished. Depressions shall be enlarged to about 8-10 cm and filled up with fresh concrete, compacted and finished.

The straight edge testing the refloating is to continue until the entire surface:

(a) is free from observable departure from the straight edge,

(b) Conforms to the required levels and across section, and

(c) Shall conform to the specified surface when the concrete has hardened.

The foregoing work is to be carried out while the concrete is still plastic and workable.

Belting

Just before concrete becomes non-plastic, the surface shall be belted with a two ply canvas belt not less than 20 cm wide and at least 1 metre longer than the width of the slab. Hand belts shall have suitable handles to permit controlled uniform manipulation. The belt shall be operated with short strokes transverse to the centre line of the pavement and with rapid advance parallel to the centre line.

Brooming

After belting and as soon as the surplus water, if any, has risen to the surface, the pavement shall be given a broom finish with an approved steel or fiber broom not less than 45 cm wide. The broom shall be pulled gently over the surface of the pavement from edge to edge. Adjacent strokes shall be slightly overlapped. Brooming shall be perpendicular to the centre line of the pavement and so executed that the corrugations formed shall be uniform in character and width and not more than 1.5 mm deep.

Brooming shall be completed before the concrete reaches such a stage that the surface is likely to be torn or unduly roughened by the operation. The broomed surface shall be free from porous or rough spots, irregularities, depressions, and small pockets such as may be caused by accidental disturbing of particles of coarse aggregates embodied near the surface. The brooming shall be of uniform pattern all through.

Edging :

After belting/brooming has been completed but before the initial setting of concrete, the edges of the slab shall be carefully finished with an edger of 6 mm radius, and the pavement edges shall be left smooth and true to line.

Honey Combing

The side forms shall not be removed until 12 hours or such longer period as the Engineer-in-

Charge may decide after the laying of concrete.

As soon as the side forms are removed, any minor honey combed area shall be filled with mortar composed of one part of cement and two parts of fine aggregate. Major honey combing areas or segregated concrete or other defective work or areas damaged by removal of the forms or concrete damaged by rain or due to any other reason whatsoever shall be considered as defective work and shall be removed and replaced by the contractor at his own expense. The total area of honey combed surface shall not exceed 4 per cent of the area of the slab side. However, no individual honeycomb patch shall exceed 0.1 sqm. Engineer-in-Charge's decision as to whether the concrete is defective or not shall be final and binding.

Surface Accuracy

After the concrete has sufficiently hardened after about 12 hours and not later than 24 hours, the surface shall be tested again for high spots. All high spots shall be marked and those exceeding 3 mm shall be ground down immediately. Care shall be taken to see that the grinding does not in any way damage the concrete surface.

The final surface finish is to be such that when tested with a profilograh/roughness indicator/or a 3 metre long straight edge or an equivalent mechanical unevenness indicator placed anywhere within the same or adjoining slab in any direction on the surface, there shall be no variation greater than 3 mm.

If the surface irregularity exceeding 3 mm still remains despite grinding the concrete shall be removed to its full depth. The area of concrete to be removed shall be complete slab between the nearest joints, where the defective slab is less than 4.5 metres from the expansion joint, the whole area upto the expansion joint shall be removed to the full depth. The concrete so removed shall not be reused in the work. Fresh concrete shall be laid in the manner already described in above paras and shall again be subject to test for surface accuracy and other quality control measures. Nothing extra shall be paid on this account.

Every slab shall bear an impression not exceeding 3 mm in depth comprising the number allotted to the slab and the date on which it is laid. This impression shall be formed by the contractor when the concrete is green so as to leave permanent mark on setting.

Initial Curing

Immediately after completion of the finishing operations, the surface of the pavement shall be entirely covered with wetted burlap, cotton or jute mats. The mats used shall be of such length (or width) that as laid they shall extend at least 45 cm beyond the edges of the slab. The mats shall be placed so that the entire surface and both edges of the slab are completely covered. This covering shall be placed as soon as, in the judgment of the Engineer-in-Charge the concrete has set sufficiently to prevent damage to the surface prior to being placed, the mats shall be thoroughly saturated with water and shall be placed with the wettest side down. The mats shall be so placed and weighed down as to cause them to remain in intimate contact with the surface covered, and the covering shall be maintained full wetted and in position for 24 hours after the concrete has been placed or until the concrete is sufficiently hard to be walked on without suffering damage. Water shall be gently sprayed so as to avoid damage to the fresh concrete. If it becomes

necessary to remove a mat for any reason, the concrete slab shall not be exposed for a period of more than half an hour.

Worn burlap or burlap with holes shall not be permitted. Burlap reclaimed from previous use other than curing concrete shall be thoroughly washed prior to use for curing purposes. If burlap is obtained in strips, shall be laid to overlap by at least 150 mm.

Burlap shall be placed from suitable bridges. Walking on freshly laid concrete to facilitate placing burlap shall not be permitted.

Final Curing

Upon the removal of the burlaps, the slab shall be thoroughly wetted and then cured as follows:-

All joints shall be filled with filler in order to prevent the edges of joints from getting damaged and entry of clay materials into the joints during final curing. Exposed edges of the slab shall be banked with a substantial berm of earth. Upon the slab shall then be laid a system of transverse and longitudinal dykes of clay about 50 mm high immediately covered with a blanket of sandy soil free from stones to prevent the drying up and cracking of clay. The rest of slab shall then be covered with sufficient sandy soil so as to produce a blanket of earth not less than 40 mm deep after wetting. The earth covering shall be thoroughly wetted while it is being placed on the surface and against the sides of the slab and kept thoroughly saturated with water for 21 days and thoroughly wetted down during the morning of the 22^{nd} day and shall thereafter remain in place until the concrete has attained the required strength and permission is given by the Engineer-in-Charge. Thereafter the covering shall be removed and the pavement cleaned and swept. If the earth covering becomes displaced during the curing period, it shall be replaced to the original depth and re saturated.

Contractor shall appoint chowkidars at his expense to prevent workmen, cattle, etc., straying on the pavement concrete.

Concrete shall not be subjected to any load or weight of any plant until at least 28 days after laying.

Construction Joints

Construction joints shall be provided as shown in the drawing and also at places where concreting is stopped due to unforeseen circumstances. The joints shall be straight and vertical through the full thickness of the slab. While concrete in adjacent bay is still green, flats of suitable size shall be drawn along the edge and a groove of size 6 mm × 25 mm deep shall be neatly formed and finished.

The edges of the groove shall be full nosed. After curing of concrete is complete, this groove shall be thoroughly cleaned of all sand dust and shall be perfectly dried and filled with hot poured sealing compound conforming to grade B of IS 1834. Before filling with sealing compound the faces of concrete of the joint shall be coated with primer of approved brand to a depth of 25 mm at the rate of 2.6 liters per 10 square meters. Bitumen emulsion shall not be used as primer.

Dummy Joints

The joints shall be 6 mm wide and shall extend vertically from the surface of the slab to a depth equal to 1/3rd of the thickness of the slab but not less than 4 cm in any case. The joint may be formed by depressing into the soft but compacted concrete a high tensile M.S. or other approved Tee of flat bar of depth not less than required depth of the joint plus 25 mm. The bar used for forming the groove shall be coated with soft soap or other suitable lubricant to facilitate its removal when the steel Tee or flat is removed joints shall be neatly formed with proper tools and mortar/fine material from the slab itself. No additional cement mortar (rich or otherwise) shall be used.

Cutting or sawing by a saw mounted on a movable frame and driven mechanically shall also be permitted as a method for making the joint. In this case the width may be reduced to 6 mm. any other method for making joints can be followed with the prior approval of the Engineer-in-Charge.

In all cases, except where cutting is done with saw, the joint edges shall be bullnosed. Care should be taken to see that the edges of the grooves are not damaged.

The grooves shall be filled with hot poured sealing compound conforming to Grade B of IS:1834. Prior to filling with sealing compound, the joints shall be cleaned by compressed air and primed with Shalijet primer or equivalent at the rate specified

All joints shall be sealed as soon as practicable after 28 days of casting of cc pavement.

Joints shall be sealed flush with the adjacent pavement surface in summer and 3-4 mm below finished concrete surface in winter. The pavement shall be opened to traffic only after joint sealing over the entire pavement. To prevent tackiness or pickup under traffic, the exposed surfaces of the sealing compound shall be dusted with hydrated lime, if directed by Engineer-in-Charge, for which nothing extra shall be paid to the contractor.

In case of sudden rain or storm, the work can be concluded at the dummy joints but these will then be formed as construction joints.

Before sealing of joints, it may be ensured that the groove extends fully across the bay between consecutive longitudinal joints, in the case of transverse joints and is continuous in the case of longitudinal joints. Any concrete or other foreign matter must be removed from the groove.

Measurement

In Cubic Meter

Premoulded Joint Filler in Expansion Joint:

It shall conform to IS 1838 (Pt. I). The thickness shall be 25 mm with tolerance 1.5 mm. and shall be of the maximum available standard length not less than one lane width. The filler board shall be positioned vertically with the prefabricated joint assemblies along the line of the joint within tolerance of + 10 mm from the intended line of the joint. The depth of board shall be 25 mm less than thickness of slab within a tolerance of ± 3mm so that the top of the board shall be below the surface or will not impead the passage of the finishing straight edge or oscillating beam of the paving machine.

Bitumen Hot Sealing Compound:

The joint sealing compound shall be fuel and heat resistant type complying to grade B of IS 1834. It shall be capable of adhering to the concrete without cracking, spalling and disintegration.

CONSTRUCTION PROCEDURE

Expansion joints shall be provided as shown in the drawing and as per directions of Engineer-in- Charge. All joints shall be constructed true to line with their faces perpendicular to the surface of the pavement. The joint shall be 20 mm wide. The depth of the non-extruding filler pad shall be 25 mm less than the depth of the concrete slab

Before the provision of expansion joint, the face of the already laid concrete slab shall be painted with primer at the rate of 2.6 liters per 10 square metres. The expansion pad shall be properly cut to shape and shall then be placed in position abutting the painted face of the already laid concrete slab. The adjacent slab shall then be concreted. The face of the pad against which the new concrete slab is to be laid shall also be painted with primer before laying the concrete, while concreting a neat groove of size 20 mm x 25 mm as per drawing shall be formed on top of the pad taking care that the edges are absolutely

straight and that the groove so made does not get filled with any material like concrete, mortar and other rubbish.

Before the curing process is started, the top of expansion joint shall be filled with bitumen sand mixture in order to ensure that no foreign material used in curing enters into the joint. This filling shall be removed before filling the joints with sealing compound.

For sealing the joints following operations shall be carried out :—

a) The joints are cleared of any foreign matter to the full depth upto the top of expansion pad with steel spatula.

b) The joints are blown with compressed air.

c) Cleaning is done with Kerosene oil.

d) Priming is done with spray gun @ 2.6 liters per 10 sqm of the surface to be primed.

e) The primer is allowed to dry completely before pouring the sealing compound.

f) The sealing compound grade 'A' is heated to the required temperature ranging between 155 deg. C to 165 deg. C or to the temperature range specified by the manufacturer. Overheating shall be avoided. Pouring shall be done from vessel with spout in such a manner that the material will not get spilled on the exposed surface of the concrete, any excess filler on the surface of the pavement shall be removed immediately and the pavement surface cleaned.

g) The filling shall be worked into the joints with hot flats to ensure escape of trapped air.

h) The filling is then ironed with hot iron. It is recommended that while in summer the joints may be sealed flush with the adjacent pavement surface, in winter the sealing compound may be filled to a depth 3-4 mm below the surface.

i) The edges of the joints are then cut and trimmed to ensure neat and straight line finish.

j) To prevent tackiness or pick up under traffic, the exposed surfaces of the sealing compound shall be dusted with hydrated lime, if directed by Engineer-in-Charge (Nothing extra shall be paid for the same).

Measurements:
The measurement of the specified depth of joint shall be recorded in metres correct to two places of decimals.

M.S. RAILING

Materials:

All structural steel shall conform to IS 226-1963 sections for grills and shall be free from loose mill scales, rusts, pitting or any other defects affecting its strength and durability.

Fabrication:

The grill/railing shall be fabricated to the design and pattern shown in the drawings. All joints shall be made in best workman like manner with slotting and welding as required to the specified size and shape. The edge of the M.S. flats shall be suitably mitred before welding to get the desired shape. The joints shall be filled to remove excess stay after welding screws, nuts, washers, bolts, rivets and any other miscellaneous fastenings devices shall be of steel and shall be provided by the contractor.

Manufactured Rails then be fixed in between the posts, balusters, M.S. frame work etc. to correct alignment. Any undulations, bends etc. found shall be rectified by the contractor at his own cost.

The complete assembly of railing so fixed shall be firm and there shall not be any lateral movements.

Staircase Railing or side hung to be, 900 mm high with main 32mm dia MS pipe 1.5mm thick as main runner and 25mm dia pipe at 3 levels along the running length of the staircase and vertical supports in 32mm dia MS pipes @ 1500mm c/c, the pipes to be 1.5mm thick with necessary supports, anchor fasteners, supports, base plates, screws.

Samples:

Samples of grill and railings shall be submitted for approval of the Engineer-in-charge and to be got approved before taking up for mass fabrication.

Installation:

The approved grills shall be fixed in position where specified and shown in drawings including in masonry walls, teakwood frames, hand railings etc. Any damages to walls, frames etc. caused during fixing the grills shall be made good by grouting with cement mortar/packing /repairing properly at the contractors cost.

Painting:

The railing to be finished with two coats of approved Enamel paint inclusive of all surface preparation, two coats of anti-corrosive Zinc chromate primer as specific etc complete.

Measurement:

The railing shall be measured correct to two decimal places. Square meter to be considered. Individual rails not to be measured separately.

The rate is to include the cost of all materials, labour, transporting, fabricating, installing, scaffolding if necessary, painting, grouting etc. complete.

STAINLESS STEEL RAILING

- Providing and fixing stainless steel railing 1000 mm high made of SS Grade 304, made of solids, Hollow tubes, channels, plates etc.,
- including welding, grinding, buffing, polishing and making curvature (wherever required) and
- fitting the same with necessary stainless steel nuts and bolts complete, i/c fixing the railing with necessary accessories & stainless steel dash fasteners , stainless steel bolts etc., of required size, on the top of the floor or the side of waist slab with suitable arrangement as per approval of Engineer-in-charge,

Measurement:

- The railing shall be measured correct to two decimal places. Square meter to be considered. Individual rails not to be measured separately.
- The rate is to include the cost of all materials, labour, transporting, fabricating, installing, scaffolding if necessary, etc. complete.

PLUMBING WORKS

General

General conditions of contract, particular specifications and special conditions of contract will apply in addition to this section.

Basis Of Tendering :-

The tender shall be complete covering the entire work of plumbing system and ancillary services including all building system and outside utilities as shown and specified.

The contractor shall consult specifications, drawings and the schedule of quantities which are instruction on this system.

Drawing :-

The drawings accompanying these specifications are design drawings and generally are schematic. They do not show every offset, T, Cross, Y, junction coupling/flanges etc., which are required for installation in the space provided.

The contractor shall prepare detailed shop drawings by following these drawings, as closely as is practicable, with necessary additional bends, elbows or junctions etc., where required to suit local site conditions, from actual site measurement taken, get the same approved from the Consultants in good time & follow then at site, without additional cost to the Owner.

The Owners reserve the right to make any reasonable change in outlet location prior to roughing in. All connections and appurtenances, shown in the various diagrams, shall be included in the finished job. The contractor shall visit the site prior to bidding, to familiarize himself with all conditions.

It shall be the contractor's responsibility to co-ordinate with all others for proper and adequate installation clearances.

Ordinance, Code And Regulations:-

It shall be the Contractor's responsibility to provide complete system, as indicated and as required by applicable code. Unless, otherwise approved the product shall bear the mark of approval of ISI as required by the Governing bodies, code and ordinances and local authorities, whose permission are required for occupation of the building on completion.

Measurement Lines & Levels :-

Check dimension at the building site and establish lines and levels for the work specified.

All inverts, slopes and manhole elevations shall be established by instruments, working from an established datum point. Elevation markers and lines shall be provided for Owner's use, to determine that slopes and elevations are in accordance with the drawings and specifications and local bylaws.

Established grid and area lines shall be used for location of trenches in relation to building and boundaries. Trenches shall be carried out to the true alignment and to required levels. No refilling will be allowed for the purpose of making up the bed of trenches, but, to make up the same with lean concrete mix 1:4:8 (at contractors cost including cost of cement).

Use of sight rails, boning rods shall be adopted during the whole process of excavation and laying of the pipes

Sight rails shall be fixed at suitable intervals which shall not exceed twenty meters before the excavation is begun. No extra charges will be paid for excess excavation.

Sufficient width shall be provided to the trenches to allow a space of minimum 150 mm on either side of the body of drain to facilitate laying of the drains and jointing. Extra width shall be provided at the joints.

When the trenches are in deep or in bad ground, the sides of the trenches shall be supported with suitable timbering.

All pipes, water mains, or gas mains, telephone and electric cables etc., met within the course of excavation, shall be carefully protected and supported without any extra charge.

Excavation & Backfill:-

General:-

Perform all necessary excavation and backfill required for installation of plumbing work, excavation shall confirm to the limits indicated on the drawings.

All the material shall be new of best quality conforming to specifications and subject to the approval of the Architects. Drainage lines shall be laid to the required gradients and profiles. All drainage work shall be done in accordance with the local municipal by-laws.

Contractor shall obtain necessary approval and permission for the drainage system from the municipal or any other competent authority. Location of all manholes, catch basins etc.

Shall be finalized and shown in approved shop drawings before the actual execution of work at site. All work shall be executed as directed by the Project Manager.

Alignment & Grade

The sewer and storm water drainage pipes shall be carefully laid to levels and gradients shown in the plans and sections but subject to modifications as shall be ordered by the Architects from time to time to meet the requirements of the works. Great care shall be taken to prevent sand etc. from entering the pipes. The pipes between two manholes shall be laid truly in straight lines without vertical or horizontal undulations. The body of the pipes shall rest on an even bed in the trench for its length and places shall be excavated to receive collar for the purpose of jointing. No deviations from the lines, depths of cuttings or gradients as called for on the drawings shall be permitted without the written approval of the Architect. All pipes shall be laid at least 60cms below the finished ground level or as called for on the drawings.

Setting out Trenches

The contractor shall set out all trenches, manholes, chambers and such other works to true grades and alignments as called for. He shall provide the necessary instruments for setting out and verification for the same. All trenches shall be laid to true grade and in straight lines and as shown on the drawings. The trenches shall be laid to proper levels by the assistance of boning rods and sight rails which shall be fixed at intervals not exceeding 10 meters or as directed by the Project Manager.

Excavation: -

Excavate trenches to the necessary depths and width, removing rocks, roots stumps and shrubs existing old foundations etc. Cost of additional excavation to facilitate utility cross over, additional offsets, etc., shall be not be paid extra. Excavation material is unclassified except rock which will be treated as per tender condition given separately. Width of trench shall be adequate for proper installation of piping.

The trenches for the pipes shall be excavated with bottoms formed to level and gradients as shown on the drawings or as directed by the Project Manager. In soft and filled in ground, the Project Manager may require the trenches to be excavated to a greater depth than the shown on the drawings and to fill up such additional excavation with concrete (1:4:8) consolidated to bring the excavation to the required levels as shown on the drawings.

All excavations shall be properly protected where necessary by suitable timbering, piling and sheeting as approved by the Project Manager. All timbering and sheeting when withdrawn shall be done gradually to avoid falls. All cavities be adequately filled and consolidated. No blasting shall be allowed without prior approval in writing from the Architect. It shall be carried out under thorough and competent supervision, with the written permission of the appropriate authorities taking full precautions connected with the blasting operations. All excavated earth shall be kept clear of the trenches to a distance equal to 75 cms.

Timbering of Sewer and Trenches

The Contractor shall at all times support efficiently and effectively the sides of all the trenches and other excavations by suitable timbering, piling and sheeting and they shall be close timbered in loose or sandy strata and below the surface of the sub soil water level.

All timbering, sheeting and piling with their walling and supports shall be of adequate dimensions and strength and fully braced and strutted so that no risk of collapse or subsidence of the walls of the trench shall take place.

The Contractor shall be held responsible and shall be accountable for the sufficiency of all timbering, bracings, sheeting and piling used and also for, all damage to persons and property resulting from improper quality strength placing, maintaining or removing of the same.

Obstruction Road

The contractor shall not occupy or obstruct by his operation more than one half of the width of any road or street and sufficient space shall then be left for public and private transit. He shall remove the materials excavated and bring them back again when the trench is required to be refilled. The contractor shall obtain the consent of the Project Manager in writing before closing any road to vehicular traffic and the foot walks must be clear at all times.

Protection of Pipes

All pipes, water mains, cables etc. met in the course of excavation shall be carefully protected and supported. Care shall be taken not to disturb the cables, the removal of which shall be arranged by the contractor with the written consent from the Project Manager.

Removal of Filth

All night soil, filth or any other offensive mater met with during the execution of the works, shall not be deposited on the surface of any street or where it is likely to be a nuisance or passed into any sewer or drain but shall be immediately, after it is taken out of any trench, sewer or cess pool, put into the carts and removed to a suitable place to be provided by the Contractor.

Water: -

Keep all excavation free of stagnant subsoil water. Excavation damaged or softened by water shall be re-excavated and filled back to original level with approved selected natural fill material placed and compacted as specified herein below under item 6.5 at no expenses to the Owners. Provisions for shoring, pumping, bailing out, draining out, dredging and disposal of subsoil water or rain water shall be made at no expense to the Owners.

Bedding: -

Concrete bedding for drain shall be cement concrete having a mix proportioned in parts by volume of 1:3:6. Lay the drains on a bed of concrete 75 mm thick and of specified width benched halfway up on both sides to the crown of the pipe.

Backfill: -

The trenches shall be backfilled using selected excavated materials in 200 mm layers and carefully rammed well and consolidated with the addition of water and compacted to 95% of maximum density at optimum moisture content as determined by the standard penetration tests. For 150 mm all-round the pipe only selected material or in its absence sand or pea gravel will be allowed for backfilling.

Width Of Trench

The Project Manager shall have power by giving an order in writing to the Contractor to increase the maximum width/depth for excavation and backfilling in trenches for various classes of sewer, manholes and other works in certain length to be specifically laid down by him, where on account of bad ground on other unusual conditions, he considers that such increased width/depths are necessary in view of the site conditions.

Grading: - Following backfilling, grade all trenches to the level of surrounding soil. Surplus earth shall be carried away or dumped at site as directed.

Tests:- During the progress of the work for compacted fill, the Owners reserves the right to provide compaction tests made under direction of an independent testing agency.

Contractor to restore settlement and Damages

The contractor shall at his own costs and expenses, make good promptly during the whole period for the works in hand if any settlement occurs in the surfaces of roads, beams, footpaths, gardens, open spaces etc. in the public or private areas caused by his trenches or by his other excavations and he shall be liable for any accident caused thereby. He shall also, at his own expense and charges, repair (and make good) any damage done to building and other property. If in the opinion of the Project Manager he fails to make good such works with all practicable dispatch, the Project Manager shall be at his liberty to get the work done by other means and the expenses thereof shall be paid by the contractor or deducted from any money that may be or become due to him or recovered from him by any other manner according to the laws of land.

The contractor shall at his own costs and charges provide places for disposal of all surplus materials not required to be used on the works. As each trench is refilled, surplus soil shall be immediately removed, the surface shall be properly restored and roadways and sides shall be left clear.

Concrete Hume Pipe Drains, Laying, Jointing And Testing:

Hume pipe item shall include excavation, 75 mm thick PCC bedding, laying, jointing and backfilling of earth with compaction.

Cement concrete pipes where called for on the drawings, shall be centrifugally spun reinforced cement concrete pipes of an approved manufacture. Pipes shall be true, perfectly sound, free from cracks, cylindrical, straight with a uniform bore throughout. Cracked or warped pipes with uneven texture shall not be used. Pipes shall be `Hume' pipes or equivalent these pipes shall confirm to Indian Standard IS 458-1971 NP 3 class.

The pipes shall be straight and free from cracks excepting craze cracks. The end of the pipe shall be square to their longitudinal axis, so that when placed in a straight line, the opening between ends in contact shall not exceed 1/8" (3mm), for pipes upto 150 mm dia.

The outside and inside surface of the pipes shall be smooth dense and hard, and shall not be coated with cement wash or other preparation. The pipes shall be free from local dents

and bulges greater than 1/8" (3mm) in depth and extending over a length in any direction greater than twice the thickness of the barrel.

The pipes, before being laid, shall be brushed throughout to remove any soil or stone, that they may have accumulated therein the inside of the socket and outside of the spigot being carefully cleaned. For small pipes, they should be tilted up to remove any accumulations.

The pipes shall then be carefully laid in position.

Laying

RCC spun pipes shall be laid on cement concrete bed of cradles as specified and shown on the detailed drawings. The cradles may be precast and sufficiently cured to prevent cracks and breakage in handling. The invert of the cradles shall be left 12 mm below the invert level of the pipe and properly placed on the soil to prevent any disturbance. The pipe shall then be placed on `the bed concrete and set for the line and gradient by means of sight rails and boning rods, etc.

Jointing

Concrete pipes:-

Shall be jointed as described in IS 783-1959. After setting out the pipes, the collar shall be centered over the joint and filled in with tarred gasket till sufficient space is left on either side of the collar to receive the mortar. This space shall then be filled with cement mortar 1:2 (1cement and 2 washed coarse sand) and caulked by means of proper tools. All joints shall be finished at an angle of 45 to the longitudinal axis of the pipe on both side of the collar. The joint shall be cured for at least 4 days with wet hessian bags.

S.W. Gully Trap

Gully trap Grade A shall be stoneware conforming to IS:651. These shall be sound and free from visible defects such as fire cracks, or hair cracks. The glaze of the traps shall be free from cracks. They shall give a sharp clear note when struck with light hammer. There shall be no broken blisters. Each gully trap shall have one CI grating of square size corresponding to the dimensions of inlet of gully trap. It will also have a water tight CI cover with frame inside dimensions as per BOQ (300 x 300mm) the cover weighing not less than 4.5 kg and the frame not less than 2.7kg. The grating cover and frame shall be of good casting and shall have truly square machined seating faces. The rate shall include providing 150mm x 100mm size P type gulley trap with sewer bricks conforming to IS 4885.

Fixing of S.W. Gully Trap

The excavation for gully traps shall be done true to dimensions and levels as indicated on plans or as directed by the Project Manager /Consultant / Architect. The gully traps shall be fixed on cement concrete foundation 65cm square and not less than 10cm thick. The mix for the concrete will be 1:4:8. The jointing of gully outlet to the branch drain shall be done similar to the jointing of S.W. Pipes described earlier. After fixing and testing gully and branch drain, a brick work of specified class in cement mortar 1:5 shall be built with a half brick masonry work round the gully trap from the top of the bed concrete up to ground level. The space between the chamber and trap shall be filled in with cement concrete 1:3:6. The upper portion of the chamber i.e. above the top level of the trap shall be plastered inside the cement mortar 1:3 finish with a floating coat of neat cement. The corners and bottom of the chamber shall be rounded off so as to slope towards the grating.

CI cover with frames (per BOQ, 300 x 300 mm (inside) shall then be fixed on the top of the brick masonry with cement concrete 1:2:4 and rendered smooth. The finished top cover shall be so as to prevent the surface water from entering the gully trap.

Measurements

Gully traps shall be measured by the number and rate which shall include all excavation, foundation, concrete, brick masonry, cement plaster inside and outside, C I grating and sealed cover and frame.

Inspection chamber:- Brick masonry inspection chamber of the following sizes in brick work in cement mortar 1:5 (1 cement:5 fine sand), With heavy duty cast iron cover and frame embedded in RCC coping on top, RCC foundation slab. 1:2:4 mix both inside and outside of plastering 12 mm thick with cement mortar 1:3 with a floating coat of neat cement on inside face, proper water proofing to ensure no ground water seepage in the manhole.

Excavation, in all kind of soil, dewatering, refilling, watering, ramming and removing the surplus excavated earth, making good the same complete as required.

Size and cover to be as per BOQ.

Soil,Waste,Rain Water,Vent And Anti-Siphonage Pipes And Fittings:-

All soil, waste and anti-siphonage pipes and fittings used shall be UPVC-SWR pipes conforming to IS 13592. All pipes and fittings shall be of the best approved Indian make of soil variety They shall not be brittle but shall allow for heavy cutting, chipping and drilling and shall be of the diameter mentioned in the schedule of quantities and shall be of the largest length available and shall be fixed against the wall on `U' clamps.

Jointing shall be carried out with molten lead. The spigot of the pipe must be forced well home into its socket and must be entered, so that the joint may be of even thickness all round. At least, one complete lap of clean white hemp spun yarn shall be drawn into the bottom of the socket without being forced through the joint into. As many laps as may be needed to leave the space of not less than 25 mm. The lead shall then be poured into the joint and caulked tight. The joints shall then be poured into the joint and caulked tight. The joints shall be run with molten lead in sufficient quantity so that after being caulked solid the lead may project 1/8" (3mm) beyond the face of the socket against the outside of the spigot but must be flush with the outside edge of the socket. Lead wool joints wherever required will not be paid extra.

Cleanouts at the head horizontal pipes running under the floor shall be of UPVC. Floor and wall cleanouts shall be of UPVC. Cleanout shall be included in the item & will not be paid separately.

Inspection chamber, gully traps, etc., within the building shall be in cast iron with bolts, nuts to close the cover, all to be fabricated as per actual requirement and as per drawing, where indicated.

Supports, pedestals, and base for inspection chambers, gully traps and pipes shall be in 1:2:4 cement concrete mix.

Pipe sleeves and inserts, etc. through RCC walls either external or internal shall be of CI of MS provided with water bar flange.

During installation open ends of pipes shall be plugged with wood cut into required shape and gunny bags to be maintained free from dirt.

GI waste pipe and fittings shall be of heavy quality with GI unions, tail piece, reducers and connections to be provided between joints to either lead or CI pipes.

WC Pan Connectors shall be to suit the requirements as per drawing, with 40 mm vent horn for connection to the anti - siphonage pipe with pan connector.

Connection to the sewage or storm water collection sumps shall be perfectly watertight and end of the pipe which shall then the screwed home in the socket with a pipe wrench. Care must be taken that all pipes and fittings are kept at all times free from dust and dirt.

Rain water flashing shall be 150 x 100 mm or 230 x 150 mm with CI dome shape grating and extension pieces.

All rain water pipes UPVC SWR pipe vertical in shafts shall be soil pipe variety conforming to IS 13592 or equivalent. This shall apply to pipe outside buildings or within the building or separate shafts.

The UPVC Floor trap for toilet blocks shall have SS grating & of bolted down design - if instructed.

Bathroom grating shall be of bolted down design out of heavy SS construction of the approved standard.

SS grating gratings shall be flat with perfect edges of the best quality procurable of the specified width end thickness and in the available lengths.

Spigotted and socketed 80 mm, 100 mm and 150mm C.I. Pipes shall be of heavy pattern for the portion below the floor and embedded and laid over 150 mm cement concrete 1:3:6, the width of the concrete being:-

80 mm dia	320 mm wide
100 mm dia	400 mm wide
150 mm dia	450 mm wide
200 mm dia	500 mm wide

The pipes shall be laid to a slope and connected to the drain. On no account should lime or lime concrete come in direct contact.

UPVC SWR Pipes:-
The waste and vent pipe system shall be of one make as far as possible. The material should be of best grade PVC, ultra violet stabilized, conforming to IS 13592. Pipes and fittings shall be with push fit rubber ring (with special lubricant) joints as far as possible. Where this is not available, solvent cement joint will be permitted. Suitable connection pieces (such as WC connector, special connector to metal fittings) shall be provided. Fittings shall have inspection doors at all junctions and turning points and as shown on drawings.

Pipes shall be so fixed that they are minimum 20 mm clear off the finished walls and all joint socket (entry) clear of walls. Supports shall be provided (clamps, hangers etc.) at maximum 1.2M in horizontal runs and maximum 1.8M on vertical runs.

Joints shall be made as per manufacturer's instructions using specified rings, lubricants and solvents only. At rubber ring joints, after pushing the pipe to the maximum extent, the same shall be pulled out to the respective marking on the end or in its absence by 2 mm. After completing the installation, the line should be on the true alignment. Standard smoke test shall be performed to check water tightness of the line. The cost of spacer clamps, hangers etc. out of 20 mm x 3 MS flats with holes for fixing clips etc. fixing clamps to walls and painting them with two coats of oil paint over a base coat should be included in the item.

Where pipes are laid below the floor slab, all openings in slabs, beams etc. after testing, be filled with suitable material as required by waterproofing considerations. Special deep seal nahani traps shall be provided where required.

All samples shall be got approved before ordering material. Pipes and fittings shall of "Supreme" or equal make. Mock-up of various types should also be got approved from the Architects from time to time

CPVC Pipes:-
The material should be of best grade PVC, conforming to CTS-SDR 11 Pipes and fittings shall be with push fit rubber ring (with special lubricant) joints as far as possible. Where this is not available, solvent cement joint will be permitted. Suitable connection pieces (such as WC connector, special connector to metal fittings) shall be provided. Fittings shall have inspection doors at all junctions and turning points and as shown on drawings.

Pipes shall be so fixed that they are minimum 20 mm clear off the finished walls and all joint socket (entry) clear of walls. Supports shall be provided (clamps ,hangers etc.) at maximum 1.2M in horizontal runs and maximum 1.8M on vertical runs.

Joints shall be made as per manufacturer's instructions using specified rings, lubricants and solvents only. At rubber ring joints, after pushing the pipe to the maximum extent, the same shall be pulled out to the respective marking on the end or in its absence by 2 mm. After completing the installation, the line should be on the true alignment. Standard smoke test shall be performed to check water tightness of the line. The cost of spacer clamps, hangers etc. out of 20 mm x 3 MS flats with holes for fixing clips etc. fixing clamps to walls and painting them with two coats of oil paint over a base coat should be included in the item.

Where pipes are laid below the floor slab, all openings in slabs, beams etc. after testing, be filled with suitable material as required by waterproofing considerations. Special deep seal nahani traps shall be provided where required.

All samples shall be got approved before ordering material. Mock-up of various types should also be got approved from the Architects from time to time.

Galvanized Iron Pipes & Fittings (External)
The pipes shall be galvanised mild steel welded (HFS), (ERW) or and (HFW) screwed and socketed conforming to the requirements of IS:1239.

The pipes under this standard are designated by their nominal bore and are further classified as Light, Medium and Heavy depending upon their wall thickness. All the three categories of pipes may be used for conveying water depending upon pressure conditions. Sockets of these pipes are designated by respective nominal bore of the pipe.

Joints:
The threads of all screwed and socket pipes shall conform to IS: 554. The minimum length of thread in Light pipes shall be 80 percent of that specified in IS: 554. Each pipe shall be supplied with one socket.

Galvanising:
The Galvanising shall conform to IS:4736, the hot dip zinc coating shall be uniform, adherent reasonably smooth and free from such imperfections as flux, ash and drop inclusions, bare patches, black spots, pimples, lumpiness, runs, rust strains, bulky white deposits and blisters. The pipes and sockets shall be cleanly finished, well galvanised in and out and free from cracks, surface flaws laminations and other defects. All screw threads shall be clean and well cut. The ends shall be cut cleanly, and square with the axis of the pipe.

Hydraulic test:
Each pipe shall be hydraulically tested at manufacturer's work to withstand a test of Pressure of 5 Mpa.

Marking: The different classes of pipes shall have 75mm colour bands when arrived on site. The following colour bands shall be provided.

Light	----------	Yellow
Medium	----------	Blue
Heavy	----------	Red

Fittings: The fittings shall be malleable iron screwed fittings and shall conform to IS: 1879 comply with all the requirements of the pipes. The fittings are classified as Light, Medium and Heavy. The sizes of pipes and fitting is specified in the schedule of quantities

Laying and Jointing Of GI Pipes
The galvanised pipes and fittings shall run in wall chase or ceiling or as specified. The fixing shall be done by means of standard pattern holder bat clamps keeping the pipes about 1.5 cm clear of the wall where to be laid on surface. Where it is specified to conceal the pipes, chasing may be adopted for pipes fixed in the shafts, ducts etc. there should be sufficient space to work on the pipes with the usual tools. As far as possible, pipes may be buried for short distances provided adequate protection is given against damage and where so required special care to be taken at joints. Where directed by the Owner's Site Representative, pipe sleeves shall be fixed at a place the pipe is passing through a wall or floor for reception of the pipe and allow freedom for expansion and contraction and other movements. In case of pipe is embedded in walls or floors it shall be painted with anticorrosive bitumastic paints of approved quality. Under the floors the pipes shall be laid in layer of sand filling.

Galvanised iron pipes shall be jointed with threaded and socket joints, using threaded fittings. Care shall be taken to remove any burr from the end of the pipes after threading. Teflon tape, White lead or an equivalent jointing compound of proprietary make shall be used, according to the manufacturer's instructions, with a grommet of a few strands of fine yarn while tightening. Compounds containing red lead shall not be used because of the danger of contamination of water. Any threads exposed after jointing shall be painted with bituminous paint to prevent corrosion.

Electric Welded steel pipes conforming to IS: 3589 for 150mm to 2000mm Nominal Diameter:
The pipes shall be made from Steel plates or strips by butt welding longitudinally or spirally. The pipes shall be butt welded by employing any of the methods such as a) Electric Resistance Welding and b) Electric Fusion Arc welding.
Minimum specified thickness of pipes as per IS: 3589:

Nominal diameter	Minimum specified thickness of pipes (mm)
150 to 300	4.0
Above 300 to 500	5.0
Above 500 to 600	6.0
Above 600 to 850	7.0
Above 850 to 1200	8.0
Above 1200 to 2000	10.0

Joints: The Joints shall be a) Plain or bevelled ends for field butt welding and b) Joints with sleeve joints or swelled and plain ends for welding.

Piping Installation Support (Valid For GI Piping)

Tender drawings indicate schematically the size and location of pipes. The Contractor, on the award of the work, shall prepare detailed working drawings, showing the cross-sections, longitudinal sections, details of fittings, locations of isolating and control valves, drain and air valves, and all pipe supports. He must keep in view the specific openings in buildings and other structure through which pipes are designed to pass.

Piping shall be properly supported on , or suspended from , on stands, clamps, hangers as specified and as required. The Contractor shall adequately design all the brackets, saddles, anchor, clamps and hangers, and be responsible for their structural stability.

Pipe work and fittings shall be supported by hangers or brackets so as to permit free expansion and contraction. All accessories and ancillaries of support system such as brackets, saddles, clamps, hangers etc. shall be hot dip galvanized after fabrication. Further to permit free movement of common piping, support shall be from a common hanger bar, fabricated from galvanised steel sections.

Pipe hangers shall be provided at the following maximum spacing's:

Pipe Dia(mm)	Hanger Rod Dia (mm)	Spacing between Supports (m)
Up to 25	6	2
32 to 50	10 8	2.7
65	10	2.7
80 to 100	12 10	2.7
125 to 150	16 10	3.6
200 to 300	19	5.3

Insulated piping shall be supported in such a manner as not to put undue pressure on the insulation. 14 gauge metal sheet shall be provided between the insulation and the clamp, saddle or roller, extending atleast 15 cm. on both sides of the clamps, saddles or roller.

All pipe work shall be carried out in a proper workman like manner, causing minimum disturbance to the existing services, buildings, roads and structure.The entire piping work shall be organized in consultation with other agencies work, so that area can be carried out in one stretch.

Cut-outs in the floor slab for installing the various pipes area are indicated in the drawings. Contractor shall carefully examine the cut-outs provided and clearly point out wherever the cut-outs shown in the drawings, do not meet with the requirements.

Pipe sleeves, larger diameter than pipes, shall be provided wherever pipes pass through walls and slab and annular space filled with fibreglass and finished with retainer rings.

The contractor shall make sure that the clamps, brackets, saddles and hangers provided for pipe supports are adequate or as specified / approved by Consultants. Piping layout shall take due care for expansion and contraction in pipes and include expansion joints where required.

All pipes shall be accurately cut to the required sizes in accordance with relevant BIS codes and burrs removed before lying. Open ends of the piping shall be closed as the pipe is installed to avoid entrance of foreign matter. Where reducers are to be made in horizontal runs, eccentric reduces shall be used for the piping to drain freely. In other locations, concentric reduces may be used.

All buried pipes for CWS shall be cleaned and coated with two coats of bitumen and then wrapped with two layers of 400 micron polythene sheet coating.

Automatic air valves shall be provided at all high points in the piping system for venting. All valves shall be of 15mm pipe size and shall be associated with an equal size isolation ball valve. Automatic air valves shall also be provided on hot water risers.

Discharge from the air valves shall be piped through a galvanized steel pipe to the nearest drain or sump. All pipes shall be pitched towards drain points.

Pressure gauges shall be provided as shown on the approved drawings and include in Bill of Quantities. Care shall be taken to protect pressure gauges during pressure testing.

Disinfection Of Piping System And Storage Tanks:

Before commissioning the water supply system, the contractor shall arrange to disinfect the entire system as described in the succeeding paragraph.

The water storage tanks and pipes shall first be filled with water and thoroughly flushed out. The storage tanks shall then be filled with water again and disinfecting chemical containing chlorine added gradually while tanks are being filled to ensure thorough mixing. Sufficient chemical shall be used to give water a dose of 50 parts of chlorine to one million parts of water.

If ordinary bleaching powder is used, the proportions will be 150 gm of power to 1000 litres of water. The power shall be mixed with water in the storage tank. If a proprietary brand of chemical is used, the proportions shall be specified by the manufacturer. When the storage tanks are full, the supply shall be stopped and all the taps on the distributing pipes are opened successively working progressively away from the storage tank. Each tap shall be closed when the water discharged begins to smell of chlorine. The storage tank shall then be filled up with water from supply pipe and added with more disinfecting chemical in the recommended proportions. The storage tank and pipe shall then remain charged at least for three hours. Finally the tank and pipes shall be thoroughly flushed out before any water is used for domestic purpose.

The pipe work shall be thoroughly flushed before supply is restored.

All water fittings shall in all respects comply with the latest Indian Standard Specifications IS 1239 (part II) 1982. The brass fittings shall be fixed in the pipe line in a workman like manner. Care shall be taken to see that joints shall be tested to a pressure of 10 kg/sq.cm unless otherwise specified. The defective fittings and the joints shall be repaired, redone or replaced.

Wherever a G.I. pipe crosses a floor then a C.I. sleeve with 12 mm all round clearance and projecting by 80 mm above and below the floor should be provided. On no account should lime or lime concrete come in direct contact with G.I. pipe and fittings.

Pressure Gauges And Recorders :

The gauges are an aid for the engineer incharge of maintenance to know whether the system is working normally or not. For regular record, pressure recorders having daily or weekly charts are needed to be provided. It is important that the range of the service pressure to the instrument selected shall be between 40 to 60 per cent only, at it is in this range, that the instrument is more accurate. This also leaves margin for indicating abnormal rise of fall in the pressure due to some fault in the system.

These gauges are available in dials 50 mm, 63 mm, 101 mm, 203 mm, 254 mm and 304 mm upto 10,000 lbs. per square inch or equivalent Kg/cm2 in imported and indigenous makes.

Dial type (100 mm) pressure gauge with isolation ball valve suitable for working pressure of 250 PSI. Cost shall be inclusive of providing any short pieces, nipples, elbow etc as required (one on each pump and one on main head in pump room &pressure vessel)

Valves

All ball valve, butterfly valve and check valves and shall have working parts suitable for cold & hot water. Valves shall be tagged with permanent label of approved design under hand-wheel, indicating type of duty.

The duty and design of all valves shall be as specified in Bill of quantities. Valves shall either be of screwed type or flanged type, as specified, with suitable flanges and non-corrosive bolts and gaskets. Tail pieces as required shall be supplied along with valves. Gate, globe and check valves shall conform to Indian Standard IS:776 and non-return valves and swing check type reflux to IS:5312.

Ball valve

The ball valve shall be made forged brass and suitable for test pressure of pipe line. The valve shall be internally threaded to receive pipe connections.

The ball shall be made from brass and machined to perfect round shape and subsequently chrome plated. The seat of the valve body-bonnet gasket and gland packing shall be of Teflon.

The handle shall be provided with PVC jacket. The handle shall also indicate the direction of 'open' and 'closed' situations. The gap between the ball and the teflon packing shall be sealed to prevent water seeping.

The handle shall also be provided with a lug to keep the movement of the ball valve within 90°. The lever shall be operated smoothly and without application of any unnecessary force.

- Valves shall be of screwed end type of approved make to IS 778, 781 complete
- With PTFE seating & gland packing.
- Maximum working pressure shall be 16 bar.
- Size To be provided of as per BOQ

Measurement-
To be measure as per unit number.

Butterfly valve
The butterfly valve shall be suitable for waterworks and rated for 300 P.S.I for Pressure requirement/ shall be suitable for PN16 bar rating with necessary fittings to be installed in the tank sump.

The body shall be of Cast Iron to GG 250 with Epoxy Coated for better resistance to corrosion, with ISO 5211 top connection. The Disc should be of heavy duty Ductile Iron grade GG 400 with Polyamide Coated to prevent corrosion, floating design to allow self centering.

The Shaft shall be of SS 420. Single piece, Spline design shaft mounted between Antifriction bearing to reduce the torque & blowout proof design. The valve liner shall be of High grade Elastomer EPDM with replaceable feature & Tongue & Groove design to allow perfect tightness. Flow Control Lever with temper proof feature.

The valve shall be fitted between two flanges o either side of pipe flanges. The valve edge rubber shall be projected outside such that they are wedged with the pipe flanges to prevent leakages.

- Size as per BOQ or design drawing.

Measurement-
To be measure as per unit number.

Float Valve
Ball valves with floats to be fixed in storage tanks shall consist of cast brass lever arm having copper balls (26 SWG) screwed to the arm integrally. The copper ball shall have bronze welded seams. The closing/opening mechanism incorporating the piston and cylinder shall be non-corrosive metal and include washers. The size and construction of ball valves and float shall be suitable for desired working pressure operating the supply system. Where called for brass valves shall be supplied with brass hexagonal back nuts to secure them to the tanks and a socket to connect to supply pipe.

Non-return valve
- Non-Return valves shall be cast iron double flanged with cast iron body and gunmetal internal parts conforming to IS:5312.
- C.I. wafer type check valve of PN 1.6 rating,
- Including rubber gasket, flanges, union, nuts, bolts, washers & painting complete as required.
- size as per BOQ or design drawing.

Measurement-
To be measure as per unit number.

AIR RELEASE VALVES (at main ring main on terrace)
- Air release valve consisting of following specification. steel spring (EN 47Gr.B) actuated with necessary fittings to be installed in the tank sump / on water supply ring main
- Shall confirm IS318 Gr.LTB2
- Steel spring chrome plated (EN 47Gr.B)actuated with necessary fittings.
- Stem:-Forged brass(IS 6912 Gr.FLB)
- size as per BOQ or design drawing.

Measurement-
- To be measure as per unit number.

UPVC NAHNI MIX TRAPS
- Short type UPVC NAHNI TRAPS of approved make with water seal(10) along with cover
- including making holes in RCC /masonry work,
- Including if required extension pipe, fixing NT to correct level & line, sealant clamps etc complete.
- Fixing of grating circular type in SS

Measurement-
- To be measure as per unit number.

DRAIN COCK FOR OH TANK

- Drain cock of 15mm size with screwed male end to IS 554 /Bs 21/ISO 7.
- The operating handle shall be integral part of plug completely polished body.
- Body & Cover: Bronze (IS 318 Gr.LTB 2)
- Plug : Bronze (IS 318 Gr.LTB 2)
- Hose : Bronze (IS 318 Gr.LTB 2)
- Nut : Brass(IS 319 Gr.LTB 2)
- Washer : Bronze (IS 318 gr.LTB)
- Test Pressure - Hydraulic : 10.55 kg/cm2g

Measurement-
To be measure as per unit number.

Sanitary Fittings:-
All sanitary fittings shall be as specified in Schedule of Quantities and approved by the Owner.
All sanitary ware and CP fittings shall be new and of approved make, type and colour. All samples of materials with catalogues shall be submitted and got prior approved before use. Approved samples along with other approved materials shall be neatly displayed on a board and such a display board of samples shall always be in exhibition in the site office.

In cases where the materials are supplied by the clients, all such materials shall be inspected and received in good condition and thereafter, it will be totally under the safe custody of the tenderer/contractor till they are handed over satisfactorily after installation, testing and commissioning.

Wherever multiple choices of fixtures are mentioned, the final choice will be as per the joint decision taken by the client and the architect.

Indian W.C
Indian W.C pan shall be Madurai / Orissa pattern in white vitreous chinaware size as specified in the schedule of work. Each W.C shall be provided with a 100 mm dia vitreous chinaware P or S trap with or without vent horn, as required.

The water closet shall be provided with an exposed or concealed type C.P brass flush valve or flushing cistern as specified in the schedule of work. Flush valves shall have a suitable flow regulating facility. Discharge connection to the W.C shall be by means of approved type of flush bend.

Foot rests
Indian W.C shall be provided wherever specified, with a pair of vitreous china foot rests at proper distance (where specified) on either side of the W.C.

Foot rests shall be set in cement mortar 1:2 mix. Edges shall be finished neatly with white cement.

ORISSA W.C
Orissa W.C shall be in white glazed vitreous chinaware of size specified. The W.C shall be provided with a 100 mm white vitreous chinaware P or S trap with or without vents as required.

Each W.C shall be provided with an exposed or concealed type brass flush valve or flushing cistern generally as for Indian W.C.

EUROPEAN W.C

European W.C shall be wash down or siphonic, floor or wall mounted White Vitreous Chinaware Water Closet with ('P' / 'S' Trap), complete with

i. concealed flushing cistern 10 Lit,
ii. CP bolts,
iii. white seat cover,
iv. CP Elbow,
v. CP wall flange,
vi. angular stop cocks with flange (for flushing cistern and health faucet),
vii. health faucet with necessary CP flexible hose 750mm long nozzle,
viii. C I brackets,
ix. making necessary connection to GI flush / inlet pipe etc. completed & approved make & approved by the architect.

URINALS

Urinals shall be as specified in the BOQ / drawings in white glazed vitreous chinaware of size as per the approved product number of approved make / brand.

Including with fittings, standard size C.P. brass flush pipe, spreaders with unions and clamps (all in C.P. brass) with waste fitting as per IS : 2556, C.I. trap with outlet grating and other couplings in C.P. brass, Including urinal push cock and CP pipe for connection to push cock and including painting of fittings and cutting and making good the walls and floors wherever required.

Lavatory Basin

Lavatory basins shall be ivory glazed vitreous china or poly marble or any other material and of size, shape and type specified in the schedule of work.

Each basin shall be complete with:
i) C.I or galvanized steel supporting brackets and clips as required.
ii) CP waste and overflow.
iii) Pop-up waste or rubber plug with CP chain as specified.
iv) CP P-trap with cleanout, unions, CP pipe to wall and wall flange
v) CP control angle valve/s with CP connections.
vi) Mixing or CP fittings as specified.

Including 15mm dia - 450mm long PVC connection pipe, one no 15mm dia CP angle stop cock with wall flange, 32 mm dia CP waste coupling, 32 mm dia CP brass bottle trap.
The works shall include cutting and making good the walls and floors. Approved by client

Sinks

The sink shall be of size specified in with glazed vitreous chinaware or stainless steel AISC 304 as specified.

Each sink shall be complete with:
i) C.I or galvanized steel brackets and clips as required.
ii) Waste fitting with brass / rubber plug and chain.
iii) P-trap with clean out, unions, CP pipe to wall and wall flange.
iv) CP control valve/s with CP connections.
v) Mixing or CP fittings with spout as specified.

S.S KITCHEN SINK would be of 21" X 18 " or as specified in the schedule of work.

Towel rods and racks

They shall be of approved make and size as specified in schedule. The towel rod shall be

provided with a pair of CP brass brackets fixed to the wall with CP brass screws with round head, using cup washers, screwed on to fill-plugs embedded in wall. The brackets shall be of concealed type.

Soap Solution dispensers
They shall be plastic push button type.
They shall be of approved make. They shall be fixed to the wall with CP brass screws, screwed on to fill-plugs embedded in wall.

Toilet paper roll holder
Toilet paper roll holder shall be of stainless steel of size specified in schedule. It shall be of recessed type with wooden rod with spring at one end for holding the paper roll. The rate shall include cutting recess in the wall, fixing the holder with cement mortar 1:2 and rectifying the wall surface to original conditions.

Tissue dispenser
Tissue dispenser fixed on wooden cleats with CP brass screws & washers including drilling hole in walls with drill gun and making good the walls.

ONE PAK FROM KIMBERLY CLARKE or equivalent & approved by the architect.

HAND DRYER
Hand dryer fixed on wooden cleats with CP brass screws & washers including drilling hole in walls with drill gun and making good the walls. Hand Drier shall be of AUTO MAT Make or equivalent & approved by the architect.

GEYSSER
Installation, Testing, Commissioning of storage water heater (Geyser) for toilets with 15 lit capacity including the following. Make to be racold or equivalent

a) C.P. Connectors
b) Angular stop cock with wall flange
c) All accessories required to complete the installation

Polyethylene Water Storage Tank
- Placing on terrace polyethylene water storage tank,
- ISI: 12701 marked,
- with cover and suitable locking arrangement and
- Making necessary holes for inlet, outlet and overflow including all fixtures and fitting.

Measurement-
To be measure in Number.

Measurements for Sanitary Fixtures-
To be measured as per unit number, unless specified different in BOQ.

Installation of Sanitary ware
All sanitary ware and CP fittings shall be installed in accordance with the interior requirements. Neat workmanship and maintaining exact position and level of each fixture shall be the sole objective of the installation. Care shall be taken to fix inlet and outlet pipes at correct positions. Faulty positioning shall be made good without any damage to the finished floor or wall tiling and any damage to the finished surfaces shall be made good at the tenderer / contractor' s cost.

In order to ensure quality of workmanship and compliance with interior requirements, one or two mock-up installations shall be done and got approved. Fixtures used in the mock-up may be reused with the approval of the Consultant.

All fixing accessories like bolts, nuts, brackets etc. may be supplied along with the ware as defined in the mode of measurement and schedule of work. All such accessories shall be CP brass or galvanized or stainless steel as approved by the Architect. All exposed pipes and bends shall be of CP brass.

The Indian W.C shall be fixed in level in a neat manner. The W.C and trap shall be set in brick bat 1:2:4 concrete mix. Joints between W.C and flush pipe shall be made with a putty or white lead and linseed oil and caulked well or with approved rubber joints. The joint between W.C and trap shall be made with 1:1 cement mortar and shall be rendered leak proof.

The Orissa W.C shall be fixed in level in a neat manner. The W.C and trap shall be set in brick bat concrete 1:2:4. Joint between W.C and flush pipe shall be made with putty of white lead in linseed oil and caulked well or with approved rubber joint. Joint between W.C and trap shall be made with 1:1 cement sand mortar and shall be rendered leak proof.

Wall-hung European W.C shall be mounted on C.I chairs which are fixed to the wall and floor using Anchor fasteners. The bolts and nuts used for fixing the chairs shall be stainless steel and the fixing bolts for the W.C and chairs could be CP brass or stainless steel. Floor-mounted W.C shall be fixed with Anchor fasteners using stainless steel bolts and nuts. The gap between the WC and floor or wall shall be neatly sealed with water proof non-hardening sealant of approved colour. The sealant should not extrude beyond the foot print or WC outline.

All W.C' s shall be aligned and levelled with the floor and wall tiles so as to present an integrated look. Utmost care and skill shall be exercised to achieve a good installation in keeping with the interior designs.

Urinals shall be fixed to the wall using Anchor fasteners and stainless steel bolts and nuts. The urinals shall be held in line and level according to the interior designs and tile modules. Partitions, wherever required shall be provided, shall also maintain line and level as shown on drawings. Supply spreader and drain piping and P-trap shall be of CP brass and installed in a neat manner. No unseemly bends or wooden support pieces shall be permitted.

Wall-mounted lavatory basins and sinks shall maintain line and level as specified by the interior drawings and also with the tile modules. The supply connections shall be of CP brass from the angle stop valves to the pillar taps or single level fixture and shall display good workmanship. Drain connections shall have a CP P-trap with unions and exposed CP drain pipe and a wall flange. In the case of counter mounted basins and sinks, extreme care shall be taken to provide independent and adequate support for the basin and aligning it with the opening in the counter slab. Supply and drain connections shall be same as that for the wall mounted basins. The crevices between basin and wall or counter shall be neatly sealed with a non-hardening sealant of approved colour.

All accessories like the mirror, soap trays etc shall be neatly fixed as per interior designs. Good workmanship is the essence of all sanitary installation for achieving the interior design objectives.

Hangers & Supports:-

General:-

Provide proper solid angle iron/channel section, supports for all pipes complete with clamps. Wherever insulation comes, to provide wooden guide to support pipe on the angle iron hangers/supports. In general where a bunch of pipes run, as far as possible M.S. plat inserts are provided in the beams/slabs to facilitate welding of angle iron supports. For attachment in concrete, use 'Dash" fasteners or Anchor plug type inserts or equivalent. Provide hangers within 0.9M of all changes in directions of mains and minimum of three hangers per expansion bend wherever shown in drawing. Provide all additional structural steel angels, channels or other members not specifically shown but are required for proper support. All hangars/supports to have a primer coat (epoxy) on fabrication & one more coat on erection & testing.

Wherever necessary additional hangers shall be provided to arrest water hammers or hydraulic resonance with proper rubber padding.

Space hangers, as noted below, except on all soil pipe which shall have a hanger of multiple fittings, sufficient hangers shall be provided to maintain proper slope without sagging; in case of angle suspended line, the following is suggested :-

Pipe sizes	Hanger Rod Dia
20 mm through 50 mm	10 mm
65 mm through 125 mm	12 mm
150 mm and over	16 mm

Provide floor stands, wall brackets pr ,as masonry piers, etc. for all lines running near the floor or near walls for these lines can be properly supported or suspended from the walls or floors. Pipe lines, near concrete or masonry walls may be hung also by hangers carried from wall brackets at a higher level than pipe. Hanging of any pipe from another is prohibited.

Hangers:-

Cleats or band type hangers shall be provided. Hot water piping are to be provided with suspended supports as far as possible. Note that strap hangers are not permitted and clamps should be removable type.

Equipment Protection :-

Keep all pipe and conduit openings closed by means of plugs or caps to prevent the entrance of foreign matter. Protect all piping, conduit, fixtures, equipment or apparatus. Any such items damaged prior to final completion or work shall be replaced at no expense to the Owner.

Accessibility:-

The installation of valves, thermometers, cleanout fittings and other indicating equipment or specialties requiring frequent reading, adjustments, inspections, repairs, removal or replacement, shall be conveniently and accessibly located with reference to the finished buildings. Thermometers and gauges shall be installed so as to be easily read from the floor.

Inserts And Sleeves:-

General:-

Layout work in advance of placing of concrete slabs or construction of walls; furnish and set insets and sleeves necessary to complete the work. Cost of cutting or patching made necessary as a result of this operation shall be at no expense to the Owner. Openings

shall be as per structural consultant's approval.

Wall sleeves:-

C.I. wall sleeves in cold water store and black pipe `A' class for cable, conduits gas pipes, etc. are to be inside flush with wall on both sides. Sleeves shall be large enough in diameter to provide 12 mm clearance around pipe for insulation. Exterior wall sleeves for cable entry/pipe/earthing strips etc., shall be cast iron, flush with wall on both sides. Sleeves shall be large enough to allow caulking from outside using lead wool.

Floor Sleeves:-

Interior floor sleeves for

NB Pipe Sizes	Spacing Of Supports
12 mm To 20 mm	1.5 M Apart
25 mm To 40 mm	1.8 M Apart
50 mm And above	1.8 M Apart Or As Per

Cleaning, Operation & Tests:-

Plumbing equipment fixtures, piping, etc., shall be free of stampings, marking, (except these required by codes), iron cuttings and other foreign materials.

Hot, Cold and drinking water systems shall be cleaned thoroughly filled and flushed with water.

The entire mechanical apparatus shall operate at full capacity without objectionable noise or vibration.

Test all plumbing systems in the presence of the site Engineer/Supervisor and the Architect as herein specified. Provide ample advance notice of test dates. Provide all equipment materials and labour necessary for inspection and tests and repair all work, not passing the tests. After repairs are made, repeat tests until test systems in found satisfactory to the above authorities. Carryout all tests prior to concealing insulating or backfilling over any piping. No exception will be made.

Test entire system of soil, waste and vent piping by water after the roughing-in is completed and before the fixtures are set. After setting the fixtures, provide smoke test after sealing all traps.

Water test: -Test entire system or section of system by closing all opening in piping except the highest opening and filling system with water to the point of overflow. If the system is tested in sections, plug each opening except the highest opening of the section filled with water. Keep the water in system or in portion under test of or at least 45 minutes before inspection starts with test pressure head lasting for two hours. The system must be tight at all joints.

All water piping: - Hydro-static test 10 kg/cm2 for a minimum of 8 hours without drop in pressure as required.

All tests on below grade lines shall be continued until backfill on such line is completed to disclose any damages caused by backfilling.

All systems shall be tested in sections as required to expedite the work or other trades and meet construction schedules and final test on completion.

On completion of the works, the following tests shall be performed to the satisfaction of the Consultants Clients' representative before issue of Virtual Completion Certificate if so required:-

- Hydraulic test

- Self-inducted test for fixtures
- Tests for anti-siphonage system
- Inspection of all units and fixture

The contractor shall arrange on his own initiative for similar tests during the progress of works, to ensure that there are no defects in material/workmanship in portions of work to the concealed or embedded under the floor or walls in ceiling.

Painting:-
Piping:-
After all the piping has been installed and tested, the piping including all MS hangars/ supports shall be given one final coat of anti-corrosive paint followed by two coats of paint as per colour code / flow direction marking etc as required by the Owners.

Equipment & Piping Identification:-
Pipe Markers
Each piping system shall be provided with a name plate properly clamped or stencilled. Letters are to be 80 mm. Plates on parallel groups of pipes etc. shall be neatly lined up. Wording of lettering shall correspond to the equipment designations used in piping legend and shall be as approved. Name plate to be of G.I. sheets (1 mm thick on 25 x 25 x 3M angle) secured on to sheet metal and angle iron to be welded on main pipes. In case of insulated pipe, the 25 x 25 mm angle bracket should be projecting beyond insulation thickness. CI markers to be fixed as directed in ground to indicate location of underground services.

Valve Register:-
To be submitted in six copies along with location and identification number in final drawing to be furnished by contractor.

Mode Of Measurement
All drain pipes shall be measured in linear lengths along the centre line of the drainage laid. Deduction shall be made for chambers. The rate shall include all work as specified in the respective items.

Stoneware of cast iron gully traps, bends, junctions, sewer traps etc., shall be measured in numbers as in above. All pipes passing through sleeves shall be caulked with asbestos rope and finish with cement mortar. Insulated pipes shall have insulation butted to floor sleeve and sealed with insulating cement on both sides.

Interior floor sleeves for kitchen areas shall be C.I. steel pipe extending 50 mm above finished floor. Caulking shall be the same for general areas.

Floor on grade sleeves shall be the same as exterior wall sleeves, caulked and made watertight.

All cast iron spigot and socket or flanged pipes shall be measured in linear length along the centre line is completed. Fittings and specials shall be measured in position as a part of the pipe. The rate shall include lead caulking or nut and bolt joints, etc., complete as specified in the respective items.

Same rate shall be applicable for pipes of same size and materials laid in building at any level or floor.

The rock only where specified cutting shall be measured in cu.m. of the stacks of

excavated rock, the deduction for voids being 25% of the stack measurement. On the rock which removed by chiselling or blasting etc. shall be measured for this item or work. Boulders shall not be considered as a rock. The excavated rock will become the Owners property.

All cast iron pipes, such as soil, waste, vent and rainwater shall be measured in linear lengths along the center line, as completed, excluding length over fittings. The rates shall include all joints and clamps etc. as specified in the respective items.

Inspection chambers shall be measured in numbers, complete as specified in the respective items in the schedule of quantities and specifications for sanitary installation work.

Lead pipes shall be measured in linear length and shall be of weights as per specifications of the respective item in installation work. The rates shall include making of necessary offsets and bends, etc.

All sanitary fittings and fixtures shall be measured in numbers and the rate shall include all the work specified in the respective item.

All G.I. pipes shall be measured in linear lengths along the center line of the pipe, including G.I. fitting. The rate for pipe line shall be inclusive of all G.I. fittings.

All gate valves, ball valves, non-return valves, sluice valves etc. shall be measured in numbers after excluding them from linear measurements.

The diameter of pipes and fittings mentioned in the specifications are the normal diameter in all cases unless otherwise stated

Tools & Materials & Storage:-
Surplus materials from the site shall be carted away by the Contractor without any cost to the Employer and the storage space provided to the Contractor shall be handed over to the employer clean and ready for occupation.

Health faucet

- Providing & Fixing health faucet with 1 Meter Long Easy Flex Tube in Chrome Finish & Wall Hook. (Jaguar ALD-CHR-585) or equivalent.
- As per approval of client and engineer in charge

Measurement
In numbers

2 way CP bibcock

- Providing & Fixing 2 way CP bibcock with Aerators and wall flange.
- Coated with High plating thickness (Nickel: 10 microns and Chrome: 0.3 microns) completed.
- Including 6 " extension CP pipe as required. (Jaguar Florantine series FLR 5041N) or equivalent ,As per approval of client and engineer in charge

Measurement

- In numbers

CP pillar cock

- Providing & Fixing CP pillar cock long body for wash basin with Aerators.

- Coated with High plating thickness (Nickel: 10 microns and Chrome: 0.3 microns) completed including connecting pipe and all fixtures and fitting as required etc. completed. (Jaguar Florentine series FLR-5015) or equivalent As per approval of client and engineer in charge

Measurement
- In numbers

CP bibcock
- Providing & Fixing CP bibcock with Aerators and wall flange.
- Coated with High plating thickness (Nickel: 10 microns and Chrome: 0.3 microns) completed.
- Including 6 " extension CP pipe as required. (Jaguar Florantine series FLR 5047 N) or equivalent As per approval of client and engineer in charge

Measurement
- In numbers

Dead plug and Angular cock
- Fixing, testing & commissioning of dead plug and Angular cock for water purifier provided by Client.
- Works includes making necessary inlet and outlet, cutting & making good the walls, floors, slab wherever required.
- All consumable items such as Teflon tape, sealant, gasket, cement solvent, Heavy CI brackets, nut bolts, washers etc. (angle cock to be Jaguar FLR-5053N) or equivalent As per approval of client and engineer in charge

Measurement
- In numbers

Hydro pneumatic system monoblock pumping sets

- Providing, installing, testing and commissioning of fixed speed hydro pneumatic system
- Comprising of two Nos. clear water monoblock pumping sets with CI body (KDI 852++ of Kirloskar or approved equivalent make),
- SS impeller and gland packing , C-40 shaft, suitable for 400/440 volts, 3 phase,
- 50 cycles AC supply, vibration eliminating pads under foundation, sequence running controller, dry running Protection, motor control centre, necessary power and
- Control cabling from MCC to pumps including required rating of MCB, one No. 150 liters capacity M.S diaphragm tank with interchangeable butyl rubber membrane, complete in all respects
- Including suction and delivery headers as required.
- For Domestic Water Supply.
- Set of two pumps (1 Working + 1 Standby) Capacity as per BOQ
- Pump to be kirloskar make or equivalent

Measurement
- In numbers

Centrifugal mono block pump

- Supply, installation, testing and commissioning of Centrifugal mono block pump in position for supply of water along with starter panel.
- Pumps motor directly coupled to the suitable T.E.F.C. induction motor and starter along with necessary electrical work
- Including the cabling and starter panel, expansion bellows, flanges and Water level switch to indicate low and high level of water in OH tank.
- The pump shall be suitable for auto / manual operation.
- Complete electrical control panel comprising of all accessories such as control wiring and any other necessary imports etc. (list to be provided by the vendor).
- The item shall include the necessary electrical cables and starter panels for operating the pumps.
- The efficiency of pumps shall not be less than 75%
- It contractors scope to provide cabling from pump to starter panel and starter panel to level switch located at terrace level.
- Including commissioning and operating of pump including all accessories etc. Complete
- Pump to be kirloskar make or equivalent Capacity as per BOQ

Measurement

- In numbers

General Services:-

Any materials brought at site shall not be removed without the written authority of the Owner and when the Contractor shall have received payment in respect of any certificate in which it is stated that the valve of any unfixed materials on the works has been taken into account, such materials shall become the property of the Employer and the Contractor shall be liable for any loss or damage thereto.

SECTION- 15

APPROVED MAKE LIST

MAKE / MANUFACTURER OF THE MATERIAL TO BE USED		
Sr No.	**Category**	**Brand name**
	Notes:-	
	No deviations shall be permitted.	
	All material to be used shall be of first quality unless otherwise specified	
	All sizes of materials mentioned shall be finished sizes.	
	All materials used shall be of I.S.I grade wherever applicable.	
	Wherever Contractor proposes to use "equivalent" makes (other than the specified makes mentioned in the Bill Of Quantities) , the same shall be done only after taking prior approval from the Architect (who may consult the Client before giving approval), time due to this will be on contractor□s account and no claims will be entertained	
	Category	**Brand name**
1.	Cement	Ultratech, Ambuja, ACC, Birla
2.	RMC	1. Nuvoco (Lafarge) 2. Ultratech 3. RDC Concrete 4. First Choice
3.	White Cement	Birla , J.K,
4.	Chemical Admixtures	MC Bauchemie, BASF, MYK Schomburg, Pidilite, Sunanda Chemicals, Sika, FOSROC, Choksey Chemicals
5.	Coal Tar	Berger, Pedilite, Shalimar
6.	Grouts	Fosroc, Ultratech, Durabuild
7.	LDPE sheet	Dunlop, Ramson, Mono
8.	Rebars	Tata, SAIL, JINDAL, Vizag, ESSAR
9.	Structural Steel	Vizag, TISCON, SAIL, RINL, ISPAT,JSW
10.	Anchors and chemicals fasteners	Hilti, Fisher
11.	Plywood	Century, Anchor Ply, Green ply, Duraboard, Kit ply, Merino Ply
12.	Veneer	Duro, Green, Donear, Century
13.	Laminate	Greenlam, Sunmica, Century, Merino
14.	Door Hardware	Godrej, Ingersolrand, Geze, Dorma, Guardian, Dorset, Magnum, Union, Kitch
15.	Door Lock & Handle	Godrej, Ingersolrand, Geze, Dorma Guardian, D-Line
16.	Door closer	Ingersolrand, Geze, Dorma , Guardian
17.	Door Locks (Concealed / Surface mounted)	Ingersolrand / Dorma,Haffle,Dorset
18.	Locks	Dorset, Sobeet, Godrej
19.	Door Seal – Wool pile Weather Strip	Enviro Seal, Anand Raddiplex
20.	Door Handle (Concealed / Surface	Ingersolrand , Geze, Dorma, Alu Alpha

MAKE / MANUFACTURER OF THE MATERIAL TO BE USED		
Sr No.	**Category**	**Brand name**
21.	Stainless Steel Screws, fasteners	Kundan/ Puja/ Atul
22.	Mild Steel Butt Hinges/ Piano Hinges	Jolly, Garg, AMIT, ASI Supreme
23.	Nuts Bolts /Screws	Kundan/ Puja/ Atul
24.	Concealed Tower Bolt	Ingersolrand, Alu Alpha
25.	UPVC Joinery	Fenesta, Veka, Euro plast, Aluplast, Amon Ra
26.	Glass	Saint Gobain, AIS ,Asahi, Pilkington, Modi, Guardian Glass
27.	Vitrified Ceramic Tiles	NITCO, RAK, Euro, Somany, Kajaria, Johnson, Simpolo
28.	Glazed Ceramic Tiles	Orient, Kajaria, Nitco, Somany,Bell, Johnson, Asian, RAK, Euro, Simpolo
29.	Interlocking Concrete Blocks	Vyara Tiles Pvt. Ltd.. Super Decorative Floorings Pvt. Ltd., Sai Enterprises,Hindustan Tiles, Nimco Prefab,R.K. Tiles.(Or locally available as approved by engineer in charge)
30.	False Floor System	Unitile Raised Access Flooring Systems, Supersil Architectural Products, Metalium Architectural Products, Kebao Access Floor System
31.	Gypsum Plaster	India Gypsum, St. Gobain,
32.	Ceiling system	St. Gobain, False ceiling, Aerolite ceiling
33.	White washing lime	Dehradun (Source) or Equivalent
34.	Paint/ primer/ oil bound distemper Acrylic paint	Asian Paints, Nerolac, Dulux, Berger, Jotun
35.	Water proof cement paint	Snowcem India Ltd , Asian Paints, Berger, Nitco Cem
36.	Mirror	Modi Guard, Saint Gobain
37.	Sanitary ware	Cera, hindware, Parry ware, Jaguar
38.	C.P fittings & Bathroom accessories	Hindware, Jaquar , Plumber, Kohler
39.	Geyser	Racold, venus wave,AO smith jaquar
40.	Stainless Steel Sink	Nirali , Franke , Parry ware , cera,jayna,amc,neelkanth
41.	C.P. Grating	GMGR , Chilly , Viking
42.	CP / SS Grating for Floor Trap & Floor Drain	NEER,ACO,VIJAY
43.	Stainless Steel (304) Square Frame Grating	Noway, Chilly, Camry
44.	Strainer	RB , Intervalve , Zoloto , VB
45.	SWR Pipe & Fittings type B (for internal drainage)	supreme, finolex, prince
46.	SWR Pipe & Fittings type A (for Rain water upto 160mm dia)	supreme, finolex, prince, Astral
47.	UPVC pipes/fittings	Supreme , Finolex , Prince, Astral
48.	UPVC ASTM pipes	Supreme, Surya Roshni, Finolex, Prince, Astral
49.	CPVC Pipes and Fittings	Astral, Ashirwad flow guard pipes, supreme, Prince
50.	Copper Pipes	Rajco, Maxflow

MAKE / MANUFACTURER OF THE MATERIAL TO BE USED		
Sr No.	**Category**	**Brand name**
51.	G.I. Pipes / M.S. Pipe	Tata , Jindal , Zenith, Surya Roshni
52.	G.I. fittings (malleable cast iron)	Unik , R Brand , Zoloto M , Unco,Ks
53.	C.I. fittings	Neel, Kartar,S arkar
54.	C.I pipe & Fittings	Neco,Skf
55.	Sand Cast Iron Pipes & fittings	Neco, Rif, Hepco
56.	RCC NP2 Class Pipe	Indian Hume pipe, AA Srinivasa pipe industries (Or locally available as approved by engineer in charge)
57.	Pressure Guage	H. Guru / Forbes Marshall / Waaree, Wika, Fiberg
58.	Water Meter	Kay Cee / Kent / Desmesh
59.	R.C.C Pipe	Jain Spun Pipe / Pragati /Daya Spun Pipe Best locally available
60.	Pipe Supports	Hangers Intello Tech / GMGR / Chilly
61.	Insulation	Thermaflex / Armaflex / Kiflex
62.	Storage Type Hot Water Heater	Venus / Bajaj / Racold
63.	pumps	Kirloskar, Grundfos, ITT, DP,
64.	Aluminum Systems/ Anodized aluminum fittings for doors/windows	Jindal, Hindalco, Bhoruka,
65.	Aluminium Cleat arrangement for Glazings / Cur. Wall size	Samples to be got approved by Engineer- in charge.
66.	Aluminium Sections	Hindalco/ Jindal/ Mahavir/ lndal
67.	E.P.D.M. Gaskets	Anand/ Roop/Bohra/Hanu
68.	Water stops	Hydrotite, BASF, Hydroswell
69.	PVC Perforated Pipes	Rex Polyextrusion Ltd., Akash Enterprises, Zenplas Pipes Pvt. Ltd.
70.	Ready Mix Concrete	ACC, RMC, Ultra tech
71.	Structural Sealant	Wacker, Dow Corning, GE
72.	Welding rod	Advani or equivalent
73.	MS black enameled/galvanized ERW conduits	AKG, BEC, Steelkraft
74.	Metal Deck Sheet	TATA/SAIL
75.	Shear Stud/Connector	KOCO or equivalent
76.	Clamp,Rebar,Chemcial fastner	Hilti, Fischer, Wurth
77.	Anchor Fasteners / bolts	Hilti, Fischer, Halfen
78.	Masking Tapes	3M, Sun Control/ Wonder Polymer
79.	Dash Fasteners	SS grade, Hilti/
80.	Stainless Steel Bolts, Washers and Nuts, Screw	Kundan/ Puja/ Atul
81.	Stainless Steel Friction Stay	Hetish, Haffle, Securistyle
82.	Weather Silicon make and grade	Dow Corning/ Momentive (GE)
83.	Structural Silicon	Dow Corning/ Momentive (GE)
84.	Backer Road	Supreme Industries Ltd, Sika, Softex Industrial Products
85.	Salitex board	Shalimar, STP, KIMPL
86.	Stainless Steel	Jindal/ SAIL/ Golden
87.	Adhesives & Grouts	Pidilite, Bal, Laticrete, KeraKoll,
88.	Galvanized Iron pipe	Jindal, Zenith.

MAKE / MANUFACTURER OF THE MATERIAL TO BE USED		
Sr No.	**Category**	**Brand name**
89.	Fire doors	Shakti horman, Radiant fire, Zenith, Agew, Ahura Mazda
90.	Rolling shutter Motorized	Gandhi, Shaktihormann, Avians
91.	Rolling shutter Motorized	Best locally available after approval from client
92.	HMPS door	Shaktihormann, Radiant fire , Ahura Mazda
93.	Auto sliding door	Dorma, Avians
94.	Puff panel	Omkar puf, Sterile tech India, Isotherm
95.	Frost film	3M,
96.	Manhole cover FRP	Everlast, SS industries, Termodrain, Rishi Cast, KK drain
97.	Manhole cover Cast Iron	NECO
98.	RCC manhole cover	Local made as approved by engineer incharge
99.	ACP	Euro bond, Viva, Altobond
100.	Galvalume sheet	Tata bluescope, Everest, Jindal
101.	Turbo Ventilator	Turbo ventilator, Sudha Ventilating System, Mukta engineering
102.	Translucent sheet Polycarbonate	Palram / Tuflite
103.	Bubble insulation	Aerolam, Trocellen /Supreme
104.	Stitch Screw	IPS Izod / Atul Fastener
105.	Fasteners	Souvenier / Shree Chamunda (MS) /Pooja Forge / Panchsheel fasteners
106.	Bubble insulation	Aerolam, Trocellen, Supreme
107.	Sewage Treatment Plant	Sintex, ASP Enviro, envicare systems, Bio Water treatment system or equivalent
108.	Anti-Termite solutions	Godrej Hi care Ltd, PCI: Pest Control (India) Pvt. Ltd, Pecopp Pest Control
109.	LOW DENSITY POLYETHYLENE SHEETS (LDPE SHEETS)	Arihant industries (india), Ashapura Polymills limited, Divya plastics, shree Sidhivinayak enterprises, Granosphere international
110.	Dock Leveler	Shakti Horman, Gandhi, Avianse, Godrej

Note if any changes required from the above list due to non-availability of material the same can be considered after consultation with engineer in charge and consultant.

SECTION- 16

REFERENCE LIST OF CODES

Sr.No.	INDIAN STANDARD No.	SUBJECT
1.	269-1976	Ordinary, Rapid Hardening And Low Heat Portland Cement
2.	383-1970	Coarse And Fine Aggregates From Natural Sources For Concrete
3.	455-1976	Portland Blast Furnace Stag Cement.
4.	650-1976	Standard Sand For Testing of Cement
5.	1489-1967	Specifications for Portland Pozzolana Cement
6.	1727-1967	Methods of Tests For Pozzolanic Materials.
7.	2386 PT I-1963	Methods of Test for Aggregates for Concrete - Part I : Particle Size and Shape
8.	2386 PT II-1963	Methods of test for aggregates for concrete Part 2 Estimation of deleterious materials and organic impurities
9.	2386 PT III -1963	Methods of test for aggregates for concrete Part 3 Specific gravity, density, voids, absorption and bulking
10.	2386 PT IV -1963	Methods of test for aggregates for concrete Part 4 Mechanical properties
11.	4031 1968	Methods of Physical Tests for Hydraulic Cement.
12.	4032 1968	Methods of Physical Tests for Hydraulic Cement.
13.	456-1978	Code of Practice For Plain And Reinforced Concrete
14.	1322-1970	Bitumen Felts for Water Proofing and Damp Proofing.
15.	2645-1975	Specifications For Integral Waterproofing Compounds
16.	432-1966	Mild Steel and Medium Tensile Steel Bars And Hard Drawn Steel
17.		Wire and Concrete Reinforcement.
18.	432 (PT I) 1966	Mild Steel and Medium Tensile Bars
19.	456-1984	Code of Practice For Plain And Reinforced Concrete
20.	516-1959	Methods Of Test For Strength Of Concrete
21.	1139-1966	Hot Rolled Mild Steel, Medium Tensile Steel & high yield strength steel deformed bars for concrete reinforcement.
22.	1199-1959	Method of Sampling & Analysis Of Concrete.
23.	1566-1967	Hard Drawn Steel Wire Fabric For Concrete Reinforcements
24.	1786-1979	Cold-worked HYSD steel rebars (Grade Fe415 & Fe500)
25.	2502-1963	Code of Practice For Bending And Fixing Of Bars For Concrete
		Reinforcement
26.	1077-1970	Specifications for bricks for masonry work
27.	2212-1962	Code of Practice for Brick Work.
28.	3102-1971	Classification of Burnt Clay Solid Bricks
29.	3495(PTS I To IV)	Method of Sampling Of Clay Building Work.
30.	5454-1974	Method for Sampling of Bricks for Tests.
31.	1122-1974	Method for Determination Of Specific Gravity & Porosity Of natural building stone
32.	1124-1974	Method of Test For Water Absorption Of Natural Building Stones.
33.	1130-1969	Marble (Blocks, Slabs & Tiles)
34.	205-1966	Non Ferrous Metal Butt Hinges
35.	206-1973	Tee And Starp Hinges
36.	287-1973	Recommendation For Maximum Permissible Moisture Contents
		Of Timber Used For Different Purpose.
37.	303-1975	Plywood for General Purpose
38.	451-1972	Technical Supply Condition For Wood Screws
39.	723-1972	Steel Counter Sunk Head Wire Nails.
40.	1003	Timber Paneled and Glazed Shutters
41.	1003(PT I) 1966	Door Shutters

Sr.No.	INDIAN STANDARD No.	SUBJECT
42.	1003 (PT II) 1966	Window & Ventilators Shutters
43.	1141-1973	Code of practice for seasoning of timber
44.	1200 (PT XIV) 1970	Glazing
45.	1200 (PT XXI) 1970	Wood Work and Joinery
46.	1328-1970	Veneered Decorative Plywood
47.	1341-1970	Steel Butt Hinges
48.	1659-1969	Fibre Hard Board
49.	1659-1969	Block Board
50.	1761-1960	Transparent Sheet Glass for Glazing & Framing Purpose
51.	1911-1967	Schedule of Unit Weights of Building Material
52.	2191	Wooden Flush Door Shutter (Cellar & Hollow Core Type)
53.	2191 (PT I) 1973	Plywood Face Panels
54.	2202	Wooden Flush Door Shutters (Solid Core Type)
55.	2202 (PT I) 1973	Plywood Face Panels for Wooden Flush Door Shutters.
56.	3618 - 1966	Phosphate Treatment of Iron and Steel For Protection Against
		Corrosion.
57.	4021-1967	Timber Door, Window and Ventilator Frames
58.	63-1964	Whiting For Paints
59.	226-1975	Structural Steel (Standard Quality)
60.	277-1962	Specification For Galvanized Steel Sheets (Plain and Corrugated)
61.	800-1984	Code of Practice For Use of Structural Steel in General
		Building Construction.
62.	806-1968	Code of Practice For Use of Steel Tube in General Building
		Construction.
63.	813-1961	Scheme of Symbols for Welding
64.	814-1974	Covered Electrodes For Metal Are Welding of Structural Steel.
65.	814-(PT II) 1974	For Welding Sheets
66.	815-1956	Classification and Code of Covered Electrodes for Metal Are
		Welding of Mild Steel Low Alloy High Tensile Steel.
67.	815-1968	Code of Practice For Safety and Health Requirements in Electric
		And Gas Welding and Cutting Operation.
68.	1038-1983	Steel Doors, Windows and Ventilators
69.	1599 - 1960	Method For Bend Test For Steel Products Other Than Sheet, Strip Wire And Tube.
70.	1608-1972	Method of Tensile Testing Of Steel Products.
71.	1977-1975	Structural Steel (Ordinary Quality)
72.	2062-1984	Structural Steel (Fusion Welding Quality)
73.	4351-1967	Steel Door, Door Frames
74.	777-1970	Glazed Earthen Wire Tiles
75.	1130-1969	Marble (Blocks, Slabs & Tiles)
76.	1443-1972	Code of Practice For Laying and Finishing Of Cement Concrete
		Floor in Tiles.
77.	1661-1972	Code of Practice For Application of Cement Lime Plaster Finishes.
78.	2571-1971	Code of Practice for Laying In Situ Cement Concrete.
79.	102-1962	Ready Mixed Paint, Brushing, Red, Lead Nonsetting, Priming.
80.	103-1962	Ready Mixed Paint, Brushing, White Lead, For Priming And
		General Purpose.
81.	133-1975	Enamel, Interior: (A) Under Coating (B) Finishing Color As
		Required.
82.	137-1965	Ready Mixed paint, brushing, matt or egg shell flat, finishing, interior, to Indian standard color as required.
83.	158-1968	Ready Mixed paint, brushing bituminous , black, lead free, acid alkali, water & heat resistance for general purpose.
84.	218-1961	Creosote & Anthracite oil for use as wood

Sr.No.	INDIAN STANDARD No.	SUBJECT
85.	1200 (PT XII) 1971 69	Plastering and Pointing Work
86.	2430-1986	Methods of sampling
87.	4082-1996	Specifications of stacking and storage of construction materials and components at site.
88.	2116-1980	Permissible clay, silt and fine dust contents in sand.
89.	2250-1981	Compressive Strength Test for cement mortar cubes.
90.	8112-1989	Specifications for 43 grade Ordinary Portland Cement (OPC).
91.	12269-1987	Specifications for 53 grade Ordinary Portland Cement (OPC).
92.	455-1989	Specifications for PSC (Portland Slag Cement)
93.	6909-1990	Specifications for SSC (Super Sulphated Cement)
94.	8041-1990	Specifications for RHPC (Rapid Hardening Portland Cement)
95.	3466-1988	Specifications for Masonry Cement
96.	10262-1982	Code for designing concrete mixes.
97.	13311 (Part I)-1992	Ultrasonic Testing of Concrete Structures.
98.	4925-1968	Specifications for Concrete Batching Plant
99.	3025-1983	Method of sampling and test (Physical and Chemical) for water.
100.	4990-1993	Specifications for plywood formwork for concrete
101.	9103-1999	Specifications for concrete admixtures.
102.	12200-2001	Specifications for PVC water bars
103.	1877-	Mild Steel of grade II.
104.	1785 (Part I)-1983	Specifications for plain hard drawn steel fabric for prestressed concrete.
105.	2090-1983	Specifications for high tensile strength steel bar for prestressed concrete.
106.	2074-1992	Specifications for prime coat for structural steel.
107.	2932-2003	Specifications for synthetic enamel paint for structural steel.
108.	12118-1987	Specifications for polysulphide sealants.
109.	2720-1985	Soil properties and its testings.
110.	515-1959	Specification for natural and manufactured aggregate for use in mass concrete.
111.	2387 (Part I)-1963	Method of Tests for aggregate for concrete
112.	1629-1960	Rules for grading of cut size of timber.
113.	1791-1985	Specification for batch type concrete mixers.
114.	2438-1963	Specification for roller pan mixer.
115.	2505-1980	Specification for concrete vibrators, immersion type.
116.	2506-1985	Specification for screed board concrete vibrators.
117.	2514-1963	Specifications for concrete vibrating tables
118.	3344-1965	Specifications for pan vibrators
119.	4656-1968	Specifications for form vibrators.
120.	2722-1964	Specifications for portable swing weigh batchers for concrete (single and double bucket type)
121.	2750-1964	Specifications for steel scaffoldings
122.	1343-1980	Code of practice of prestressed concrete.
123.	3370-1967	Code of practice of concrete (Part I to IV structures for storage of liquids)
124.	3935-1966	Code of practice of composite construction
125.	3201-1988	Criteria for design and construction of precast concrete trusses.
126.	2204-1962	Code of practice for construction of reinforced concrete shell roof
127.	2751-1979	Code of practice for welding of mild steel structures.
128.	3558-1983	Code of practice for use of immersion vibrator for consolidating concrete.
129.	3414-1968	Code of practice for design and installation of joints in buildings.
130.	73-1961	Specifications for paving bitumen.
131.	651-1992	Glazed stoneware pipes and fittings

Sr.No.	INDIAN STANDARD No.	SUBJECT
132.	702-1988	Specification for industrial bitumen.
133.	1200 (PT X)-1973	Method of measurements of building and civil engineering works: Ceiling and Lining.
134.	1729-1979	Cast iron drain water pipes and fittings.
135.	2095 (PT I)-	Plain gypsum plaster boards.
136.	2115-1980	Code of practice for flat roof finish: Mudphuska
137.	2633-1986	Method of testing uniformity of coating on zinc coated articles
138.	3007 (Part I)-1999	Code of practice for laying iof asbestos cement sheets
139.	3346-1980	Method of the determination of thermal conductivity of thermal insulation materials.
140.	3348-1965	Specifications for fibre insulation boards
141.	3384-1986	Specification for bitumen primer for waterproofing and damp proofing.
142.	5382-1985	Specification for rubber sealing rings for gas mains, water mains and sewers.
143.	771 (PT I)-1979	Specification for glazed fire clay sanitary appliances: General requirements
144.	771 (PT II)-1979	Specification for glazed fire clay sanitary appliances: Specific requirements of kitchen and laboratory sink.
145.	774-2004	Flushing cisterns for water closets and urinals (Other than plastic cistern)
146.	2326-1987	Specification for Automatic Flushing Cisterns for Urinals (Other than plastic cistern)
147.	2556 (Part I)-1994	Vitreous sanitary appliances (Vitreous china)-Specifications.
148.	10297-1982	Design and Construction of Floors and Roofs using Precast Reinforced.
149.	8520-1977	Guide for selection of industrial safety equipment for eye, face and ear protection.
150.	6313 (Part III)- 1981	Anti-Termite measures in buildings : Treatment for existing buildings.
151.	822-	Inspection of welds
152.	8009 (Part I)- 1976	Calculations of settlements of foundations.
153.	1904-1986	Calculations of settlements of foundations.
154.	6403-1981	Determination of bearing capacity of shallow foundations.
155.	6313 (Part II)- 1981	Anti-Termite measures in buildings
156.	10042-1981	Site investigations for foundation in gravel-boulder deposit.
157.	9143-1979	Determination of unconfined compressive strength of rock materials.
158.	8142-1976	Determination of setting time of concrete by penetration resistance.
159.	1477 (Pt I & II)-1971	Painting of ferrous metals in buildings: Pretreatment & Painting.
160.	9013-1978	Method of making, curing and determining compressive strength of accelerated-cured concrete test specimens.
161.	2911 (PART IV)-1985	Design and construction of Pile Foundations (Load test on Piles)
162.	4326-1993	Earthquake resistant design and construction of buildings.
163.	3103-1975	Industrial ventilation.
164.	2470 (PART I)-1985	Installation of septic tank : Design criteria and construction.
165.	7861 (Part II)- 1981	Extreme weather concreting: practice for cold weather concreting.
166.	3812-1981	Specification for Fly ash for use as pozzolana and admixture.
167.	3770 (Part I, II)-1965	Concrete structure for the storage of liquids.
168.	1641-1988	Fire safety of building.
169.	4926-2003	Ready mixed concrete
170.	1391 (Part II)-1992	Room air conditioners (Split Air Conditioner)
171.	1888-1992	Method of Load Test on soil.
172.	783-1985	Laying of Concrete pipes.

Note: - In case of introduction or amendment in any code from the above mentioned list, latest code to be used for the same.

SECTION- 17

QUALITY ASSURANCE PLAN

EXCAVATION WORK

Site should be properly cleaned off all shrubs, trees and leveled.

First record existing ground levels, as per instructions of Senior Engineer. Levels should be recorded jointly with Contractor's Engineer in order to avoid discrepancy in future.

Tie nylon strings on both the axis, mark the dimensions of footings and check the orientation as shown in execution drawing.

Provide permanent brick pedestal as bench mark for reference

Dimensions shall be marked including working space or as specified in specification.

Check in beforehand as to upto what depth excavation should be done, from Structural Consultant or refer trial pit for final depth if approved by Structural Consultant.

Excavated earth should be dumped away from excavated pit to avoid collapsing of dumped earth back inside the pit.

Dewatering pump should be kept ready so as to keep the pit free from water and enable smooth excavation activity.

Provide shoring in the excavated pit to avoid collapsing of earth, if conditions dictate.

Record depth of excavation at various intervals (i.e after completion of excavation in soft soil, soft murum, hard murum, rock etc.) along with Contractor's Engineer. The undisturbed formation of levels of the ground to be recorded for asserting the depth of excavation. If ground is undulating, separate level to be taken to establish the average ground level.

Maintain work study register by keeping records of manpower engaged to excavate for various categories of earth and also record actual working hours of dewatering pump.

Check the yield after dewatering the pit. Check the ground water table.

In case of Rock cutting; stack the chiseled rock in a way so that it can be removed.

After reaching a required depth as required by Structural Consultant, get the excavation pit and strata approved from Structural Consultant.

Since these measurements are hidden, joint measurement should be taken and recorded to avoid discrepancies in future.

Work out the appropriate quantity of soil required for back filling. If the excavated soil is of acceptable quality for backfilling, the same should be stacked properly for the future backfill and rest of the surplus soil to be carted away.

In case if Poclain or JCB is used for excavation, record the actual working hours.

Excavated earth is simultaneously carted out of the premises with the help of dumpers, record the number of dumpers and their quantity is to be maintained.

In case of jack hammer is used, record the actual hours used. plus the record of the diesel consumed should be maintained.

During the excavation procedure all the health and safety measurement should be followed and whole excavation area should be separated by using red tapes form adjacent area.

Checklist for Excavation work:

Sr. No.	Checks	Verified
1	Record of the existing ground levels	Yes/ No
2	The face, centres and diagonals of the structure	Yes/ No
3	Depth of excavation to be as specified by the Structural Consultant	Yes/ No
4	Yield after dewatering of pit	Yes/ No
5	Ground water table	Yes/No

SOLING WORK

Stone procured on site for soling should be black in colour and should be approved by Engineer- in-Charge.

Thickness of soling should be as specified in the tender/ execution drawing.

Levels for top of soling should be marked beforehand to avoid undulations in the levels.

Flat portion of stone should be below and tapered portion should be kept facing upwards.

Soling should be done in a compact way and voids should be filled with kapachi or material as approved by Engineer-in-Charge.

Rubble should be properly rammed with mechanical hammer or dhumus weighing at least 50 kgs to avoid settlement.

Checklist for Soling work:

Sr. No.	Checks	Verified
1	Thickness of soling to be as specified.	Yes/ No
2	Marking of level for top of soling.	Yes/ No
3	Proper ramming of rubble.	Yes/ No

PLAIN CEMENT CONCRETE

PCC of specified grade should be done on soling as a base to cast footing.

Dimension / Thickness/ Grade of PCC should be as specified in the tender/ execution drawing.

Place / pour concrete in position and compact and level it correctly within the boundaries of shuttering.

In case of ground water, sump should be made in one corner and dewatering for the same shall be done.

In no case, dry concrete should be provided.

Record the top levels of PCC and mark it as a reference for future works.

Mark the centre of footing for the both the axis with the oil paint on the top of PCC on the preceding day.

Concreting should be done with mixer and not with hand mixing.

Concreting with hand mix should be allowed only on prior approval / instructions from Structural Consultant.

In case of RMC, record of all challans should be maintained.

Slump test should be carried out to check the workability and if it fails, it is suggested to take appropriate action.

During the concrete work of floor Plain Cement Concrete, minimum six cubes of which, 2 are at the start, next 2 are in the middle of work and last 2 are at the end of concreting; should be filled and the appropriate identification marking must be done for the same. In case if concrete is made using PPC cement then three additional cubes to be prepared.

Cure the concrete for at least 7 days.

The filled cubes should be placed in the cube tank and each 3 cubes should be sent to laboratory for 7 days and 28 days testing respectively. In case if concrete is made using PPC cement then three additional cubes should be sent for 56 days testing.

Checklist for PCC work:

Sr. No.	Checks	Verified
1	Grade of PCC	Yes/ No
2	Thickness of PCC	Yes/ No
3	Dimension of PCC	Yes/ No
4	Top Level of PCC	Yes/ No
5	Curing for 7 days	Yes/ No

STARTERS : FOR COLUMNS / LIFT PARDIES (WALLS)

Before erecting shuttering for columns / lift pardies casting of starter is extremely important.

Errors in centre, eccentricity of proposed structure are eliminated with starters.

Check centers of columns / lift pardies on both the axis and mark with oil paint on the existing concrete.

Erect reinforcement as shown in drawings.

Check dimensions, orientation, reinforcement, laps, covers, as per plan.

Record the laps, reinforcement in the measurement book.

Erect the formwork for starter up to at least 100 millimeter to150 millimeter.

Check centers, face of columns again.

Shuttering oil should be applied on the shuttering plates before starting the shuttering work.

Check supports.

The covers should be checked before the concreting and all covers must be according to tender specifications.

Slump test should be carried out to check the workability and it fails, it is suggested to take appropriate action.

Pour concrete in the starter .Grade of concrete shall be similar as that of the proposed column.

Compact the concrete and level the same.

Provide shear keys for proposed structure.

All the holes; made due to shear keys should be grouted.

When the work will resume for further lift, cement slurry should be applied before starting the further concreting.

For the next lift of concreting work for the same, the shuttering should be overlapped on previous work and it should not be less than 150 millimeter.

Pour card must be filled while carrying out the concrete work and should be signed by contractor and consultant

During the concrete work, minimum six cubes which are 2 at the start, next 2 in the middle of work and last 2 are at the end of concreting;

should be filled and the appropriate identification marking must be done for the same. In case if concrete is made using PPC cement then three additional cubes to be prepared.

The filled cubes should be placed in the cube tank and each 3 cubes should be sent to laboratory for 7 days and 28 days testing respectively.

In case if concrete is made using PPC cement then three additional cubes should be sent for 56 days testing.

Checklist for starters of columns and Lift pardies (walls):

Sr. No.	Checks	Verified
1	Centers of columns / lift pardies on both the axis	Yes/ No
2	Dimensions, orientation, reinforcement, laps, cover as per plan.	Yes/ No
3	Check Supports	Yes/ No
4	Grade of concrete	Yes/ No
5	Proper compaction	Yes/ No

FOUNDATIONS (FOOTINGS)

Check dimensions, orientation of footings as per approved Structural drawings.

Check the center of footings, columns on both the axis.

Check shuttering for its dimensions, diagonals and supports.

Check reinforcement, covers, anchorage length and plumb.

Check and mark the thickness of concrete as per approved structural drawing on the columns.

Clean the existing PCC of all the mud and clean it with strong jet of water before placing the concrete.

Water, if any, should be dewatered from the pit.

Check whether vibrator, needles, mixer are in working condition. Ensure that at least two vibrators are in working condition on site.

Keep cube moulds, slump cone and ghani register ready.

Concrete should be poured in the footings and should not be thrown from a height as it will lead to segregation. In no case dry concrete shall be permitted for concreting.

Vibrate / Compact the concrete to make it dense.

Finish the concrete neatly with trowel and provide shear keys in the columns.

In case if mixer / vibrator stops working during the concreting, the instructions of structural consultant shall be followed.

Checklist for foundations (footings):

Sr. No.	Checks	Verified
1	Dimensions and orientation of footings to be as per drawing	Yes/ No
2	Centre of footings, columns on both axis	Yes/ No
3	Dimensions, diagonals and supports of Shuttering	Yes/ No
4	Reinforcement , covers , anchorage length and plumb	Yes/ No
5	Thickness of concrete as per drawing	Yes/ No
6	Vibrator and mixer are in working condition.	Yes/ No
7	Proper finish to concrete	Yes/ No

STUB COLUMNS

Erect the reinforcement upto the required level with proper laps, if starter is not cast.

Check center of the columns on both the axis.

Erect shuttering of columns as per dimensions in the structural drawings.

Check supports, line, levels, plumb, gaps in shuttering and also covers for reinforcements.

Mark the actual height for which the columns is to be cast on the shuttering of columns.

Prepare mortar as in proportion 1:2 in sand and cement and pour into the column upto a height of 100 millimeter before commencing concreting to avoid segregation.

Erect the platform for pouring concrete and placing vibrator.

Under no circumstances labour shall be allowed to stand on the shuttering for pouring concrete.

Check whether vibrator and concrete mixer are in working condition.

Ensure the size of forms for proper mix proportions.

Pour concrete inside the column and assure that proper vibration and compaction is done.

Take concrete specimen in the cube mould (at least 6 cubes) and mark the date of casting on the cubes when it is wet along with the column number for proper identification.

Check whether the slump of concrete is as per instructions of structural consultant.

Maintain the ghani register during concreting.

After de-shuttering the columns, check plumb again.

Write column number and date of casting with oil paint on the column.

Checklist for stub columns:

Sr. No.	Checks	Verified
1	Centre of columns on both axis	Yes/ No
2	Supports , line , levels , plumbs , gaps in shuttering and also cover for reinforcement	Yes/ No
3	Proper vibration and compaction of concrete in columns.	Yes/ No
4	Slump of concrete	Yes/ No
5	Plumb	Yes/ No

PLINTH BEAMS

Check in advance whether the plinth beams are to be placed on PCC or wooden bottom. If to be placed on PCC, then check in advance whether proper ramming of soil and soling is done before laying PCC and subsequent steel.

Check orientation of plinth beams (i.e. whether it is from the center of face of the column)

Check reinforcement of plinth beam as per approved Structural drawings.

Check cover, laps and anchorage for reinforcement.

Check the dimensions of plinth beams as per approved Structural drawings.

Check shuttering for line, level, plumb, support and gaps.

Shuttering is to be neatly oiled before placing in position.

Mark the top of concrete level on the sides of beam and columns to maintain the proper line and level.

Check whether vibrations and concrete mixer are in working condition.

Ensure that provision for plumbing pipes or electric cables in required location is made.

Check that proper dowels are fit at places wherever shown in drawing (i.e. for staircase etc.)

Check the inner clear dimension of rooms before erecting the shuttering.

Ensure proper vibrations and compaction during concreting.

After deshuttering, write beam numbers and date of casting on the beam using oil paint.

Cubes to be taken and properly marked as mentioned earlier.

Checklist for plinth beams:

Sr. No.	Checks	Verified
1	Proper ramming of soil and soling prior to laying PCC and steel	Yes/ No
2	Orientation of plinth beams	Yes/ No
3	Cover , lap and anchorage for Reinforcement	Yes/ No
4	Dimensions of plinth beam as per drawing	Yes/ No
5	Line, level, plumb, support and gaps for shuttering	Yes/ No
6	Proper oiling of shuttering prior to laying in position	Yes/ No
7	Provision of plumbing pipes in required location	Yes/ No
8	Dowels as per drawing	Yes/ No
9	Inner clear dimensions of rooms	Yes/ No
10	Proper vibration and compaction during concreting	Yes/ No

PLINTH WORK

Check whether the plinth level is as per the working drawing.

Working drawing of the ground floor must be studied before doing the plinth masonry.

Check whether the masonry for external plinth beams if necessary is done or not.

Check if the anti-termite treatment is given to plinth area before commencing of further activity.

Minimum 15 days curing is required before filling the murum or backfilling.

Check whether the soil used for back filling is approved by the Engineer-in-Charge.

Check whether the back filling is done in layers (i.e. compacted, rammed, and consolidated as specified in the tender specification).

Take compacted soil sample for modified Proctor density test.

Soling of required thickness to be provided, rammed and consolidated.

Gaps in the same should be filled with mechanical ramming or with dhums weighing at least 50 kgs.

PCC of specified grade to be placed above soling upto the plinth level.

However ensure that the starter of columns in the plinth area is cast before PCC.

Checklist for Plinth work:

Sr. No.	Checks	Verified
1	Level of plinth as per drawings	Yes/ No
2	Antitermite treatment to plinth area	Yes/ No
3	Proper backfilling of soil in layers as specified	Yes/ No
4	Proctor density test	Yes/ No
5	Soling provided is of required thickness	Yes/ No
6	PCC is of specified grade	Yes/ No
7	Starter of columns in plinth area to be cast prior to PCC	Yes/ No

FLOOR COLUMNS

Check the center of columns on both the axis with center line plan.

Dimension and orientation of columns to be checked. In case if any reduction is shown in the drawing, ensure exactly from which side reduction is shown.

Check whether the reinforcement is as per Structural drawings (i.e. laps, covers, joggling and staggering of bars)

Check shuttering of columns i.e. supports, plumb, line, right angle, centre to centre and face to face distances. Any gaps if seen, should be properly plugged.

Shuttering should be properly oiled with recommended shuttering oil.

Erect working platform adjacent to the columns for concreting purpose and for placing vibrator.

Check whether vibrator, concrete mixer is in working condition.

Under no circumstances concreting should be done by climbing on the column shuttering.

Check dosage of admixture, if at all, to be added to concrete.

Check the depth of beams for proposed slab or if any tie beam is to be provided. Mark the level of the reinforcement to column

accordingly so as to concrete the column upto an accurate height.

Take a specimen of concrete in the form of cubes and also check slump.

Deshuttering should be done after 36 hrs of column casting.

After deshuttering, check the plumb of column again so as to check accuracy in workmanship.

Mark date of casting and number on the column surface with oil paint.

Hacking of columns should be of 50 numbers in 1 sqft. (i.e. 500 nos. in 1 sqm.)

Cure concrete for minimum 7 days.

After floor columns are cast, mark a uniform reference level on the column with red paint.

Testing of the concrete specimen cube should be done before due date i.e. after the 7th and 28th days.

Checklist for columns:

Sr. No.	Checks	Verified
1	Centre of columns as per centre line plan	Yes/ No
2	Dimension and orientation of columns	Yes/ No
3	Reinforcement as per structural drawing	Yes/ No
4	Proper shuttering of columns and proper oiling of shuttering	Yes/ No
5	Depth of beams for proposed slab	Yes/ No
6	Slump of concrete	Yes/ No
7	Plumb of column	Yes/ No
8	Proper hacking of column	Yes/ No
9	Proper curing	Yes/ No

SLAB WORK

BEAM:

Shuttering bottoms / columns caps.

Check the level and line of bottoms as per plans.

Check dimensions of bottom.

Check plumb, supports to pile caps to avoid bulging and eccentricity during concreting.

Check the orientation of beams as per the Structural drawing.

Check the inner dimension of rooms after finalizing beam bottoms.

Provide adequate props i.e. it should be in line and plumb at every 2'0" (0.60 m). Props should be erected in a vertical position.

Props should be properly anchored at the base and only one or two wooden plank pieces are allowed (bricks or blocks should not permitted at any cost) If required, additional bracing at 1.2 m height to be provided both ways.

BEAM SIDES

Check the line, level, plumb and depth of beams.

Check whether shuttering is as per design approved by the Structural Consultant.

Check the junction of beam bottoms and sides. Junction / corners should be properly nailed and tightened and no gaps should be left for cement slurry escape. If any gaps were shown, fill it properly.

SLAB

Check quality of shuttering plates and make sure it should be oiled properly before they are placed on the slab.

Check right angle and dimension of panels as per architectural / structural drawing.

Mark the thickness of the slab.

Ensure that there are no gaps/voids in slab and if seen should be plugged with cotton wire, thermocol or waterproof paper.

Ensure proper propping on slab, i.e. props should be firmly anchored at both ends and should be placed vertical.

No Joints in chabbi shall be allowed.

Beam bottom with sides should be properly clamped with sikangas/wire.

REINFORCEMENT

Before placing the reinforcement bars in position the shuttering of Slab and beams should be cleaned and oiled.

BEAMS (As per approved Structural drawing)

Check the top and bottom bars of the reinforcement. Check the diameter and spacing of stirrups, no. of groups, types within groups, size, hooks, double groups and tying.

Check location, diameter and length of extra bars.

Check diameter, length and location of the surface reinforcement.

Check laps, anchorage of steel and covers.

Diameter of bars, bending of stirrups in plumb.

Binding wire should be neatly tied to strips / bars and rolled over and the wire should not touch shuttering.

Check the length of bent up bars continuing in adjacent beams.

Strips should be placed in a vertical position and not in an inclined position.

Extra stirrups should be provide at the junction of beam.

SLAB

Check diameter/spacing of main bars and bent up bars

Check the distance of bent up bars form face of beam.

Length of bent up bars projecting in adjacent panel

Height of bent up bars

Provide chare below every bent up bars.

Covering for the slab at bottom.

Check the dowels of the slab and beam

Check the provision of fan hooks if necessary

Check whether slab reinforcement is. proper.

Check chairs, covers and laps.

LEVELS / PROVISIONS

Check the final level of slab with leveling instrument.

Check outer to outer dimensions of slab as per drawings.

Check whether outside of beams is in line and properly supported.

Ensure all provisions are made in slab i.e. electric conduits, telephone pipes, plumbing pipes, HVAC, fan hook etc prior to concreting.

The slab should be neatly cleaned before concreting.

Check provision of lap length in columns.

Ensure bars are properly joggled as a provision for reduction in column size.

PRE-CONCRETING ARRANGEMENT

Check the stock of Cement, Sand, M1, M2, Admixtures and water.

Check whether mixer/ hoist machine are in working condition.

Ensure the number of Cube moulds to be 12 nos. Slump Cone should be available.

Vibrators at least 2 nos. with 4 needles (40mm) should be available.

Check the sufficient petrol or diesel is available for the vibrator and mixer.

Check the labour strength required and available at the site.

Standard farmas of required size as per mix design.

Stands for different depth of concrete.

Decide the position of the concrete joint in case of large slab after consulting and the approval from the senior staff.

Bottom planks i.e. bottom patti for ramming concrete.

Tarpaulins to be kept ready in case of monsoon season.

The arrangement for walk ways to be checked if concreting is to be done by trolleys.

The arrangement for planks to be done if concreting is being done by labour.

To check whether proper lighting arrangements are made.

Scaffolding for hoist should not be tied either to slab steel or to props.

Get signature of concerned agencies on pour cards before concreting.

Check the variable test of sand on site such as moisture content, bulkage, silt content, fineness modulus, screening and the stock.

Check the variable test of aggregates on site such as silt content, fineness modulus, and stock of material.

Check the brand , date of manufacture, stacking , physical test screening through 90 micron sieve and stock of cement available on site

Check the grading of sand and aggregates, batch weight and moisture adjustment.

Check the location of mixer and raw material from concreting place to avoid delay in concreting.

Check the arrangement of cube moulds, slump cone and tamping rods.

Check out the machineries available on site with their certificate from testing agency and lubrication.

Check the safety provision.

Check the working of weigh batcher, measuring box / forms for aggregates.

DURING CONCRETING ARRANGEMENT

Take concrete specimen in the form of cube and also check whether slump is as desired by Structural Consultant.

Maintain Ghani register.

Maintain pour card register.

Check concrete for cohesion and workability.

Vibrate the concrete and ensure proper compaction.

Avoid construction joints.

In case construction joints have to be given, it should be given as per instructions of Structural Engineer.

The mixing time should be at least 1 ½ minutes, after placing aggregates and water.

Check whether admixture is properly added to concrete.

Checklist for concreting works:

Sr. No.	Checks	Verified
	Formwork:	
1	Line , level , plumb and dimensions	Yes/ No
2	Gap closing and oiling	Yes/ No
3	Adequate supports and bracing	Yes/ No
4	Quality of props	Yes/ No
5	Cover blocks	Yes/ No
6	Verticality of props	Yes/ No
	Reinforcement:	
1	No. of bars, diameter as per drawing	Yes/ No
2	Diameter/ spacing of stirrups	
3	Proper tying and fixing of cover blocks	Yes/ No
4	Lap length , lap provision for further lift if required	Yes/ No
5	Provision of chairs if required	Yes/ No
	Concrete:	
1	Type of concrete	Yes/ No
2	Approximate quantity.	Yes/ No
3	Availability of cement, aggregate and admixture, if required.	Yes/ No
4	Slump	Yes/ No

BRICK MASONRY / BLOCK MASONRY

Only bricks approved by Architect / Client should be used in masonry.

Bricks should be thoroughly soaked in water before using it in masonry. Dry bricks or half wet bricks shall not be allowed to use.

Masonry joints should not be wider than 10 mm.

Masonry should not be more than 1 meter height.

RCC stiffener to be provided as specified.

The face of the column is to be plastered before placing brick masonry so as to get a bond and avoid separation cracks.

Cure the first coat at least for 4 days.

Top layer of masonry i.e. between beam bottom and last layer should be proper packed to avoid separation cracks.

Provision to be left for proposed door, window or proposed masonry in any.

Cure the masonry for 7 days.

Rake out the joints.

Check line, level and plumb.

Checklist for masonry works:

Sr. No.	Checks	Verified
1	Fully wetting of Bricks before use.	Yes/ No
2	Proper scaffolding.	Yes/ No
3	Proportioning of cement mortar	Yes/ No
4	Using cement mortar within 30 minutes of adding water	Yes/ No
5	Raising of masonry not more than 1m at a time	Yes/ No
6	Thickness of joints not more than 10-12mm.	Yes/ No
8	Raking of joints	Yes/ No
9	Plumb , horizontal joints	Yes/ No
10	RCC/PCC bands of required thickness and at regular intervals	Yes/ No
11	Fixing of door/ window frames in plumb with required hold fasts	Yes/ No
12	Cleaning and curing	Yes/ No

INTERNAL PLASTERING WORK

Masonry should be properly cured well in advance and it should be thoroughly saturated.

RCC member should be properly hacked, chiseled wherever needed.

Level of the ceiling and walls to be checked for thickness.

Plumb for the wall to be checked.

Thickness for the internal plaster should not exceed 12 mm.

Chicken mesh should be fixed to all vertical and horizontal joints of RCC and masonry wall.

Chicken mesh should not be loose or else it will come out of the plaster.

Check that no chicken mesh wires are sen outside the plaster.

Bamboo scaffolding should not be allowed in the plaster.

In case of undulations in the parent body, the thickness of plaster may increase to match the plumb line.

Hence in this case, the plaster should be applied in 2 coats.

Sand plastering of ceiling should be done first and then walls.

Apply first coat provide a key for the second coat.

Add the approved admixtures to mortar as per dosage directed.

On applying the second coat / finish coat apply neeru to it to give a smooth finish.

Extra thickness of neeru should not be allowed as it leads to surface cracking.

In no case dry cement should be applied to complete the job earlier.

Write the date of plastering on the plastered wall with oil paint.

Waste mortar shall not be reused for plastering purpose.

Cure the plaster surface for 7 days.

Checklist for internal plaster work:

Sr. No.	Checks	Verified
	Prior to plastering:	
1	Screening of sand	
2	Floor cleaning.	Yes/ No
3	Door and window- Plumb, dimensions, level and position.	Yes/ No
4	Proper hacking of RCC members.	Yes/ No
5	Sleeves and holes for plumbing and electrification	Yes/ No
6	Level of Ceiling and Thickness of walls	Yes/ No
7	Plumb of wall	Yes/ No
8	Plaster pad of specified thickness	Yes/ No
9	Fixing of chicken mesh wherever required	Yes/ No
10	Cill fixing	Yes/ No
11	Proportioning of mortar	Yes/ No
12	Proper curing of masonry prior to start of plastering work.	Yes/ No

	During plastering:	
1	Use of mortar within 30 minutes of adding of water	Yes/ No
2	Plumb , right angle and level of plaster	Yes/ No
3	Thickness of internal plaster not more than 12mm	Yes/ No
4	Round edges of doors and window frames, column corner	Yes/ No
5	Cleaning of door and window frames, Floor and ceiling	Yes/ No
6	Gauges of plaster at regular intervals	Yes/ No
7	Curing for 7 days	Yes/ No

EXTERNAL PLASTERING WORK

External plaster is to be done mainly in two coats.

Surface preparation for the same is essentially important.

Make the scaffolding work in advance, where plaster is to be done.

Masonry joints are to be raked out properly. RCC members should be hacked and chiseled wherever required.

If the beam or columns are bulged out, it should be chiseled with sharp chisel and hammer.

Junction of masonry, columns and beams to be packed with the stiff concrete mix of specified grade.

Chicken mesh of 12 mm holes and 24 gauge should be used while carrying out external plaster work.

Minimum 20 cm to 23 cm wide chicken mesh should be fixed over the RCC and wall joint.

RCC members should be made free from the unwanted material such as wooden pieces, papers, kathyas etc.

The masonry surfaces should be watered to its saturation.

Drop plumb from the top of the wall, prepare plumb pads at various places to avoid undulations in plaster.

Avoid the puncture in the masonry wall or RCC wall for embedding scaffolding in any case and double scaffolding is to be erected.

First coat should be applied in Thickness not more than 12 mm.

Admixtures in mortar to be added as per dosage directed by the manufacturer.

Waste mortar shall not be used in any circumstances.

Apply second coat plaster in a mix as specified in tender.

Ensure that sand grains are generally protruding outwards.

Plaster should be used for both the coats.

In case of excess undulations in the parent surfaces, a preliminary coat is to be applied Surface preparation to avoid

excess thickness in plaster to be done.

Check the line, level and plumb of plaster.

Write date of plastering on the plastered wall and cure the plaster for at least 7 days.

Checklist for external plaster work:

Sr. No.	Checks	Verified
	Prior to plastering:	
1	Proper screening of sand	Yes/ No
2	Proper curing of masonry prior to start of plastering work.	Yes/ No
3	Door and window- Plumb, dimensions, level and position.	Yes/ No
4	Proper hacking of RCC members.	Yes/ No
5	Plumb of wall	Yes/ No
6	Provision of chicken mesh at concrete masonry joints	Yes/ No
7	Filling of gaps between beam and masonry at top layer by means of concrete	Yes/ No
8	Filling of holes made for brickwork	Yes/ No
9	Proper scaffolding	Yes/ No
10	Proportioning of mortar	Yes/ No
	During plastering:	
1	Use of mortar within 30 minutes of adding of water	Yes/ No
2	Plumb , right angle and level of plaster	Yes/ No
3	Thickness of external plaster not more than 12mm	Yes/ No
4	Plastering in 2 coats	Yes/ No
5	Compaction of plaster on sill/ chajja and parapet top	Yes/ No
6	Time gap between 2 coats	Yes/ No
7	Gauge of plaster at regular intervals	Yes/ No
8	Curing for 7 days	Yes/ No

FRAMES:

Check the dimension as per drawings.

Check whether the numbers and locations of hinges are in right position.

Check the location and size of Hold fast.

Check the verticality, level, orientation and alignment of frame.

Ensure the frame should be properly painted.

SHUTTERS

Check the dimension of shutter as per drawings.

Check the location of door fittings.

Check the make and brand of the door with ISI mark.

Shutters with bend at the corner should be rejected.

Check the shutter should properly painted.

Check the alignment of shutter.

Check that all fittings are fixed as per drawings.

Primer, putty and first coat of oil paint should be completed before fixing any fittings on the shutter.

All visible dents, scratches, unevenness should be properly repaired by applying putty made from wood dust an resin. It should be scraped with sand paper.

Checklist for door and window frame and shutters:

Sr. No.	Checks	Verified
	Frames:	Yes/ No
1	Dimensions as per drawing	Yes/ No
2	No. and location of hinges	Yes/ No
3	Location & size of holdfast	Yes/ No
4	Verticality of frame	Yes/ No
5	Level of frame	Yes/ No
6	Painting	Yes/ No
7	Location / Orientation	Yes/ No
8	Alignment	Yes/ No
	Shutters:	
1	Dimensions as per drawing	Yes/ No
2	Location of door fitting	Yes/ No
3	Painting	Yes/ No

PAINTING WORK

Internal Painting

Clean the entire surface thoroughly.

Ensure proper Scaffolding.

Check the preparation of paint whether it is as per specified shade or as per Architect's requirement.

Make sure the brand of the paint as per specified in the tender/ confirmed by owner.

Check whether the quality of brush is of good quality.

Check whether all cracks in the walls are filled properly.

External Painting

Check all the surface whether it is cleaned by washing.

Check the scaffolding erected is proper.

Check the preparation of paint whether it is as per specified shade or as per Architect's requirement.

Make sure the brand of the paint as per specified in the tender confirmed by owner.

Check whether the quality of brush is of good quality.

Check whether all cracks in the walls are filled properly.

Checklist for painting:

Sr. No.	Checks	Verified
	Internal painting:	Yes/ No
1	Cleaning of surface	Yes/ No
2	Scaffolding	Yes/ No
3	Preparation of paint	Yes/ No
4	Application of paint by good quality brush.	Yes/ No
5	Filling of cracks	Yes/ No
6	Surface wetting	Yes/ No
	External painting:	
1	Cleaning of surface	Yes/ No
2	Scaffolding	Yes/ No
3	Preparation of paint	
4	Application of paint by good quality brush.	Yes/ No
5	Filling of cracks	Yes/ No
6	Curing	Yes/ No
7	Surface wetting	Yes/ No
	Wooden surface:	
1	Filling of holes, nail holes by putty.	Yes/ No
2	Application of primer coat	Yes/ No
3	Application of paint by smooth brush.	Yes/ No
	Iron Work:	
1	Removal of rust scales by rubbing.	Yes/ No
2	Application of primer coat	Yes/ No
3	Application of paint	Yes/ No

FLOORING WORK

FLOORING

Check the removal of loose material like mortar.

Check whether the sand used for bedding is washed, screened to maintain the silt content.

Check whether the measuring box is available for sand.

Check the level which is taken at the floors to maintain proper level or slope.

Check the size and make as per tender specification.

Check the proper cutting of tiles at edges, corner & sill.

Check the preparation of bedding with proper proportion.

Don't allow hand mixing of mortar as it leads to poor mixing and more cement consumption.

Check the right angles before starting the work.

Check the laying of tiles in line and level with minimum thin joints.

Check whether cement grout at joints is removed.

Check the cleaning and grouting of joints of tiles.

Apply a thin layer of cement slurry on the surface to avoid the rupture.

Provide the proper curing to flooring, if required.

Check the grinding of floor by machine as per requirement

Cleaning should be properly.

One should not allow walking on the newly fixed floors for at least 24 hours.

Fill the joints with the cement slurry immediately the next day.

Checklist for flooring:

Sr. No.	Checks	Verified
1	Removal of loose material like mortar washing, screening and silt content of sand.	Yes/ No
2	Measuring box for sand.	Yes/ No
3	Level.	Yes/ No
4	Cutting of tiles at edges, corner & sill	Yes/ No
5	Preparation of bedding with proper proportion.	Yes/ No
6	Laying of tiles in line and level with minimum thin joints.	Yes/ No
7	Removal of cement grout at joints.	Yes/ No
8	Cleaning and grouting of joints.	Yes/ No
9	Application of thin cement slurry on entire surface.	Yes/ No
10	Curing	
11	Grinding of floor by machine.	Yes/ No
12	Cleaning	Yes/ No

DADO WORK

Complete all the plumbing work and conduting work before dado fixing.

Check the removal of loose material like mortar.

Check whether the sand used for bedding should be washed, screened to maintain the silt content.

Check whether the measuring box is available for sand.

Check all the level which is taken at the floors to maintain proper level or slope.

Check the proper cutting of tiles at edges, corner & sill.

Check the preparation of bedding with proper proportion.

Check the laying of tiles in line and level with minimum thin joints.

Ensure that the full tile should be taken on the opening side of the door for W.C. floor.

Check whether cement grout at joints is removed.

Check the cleaning and grouting of joints of tiles.

Provide the proper curing as per requirement.

Checklist for dado work:

Sr. No.	Checks	Verified
1	Removal of loose material.	Yes/ No
2	Preparation of base coat.	Yes/ No
3	Soaking of glazed tiles.	Yes/ No
4	Washing, screening and silt content of sand.	Yes/ No
5	Measuring box for sand.	Yes/ No
6	Level.	Yes/ No
7	Cutting of tiles at edges, corner & sill.	Yes/ No
8	Fixing of tiles in line and level.	Yes/ No
9	Cleaning of joints	Yes/ No
10	Grouting of joints.	Yes/ No
11	Curing.	Yes/ No

PLUMBING WORK

G.I. INTERNAL / EXTERNAL

Coordination with the different agencies such as electrical should be done before starting work.

G I work should be as per drawings.

It should be in proper line.

It should be clamped on saddles.

Check the joint to avoid the leakages.

Provide proper painting as per details.

Check the filling of opening in walls.

SANITARY PIPES:

It should be as per drawings.

Maintain the proper line of work.

Check the proper clamping at proper distance.

Check whether all joints are properly filled.

Provide proper painting as per details.

Check the filling of opening in walls.

Checklist for plumbing and sanitary work:

Sr. No.	Checks	Verified
	Plumbing work:	
1	Details as per drawing.	Yes/ No
2	Proper Line	Yes/ No
3	Clamping on saddles	Yes/ No
4	Joints to be checked for leakages.	Yes/ No
5	Proper Painting as specified.	Yes/ No
6	Filling of openings in walls.	Yes/ No
	Sanitary work:	
1	Details as per drawings.	Yes/ No
2	Proper Line	Yes/ No
3	Clamping at proper distance.	Yes/ No
4	Joint filling	Yes/ No
5	Painting	Yes/ No
6	Filling of openings in walls.	Yes/ No

WATERPROOFING WORK

Waterproofing is normally done in conventional brick bat coba, on terrace, toilet, open terraces and balconies.

First plug the outlets of surface where waterproofing is to be carried out.

Pond the place upto specified height and keep it for 7 continuous days.

Concrete if normally done with quality checks does not show signs of leakages/seepages.

Brick bat coba works as an insulation and also helps in maintaining proper slopes.

After 7 days, if seepages or dampness is observed then immediately mark the boundaries and put the date.

At location showing dampness / leakages, injection grouting to be done.

Break open the concrete upto cover.

Next, start doing grouting either by gravity or by pump.

Grout material shall be either cement slurry or any grouting material as approved by Engineer-in-charge.

Pond the area again with water upto specified height. Check the soffit again whether the dampness / leakages has stopped or not.

First confirm from the Architect, the slope required and location of rain water pipes.

Brick bat should be thoroughly soaked in water to its saturations.

Very small pieces of the bricks should be rejected

Under burnt and over burnt brick bats should not be used for waterproofing work.

Fix ridge line to ensure proper slope.

Place brick bat in staggered position. The joints should not be more than 12mm width.

Proportion of mortar should be as specified in tender.

Dosage of admixture shall be as specified by the manufacturer.

After placing the bricks bats, cure the same at least for 7 days.

Providing the finishing coat with neat cement finish in proportion of mortar as specified in tender.

Pond the waterproofed area upto a specified height and keep it constantly ponded at least upto 7 days.

After 7 days remove the water from the surface completely.

Allow the area to dry completely upto 14 days.

Again pond the area with the water and check the leakages /dampness.

This is known as alternate drying and wet test for waterproofing.

Checklist for waterproofing work:

Sr. No.	Checks	Verified
1	Cleaning of surface.	Yes/ No
2	Removal of loose material.	Yes/ No
3	Level of waterproofing.	Yes/ No
4	Application of waterproofing compound with C.M. in recommended proportion.	Yes/ No
5	Laying of bricks in C.M. with given slope.	Yes/ No
6	Curing with ponding of water.	Yes/ No
7	Check dampness below slab.	Yes/ No
8	Ponding.	Yes/ No

INFRASTRUCTURE WORK

SEWER LINES:

Check the layout as per drawings.

Check the proper bedding for line.

Check whether the proper slope is given to line.

Make sure that the joints are sealed properly.

Take the Smoke test for the line.

Check the proper back filling on the line laid.

Checklist for sewer line work:

Sr. No.	Checks	Verified
1	Layout as per drawing	Yes/ No
2	Proper bedding	Yes/ No
3	Proper slope	Yes/ No
4	Proper sealing of joints	Yes/ No
5	Smoke test	Yes/ No
6	Backfilling.	Yes/ No

STORM WATER DRAIN

Check the layout of drain as per drawing.

The slope should be proper.

Check the expansion joint filler.

Check the N.D.T.

Checklist for storm water drain work:

Sr. No.	Checks	Verified
1	Layout as per drawing	Yes/ No
2	Slope	Yes/ No
3	Expansion joint filler	Yes/ No
4	NDT	Yes/ No

CABLING WORK

Check the layout of cabling work as per drawing.

Check the size of cable.

Provide proper bedding.

Give proper attention to jointing and terminating.

Check the proper back filling on the cable laid.

Checklist for cabling work:

Sr. No.	Checks	Verified
1	Layout as per drawing	Yes/ No
2	Size of cables	Yes/ No
3	Bedding	Yes/ No
4	Jointing and terminating	Yes/ No
5	Backfilling	Yes/ No

STRUCTURAL WORK

Structural work consists of steel members ISMB, ISMC, ISA etc.

Check the sizes of the members as per the drawings.

Check their position and size as per requirement.

Check the line, level and position as per drawing.

Check the bolt holes in numbers, size and position.

Check the welding and bolting work properly.

All the weld should be done in continues manner.

The make and size of the electrodes should be checked according to the tender specification.

During welding, electrodes should be used which should be properly stored.

Check the quality of weld.

Check the welder's certifications.

Checklist for Structural work:

Sr. No.	Checks	Verified
1	Check members as per drawing	Yes/ No
2	Line, level and position as per drawing	Yes/ No
3	Quality of weld	Yes/ No
4	Welder's certification.	Yes/ No

DYE PENETRATION TEST FOR WELDED JOINT

1.0 INTRODUCTION

This standard details the Dye penetration test procedure for detecting discontinuities that are open to the surface on ferrous, non-ferrous materials and weld joints.

2.0 CHEMICAL USED

Following chemicals are used for testing :

1. Viable Red Dye Penetrant PP-15A
2. Cleaner PC-21 A
3. White colored liquid Developer PD-31 A

3.0 REFERENCE STANDARDS

3.1 This document makes reference to ASTM-E-165 AND ASME SECTION VII DIVISION I APPENDIX VIII

4.0 TEST PROCEDURE

4.1 Surface to be tested is thoroughly cleaned to remove dust, rust, paint and any other foreign matters and irregularities.

4.2 Cleaned surface is then cleared with cleaner. Application may be with either spray or brush.

4.3 This surface is now ready for application at the Dye Penetrant. This application may either be with spray or brush.

4.4 Dye Penetrate treated surface is left in normal condition for 15 minutes minimum to 20 minutes maximum.

4.5 The penetrate remaining on the surface is removed by wiping with a soft white fabric. Whatever, surplus penetrant remaining is wiped off with the cloth dipped in cleaner. The surface is then left for couple of minutes for normal evaporation of the excess cleaner.

4.6 Now the Developer is sprayed on the surface within 10 minutes of normal evaporation.

4.7 The surface is visually examined to locate penetrant indications. The inspection is carried out within 10 to 30 minutes after the developer is sprayed.

5.0 VALUATION OF DEFECT INDICATIONS

5.1 Only indications with major dimensions greater than 1.6 mm shall be considered relevant.

5.2 A liner indication is one having a length greater than three times its width.

5.3 A rounded indication is one of circular or elliptical shape with the length equal to or less than three times the width.

5.4 Any questionable or doubtable indication shall be re-examined to determine whether or not they are relevant.

6.0 ACCEPTANCE STANDARD

6.1 All surfaces to be examined shall be free of following defects.

1. Relevant Linear indications.
2. Relevant rounded indications greater than 4.8 mm
3. Four or more relevant rounded indications in a line separated by 1.6mm or less (edge to edge)
4. Size of indication is the basis for acceptance.

6.2 Defective material shall be rejected.

HYDRO TEST FOR ERW PIPE LINE

1.0 Scope: This procedure shall be used for conducting hydro test for the pipe line loop at site.

2.0 Reference document: IS: 1239 / Tech spec / Drawing

3.1 The test shall be hydrostatic using potable water and soluble oil (Rust inhibiter) shall be added.

3.2 Test pressure shall be calculated based on the line pressure (working pressure). Normally test pressure shall be 1.5 times of working pressure.

3.3 The pipe shall be tested (holding time) for a minimum period of 1 hrs .

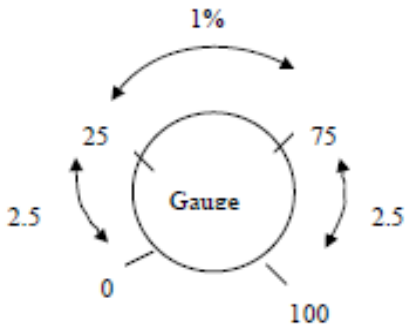
3.4 Calibrated pressure gauges shall be used during testing for verification of test pressure and chart recorder shall be provided to record the total pressurizing time, total pressure and hold time on graph paper.

3.5 Test pressure shall be maintained as per above to ensure no leakage in the joints and the parent material.

4.**0 Calibration of pressure gauges**

The pressure gauge used for Hydrostatic testing shall be Re-calibrated with a Dead Weight tester and the record shall be maintained. Permissible error shall not exceed the following :

[I] 0-25 % & 75 – 100% of gauge range = 2.5% of maximum gauge range [II] 25 – 75 % of gauge range = 1% of maximum gauge range.



5.0 Test Procedures: **Procedure for clamping, pumping, test pressure emptying and unloading shall be followed as given below.**

a. Clamping

Hold & clamp the pipe under testing between two plates of the hydro tester against two sealing rings.

Control of the hydraulic pressure to balance the end load such that there is no scope of any leakage from the pipe ends.

b. Pumping

Potable water to be used in Hydrotesting process and soluble oil shall be added.

The pipe shall be filled up with water in such a way that the air is completely vented out.

As the pipe under test is being water filled check for leakage at the sealing plates.

Increase the balancing hydraulic pressure a little if there is a leakage.

Start the pressurizing water pump from the pump control panel.

Allow the filling pump to continue running. The swing checks valve acts as a non-return valve & will not allow pressure to drop.

The pipe shall be positioned inclined with the vent at the highest position.

c. Test Pressure

After obtaining the specified test pressure the hydraulic pump supplying water into the pipe is cut-off and the pressure is retained for specified time to carryout inspection for any leakage.

d. Emptying

Open the manual pressure release valve (Lower Valve) slowly and water will be ejected into the water sump.

When the pressure has reduced to a low level commence to open the hydraulically operated gate valve gradually from the control panel

Avoid releasing the water too fast to prevent excessive splashing.

Lower the pipe support beams to tilt the pipe and increase the emptying rate.

Take the floating platen further clear of the pipe end by operating the Fast Release push-button.

e. Unloading

When the pipe is empty of water lower all three-pipe support beams until they are in level with the transfer rails.

Roll the pipe out of the hydro tester onto the transfer rails.

Adjust the pipe stops to their correct positions to accept the next pipe to be tested Dry the inside of the pipe with moist free / oil free / dust free dry air.

SAFETY MEASURES TO BE FOLLOWED AT SITE

Crèche should be provided away from the worksite where the children of workmen can be sheltered during working hours. No children should be allowed to loiter in the work zone.

Scaffolding provided to negotiate the height, should be properly designed for superimposed dead and live loads. Erection of the scaffolding should be entrusted to experts in the field and the erected scaffolding should be thoroughly checked by the Engineer before put to use.

Electrical distribution system, switches etc. should be provided by an experienced and licensed electrician.

Wire ropes of hoists, crane elevators etc. should be periodically checked and damaged ropes should be replaced without delay.

All precautions laid down for blasting operations should be meticulously followed.

Unloading of stone on the masonry surface should not be done by throwing them from height. Apart from damaging the masonry done, such throwing might injure the nearby workmen due to flying pieces.

Wherever mason and others are required to work on the face work, safety nets should be provided.

At the working platform, adequate space should be provided for movement and reversal of trucks and tippers.

Haul and approach roads should be well watered. No hard curves should be there on these roads.

Walking with head load on the rough masonry surfaces might result in sprained legs. Good plank ways should be provided for labour movement on the top of masonry.

When gate erection activity, involving the hoisting of heavy loads is in progress on any block, no masonry or concrete work should be allowed.

Overcrowding of people in the driver's cabin of trucks and tippers should be disallowed.

Movement of trucks and tippers for transportation of labour should not be permitted.

Labour working within the operating radius of crane should be asked to wear helmets.

CHECKLIST FOR SAFETY PRECAUTIONS		
SR. NO.	DESCRIPTION	VERIFIED
1	Shoes / gumboots are worn by concerned worker?	Yes / no
2	Safety helmets / safety belts worn by workers working at site & at higher level	Yes / no
3	Safety goggles/hand shields/welding helmets/ leather gloves worn by workers doing welding work?	Yes / no
4	Openings, corners & edges are guarded with barriers?	Yes / no
5	Availability of first aid boxes at different sections is checked?	Yes / no
6	All electrical cables are laid underground or overhead on wooden poles? (except - temporary lines)	Yes / no
7	Live joints/cable joints are insulated/protected By insulation tape or chamber?	Yes / no
8	Warning signs as "danger-440 volts", "no smoking" & other safety slogans are displayed?	Yes / no
9	Fire extinguishers & sand buckets are available at the point of storage where inflammable materials are stores?	Yes / no
10	Ladder shall be given an inclination not steeper than 1/4 h to 1 v	Yes / no
11	Working platforms, gangways and stairways shall be constructed for working heights more than 3.25m as per requirement with safe means of access	Yes / no
12	Crane operators of age more than 21 shall be properly qualified person	Yes / no
13	Excavation trenches more than 1.5 m deep and sewer manholes under construction shall be protected by means of covering temporary plates or fencing	Yes / no
14	Sewer manholes covers to be opened and manholes are to be ventilated for an hour before workers are allowed to enter for sewer lines in use.	Yes / no

Types of Tests With Sampling Frequency And Acceptance Criteria

Sr. No.	Material	Types of test/ Requirements		Acceptance Criteria				Sampling frequency
1	Cement		**Physical**					
		i)	Manufacturer's Certificate					Every 50 tonnes or part thereof (for every 1000 bags of 50kg). Each brand of cement brought to site shall be tested as per this frequency.
		ii)	Compressive strength	33 Grade	43 Grade	53 Grade		"-do-"
			(Kgf/Sq.cm)	IS:269-1976	IS:8112-1989	IS:12269-1987		
			3 days	160 min.	230 min.	270 min.		
			7 days	220 min.	330 min.	370 min.		
			28 days	330 min.	430 min.	530 min.		
		iii)	Initial setting time (minutes)	30 min.	30 min.	30 min.		"-do-"
		iv)	Final setting time (minutes)	600 max.	600 max.	600 max.		"-do-"
		v)	Normal consistency					"-do-"
		vi)	Fineness (%)	10% max.	10% max	10% max		"-do-"
		vii)	Soundness (mm)	10 max	10 max	10 max		"-do-"
		viii)	Specific Gravity					"-do-"
		ix)	All above tests to check the air setting of cement.	Same as above				Once in a month from same lot.
			Chemical	**(%)**	**(%)**	**(%)**		
			Loss on Ignition	Max. 5.0	Max. 5.0	Max. 4.0		Every 50 tonnes or part thereof (for every 1000 bags of 50kg). Each brand of cement brought to site shall be tested as per this frequency.

Sr. No.	Material	Types of test/ Requirements		Acceptance Criteria				Sampling frequency
			Insoluble Residue	Max. 5.0	Max. 5.0	Max. 5.0		"-do-"
			Sulphur tri Oxide (SO3)	Max. 3.5	Max.3.5	Max. 3.5		"-do-"
			Silica Content (SiO2)	--	--	--		"-do-"
			Alumina Content (Al2O3)	--	--	--		"-do-"
			Iron Content (Fe2O3)	--	--	--		"-do-"
			Calcium Oxide (CaO)	--	--	--		"-do-"
			Magnesium Oxide (MgO)	Max. 6.0	Max. 6.0	Max. 6.0		"-do-"
			Chloride (Cl)	*	*	*		"-do-"
			Total Alkali Content (Na2O + 0.658 (K2O))	Max. 0.6	Max. 0.6	Max. 0.6		"-do-"
			Tricalcium Aluminate (C3A)	--	--	--		"-do-"
			Dicalcium Silicate (C2S)	--	--	--		"-do-"
			Tricalcium Silicate (C3S)	--	--	--		"-do-"
			Al2O3 / Fe2O3	Min. 0.66	Min. 0.66	Min. 0.66		"-do-"
			Lime Saturation Factor	0.66-1.02	0.66-1.02	0.80-1.02		"-do-"
			*** Chloride content shall not exceed 0.1% for structure other than prestressed concrete.** *** Chloride content shall not exceed 0.05% for prestressed concrete.**					
2	Aggregates IS:383-1970	i)	Specific gravity					Once for each quarry for all the tests.
		ii)	Alkali Aggregates reaction.					"-do-"
		iii)	Crushing value.	Max. 45%				"-do-"
		iv)	Chloride content					"-do-"
		v)	Impact value	Max. 45%				"-do-"
		vi)	Abrasion value	Max. 50% (Except wearing surface concrete)				"-do-"
		vii)	Soundness	Max. 12% when tested with sodium Sulphate.				"-do-"
				Max. 18% when tested with Magnesium Sulphate.				"-do-"

Sr. No.	Material	Types of test/ Requirements		Acceptance Criteria	Sampling frequency	
		viii)	Grading			Weekly
		ix)	Silt content	3% by weight (max.)		Daily
		x)	Moisture content			Daily
3	Concrete IS:383-1970, IS: 456-2000	i)	Slump test: before leaving the batching plant and on arrival at the site.	Dry Mixes; Slump= 0-25 mm		
				Low workability mixes: Slump= 10-40 mm		
				Medium workability mixes: Slump= 50-90 mm		
				High workability mixes: Slump>100 mm		
		ii)	Compressive Strength Test	As per IS: 456-2000		For every batch of concrete, 6 cubes shall be tested.
					Each Batch of freshly mixed concrete	
			If on-site calibrated testing facility is not available, then all the above test as per the mentioned frequency would have to be done from a 3rd party testing laboratory approved by Engineer in charge.			For 1-5 cum of concrete : 1 nos of samples
						For 6-15 cum of concrete :2 nos samples
						For 16-30 cum of concrete : 3 nos samples
						For 31-50 cum of concrete : 4 nos samples
						For concrete >51 cum : 4+ one sample for each additional 50 cum
4	Sand IS:383-1970	i)	Specific gravity			
		ii)	Soft fragments and coal.	1% by weight (max.)-		
		iii)	Silt content	3% by weight (max.)		Daily
				8% by volume - C.P.W.D specifications		

Sr. No.	Material	Types of test/ Requirements		Acceptance Criteria			Sampling frequency	
		iv)	Bulkage					Daily
		v)	Moisture content					Daily
		vi)	Grading					Weekly
5	Reinforcing Steel IS:1786-1985	1)	Chemical	**All test to be carried out by 3rd party testing laboratory approved by Engineer in charge**				
				Fe 500 D	Fe 500	Fe 415	i)	Each lot for every 50 T. or part thereof 3 bar per dia.
			Carbon	0.25% max.	0.3% max.	0.3% max.		
			Sulphur	0.040% max.	0.055% max.	0.06% max.		
			Phosphorus	0.040% max.	0.055% max.	0.06% max.		
		2)	Physical	**All test to be carried out by 3rd party testing laboratory approved by Engineer in charge**			ii)	Each lot for every 50 T. or part thereof 3 bar per dia.
		i)	Yield strength	50 Kg/Sq.mm	50 Kg/Sq.mm	41.5 Kg/Sq.mm		
		ii)	Ultimate tensile strength	56.5 Kg/Sq.mm	54.5 Kg/Sq.mm	48.5 Kg/Sq.mm		
		iii)	Elongation	16%	12%	14.50%		
		iv)	Weight per meter					
		v)	Rebend Test	Shall not show fracture in bend portion.				

Sr. No.	Material	Types of test/ Requirements		Acceptance Criteria				Sampling frequency
6	Water IS:456-1978	i)	Organic	200mg/lit.				Start of work and if contamination noticed or source changes
		ii)	Inorganic	3000 mg/lit.				Start of work and if contamination noticed or source changes
		iii)	Chloride content	2000 mg/lit. for PCC				Start of work and if contamination noticed or source changes
				1000 mg/lt. for RCC				
		iv)	Sulphate content	500 mg/lit				Start of work and if contamination noticed or source changes
		v)	Suspended matter	2000 mg/lit				Start of work and if contamination noticed or source changes
		iv)	pH value	shall not less than 6				Start of work and if contamination noticed or source changes
7	Bricks	i)	Absorption	Max 20% weight of dry brick				Each consignment or every 5000 nos
		ii)	Crushing Strength	Minimum Crushing strength: 3.50 N/mm2				"-do-"
		iii)	Hardness	No impression of scratch on the surface.				"-do-"
		iv)	Presence of soluble salts	Max 20% weight of dry brick				"-do-"
				% efflorescence	Type	Condition		
				0%	No efflorescence	Absence of salts		
				10%	Slight			
				<50%	Moderate			
				>50%	Heavy	Serious		
		v)	Shape & size	Max 20% weight of dry brick				"-do-"
		vi)	Soundness	Ringing sound when struct and no breakages in the bricks				"-do-"
		vii)	Structure	Homogenous, compact and free from any defects such as holes, lumps etc				"-do-"

Sr. No.	Material	Types of test/ Requirements		Acceptance Criteria	Sampling frequency	
8	Solid concrete Blocks (100&150 mm thick) IS:2185 (Part-II)-1983	i)	Density	Min. 1800 Kg/Cu.m		3 Blocks = Density
		ii)	Water absorption	Max.10%		3 Blocks = Water absorption.
		iii)	Compressive strength	50 Kg/Sq.cm		8 Blocks = Compressive Strength.
		iv)	Moisture movement	0.09% max.		3 Blocks = Drying Shrinkage.
		v)	Drying shrinkage	0.1% max.		3 Block = Drying shrinkage & moisture movement if needed.
						20 Blocks/5000 Blocks
9	Flush door shutters. IS:2202 (Part-I)- 1991	i)	Dimensions	Width & height + 5 mm Thickness + 1.2 mm		Lot size : Sample size
		ii)	End immersion test	No delamination		26 - 50 8
						51 - 100 13
		iii)	Knife test	Only for the knife width should peel off and nothing extra.		Lot size / Sample size
						101 - 150 / 20
						151 - 300 / 32
						301 - 500 / 50
						501 & above / 80
		iv)	Glue adhesion test	No delamination		

Sr. No.	Material	Types of test/ Requirements		Acceptance Criteria	Sampling frequency	
10	Marine ply for panel shutters. I.S. 1734 (Part 1 to 20) - 1983.			I.S. 710 - 1976		1% of total requirement.
		i)	Manufacturer's Certificate			
		ii)	Density			
		iii)	Moisture Content	min. 5%		
				Max. 15%		
		iv)	Water resistance			
		a)	Glue shear strength	Average min. 100 Kg.		
				Individual min. 80 Kg.		
		b)	Knife test	Ply only for the knife width should peel off and nothing extra.		
		v)a)	Glue shear strength	Average min.135 Kg.		
				Individual min. 110 Kg.		
		v)b)	Knife test	Ply only for the knife width should peel off and nothing extra.		
		vi)	Mycological test	No sign of separation of the edges of veneers.		
11	Floor Tiles IS: 1237 - 1980	i)	Dimensions			As per inspection level I in table 1 and AQL 6.5% in table 3 of IS : 2500 (Part -I)1973.
		a)	L & B	+ 1 mm		
		b)	Thickness	+ 5 mm		
		ii)	Water Absorption	Average max. 10%		
		iii)	Abrasion	Average max. 3.5 mm		
				Individual max. 4.0 mm		
		iv)	Wet Transverse	Average min. 3 N/Sq.mm		
		v)	Wearing layer	5 to 6 mm		

Sr. No.	Material	Types of test/ Requirements		Acceptance Criteria	Sampling frequency	
12	Stoneware pipes & fittings. IS : 651 - 1971	i)	Acid resistance	The loss in mass shall not exceed 0.25%	Lot size : No. of pipes to be tested	
		ii)	Alkali resistance	There shall be no evidence of pitting, softening spalling or cracking in the pipe or fitting after the last.	Upto 150	2
		iii)	Crushing strength	When tested along the full length of the pipe barrel from shoulder to spigot, the pipe tested shall have a min. crushing strength of 16 KN/m length.	151 to 300	3
					301 to 500	4
					501 to 1000	5
					1001 to 3000	7
					3001 and above	8
13	Glazed tiles IS : 777 - 1988	i)	Water absorption	max. 20%	Lot size : (Nos.)	Sample size (Nos.)
		ii)	Crazing	Shall show signs of crazing.	3000 - 10000	32
		iii)	Impact resistance	Shall remain intact, apart from surface marking.	over 10000	50
		iv)	Chemical resistance	Shall show no modifications.		
		v)	Warpage (149 x 149mm)	- 0.4mm, +0.7mm		
		vi)	Dimensions			
			a) Facial dimensions	i) Average value (length of all four sides)		
				shall not vary more than +0.8mm		
				ii) The variation of individual dimensions from average value shall not exceed + 0.5mm		
			b) Thickness	shall be + 0.4 mm		

Sr. No.	Material	Types of test/ Requirements		Acceptance Criteria	Sampling frequency	
14	Cement paint		Dying time, recoating properties, finish, colour fasteners to light, residue on sieve, resistance to dry rubbing, water repellency, pot life, keeping properties etc.	In accordance with IS:5410 - 1960 and IS : 101-1964, latest revision.		Each lot / consignment.
15	Water Supply (on site/Bldg.) of off site.		Pressure Test	Internal - Pressure min. 5 kg/Sq.cm		Each line. Also, when the source of supply changes.
				External - Pressure min. 7.5 Kg/Sq.cm		
				Off site - Pressure min. 10 Kg/Sq.cm		
16	Pathways (on site)		Plate load test.	For Sub grade :		"-do-"
				Plate load value of 5 Kg/Sq.cm for a penetration of 2.5 cm with plate size 30cm x 30cm in fully standard condition.		
17	Plinth filling & embankment.		Compaction test :	95% of proctor density @ optimum moisture content.		Each building. (1 for every 200 sqm for each layer)
		a)	Density			
		b)	Moisture content			
		c)	K value			Each building. (1 for every 500 sqm for each layer)

Nondestructive Test
For Structure and Other Miscellaneous Tests For Infrastructures And Its Acceptance Criteria

NON-DESTRUCTIVE TEST FOR STRUCTURE AND OTHER MISCELLANEOUS TESTS FOR INFRASTRUCTURES AND ITS ACCEPTANCE CRITERIA.

Sr. No.	Material	Types of test/ Requirements	Acceptance Criteria			Sampling Frequency
1	Structure	Load test	As per clause 17.6 of IS : 456 - 2000			One building of each type.
2	Joints	For Bending & Shear	No signs of distress or cracking shall be observed.			To be decided later on.
3	concrete Members	Ultrasonic test	If velocity (IS 13311 - (part I) - 1992)			
			Below 3 km / Sec	Doubtful		
			3.0 Km/Sec	3.5 Km/Sec	Medium	5% of structural elements.
			3.5 Km/Sec	4.5 Km/Sec	Good	
			4.5 Km /Sec	and above	Excellent	
		Schmidt Hammer test	(IS 13311 - (Part - II) - 1992)			5% of structural elements.
			The rebound nos. should correspond to 200 Kg. /Sq.cm for M20 concrete			
4	Sewerage (Building) /off/on site	Smoke test	No smoke leakage from joints			Each stack / line
5	Rain water pipe	Smoke test	No smoke leakage from joints			Each stack.
6	Water supply (on site / Bldg. & off site.)	Pressure test	Internal	Pressure min.	5 Kg / sq. cm	Each line.
			External	Pressure min.	7.5 Kg/Sq.cm	
			Off site	Pressure min.	10 Kg/Sq.cm	
7	Road (off site)	Plate load test	For Sub grade :			One test / 1000 Sq.m
			Plate load value of 5 Kg / cm for a penetration / settlement of 2.5 cms with a plate size 30cm x 30cm in fully saturated condition.			

		Core test.				
8	Storm water drain (off stie)	Load test & Ultrasonic / Hammer test.	If velocity (IS 13311 - (Part - I) - 1992)			To be decided later on.
			Below 3 Km/Sec.		Doubtful	
			3.0 Km/Sec	3.5 Km/Sec	Medium	
			32.5 Km/Sec	4.5 Km/Sec	Good	
			4.5 Km/Sec	and above	Excellent	
9	Pathways (on site)	Plate load test	For Sub grade :			" - do - "
			Plate load value of 5 Kg/Sq.cm for a penetration of 2.5 cm with plat size 30cm x 30cm in fully standard condition.			
			For Pavement :			" - do - "
			Plate load value of 15 Kg / Sq. cm with 2.5 cm. settlement with plate size of 15 cm x 15 cm			
10	Plinth filling & embankment	Compaction test :	95% of proctor density @ optimum moisture content			Each building.
		a) Density				
		b) Moisture content				

ANNEXURE A - APPENDIX TO CONDITONS OF CONTRACT

Details	Clause
Earnest Money Deposit	**₹ 3,50,000/- payable by cheque**
Performance Guarantee/ Security Deposit	Within 7 days of finalization contractor to submit Performance guarantee of amount 1% of the contract value in the form of Bank Guarantee shall be from a Nationalized Bank, validity till the contractual completion date plus 4 months. If the work gets delayed or extended the bank guarantee will be extended at no extra cost to client.
Time for project completion	**3 months** for one floor date of issue of LOI including Monsoon season including complete handing over including snag list clearance
Mobilization Advance	The contractor, if requested shall be paid recoverable Mobilization Advance upto a maximum of 5% of awarded Contract value against submission of Bank Guarantee for an equivalent amount. Mobilization advance shall be completely recovered from first five bills. The Bank guarantee furnished shall be valid up to date of completion of entire work as stipulated in the contract. Bank guarantee will be released once the Mobilization advance is recovered. Mobilization at site by the contractor is not subject to disbursement of Mobilization Advance by client.
Mobilization Time	The Contractor shall start work within a period of 7 Days from the date of LOI or notice to Proceed.
Insurance	The Insurance Policies / Contractor all risk policy to be taken and kept in force by the contractor throughout the construction. The amount of Rs. ----------/- to be insured at all times
Licenses and local approvals	The contractor shall obtain at his own cost Govt/ Municipal licenses/permits required for labour, site facilities and all other government licenses required before start of work in the area.
Site office	Contractor to provide furnished office to his site staff, Employer & representative with computer, printer & internet connection, and other basic facilities. Contractor shall provide and maintain site office of minimum size 10' feet X12' feet for consultant with toilet facility and air-conditioning including furniture,

Details	Clause
	fixtures, drinking water and electrical power. The location shall be finalized by the Engineer-In-Charge.
Supply of Material and reconciliation.	All materials shall be supplied by Contractor. No wastage allowance shall be considered. The Contractor shall also provide a proper reconciliation of the material consumed, duly verified by the Consultants / Employer, and along with the RA bills submitted from time to time and Final reconciliation Statement with final Bill.

Details	Clause
Contract Rates.	The Contract rates shall remain firm throughout the period of the contract. No escalation or price adjustment shall be done due to any reason. Except Steel/reinforcement and RMC +/- 5 %. Variation beyond 5% reduction in cost, the benefit to be passed on to the client & above 5% client need to pay variation to the contractor upon Basic Rates.
Local Issues	All local issue will be handled by the contractor
RA (Running account) Bill	It will take 7 working days to check and certify the bill by consultant after receiving soft and hard copy of bill along with all necessary documents and R.A. Bills will be paid within 15 working days from the date of certification of bills by consultants. This payment will be made after making necessary deductions as stipulated elsewhere in the CONTRACT DOCUMENT.
Final Bill	Only on obtaining completion certification from the Consultants & Employer, the Contractor shall submit the FINAL BILL which will be settled within a period of 1.5 months (45 days) provided the contractor completed work as per conditions of contract. Final Bill shall be complete in all respects including duly signed final measurements, material reconciliation statements, authentication of non-tender items by quantity and by rates agreed upon. Payment against final bill will be made as set, after deducting of any advance, other dues/income tax and recoveries.
Liquidated Damage/ Bonus	In the event of delay in completion of work, the contractor shall pay liquidated damages at the rate of 0.5% of contract price per week of delay subject to a maximum of 5% of contract price. The contractor shall be entitled for a bonus of 1% for each 30 days early completion of work. The period of less than 30 days shall be ignored while working out bonus. The maximum bonus shall be limited to 2.5% of original contract value.
Defects Liability Period	12 months from date of issue of virtual completion Certificate.
Retention money	5% retention amount will be deducted from every running account bill. Maximum of 5 % of contract value. 100% after completion of one year / after defects liability period after certification of consultant. 100% amount can be release on receipt of bank guarantee from nationalized bank of the amount up to end of defects liability period

Details	Clause
Water	Water for construction shall not be made available to the contractor. Contractor has to arrange the construction water without any extra cost. The contractor at his own cost shall arrange distribution of pipe networks, storage and such distribution network arrangement shall have the prior approval of the Engineer-in-Charge.
Electricity	Supply of electric power for the work shall be arranged by the Contractor without any extra cost. The contractor shall make further distribution arrangements form this point. Contractor will be responsible for overall lighting of the site.
Labour Hutments	The contractor to make his own arrangement for labour hutments outside the plot. Labour camp will not be allowed to stay inside the plot. He will not be allowed to make hutments just outside the plot or adjoining to the existing compound wall.
Penalty	1. **Rs. 1,000/-** per incident of unsafe act / non-compliance of Legal / Statutory requirements as may be pointed out by the Consultants / Employer. Such fault shall also include acts that are specifically prohibited under various provisions / clauses provided as part of this tender document.

I/WE AGREE TO ABOVE

Witness :

Signature of Contractors
(With Rubber Stamp)

ANNEXURE B

FORM OF AGREEMENT

THIS AGREEMENT made the _____ day of _____ 2024 BETWEEN. **Devi Ahilyabai Smarak Samitee, Dhantoli, Nagpur"** (Hereinafter called "the Employer") of the first part and _____ _____ (hereinafter called the "the Contractor") of the other part.

WHEREAS the Employer is desirous that certain work should be carried out viz " **Proposed Civil Works for Civil and MEP Works of proposed Washroom renovation of Ground to Fourth floorAt WELINGKAR INSTITUTE OF MANAGEMENT,MATUNGA"** and has accepted a tender by the Contractor for execution and maintenance of such works.

NOW THIS AGREEMENT as follows:
In this Agreement words and expressions shall have the same meanings as are respectively assigned to them in the Conditions of Contract hereinafter referred to.

(1) The following documents shall be deemed to form and be read and construed as part of this agreement, viz.
   a) The said Tender and Appendix thereto.
   b) Instructions to Tenderers
   c) The Drawings
   d) The Conditions of Contract
   e) Special Conditions and Specifications
   f) General Specifications
   g) Standard Descriptions of Items
   h) Bill of Quantities
   i) Letter of Acceptance dated _____
   j) Any correction or addition thereof.
   k) Final negotiation meeting records

(2) In consideration of the payments to be made by the Employer to the contractor as herein after mentioned the contractor hereby covenants with the Employer to construct complete and maintain the works in conformity in all respects with the provisions of the contract.

(3) The Employer hereby covenants to pay to the Contractor in consideration of the construction, completion and maintenance of the work the contract price at the times and in the manner prescribed by the contract.

IN WITNESS whereof the parties hereto have caused their respective common seals to be hereunto affixed (or have hereunto set their respective hands and seals) the day and your first above written.

SIGNED BY THE SAID IN THE PRESENCE OF OWNER

WITNESS
NAME :
ADDRESS:

SIGNED BY THE SAID IN THE PRESENCE OF CONTRACTOR
WITNESS
NAME :
ADDRESS:

Note this format may be changed as per the requirement of client.

****

ANNEXURE C

Proforma for Structure & Organization Details

Sr. no	Description	Detail
1.	Name of the firm	
2.	Address.	
3.	Telephone no. – Office	
	Residence.	
4.	Telegraphic Address, if any.	
5.	Month and year in which the present firm was established in present name	
6.	Particulars of old firm(if present firm is new) if main partners of the present firm were working as construction contractors in some other name in the past(the partnership deed of the old firm be enclosed)	
7	Particulars of sister concern if any	
8(i)	What is the constitution of the firm viz. sole proprietor, partnership, Pvt Ltd. Public ltd. Etc.	
(ii)	Enclose copy of partnership deed or Articles of Association etc.	
9.	Give details of enrolment with Govt./Semi Govt/PSU & with other organizations.	
10 (i)	Annual turnover for last five years(enclose documentary evidence or proof to support figures)	Year Rs. In Lacs i) ii) iii) iv) v)
iii)	Enclose latest Income-tax clearance certificate. Certificate enclosed for Assessment year.	

Sr. no	Description	Detail
11 (i)	Name and complete address of bankers	
(ii)	Enclose solvency certificate indicating the amount	Rs.
iii)	Bank Guarantee Limits with various Banks.	i) Rs. Lacs with ii) Rs. Lacs with
12 (i)	Enclose list of immovable properties with complete postal addresses, full description.	Rs.
18(i)	How do you normally carry out work of water supply, sanitary and plumbing installations ?	
ii)	Who is the license holder and what is his experience of this work ?	
19(i)	How do you normally get the work of electrical installations carried out ?	
(ii)	Who is the license holder and what is his experience ?	
20.	Any other information, the applicant might like to give .	

I/We certify that the above particulars are correct and that it should be found that I/We fails to notify the fact of my/our subsequent amalgamation with another contractor or firm, The Shikshan Prasarak Mandal, Pune may remove my/our name from the list of contractors and any contract that I/We may be holding at the time may be rescinded.

(SIGN & STAMP OF BIDDER)

Date:

ANNEXURE D

Proforma for Details of Technical & Administrative Personnel of the company.

Sr. No.	Name	Designation	Age	Academic Qualification	Period of Service with the firm	Total Experience	Details of experience

SIGN & STAMP OF BIDDER

ANNEXURE E

Proforma for ENROLLMENT WITH VARIOUS ORGANISATIONS:

Sr. no.	Name and address of Authority with whom You are Enrolled	Year to year	Is copy of letter enclosed	Class or category	Limit works enrolled for . (Rs. In Lacs)

SIGN & STAMP OF BIDDER

ANNEXURE F

LIST OF MAJOR WORKS COMPLETED DURING LAST FIVE YEARS.

Sr. no.	Name and Complete Postal Address of			Order			Date of commencement	Scheduled date of completion	Progress made and expected date of completion and reasons for delay if any.
	Site of work & nature of work	Owner	Authority under whom work is carried out	Ref. No. & Date	Amount (Rs. In lacs)	Is copy enclosed			

SIGN & STAMP OF BIDDER

ANNEXURE G

LIST OF MAJOR WORKS ON HAND

Sr. no.	Name and Complete Postal Address of			Order			Date of commencement	Scheduled date of completion	Progress made and expected date of completion and reasons for delay if any.
	Site of work & nature of work	Owner	Authority under whom work is carried out	Ref. No. & Date	Amount (Rs. In lacs)	Is copy enclosed			

SIGN & STAMP OF BIDDER

ANNEXURE H

DETAILS OF PLANT AND EQUIPMENT WITH BIDDER

Sr.No.	Item of equipment	Availability		
		Owned/ leased/to be procured	Nos/capacity	Age/condition
				,

We declare that the information provided by us is correct and when required we shall provide the required documentation for the same.

Contractor

ANNEXURE I

OTHER RELEVANT INFORMATION

Sr. No.	Particulars						
i)	WORK FORCE						
	Permanently		No.	Any other	Years with the firm		
	a)						
	b)						
	c)						
	d)						
	e)						
	f)						
ii)	OTHERS						
	a)						
	b)						

ANNEXURE J

Sr. No	Equipment	Quantity	Remark
1	Total Station with all required accessories (like prism, tripod etc.)	1	SURVEY
2	Theodolite	1	
3	Auto level	2	
4	Leveling staff	3	
5	Cloth linen Measure Tape (30M)	3	
6	Metal Tape (3m,5m, 30m)	3	
7	Line dori		
8	Paint/lime powder for marking		
9	Water level Tube	2	
10	Spirit Level	2	
12	Set of IS Sieves of sizes	1	GRADING OF AGGREGATE
13	Mechanical sieve shaker	1	
14	Bristle Brush	5	
15	Weight balance(0.1 percent accuracy)	2	
16	Silt jar	2	
17	VICAT APPARATUS	1	CONSISTENCY /INITIAL & SPECIFIC GARVITY
18	Gauging trowel	1	
19	Wire basket - perforated, electroplated or plastic coated with wire hangers.	1	WATER ABSORPTION & SPECIFIC GRAVITY
20	Water-tight container	1	
21	Dry soft absorbent cloth - 75cmx45cm.	1	
22	Shallow tray of minimum 650 sq.cm area	1	
23	Air-tight container made of non-corrodible material with lid.	1	
24	ELECTRIC OVEN (Thermostatically controlled oven maintained at a temperature of 110 ± 5 Deg C)	1	
	Metal gauge confirming to IS 2386-1963 (Part 1)	1	FLAKINESS AND ELONGATION INDEX
25	Slump cone	2	FRESH AND HARDENED CONCRETE
26	Tamping rod	2	
27	Cube Moulds	24	
28	Needle Vibrator	1	
29	Compression Testing Machine operated by electrical & manual means	1	

ANNEXURE K

TEF ACCEPTANCE FORMAT

To,

Devi Ahilyabai Smarak Samitee, Dhantoli, Nagpur"

TENDER ENQUIRY No – _____ **Date: -** _____

I/We hereby accept all the tender enquiry terms.

COMPANY'S NAME & ADDRESS:

_____

_____

_____

SIGNATURE:

DATE:

NAME:

DESIGNATION:

BIDDER'S COMPANY SEAL:

NOTES:

Bidders should carefully read the Terms & Conditions of the Tender Enquiry Form (TEF) prior to filling up this acceptance format.

This format should be properly filled, signed and returned by the bidder(s) along with their technical offer for considering their Bid.

Bidder(s) to attach Separate Sheet for any deviations taken by them.

ANNEXURE L

Payment Terms Acceptance Format

To,

SHIKSHAN PRASARAK MANDALI,PUNE;SHARADA SABHAGRUH,S P COLLEGE CAMPUS,PUNE411030

TENDER ENQUIRY No – _____ **Date: -** _____

I/We hereby accept all the payment terms mentioned in tender.

COMPANY'S NAME & ADDRESS:

_____

_____

_____

SIGNATURE:

DATE:

NAME:

DESIGNATION:

BIDDER'S COMPANY SEAL:

NOTES:

1. Bidder(s) should carefully read payment terms included in the tender prior to filling up this acceptance format.
2. This format should be properly filled, signed and returned by the bidder(s) along with their technical offer for considering their Bid.
3. Bidder(s) to attach Separate Sheet indicating all relevant details such as Number & description of the Clause, Reasons for Deviation and Alternative suggested for any deviations taken by them.

ANNEXURE M

FORM OF UNDERTAKING TO BE FURNISHED BY THE BIDDER

To,
SHIKSHAN PRASARAK MANDALI , PUNE; SHARADA SABHAGRUH,S P COLLEGE CAMPUS,PUNE411030.
SHIKSHAN PRASARAK MANDALI,PUNE;SHARADA SABHAGRUH, S P COLLEGE CAMPUS,PUNE411030.

Sir / Madam

Sub: **Proposed Civil Works for Civil and MEP Works of proposed Washroom renovation of Ground to Fourth floorAt WELINGKAR INSTITUTE OF MANAGEMENT,MATUNGA**

REF: **SHIKSHAN PRASARAK MANDALI,PUNE;SHARADA SABHAGRUH,S P COLLEGE CAMPUS,PUNE411030**TENDER ENQUIRY No –_____ Date: _____

1. Having visited the site and examined the Drawing(s), Conditions of Contract, Special Conditions of Contract, General Specification and Detailed Specifications, building specifications of the above named work(s), we offer to design and construct, the whole of the said works as listed in the scope in conformity with the said Drawings, General Conditions of Contract, Specification, building specification included in this Tender Document for such other sum as may be ascertained in accordance with the said conditions of Contract.
2. We undertake to complete and deliver the works as per the time period mentioned in the tender
3. We have independently considered the amount of Liquidated damages shown in the tender and agree that it represents a fair estimate of the loss likely to be suffered by you in the event of the work(s) not being completed in time.
4. The Contractor's All Risk Policy for the full value of the Contract valid till the completion period will be obtained by us in the joint names of SHIKSHAN PRASARAK MANDALI,PUNE;SHARADA SABHAGRUH,S P COLLEGE CAMPUS,PUNE411030and us. We shall also undertake workmen compensation policy as per the tender terms.
5. We agree to abide by this Tender for the period of 30 days form tender closure date from the date fixed for receiving the same and it shall remain binding upon us and may be accepted at any time before the expiry of this period.
6. Unless and until a formal Agreement or Order is prepared and executed, this tender together with your written acceptance thereof, shall constitute a binding Contract between us.
7. We understand that if our Tender-Bid is accepted, we are to be jointly and severally responsible for the due performance of the Contract.
8. We understand that you are not bound to accept the lowest or any Tender you may receive.

Dated this _____ day of _____(year)
Signature _____in the capacity of_____ Duly authorized to sign Tenders for and on behalf of _____
_____

(IN BLOCK CAPITALS)
Witness:
Signature _____
Address of Witness _____
Name _____
Occupation _____

ANNEXURE N

RTGS/NEFT – MANDATE AUTHORISATION FORM

1. Supplier's / Vendor's Name:

2. Supplier's / Vendor's Name as per Bank Records:

3A. Supplier's Code **3B. Supplier's PAN Number: #**

Quoting PAN No. in all the e-returns has become 100% mandatory w.e.f. 14-02-2008 hence, ensure to fill- up this and also send a photocopy of PAN duly self-attested. If there is any difference between the name given in the supplier's name and name given in the PAN card, then a note to explain the reason for the difference and the correlation between both.

4. Supplier's / Vendor's Complete Postal Address:

Door No.	Street:		
Location :	District:		
City:	State	PIN	

5. Supplier's / Vendor's E-mail ID:

6. Supplier's / Vendor's Telephone Number & Mobile Phone Number:

7. Name of the Bank:

8. Bank (Branch) Postal Address:

9. RTGS*/NEFT - Code of the Branch:**

RTGS:	
NEFT:	

RTGS* - "Real Time Gross Settlement", NEFT** - "National Electronic Fund Transfer".
These "IFSC" Codes are unique numbers of each Branch – "Indian Financial Services Code". For some Branches both the codes are the same and some Banks, may maintain one Code No. for RTGS and another Code No. for NEFT. Hence, please fill-up both the rows, even if it is the same.

10. Nature of the Account: (Tick whichever is applicable & put 'x' mark for the balance two accounts)

Saving Bank Account:		Cash Credit Account:		Current Account:	

11. Bank Account Number of the Supplier: ©

© Fill up from the 1st column. For the balance left out blank columns, please mention 'x' mark.

We hereby declare that the particulars given above are correct and complete. If the transaction is delayed for reasons of incomplete or incorrect information, we would not hold Devi Ahilyabai Smarak Samitee, Dhantoli, Nagpurresponsible.

Date:

Supplier's Seal:

ANNEXURE O
PAYMENT TERMS:

Sr. No.	Description	Percentage
1	Mobilization advance	The contractor, if requested shall be paid recoverable Mobilization Advance upto a maximum of 5% of awarded Contract value Mobilization advance shall be completely recovered from first five bills. Mobilization at site by the contractor is not subject to disbursement of Mobilization Advance by client.
2	Running Bills- Maximum one each month	95% Via Running Bills
3	Retention Money: After defect liability period i.e. 1 year or against bank guarantee from nationalized bank valid till defects liability period	5 %
4	**RA Bill Checking Time**	
	The Consultant shall then check the verified/corrected R.A. bill within 7 (Seven) days from its receipt	
	The Owner will make payment against certificate of payment through Demand Draft drawn of any bank within 15 days from the receipt of bill & Certificate of Payment in their office unless such amounts are being disputed or not approved by the Engineer.	
5	Frequency of Interim Valuations (R A Bills)	Maximum 1 (one) R A bills per month.
6	Value of Interim Valuations (R A Bills)	Each Interim Valuation (R A Bill) to have a minimum value Rs. 50,00,000/- (Rupees Fifty Lakhs only).

ANNEXURE P

NAME OF WORK: Proposed Civil Works for Civil and MEP Works of proposed Washroom renovation of Ground to Fourth floorAt WELINGKAR INSTITUTE OF MANAGEMENT,MATUNGA

NAME OF TENDERER :

PRICE BID

I have gone through the entire tender documents and the building specifications
Our price as per the Annexed Bill of Quantities will be Rs. _____. (In words Rupees _____Only).

The above quoted rate is inclusive of all taxes/ duties as mentioned below:

	quote in INR	Taxes applicable	Tax %	Total including taxes
Final Amount as per BOQ				

SIGNATURE OF TENDERER

ANNEXURE Q

Appendix

To be printed on 100 RS. Stamp paper

Proforma for Waterproofing Quality Performance Guarantee

To,

Name of Work : **Proposed Civil Works for Civil and MEP Works of proposed Washroom renovation of Ground to Fourth floorAt WELINGKAR INSTITUTE OF MANAGEMENT,MATUNGA**

We hereby guarantee that the treatment given to the Construction work, open terrace, chajja W/C, bath, toilets, roofing, gutter and cladding works of ***Siteaddress*** for **Client name*** We remain waterproof of free of any defects and leakages for a period of ten years from the date of completion of work.

2. If by any chance a defect is noticed in the waterproofing work in the above case due to bad workmanship, we will rectify the same at free of cost to **Client name*** , at any time of above guarantee period.

3. The question of whether the work is defective as aforesaid shall be decided by the _____ _____, shall be final, conclusive and binding on the contractor. The defect will be rectified provided that:

   (A) The work is not subject to any undue pressure and tension due to abnormal conditions such as earthquake, or bombardment or natural etc.

   (B) On account of the waterproof being tempered with or punctured under any circumstances.

   (C) The RCC base on which waterproofing work etc. is done remain safe and does not develop any cracks or gives way or sinks during the guarantee period.

4. In case we are unable / decline or neglect to remedy the defects notice the TEN YEARS of guarantee period as stand above, the _____ will rectify these through any other competent contractor and recover (including) interest from us all expenses for doing the job.

5. All disputes arising out or in any way connected with these be decided to have arisen in Mumbai and only the Court in Mumbai shall have jurisdiction to determine the same.

6. Several parts of this contract have been read and fully understood us.

7. In token of their consent, the guarantee is countersigned by _____ who have carried out the specialized waterproofing treatment.

Signature	Signature
Waterproof Contractor	Contractor
Address	Co. seal

Witness :

Name :

ANNEXURE R

Appendix
To be printed on 100 RS. Stamp paper
Proforma for Anti-termite Treatment performance Guarantee

To,

Name of Work: **Proposed Civil Works for Civil and MEP Works of proposed Washroom renovation of Ground to Fourth floorAt WELINGKAR INSTITUTE OF MANAGEMENT,MATUNGA**

We hereby guarantee that the treatment given to the Construction " ***Proposed Civil Works for Construction of Girls Hostel Building and Ancillary Structures, for Devi Ahilyabai Smarak Samitee, Dhantoli, Nagpurat Plot No 226 (C. S. No. 202B/10), Matunga (E)-400019, Mumbai, India***, will protect and keep the structure and building free of any termite (of any type and kind or termite attacks / activity for a period of TEN YEARS from the date of completion of work. If by any chance it is noticed in the structure or building that a damage due to attach of termite has occurred or an evidence of termite activity, in which case, we undertake to bring the attack of termites under control through appropriate measures and rectify the situation at our own cost to **Devi Ahilyabai Smarak Samitee, Dhantoli, Nagpur"** at any time within the guarantee period. The question of whether the work is defective as aforesaid shall be decided by the Client / Consultant and the decision of the Client / Consultant shall be final, conclusive and binding on the contractor.

In case, we are unable / decline or neglect to remedy the defects noticed, within the **TEN YEARS** of guarantee period as stated above, the Client will rectify these through any other competent contractor and recover (including) interest form us all expenses for doing the job.

All disputes arising out of or in any way connected with these be decided to have arisen in Mumbai and only the Courts in Mumbai shall have jurisdiction to determine the same.

All parts of this contract have been read and fully understood us.

In token of their consent, the guarantee is countersigned by M/s. _____ who have carried out the specialized ANTI-TERMITE TREATMENT

Signature	Signature
Anti – termite treatment specialist Address	Contractor Co. seal

Witness :
Name :

ANNEXURE S

Name of Work: **Proposed Civil Works for Civil and MEP Works of proposed Washroom renovation of Ground to Fourth floorAt WELINGKAR INSTITUTE OF MANAGEMENT,MATUNGA**

NAME OF TENDERER :

SCHEDULE OF RATES (FORM – A)

1. **The Schedule of rates should be read in conjunction with all the other sections of the tender.**

2. The tenderer shall be deemed to have studied the specifications, drawing and the details of work to be done within the time schedule attached and to have assessed the extent of work to be done and also to have acquainted himself of the conditions prevailing at the site.

3. The quantities shown against the items of work are only approximate and may vary to any extent subject to relevant clause of General Conditions of Contract.

4. The work shall be measured on completion and paid for at the accepted rates.

5. The item of work mentioned in the Schedule of Rates and covered by this contract shall be carried out as per the specifications, drawing and directions of the Consultants and shall be include all labor, materials, tools etc., required to complete the job, in all respects.

6. The rates inserted in the bills of quantities are to be for the full inclusive value of the work described under the several items, including all costs and expenses which may be required in and for the construction and full protection on the work described, together with all general risks, liabilities and obligations set forth or implied in the documents and on which are tender is based. The quoted rates will be for all heights, lifts and leads unless otherwise mentioned specifically in the description of item.

7. General directions and descriptions of work and materials given elsewhere in the contract documents are not necessarily repeated in the Bills. Reference is to be made to the other documents for the full information.

8. The Contractor will be deemed to have visited the site before quoting for the tender and to have examined for himself the conditions under which the work will be carried out including local conditions effecting labour and to have studied the items of the Bills of Quantities, the drawings and specifications clauses relating to them and to have satisfied himself that the rates quoted by him provide for all minor accessories and contingent works or services necessary for the works described even though they are not precisely defined.

9. Part of this contract, then the Contractor being called upon Tenderer is advised to read items of works carefully and quote the rates accordingly, however, if he quotes different rates for the same items of work under different schedules of items, the lowest rates quoted shall be made applicable to all the Bills of Quantities and the contract sum corrected accordingly.

10. Where an item of work not mentioned in a particular Bill of Quantities, is required to be executed and where the rate for such an item of work is quoted under a different Bill of Quantities forming shall execute the work and shall be paid at the rate so quoted Nothing extra over shall be payable on this account.

11. The drawing (s) attached with these tender documents are for the purpose of tender only, giving the tenderer a general idea of the nature and the extent of works to be executed. The rates quoted by the tenderer shall be deemed to be for the execution of works in accordance with the “Construction drawings” (to be supplied to the Contractor at the time of execution of the works) taking into the account the “Design Aspect” of these drawings.

I agree to above

SIGNATURE OF TENDERER

ANNEXURE T

Name of Work: **Proposed Civil Works for Civil and MEP Works of proposed Washroom renovation of Ground to Fourth Floor At WELINGKAR INSTITUTE OF MANAGEMENT,MATUNGA**

NAME OF TENDERER :

SCHEDULE OF DAILY SKILLED / UNSKILLED LABOUR/RATES (FORM – B)

The Contractor shall quote rates, which should be inclusive of pay roll cost and allowances, taxes, fringe benefits, overhead supervision and profits for categories listed below on hourly basis to be employed for execution of works. These rates may be utilized entirely at the discretion of the Consultants for computing rates for extra items in accordance with the provisions in the general conditions of contract.

The rates at 'A' below shall be inclusive of hand tools, Contractor supervision, overheads and profits. The rates at 'B' below shall be inclusive of hand tools, and all equipment's and machinery (but excluding cranes, tractors, trailers, trucks) and consumables, Contractor's, supervision, overheads made on prorata basis.

SL. No.	Description of Categories	Standard time Rate/Day	Over Time Rate/Day

(Contractor to add other categories as required by the projects).

SIGNATURE OF TENDERER

ANNEXURE U

Name of Work: **Proposed Civil Works for Civil and MEP Works of proposed Washroom renovation of Ground to Fourth Floor At WELINGKAR INSTITUTE OF MANAGEMENT,MATUNGA**

NAME OF TENDERER:

LIST OF ARBITRATION /
DISPUTES.

LIST OF DISPUTES/LITIGATIONS/ARBITRATIONS

The tenderer shall give herein below the details of disputes/litigations/Arbitrations in the works executed in last 5 years in the following Proforma:

Sr.. No.	Year of Work	Name of Client	Nature of dispute/ In brief	Name of Arbitrator	Money Amount involved Thereof	Status &details

SIGNATURE OF TENDERER

In case if space is insufficient the tenderer may attach additional sheets with clear indication.

ANNEXURE V

Name of Work: **Proposed Civil Works for Civil and MEP Works of proposed Washroom renovation of Ground to Fourth floor At WELINGKAR INSTITUTE OF MANAGEMENT,MATUNGA**

NAME OF TENDERER:

QUALITY ASSURANCE PLAN

(The tenderer shall describe in details a various measures for each item of work to insure desire Quality.)

SIGNATURE OF TENDERER

In case if space is insufficient the tenderer may attach additional sheets with clear indication.

ANNEXURE W

Name of Work: **Proposed Civil Works for Civil and MEP Works of proposed Washroom renovation of Ground to Fourth floor At WELINGKAR INSTITUTE OF MANAGEMENT,MATUNGA**

NAME OF TENDERER :

HOUSEKEEPING

(The tenderer shall describe in details a various measures for maintaining Housekeeping in a manner suiting best standards in terms of Daily schedule, by alternate daily, weekly schedule, fortnightly schedule and monthly schedule)

SIGNATURE OF TENDERER

In case if space is insufficient the tenderer may attach additional sheets with clear indication.

ANNEXURE X

Name of Work: **Proposed Civil Works for Civil and MEP Works of proposed Washroom renovation of Ground to Fourth floo rAt WELINGKAR INSTITUTE OF MANAGEMENT,MATUNGA**

NAME OF TENDERER :

MATERIAL PROCUREMENT PLAN

(The tenderer shall describe in details of procurement of material for major items of works.)

SIGNATURE OF TENDERER

In case if space is insufficient the tenderer may attach additional sheets with clear indication.

Annexure EE

SPECIFICATION FOR SANITARY & PLUMBING FIXTURES

ASSOCIATED ARCHITECTS			
"SHREEDHAR",1170/31/4,REVENUE COLONY,SHIVAJINAGAR,PUNE-411005			
Specification-Sanitary & Plumbing Fixtures			
S.No	**AREA NAME**	**DESCRIPTION**	**BRAND/MAKE/CAT.NO**
A	**Water Closets**		
1	wall mount wc	Rimless Back To Wall WC With UF Soft Close Slim Seat Cover, Hinges, Fixing Accessories And Accessories Set, Size: 370x580x430 mm, P Trap- 180 mm	Jaguar/white gloosy/ OPS-WHT-15955P180UFSM
2	flush valve	Metropole Flush Valve Dual Flow 40mm Size (Concealed Body) with Concealed Shut Off Provision & Rectangular Dual Flush Plate (ABS Chrome Plated)	Jaguar/chrome finish/ FLV CHR-1089DFP
3	2 way bib cock	2-Way Bib Tap with Wall Flange	Jaguar/chrome finish/ OPP-15041PM
4	health faucet	Health Faucet Kit (Flexible Hose, Handset & Bracket)	Jaguar/chrome finish/ ALD-CHR-573
B	**Bath**		
1	overhead shower	Maze Overhead Shower ø200mm Round Shape Single Flow (Body & Face Plate Stainless Steel with Chrome Finish) with Rubit Cleaning System	Jaguar/chrome finish/ OHS-1613
2	shower arm	Shower Arm Straight ø20mm & 450mm Long Round Shape without Bend For Wall Mounted Showers with Flange	Jaguar/chrome finish/ SHA-49483
3	spout	Bathtube spout with wall flange	Jaguar/chrome finish/ SPJ-15429PM
4	mixer	Aquamax Exposed Part Kit of Single Lever Shower Mixer with 3-way diverter (Suitable for ALD-783)	Jaguar/chrome finish/ OPP-15783KPM
5	allied	Aquamax Concealed Body of Single Lever Shower Mixer with 3-way diverter	ALD-783
6	hot water solution	Elena manual storage water heater 15 litre capacity horizontal installation	ELM-WHT-H015
7	nahni trap	**Nirali** Kiara Floor Drain In Stainless Steel 304 Grade	Nirali/chrome finish
C	**Bath accessories**		
1	mirror	oval shape-600 X 900 mm	6mm/ 8mm
2	soap dish	Soap dish holder	Jaguar/chrome finish/ AQN-7731
3	hook	Double coat hook	Jaguar/chrome finish/ AQN-7761
4	towel ring	Towel ring round	Jaguar/chrome finish/ AQN-7721

5	towel rail	Single towel rail 600mm long, SS	Jaguar/chrome finish/ AQN-7711
6	toilet paper holder	Toilet paper holder with flap recessed type, SS	Jaguar/chrome finish/ AHS-1553
D	**Wash basin**		
1	table top	Thin Rim Table Top Basin, Size: 495x395x150 mm, Shape - Rectangular	Jaguar/white gloosy/ JDS WHT-25909
2	faucet-pillar cock	Pillar Cock with 200mm Extension Body	Jaguar/chrome finish/ OPP-15021PM
3	angular stop cock	Angular Stop Cock with Wall Flange	Jaguar/chrome finish/ OPP-15053PM
4	bottle trap	Bottle Trap 32mm Size with 300mm & 190mm Long Wall Connection Pipes & Wall Flange	Jaguar/chrome finish/ ALD CHR-769L300X190
5	waste coupling	Waste Coupling 32mm Size Ful l Thread with 130mm height	Jaguar/chrome finish/ ALD CHR-705L130

TECHNICAL SPECIFICATION

For

ELECTRICAL WORK

1) GENERAL SPECIFICATION FOR ELECTRICAL WORKS

The general character and the scope of work to be carried out under this contract is Illustrated in Drawings, Specifications and Schedule of Quantities. The Contractor shall carry out and complete the said work under this contract in every respect in conformity with the contract documents and with the direction of and to the satisfaction of the client's site representative. The Contractor shall furnish all labour, materials and equipment (except those to be supplied by the client) as listed under Schedule of Quantities and specified otherwise, transportation and incidental necessary for supply, installation, testing and commissioning of the complete system as described in the Specifications and as shown on the drawings. This also includes any material, equipment, appliances and incidental work not specifically mentioned herein or noted on the Drawings/Documents as being furnished or installed, but which are necessary and customary to be performed under this contract.

The scope of work shall generally comprise, but not limited to the following:

a) Supply, Installation, Testing & Commissioning of Point Wiring, light fixtures,etc.
b) Supply, Installation, Testing & Commissioning of 415 V Main LT Panel, Automatic power factor Control Panel, Distribution Boards, etc.
c) Supply, Installation, Testing & Commissioning of LT Cables,Bus Duct,etc.
d) Supply, Installation, Testing & Commissioning of Cable trays, earthing station/materials.
e) Any other items specified in Schedule of Quantities.

1.1 General Condition of Contract

i) The general specification for electrical works (Internal) aims to lay down general guidelines to ensure safe, efficient, reliable and economical use of electricity.

ii) While these Specifications serve as general guidelines, appropriate technical sanctioning authority can depart from such guidelines to meet the particular requirements of any work or for other technical reasons.

iii) This Chapter covers the general and technical requirements applicable to works contract for execution of Internal & External Electrical Installation works.

iv) It is the responsibility of the contractor to coordinate with various utility agencies, the exact location of such point of supply and mode of connection. Power Supply shall be available at one location & agency has to make further arrangement for his work.

vi) The contractor shall get approval for the work, etc from Client/Consultants

vii) Before procuring any new item, the contractor should take approval from the client/consultant.

1.2 Related Documents:

Each work has its own particular requirements. Therefore, in addition to the General Specifications, governing BIS, I.E. Rules, Standard Contract Conditions etc. there would be necessity of Additional Conditions / Specifications for a particular work. In-case of any discrepancy such additional conditions/ specifications will override these General Specifications.

1.3 Terminology:

The definition of terms shall be in accordance with IS: 732-1989 (Indian Standard Code of Practice for Electrical Wiring), except for the definitions of point, circuit, and sub main wiring, which are defined in this specification.

1.4 Works to be done by the Contractor:

Unless and otherwise mentioned in the tender documents, the following works shall be done by the contractor, and therefore their cost shall be deemed to be included in their tendered cost: -

(i) Foundations for equipment's and components where required, including foundations bolts.

(ii) Cutting and making good all damages caused during installation and restoring the same to their original finish.

(iii) Sealing of all floor openings provided by him for pipes and cables, from fire safety point of view, after laying of the same.

(iv) Painting at site of all exposed metal surfaces of the installation other thanpre-painted items like fittings, fans, switchgear/distribution gear items, cubicle switchboard etc. Damages to finished surfaces of these items while handling and erection, shall however be rectified to the satisfaction of the Engineer-in-charge.

(v) Testing and commissioning of completed installation.

1.5 Electric Power Supply and Water Supply:

Unless and otherwise specified, power supply and water supply will be arranged by the Contractor at the site for installation purpose.

Contractor will take due care to ensure safety of Electrical installation during execution of work.

1.6 Tools for handling and erection:

All tools and tackles required for handling of equipments and materials at site of work as well as for their assembly and erection and also necessary test instrumentsshall be the responsibility of the contractor.

1.7 Co-ordination with other agencies:

The contractor shall co-ordinate with all other agencies involved in the building work so that the building work is not hampered due to delay in his work.

1.8 Care of Buildings:

Care shall be taken by the contractor to avoid damage to the building during executionof his part of the work. He shall be responsible for repairing all damages and restoringthe same to their original finish at his cost. He shall also remove at his costs allunwanted and waste materials arising out of his work from the site.

1.9 Structural Alterations to Buildings:

(i) No structural member in the building shall be damaged/altered, without prior approval from the competent authority through the Engineer-in-charge.
(ii) Structural provisions like openings, cut-outs, if any, provided by the department for the work, shall be used. Where these require modifications, or where fresh provisions are required to be made, such contingent works shall be carried out by the contractor at his cost.
(iii) All such openings in floors provided by the Department shall be closed by the contractor after installing the cables/conduits/rising mains etc. as thecase may be, by any suitable means as approved by the Engineer-in-chargewithout any extra payment.
(iv) All chases required in connection with the electrical works shall be provided and filled by the contractor at his own cost to the original architecturalfinish of the buildings.

1.10 Addition to an installation:

Any addition temporary or permanent to the existing electrical installation shall not be made without a properly worked out scheme/design by a qualified Electrical Engineer to ensure that such addition does not lead to overloading, safety violation of the existing system.

1.11 Drawings:

(i) The work shall be carried out in accordance with the drawings enclosed with the tender documents and also in accordance with modification thereto from time to time as approved by the Engineer-in-charge.
(ii) All General Arrangement Drawing of panels,wiring diagrams shall be deemed to be 'Drawings' within the meaning of the term. They shall indicate the locations,no of runs of various cables and sub mains.

1.12Conformity to IE Act, IE Rules and standards:

All Electrical works shall be carried out in accordance with the provisions of Indian Electricity Act, 2003 and Indian Electricity Rules, 1956 amended up to date (Date of call of tender unless specified otherwise). List of Rules of particular importance to Electrical Installations under these General Specifications is given in Appendix C for reference.

1.13 General requirements of components:

1.13.1 Quality of materials:

All materials and equipments supplied by the contractor shall be new. They shall be of such design, size and materials as to satisfactorily function under the rated conditions of operation and to withstand the environmental conditions at site.

1.13.2 Inspection of materials and equipments: (FACTORY INSPECTION AND TESTING)

The Client may carry out inspection and testing at Manufacturer's works for equipment covered herein. All

such testing and inspection expenses shall be to Contractor's account. Such tests shall generally prove that the equipment to be supplied complies the Specifications and relevant Standards. Tests shall also demonstrate suitability in terms of site conditions, operational and control facilities, circuitry of controls, protection etc.
If performance tests are not satisfactory, the Contractor shall, at his own expenses, rectify the defects observed, and re-conduct the tests to Client's satisfaction. The equipment shall be tested again after removal of defects, found if any, and shall be delivered and installed only after approval by the Client's representative.

Equipment shall be delivered without the consent from Client, in writing.
(a) Materials and equipments to be used in the work shall be inspected by the Engineer In charge. Such inspection will be of following categories:
(i) Inspection of materials/equipments to be witnessed at the Manufacturer's premises in accordance with relevant BIS/Agreement Inspection Procedure.
(ii) To receive materials at site with Manufacturer's Test Certificate(s).
(iii) To inspect materials at the Authorized Dealer's Godowns to ensure delivery of genuine materials at site.
(iv) To receive materials after physical inspection at site.
(b) The Engineer in charge will take adequate care to ensure that only tested and genuine materials of proper quality are used in work(c) Similarly, for fabricated equipments, the contractor will first submit dimensional detailed drawings for approval before fabrication is taken up in the factory. Suitable stage inspection at factory also will be made to ensure proper use of materials, workmanship and quality control.
(c) The tender specifications will stipulate the Inspection requirements or their waiver for various materials/equipments including norms of inspection in specific cases.

1.13.3 Ratings of Components:
(a) All components in a wiring installation shall be of appropriate ratings of voltage, current, and frequency, as required at the respective sections of the electrical installation in which they are used.
(b) All conductors, switches and accessories shall be of such size as to be capable of carrying the maximum current, which will normally flow through them, without their respective ratings being exceeded.

1.13.4 Conformity to standards:
(a) All components shall conform to relevant Indian Standard Specifications, wherever existing. Materials with ISI certification mark shall be preferred.
(b) A broad list of relevant Indian Standards is given in Appendix D. These Indian Standards, including amendments or revisions thereof upto the date of tender acceptance, shall be applicable in the respective contracts.

1.13.5 Interchangeability:

Similar parts of all switches, lamp holders, distribution fuse boards, switch gears, ceiling roses, brackets, pendants, fans and all other fittings of the same type shall be interchangeable in each installation.

1.14 Workmanship:

1.14.1 Good workmanship is an essential requirement to be complied with. The entire work of manufacture/fabrication, assembly and installation shall conform to sound engineering practice.

1.14.2 Proper supervision/skilled workmen:

The contractor shall be a licensed electrical contractor of appropriate class suitable for execution of the electrical work. He shall engage suitably skilled/licensed workmen of various categories for execution of work supervised by supervisors / Engineer of appropriate qualification and experience to ensure proper execution of work. They will carry out instructions of Engineer-in-charge and other senior officers of the Department during the progress of work.

1.14.3 Use of quality materials:

Only quality materials of reputed make as specified in the tender will be used in work.

IS 8084 / 1976	Interconnecting bus-bars for A.C. voltage above 1 kV up-to & including 36 kV.
IS 13032 / 1991	A.C. miniature circuit breaker board for voltage not exceeding 1000V specification.
IS 3043 / 1987	Code of practice for earthing.
IS 3427 / 1997	A. C. metal enclosed switchgear & control gears for rated voltage above 1kV up to & including 52 kV.
IS 3837 / 1977	Accessories for rigid steel conduits for electrical wiring.
IS 13947 / Part3 / 1993	Specification for low voltage switchgear& control gear.
IS 4615 / 1968	Switch socket outlets (Non – interlocked type)
IS 5216 / Part1, 2 / 1982	Guide for safety procedure & practices in electric work.
IS 5578 / 1984	Guide for marking of insulated conductors.
IS 5820 / 1970	Specification for precast concrete cable covers.
IS 6381 / 1972	Specifications for construction & testing of electrical apparatus with type of protections.
IS 10322 / Part1, 2 / 1982	Specification of luminaries.
IS 103222 / Part3, 4 /1984	Specification of luminaries.
IS 10322 / Part5 (Sec 1, 2) / 1985	Specification of luminaries.
IS 13022 / Part 5 (Sec3 to 5) / 1987	Specification of luminaries.
IS 13947 / Part1 / 1993	Specification for low-voltage switchgear & control gear.
IS 13703 / Part4 / 1993	Specification for low voltage fuses for voltages not exceeding 1000V AC or 1500 V DC.
IS 2551 / 1982	Danger notice plates.
IS 2268 / 1994	Call bells / Buzzers.
IS 732 / 1989	Code of practice for electrical wiring installation.
IS 3854 / 1997	Switches for domestic & similar purpose.
IS 2312 / 1967	Exhaust fans.

IS/IEC62305 / 2010	Code of practice for lighting protection
IS 2418 / Part 1 to 3 / 1977	Tubular florescent lamps for general lighting service.
IS 1937 / Part3 / 1983	Conduits for electrical installations.
IS 13032 /1991	AC miniature circuit breaker board for voltage not exceeding 1000V.
IS 2706 / Part 1 to 5 / 1992	Current transformers.
IS 15086 / Part1 / 2001	Surge arresters.
IS 13925 / Part1 / 1998	Shunt capacitors for AC power systems having a rated voltage above 1000V.
IS 13118 / 1991	Specification for HVAC circuit breakers.
IS 374 / 1979	Ceiling fans.
IS 5578 / 1984	Guide for marking for insulated conductors.
IS 418 / 1978	Tungsten filament general service electrical lamp.
IS 694 / 1990	PVC insulated cable & cords for power / lighting.
IS 13010 / 2002	A.C. watt –hour meters.
IS 732 / 1989	Electrical wiring installation (up to 650V).
IS 10870 / 1984	Code of safety for hexane.
IS 1248 / Part 1 / 1993	Direct acting indicating instruments & their accessories.
IS 1248 / Part 2 / 1983	Direct acting indicating instruments & their accessories.
IS 1248 / Part 7 / 1984	Direct acting indicating instruments & their accessories.
IS 1248 / Part 9 / 1983	Direct acting indicating instruments & their accessories.
IS 1293 / 1988	3 pin plugs & socket outlets.
IS 1554 / Part1 to 3/1988	PVC insulated cables – heavy duty.
IS 13947/Part 1 to 5 /1993	Low voltage switchgear & control gear.
IS 1651 / 1991	Lead acid cell batteries.
IS 9537 / Part 5 / 2000	Conduits for electrical installation.

1.14.4 Fabrication in reputed workshop:

Switch boards and LT panels shall be fabricated in a factory/workshop having modern facilities like quality fabrication, seven tank process, powder/epoxy paint plant, proper testing facilities, manned by qualified technical personnel.

1.15 Testing:

All testes prescribed in these General Specifications, to be done before, during and after installation, shall be carried out, and the test results shall be submitted to the Engineer-in-charge in prescribed Performa, forming part of the Completion Certificate.

1.16 Commissioning on Completion:

After the work is completed, it shall be ensured that the installation is tested and commissioned.

1.17 Completion Drawings and Completion Certificate:

(i) For all works completion certificate after completion of work shall be submitted to the Engineer-in-charge.

(ii) Completion drawings drawn to a suitable scale and readable size, clear white papers (three sets) indicating the following, along with three blue print copies of the same shall also be submitted.

(a) Single Line Diagram of all Panels

(b)) Name of work, job number, accepted tender reference, actual date of completion and name of the firm who executed the work with their signature.

1.18 Guarantee

The installation will be handed over to the Department after necessary testing and commissioning. The installation will be guaranteed against any defective design/ workmanship. Similarly, the materials supplied by the contractor will be guaranteed against any manufacturing defect, inferior quality. The guarantee period will be for a period as indicated in the General/Special Conditions of Contract from the date of handing over to the Department. Installation/equipment's or components thereof shall be rectified/ repaired to the satisfaction of the Engineer-in-charge.

1.19 Applicable codes:

The following codes and standards shall be applicable for continuous performance of all electrical equipment to be supplied, delivered at site, erected, tested and commissioned. The electrical equipment offered shall comply with the relevant Indian standard specifications, fire insurance regulations, tariff advisory committee's regulations, and in particular to Indian electricity rules in all respects with all its latest amendments up-to-date.

For guidelines to the tenderers, few of the Indian standards are indicated below:

IS 8084 / 1976	Interconnecting bus-bars for A.C. voltage above 1 kV up-to & including 36 kV.
IS 13032 / 1991	A.C. miniature circuit breaker board for voltage not exceeding 1000V specification.
IS 3043 / 1987	Code of practice for earthing.
IS 3427 / 1997	A. C. metal enclosed switchgear & control gears for rated voltage above 1kV up to & including 52 kV.
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IS 5820 / 1970	Specification for precast concrete cable covers.
IS 6381 / 1972	Specifications for construction & testing of electrical apparatus with type of protections.
IS 10322 / Part1, 2 / 1982	Specification of luminaries.
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IS 13703 / Part4 / 1993	Specification for low voltage fuses for voltages not exceeding 1000V AC or 1500 V DC.
IS 2551 / 1982	Danger notice plates.
IS 2268 / 1994	Call bells / Buzzers.
IS 732 / 1989	Code of practice for electrical wiring installation.
IS 3854 / 1997	Switches for domestic & similar purpose.
IS 2312 / 1967	Exhaust fans.
IS/IEC62305 / 2010	Code of practice for lighting protection
IS 2418 / Part 1 to 3 / 1977	Tubular florescent lamps for general lighting service.
IS 1937 / Part3 / 1983	Conduits for electrical installations.
IS 13032 /1991	AC miniature circuit breaker board for voltage not exceeding 1000V.
IS 2706 / Part 1 to 5 / 1992	Current transformers.
IS 15086 / Part1 / 2001	Surge arresters.

IS 13925 / Part1 / 1998	Shunt capacitors for AC power systems having a rated voltage above 1000V.
IS 13118 / 1991	Specification for HVAC circuit breakers.
IS 374 / 1979	Ceiling fans.
IS 5578 / 1984	Guide for marking for insulated conductors.
IS 418 / 1978	Tungsten filament general service electrical lamp.
IS 694 / 1990	PVC insulated cable & cords for power / lighting.
IS 13010 / 2002	A.C. watt –hour meters.
IS 732 / 1989	Electrical wiring installation (up to 650V).
IS 10870 / 1984	Code of safety for hexane.
IS 1248 / Part 1 / 1993	Direct acting indicating instruments & their accessories.
IS 1248 / Part 2 / 1983	Direct acting indicating instruments & their accessories.
IS 1248 / Part 7 / 1984	Direct acting indicating instruments & their accessories.
IS 1248 / Part 9 / 1983	Direct acting indicating instruments & their accessories.
IS 1293 / 1988	3 pin plugs & socket outlets.
IS 1554 / Part1 to 3/1988	PVC insulated cables – heavy duty.
IS 13947/Part 1 to 5 /1993	Low voltage switchgear & control gear.
IS 1651 / 1991	Lead acid cell batteries.
IS 9537 / Part 5 / 2000	Conduits for electrical installation.

The entire electrical installation work shall be strictly complied with the codes standards, rules and regulations framed under the Indian electricity act. Further, it shall be carried out as per the regulations and rules set out by “Tariff Advisory Committee and / or Fire Insurance Regulations.”

Any other IS codes as applicable at the time of execution over and above whatever stated above. Some of the rules framed under Indian electricity rules of 1956 and all amendments thereof more particularly complied to: 35, 43, 44, 44-A, 45 (Part – I), 50, 51, 59, 61 (a), 61(c), 62, 63 (2), 65, 66, 67, 68, 69 and 92 (2).

Drawings:

The contractor will furnish wherever in his opinion such drawings are required to show the areas to be excavated/filled, sequence of priorities etc. The engineer-in-charge will approve the same. The contractor shall follow such drawings strictly.

ADDITIONAL SPECIFICATION/CONDITION

1) Arrangement for the cutting of C.C. foundation muffing, brick masonry work etc. shall be done by clean and soft water at site by the contractor at his own cost.
2) The Agency shall follow the ISI specification, relevant standards, CEA Regulations during the execution of work.
3) The agency shall obtain the permission of local Authority (N.O.C.) for digging the road if necessary.
4) If during the execution of work, shut down form Power Supply Agency side is necessary; in that case it is solely responsibility of bidder to take necessary shut down with permission of local Power Supply Agency authority.
5) The bidder will have to use necessary T&P while execution of work at his own cost.
6) After completion of work, the Bidder shall have to carry necessary IR test and earth test with calibrated meggar & earth tester and the test report of same shall be submitted.

7) The bidder shall have to arrange the approval & inspection of E.I. from Electrical Inspector and accordingly N.O.C. shall be obtained however the necessary inspection fee will be borne by Client.

8) The work insurance and insurance of worker Labour insurance shall be done by bidder under the insurance act of his own cost.

9) The complete responsibility of safety of worker during the execution of work is solely of bidder. The bidder will have to follow all the safety rules during the execution of work. If any accident occurred during the execution of work, the responsibility of compensation will be of bidder. In any case, this Department will not be responsible for any compensation.

10) It will be the responsibility of the bidder to obtain permissions/NOCs etc from the Local/Statuary Bodies required for execution of the work and any fees/charges/taxes or penalties towards payment of Government/Semi-Government /Local /Private bodies arising during the execution of the work is to be borne by the bidder. No compensation or refunds will be paid for this by the tendering Authority or the user department.

11) Necessary approval for the material procurement shall be obtained by the contractor from the authority before starting the work.

12) The actual layout drawing shall be got approved by the contractor from the concern Electrical Inspector, consultant before starting the work.

13) The permission for charging the installation shall be obtained by the contractor from the concern Electrical Inspector after completion of the work.

ADDITIONAL CONDITION OF THE WORK

1) Contractor shall visit the site & get himself thoroughly conversant with the actual site conditions before tendering..
2) Contractor shall prepare the bar chart of activities submit it to engineer in charge & strictly follow the time schedule.
3) All material supplied shall confirm the technical specifications. Necessary approval for the material procurement shall be obtained by the contractor from the authority before starting the work.
4) The overall defect liability period for all major equipment's and machinery will be 36 months i.e. replacement warranty, out of this 36 months, first 12 months period will be fully comprehensive guarantee/ warranty of complete System. During first 12 months period, contractor should carry out regular Servicing/ Maintenance to maintain healthy operational condition of electrical systems. The periodic Comprehensive maintenance/Servicing should be carried out once in every three months during first 12 months.
5) The Site shall be cleaned after completion to the satisfaction of Engineer in charge.
6) Electrical work shall comply CEA Regulations -2010 & other related statutory provisions.
7) The Electrical wiring, accessories, fittings shall be suitable to perform at their desire standard.
8) The Sample from material installed at site if necessary shall be sent for testing to Govt. Laboratory by the Engineer-in-charge. In case of unsatisfactory test reports the all Faulty

material shall be replaced by the contractor at No extra cost and necessary charges shall be borne by the contractor in case of unsatisfactory reports. The decision shall be taken by the Engineer-in-charge shall be final. Replaced material duly tested at his own cost.

9) The final payment will be made only after producing the successful original test certificate of the material for which the Testing has been done if directed by Engineer -in-charge the necessary test will be carried out by contractor at his own cost in this ca se this decision taken by Engineer-in-charge shall be final.
10) Contractor should arrange power supply at site at his own cost; no extra money will be paid on account of this. Contractor will be responsible for obtaining Electrical supply including Installation of Electric Meters from Power supply Agency. & obtaining NOC from Electrical Inspector of Govt. of Maharashtra.
11) If scaffolding is necessary during work contractor should arrange it at his own cost.
12) All Civil Engineering Works such as, foundation of various motors, Compressors, Switchgears, Panels, and making the finishing of the poles & recess in the walls/ ceiling for ducting pipeline, Plumbing etc. necessary for completion of Electrical work shall be carried out by the contractor in an approved manner. The Contractor has to carryout holes by chipping/core cuts in the floor slab if necessary for laying pipeline as per the requirements. Necessary coordination shall be done by contractor.
13) DRAWINGS

The contractor shall prepare shop drawings in AUTOCAD and get duly approved from client/consultant/PMC. The three sets of hard copy and one soft copy of approved drawings shall be submitted by the contractor.

14) ACTIVITY BAR CHART

The contractor should submit activity bar chart and shop drawing/ working drawings for the work tendered to the engineer- in-charge within three days.

15) COMPLIANCE OF SAFETY CODE:

Successful tenderer shall ensure compliance with statutory provision of Safety regulation & departmental requirements of safety codes in respect of labor employed on the work by the Tenderer. In the event of the contractor falls to observe the same, the Department will be at liberty to make the necessary arrangement at the cost of the contractor and recover this cost from him. The contractor shall be responsible for any compensation to the workmen payable under the Workmen Compensation Act 1923 duly amended as on date or any other statutory Regulations in force. In case of fatal or non-fatal accident occurred to the workers during erection and maintenance of system, the Department will not be liable to pay for any compensation and it is duty of Contractor to observe all labor Acts and Rules.

16) The Contractor shall submit the Photographs of site work before /during execution /completion of work to concerned Engineer. The Photographs shall show the clear picture of material Cable, Laying, Construction of Plinth, Wiring, installation of Switchgears etc without the Photograph bills will not be paid.
17) The contractor has to submit weekly progress report in given format without fail.

18) The Contractor shall get the list of make/brands approved by Engineer in-charge or any of his authorized representative well in advance before the execution of work.
19) No deviation of Make/ Brands will be allowed subsequently.
20) The Contractor shall prepare Drawing as required by Electrical Inspector/Appropriate authority from Fire Department and get it approved before starting the work and get necessary certificate/primary NOC /Final Permission from concern authority, necessary fee/charges if any shall be borne by the contractor.
21) It will be the responsibility of contractor to handover installation with detail inventory before Final bill with all original documents such as permission from Electrical Inspector and local Fire department Approval of Drawing etc. and one set of papers /Documents shall be submitted to Engineer In-charge
22) After the completion of work the contractor shall test the entire installation in the presence of Engineer in-charge or any of his authorized representatives and submit the test report and submit the test reports
23) If necessity, Tree cutting shall be done by contractor with necessary permission of concern authority. Fees /charges if any shall be borne by the contractor.
24) While executing excavation work for underground piping or any other purpose, the contractor should coordinate at his own with all the related authorities such as MCGM, etc. before starting works and get information regarding power cables, telephone cable, drainages, water pipes etc. across or along the road or open space and carry out excavation/ digging works carefully and safely. During execution of work, loss or damage to property or lives occurs due to incorrect or inappropriate approach by contractor or its representative, agency will be held responsible for such loss
25) During execution, if any permission required from local authority/police Dep't./Power Supply Agency , it will be the responsibly of the contractor get the permission at his own cost.
26) Any minor modification work or site clearance work such as removal of few false ceillig sheet, removal of small debris etc. should be carried out by contractor at his own, delay in the work will not be allowed for such minor work.
27) Arrangement for the curing of CC foundation muffing, brick masonry work etc. shall be done by clean and soft water at site by the contractor at his own cost.
28) The contractor will have to use all required T & P while execution of work at his own cost.
29) The insurance labor / staff work in gat site shall be done by the contractor under the insurance act at his own cost.
30) Any fees/charges/taxes or penalties towards payment of Government/semi government/local/ private bodies a rising during the execution of work is to be borne by the contractor. No refund will be paid for this.
31) The contractor should conduct complete testing of Electrical system in Co-ordination with client/consultant/PMC
32) The contractor / Licensed Agency will be responsible to submit Form "A & B" & Drawings / Plan Approval (As per Maharashtra Fire Service Act, 2006 & Rules made under the Act after

completion of work and submit to “The Authorized Local Fire Service Officer” or nominated Officer by The Director , Maharashtra Fire Services, under “Prevention & Life Safety Measures Act, 2006.” Contractor will not be paid bill unless he submits Form “A & B” & Plan Approval as mentioned above. For Two Years, after completion of One year compulsory warranty period. Contractor shall be responsible to obtain Fire NOC for every Six Month (i.e. 6, 12, 18, 24, 30, 36), from Local Fire Service Officer or Nominated Officer by Director, Maharashtra Fire Prevention & Life Safety Measures Act, 2006.

33) Contractor should give the warrantee of LED Fittings for performance of Lamps and failure during warranty period and shall repair or replace without additional cost upto the satisfaction of Site Engineer. In failure of this, the penalty will be levied Rs. 100/- per lamp per month maximum up to 1/6th cost of Lamps. (where if applicable)

34) Further all the liaison and co-ordination work with the Supply Authorities for obtaining electrical load sanction, obtaining the released order from **Power Supply Agency** and other bodies like MCGM ,Electrical Inspector, Maharashtra Pollution Board, State Electricity Board, PWD, Adani, BEST, etc for Electrification, Fire Fighting and HVAC works. Or any other type of Electrical Panel room, including submitting of all relevant Tests, Reports, Installation compliance, drawings etc. shall be done by the Contractor without any Extra Cost. No Separate Amount towards the same will be paid. Employer shall arrange only for official payments towards service connection charges for getting electric supply on produce of original receipt of same in name of employer for reimbursement. On completion of the work, the Contractor shall obtain and deliver to the Client / Consultants Certificates of final inspection and approval by the Local Electric Supply Authority.

Technical specifications of LV Power & Control Cables

1.1.1 Scope

This specification covers the requirements of design, manufacture, inspection, testing, supply and delivery at site of LV power & control cables for Girls Hostel, Matunga.

1.1.2 Site conditions

Climatic conditions	:	Normal
Ambient Temp.	:	50º C
Elevation	:	BELOW 1000M.
Seismic zone	:	-

1.1.3 Electrical system

Nominal Voltage	:	415 V ±10%
Frequency	:	50 Hz.
No. of phases	:	3 phase, 4 wire
Neutral grounding	:	Solidly Earthed.

1.1.4 Standards

The LV cables shall comply with the requirements of the following standard specifications:

IS 7098 (Part 1)	XLPE cables for voltage up to and including 1.1kV
IS 8130	Conductors of insulated cables
IS 3975	Mild steel wires, strips & tapes of armouring of cables
IS 1554 (Part 1)	PVC insulated heavy duty cables
IEC 502	Power cables with extruded insulation and their accessories for rated voltage from 1 kV

1.1.5 General construction

All cables shall be suitable for laying in trays, trenches, ducts, conduits and buried underground installation with uncontrolled backfill, possibility of flooding by water and suitable for high ambient, high humid tropical Indian climatic conditions. The cables shall be designed to withstand the mechanical, electrical and thermal stresses under the foreseen steady state and transient/fault conditions and shall be suitable for the proposed method of installation. All power and control cables shall have extruded the outer sheath.

1.1.6 XLPE insulated cables

415V system power cables shall be of 1.1kV grade, heavy duty, stranded aluminium conductor, XLPE insulated, armoured, FRLS extruded PVC outer sheathed. (Above 16sq.mm cable)
415V system power cables shall be of 1.1kV grade, heavy duty, stranded copper conductor, XLPE insulated, armoured, FRLS extruded PVC outer sheathed. (Up to 16sq.mm cable)
The construction of the conductor shall be stranded and compacted circular for all cables.
The core insulation shall be with cross-linked polyethylene unfilled insulating compound. It shall be free from voids and shall withstand all mechanical and thermal stresses under steady state and transient operating conditions.
The inner sheath shall be applied over the laid up cores by extrusion and shall confirm to the requirements of type ST 2 compound of IS: 5831. The extruded inner sheath shall be of uniform thickness of size as per IS 7098-Part I.
The outer sheath for the cables shall be applied by extrusion over the armouring and shall be of PVC compound conforming to the requirements of FRLS type ST 2 compound of IS 5831.
To protect the cable against rodent and termite attack, suitable chemicals shall be added into the PVC compound of outer sheath.
The dimensions of the insulation armour and outer sheathing materials shall be governed by values given in Tables 2, 3, 4 & 5 of IS 7098 Part-1.
The cable shall withstand continuous and short circuit temperature of 90º C and 250º C respectively.
All armoured and multicore unarmoured cables shall have distinct extruded inner sheath
Material of inner sheath shall be PVC and shall be with black colour
Material of armour shall be aluminium wire and GS wire / formed wire for single core and multicore cables as per relevant IS and should be as per IS 7098-Part I.

Outer sheath of all power cable shall have extruded. Flame retardant low smoke type PVC material shall be used; same shall be with black colour. Polyethylene based halogen free material not acceptable.
Marking of power cable shall contain cable size, voltage grade and word “FRLS” marking and sequential marking at every 1 meter.

1.1.7 PVC insulated cables (For flexible cables and wires)

All flexible cables and wires shall be provided as per IS 694.

1.1.8 Type

All cables shall be flame retardant low smoke (FRLS) type.

1.1.9 Inspection & testing

Representative of the purchaser shall have free access to vendor's works to inspect, expedite and witness shop tests. Any materials or works found to be defective or which does not meet the requirements of the specification will be rejected and shall be replaced at supplier's cost.
All routine tests shall be carried out on the cables as per relevant Indian Standard Specifications and will be witnessed by the Purchaser.
Four sets of routine test certificates as well as four sets of type test certificates for the type tests carried out on identical cables shall be furnished to the purchaser for reference and record.

1.1.10 Data & information

Vendor shall furnish with the bid full constructional data along with ratings and other parameters of the cables. Deviations, if any, shall be brought out clearly in the bid.

1.1.11 Packing

The cables shall be supplied in standard drum lengths duly wound on non-returnable wooden drums.
Vendor shall ensure that the bending radii of cables are not less than 15 times their overall diameters when wound on drums. Both ends of the cables shall be sealed.
Following information shall be printed on the flange of each cable drum.
Type; Size; Voltage grade; Length in meters; ISI mark; Gross weight; Direction of rolling

1.1.12 Data to be furnished by Manufacturer

1.1.13 Specific requirement

Size, core and length of 415V system XLPE insulated, copper/aluminium conductor, armoured power cables and PVC insulated, plain annealed copper conductor, armoured control cables shall be furnished after finalization of load list.

1.1.14 Note:

Negative tolerance on the cable lengths will not be acceptable.

TECHNICAL SPECIFICATION OF Diesel Generator (DG)

Scope:

Providing D.G. Set at site, carrying out all preparatory works, assembling, installing, making adjustments, confirming all pre-commissioning requirement as per manufacturer's instructions, commissioning, final testing, putting in to operation and handing over of the complete system of D.G. set including inspection from inspectorate office. The work include necessary minor Civil works including opening on wall/Slab/floor and making good as it was etc. & comprehensive maintenance of the DG set for 1 year from date of commissioning.

Material:

Diesel Generator set with continuous rating, 3 Phase, 415 V., 50 Cycles A.C. supply of specified capacity, comprising of totally enclosed air/water cooled diesel engine with standard control panel & tool kit.

Diesel Engine:

The engine shall be of standard design of original manufacturers. It should be a totally enclosed air/water cooled Diesel engine with 4 stroke multi cylinders developing suitable BHP (As per Table 11/3) for giving power rating of (As per table 11/3) at the load terminals of alternator at 1500 R.P.M., at armature temperature of 400 C for height at 1000 Meter above M.S.L. at 50% R.H. The engine shall be capable of delivering specified power at variable loads for P.F. of 0.8 (lag) with 10% over load available in excess of specified output for one hour in every 12 hours. The average load factor of the engine over period of 24 hours shall be 0.85 for power output. The engine shall confirm to IS: 10000 and Amended up to date.

The engine shall be fitted with following accessories: -

1) Dynamically balanced fly wheel.
2) Necessary flexible coupling and guard for alternator and engine applicable
3) Lubricating oil cooler
4) Air cleaner Dry/Bath type
5) Lubricating oil pressure gauge
6) Lubricating oil filter with replicable element
7) Dry exhaust manifold with suitable exhausts heavy duty residential type exhaust silencer and vertical hot air duct both logged with asbestos rope exhaust piping of required length to reduce noise level.
8) 12/24 V. Electric starting equipment complete with standard batteries, dynamo, cut-out, ammeter, necessary wiring, self starter etc. The system shall be capable of starting D.G. set within 20 to 30 second even in winter condition with an ambient temperature down to 00 C.
9) Mechanical Governor of Class A2 for up to and including 200 KVA capacity and electronic governor of Class A1 for capacity above 200 KVA shall be provided as per standard design of manufacturer. Governor shall be a self contained unit capable of monitoring speed.
10) Radiator
11) Daily fuel Tank

Daily fuel service tank of minimum capacity as per Table 11/1, below, fabricated from M.S. sheet with inlet, outlet connections air vent tap, drain plug and level indicator (gauge) M.S. fuel piping from tank to engine with valves, unions, reducers, flexible hose connection and floor mounting pedestals, twin fuel filter. The location of the tank shall depend on standard manufactures design.

Minimum capacity of Daily fuel tank for Generators

Engine Control Panel:

Engine control panel should be fitted with following accessories/indicators and shall have display:-

• Start/stop key switch
• Lube oil pressure indication
• Water temperature indication
• RPM indication
• Engine Hours indications
• Battery charging indication
• Low lube oil trip indication
• High water temperature indication
• Over speed indication

Battery Charger:

The battery charger shall be of Trickle & Boost type, and suitable to charge required numbers of batteries at 12V/ 24 Volts complete with, transformer, rectifier, charge rate selector switch, indicating ammeter, voltmeter, battery over charging protection with audible alarm. Connections between the battery charger & batteries shall be provided with suitable copper leads with lugs.

Battery:

Battery capacity and copper cable sizes for various engine capacities shall be as per the details given in Table No 11/2. Cable sizes shown are for maximum length of 2m length, if higher size of cable is required, it shall be selected in such a way that voltage drop does not exceed 2 V.

Sr. No Capacity of D.G. set Minimum Fuel Tank Capacity

1. Up to 25 KVA 100 Liters
2. Above 25 KVA to 62.5 kVA 120 Liters
3. Above 62.5 KVA to 125 KVA 225 Liters
4. Above 125 KVA to 200 KVA 285 Liters
5. Above 200 KVA to 380 KVA 520 Liters

For AMF applications, a static battery charger working on mains supply recommended to keep the batteries charged at all times.

Alternator:

Alternator of specified rating, 415 Volts, 1500 RPM, 3 Ph, 50 HZ, A/c Supply with P.F 0.8 lagging at 400 C armature temperature for height 1000 mtr. Above MSL at 50 % R.H. alternator shall be brush less type self regulated having static excitation system having capacity of desired output confirming to IS: 4722-1968 with automatic voltage

Regulation + 5% operated voltage from no load to full load, two numbers of earth terminal on opposite sides. Terminal box shall be suitable for underground cables and same shall be with stand mechanical and thermal stresses developed due to any short circuit at the terminals. The alternator shall be in accordance with following standards:-

IS: 4722 The performance of rotating electrical machines

IS: 4889 Rules for method of declaring efficiency of electrical machines

IS: 13364 Part I 1992 Alternator-voltage Regulation up to 20 KVA

IS: 13364 Part II 1992 Alternator Voltage regulation above 20 KVA to 80 KVA

Performance:

Voltage dip shall not exceed 20 % of the rated voltage for any step load or transient load as per IS: 8528 (Part I). The winding shall not develop hot spots exceeding safe limits due to unbalance of 20% between any two phases from no load to full load.

The performance characteristics of the alternator shall be as below:-

(a) Efficiency at full load o.8 P.F. (i) Up to 25 KVA- not less than 82 %

(ii) Above 25 KVA and up to 62.5 KVA- not less than 86 %

(iii) Above 62.5 KVA/upto 250 KVA- not less than 90 %

(iv) Above 250 KVA- not less than 93 %

(b) Total Distortion factor Less than 3 %

(i) 10 % Overload One Hour in every 12 hrs of continuous operation

(ii) 50% overload 15 seconds.

Common Base Plate:

Engine and alternator shall be coupled by means of flex plate/flexible coupling as per manufacturer standard design and both units shall be mounted on a common base plate together with all auxiliaries to ensure perfect alignment of engine and alternator with minimum vibrations. The base plate shall be suitable for installation on suitable ant vibration mounting system comprising of 6 anti-vibration pads duly provided.

Control Panel:

Floor/wall mounted control panel Box comprising of voltmeter, ammeter, selector switches MCCB/MCB of adequate capacity, indicator lamp duly wired with HRC fuses. Alternator & control panel shall be connected with provided suitable capacity armored cable with necessary cable glands & lugs etc.

Exhaust system:

It shall comprise of following parameters:-

Exhaust system should create minimum back Pressure.

Smooth bends shall be used for minimizing the back pressure.

Minimum number of bends shall be used for minimizing the back pressure.

Pipe sleeve of larger diameter should be used while passing the pipe through concrete wall & gap shall be filled with felt lining.

Exhaust piping inside the Acoustic enclosure / Generating set room should be lagged with asbestos rope and covered with aluminum sheet cladding to avoid heating of the area.

Class 'B' MS pipes and long bend/elbows should be used.

The exhaust outlet should be in the direction of prevailing winds and should not allow exhaust gases to enter air inlet / windows, etc.

Factory Testing:

DG set shall be tested in presence of Engineer in charge or his authorized representative in the factory for following before dispatch;

• Full load trial for 12 hour. Fuel, lubricating oil, etc shall be arranged by the agency.

• 10% overload trial for one hour within 12 hrs test.

Certificates:

• Manufacturer's test certificates for Engine, Alternator and of the set.

• Necessary certificate for the engine model so selected along with compliance of noise and emission norms as per latest CPCB guidelines for D.G. set should be furnished from the manufacturer along with manufacturer's technical details.

• Permission from Electrical Inspector.

Method of Construction:

The DG Set with canopy shall be erected with due care and ensuring the perfect level with the help of Sprit level, on provided cement concrete foundation and connecting the provided earthing connections. The exhaust system shall be connected to the exhaust manifold. After ensuring the filling of fuel, lubricating oil and medium of coolant, the set shall be commissioned, with giving necessary full load trials or with the available load at site. The set shall then be handed over to the department along with the installation report given by the manufacturer and with all the necessary certificates and permissions obtained.

Mode of Measurement: Executed quantity will be counted on number basis. (I.e. each)

Automatic Mains Failure Panel (AMF)

Scope:

Specification No (GEN-AMF)

The work includes supplying, installing, Testing & commissioning of automatic mains failure control panel including auto by-pass, suitable for specified rating of DG Set complete with accessories and comprehensive maintenance of the panel up to 1 year from date of commissioning.

AMF Panel shall comply following IS specification:

IS: 2147 1962 Degree of protection.

IS: 4722 H.V. testing for panel

Material:

Panel shall consist of following:

Power module a pair of electromechanically interlocked contactors for all the phase / phases & neutral. (For mains & generator)

Overload relay for generator contactor, neutral contactor for mains and generator.
Control and Metering module: Line voltage monitor. Generator voltage monitor, Ammeter, 3 times attempt to start facility.
MCB/MCCB of suitable rating for auto/manual operation. Auto/manual switch.
Emergency stop push buttons.
Manual start push button.
Frequency meter.
Engine hour and RPM meter. (Taco meter)
Two earthing studs.
Protection module: The engine shutdown in the unlikely event of low lube oil pressure, high cylinder head temperature, high water temperature (For water cooled engine)
Indicators with alarm for Full/ Maximum Load on generator.
Indicators for Load on mains, Load on D.G. set, Engine fails to start, Emergency stop.
Battery charger complete with transformer/ rectifier, D.C Voltmeter and Ammeter, selector switch for trickle, off, and boost charging and current adjustment.
Main supply failure monitor.
Timers.
Fault reset push button.
Method of Construction:
AMF Panel complete with relays, timers, set of CT's for metering & protection and energy analyzer to indicate currents, phase and line voltages, frequency, power factor, KWH, KVARH & provision for overload, short circuit, fault, under frequency, control cabling from AMF panel to diesel engine and elsewhere if required, complete with metering as per material list.
System Operation:
The above-mentioned facilities provided shall be functional for following operational requirements:
1. Auto Mode
• A line voltage monitor shall monitor supply voltage on each phase when the mains supply voltage fails completely or falls below set value (variable between 80 to 95 % of the normal value) on any phase, the monitor module shall initiate start-up of diesel engine. To avoid initiation due to momentary disturbance, a time delay adjustment between 0 to 5 second shall be incorporated in start-up intimation.
• A three attempt starting facility shall be provided 6 seconds ON, 5 seconds OFF, 6 seconds ON, 5 Seconds OFF, 6 seconds ON. If at the end of the third attempt, the engine does not start it shall be locked out of start and a master timer shall be provided for this function, suitable adjustment timers are to be incorporated which will make it feasible to vary independently ON-OFF setting periods from 1-10 seconds, if alternator does not build up voltage after the first or second start as may be the case, further starting attempt will not be made until the starting facility is reset.
• Once the alternator has built up voltage, the alternator circuit breaker shall close

connecting the load to the alternator. The load is now supplied by the alternator.
When the main supply is restored and is healthy as sensed by the line voltage monitor setting, both for under voltage or unbalance, the system shall be monitored by a suitable timer which can be set between 1 minute to 10 minutes for the load to be transferred automatically to main supply.

• The panel shall start the set in the event of fault condition of under voltage, over voltage, phase reversal, high frequency, neutral snapping, short circuit, etc., on the mains side. If the above fault condition arises if the load is being fed from the DG Set, then the panel start cut off the load from the set with an audible alarm, and the set shall run on no load.

2. Manual Mode:

• In a manual mode, it shall be feasible to start-up the generator set by the operator on pressing the start push button.

• Three attempts starting facility shall be operative for the start-up function.

• Alternator circuit breakers closing and trip operations shall also be through operator only by pressing the appropriate button on the panel and closed shall be feasible only after alternator has built up full voltage.

3. Test Mode:

• When under test mode, pressing of test button should complete the start up sequence simulation, and engine shall be started.

• Engine shall build up voltage but the set shall not take load by closing alternator circuit breaker when the load is on the mains, monitoring performance for voltage/ frequency etc. shall be feasible without supply to load

• If during test mode, the power supply has failed, the load shall automatically get transferred on DG Set.

• Bringing the mode selector to auto position shall shut down the set provided main supply is ON if the mains supply is not available at that time, the alternator shall take load.

Mode of Measurement: Executed quantity will be counted on number basis. (i.e. each)

Acoustic Enclosure (AEC)

Scope:

Specification No (GEN-AEC)

The Work includes supplying & erecting the Acoustic Enclosure (Canopy) fabricated from CRCA sheet of specified gauge, suitable for indoor / outdoor installation exposed to weather conditions & to limit overall noise level to 75 dB at distance 1 meter from the enclosure as per CPCB / MPCB norms under free field condition.

Material:

Acoustic enclosure (canopy) shall be fabricated out of the CRCA sheet of thickness not less than 1.6 mm on the outside cover with inside cover having not less than 0.6 mm thick perforated power coated CRCA sheet.

Method of Construction:

The construction of Acoustic enclosure (canopy) should be such that, it shall prevent entry

of rain water splashing into the enclosure, and shall allow free & quick flow of rain water to the ground in the event of heavy rain.

The detailed construction shall confirm to the details as under:-

The hinged doors shall be made from not less than 16 SWG (1.6 mm) thick CRCA sheet and will be made air tight with neoprene rubber gasket and heavy duty locks.

All sheet metal parts should be processed through 7-tank process.

The enclosure should be powder coated.

The enclosure should accommodate the daily service fuel tank of the D.G. set to make the system compact.

There should be provision of fuel gauge, which should show the level of the fuel even when the DG set is not running. The gauge should be calibrated. The fuel tank should be filled from the out side as in automobiles and should be with a lockable cap.

The batteries should be accommodated in the enclosure in battery rack.

The canopy should be provided with high enclosure temperature safety device.

The acoustics lining should be made up of high quality insulation material/ glass / mineral or rock wool of minimum 50 mm thickness and shall be of 75 kg/m3 to 100 kg/m3 density for sound absorption as per standard design of manufacturers to reduce the sound level as per CPCB norms. The insulation material shall be covered with fine glass fiber cloth and would be supported by perforated MS sheet duly powder coated.

The enclosure shall be provided with suitable size and No. of hinged type doors along the length of the enclosure on each side for easy access inside the acoustic enclosure for inspection, operation, and maintenance purpose. Sufficient space will be provided inside the enclosure on all sides of the D.G. set for inspection, easy maintenance, and repairs.

The canopy should be as compact as possible with good aesthetic look

The complete enclosure shall be of modular construction.

The forced ventilation shall be as per manufacturer design using either engine radiator fan or additional blower fans. If the acoustic enclosure is to be provided with forced ventilation then suitable size of axial flow fan with motor (Auto-start arrangement) and suitable size of axial flow exhaust fan to take the hot air from the enclosure complete with necessary motors and auto start arrangement should be provided. The forced ventilation arrangement should be provided with auto stop arrangement to stop after 5 minutes of the stopping of D.G. sets.

The acoustic enclosure should be suitable for cable connection through bus-trucking. Such arrangements on acoustic enclosure should be water proof and dust-proof conforming to IP-65 protection.

Mode of Measurement: Executed quantity will be counted on number basis. (i.e. each)

TECHNICAL SPECIFICATION OF EARTHING (EA)

Scope

This chapter covers the essential requirements of earthing system components and their installation. For details not covered in these specifications, IS Code of Practice on Earthing (IS: 3043-1987) as per relevant Indian Electricity Rules 1956 amended up to date, shall conform to CPWD General Specifications for Electrical works (part-I-Internal) 1994 and in the regulations of the local Electrical Supply Authority shall be referred too.

Application

The electrical distribution system is with earthed neutral (i.e. neutral earthed at the Transformer). In addition to the neutral earthing, provision is to be made for Body earthing to the metallic body of equipment and non-current carrying metallic components in the sub-station, as well as in the internal/external electrical installations such as for Transformers, HT/LT Panel, Capacitor Panels & DG Sets etc. through a common grid formed in the Substation building however neutral earthing to be kept dedicated. Earthing requirements are laid down in Indian Electricity Rules, 1956, as amended from time to time, and in the Regulations of the Electricity Supply Authority concerned.

Each equipment shall be connected with two independent earth conductors to earth bar located in respective area. Each earth bar shall be connected to Earth Grid by two independent earth conductors. Earthing Grid shall be directly connected by two independent earth electrodes. Earthing shall be 600 x 600 x 3mm thick with copper/600x600x6 mm GI earth plates and 300x300x3 mm thick as and when specified.

Further internal connection to panel and equipment may be carried with GI bare wire or Cu flexible cable of suitable size

Static earthing for human and the entry to plant to be provided as specified in layout, they should be carried with Cu plate and strip.

Materials

The material of earth and earth conductor shall be as specified in BOQ.

EARTH ELECTRODES

The type of earth electrode shall be any of the following

Plate/ Pipe earth electrode as specified in BOQ.

Chemical Earthing as specified in BOQ.

Electrode materials and dimensions

The materials and minimum sizes of earth electrodes shall be as specified.

Earthing conductor

The earthing conductor (protective conductor from earth electrode up to the main earthing terminal/ earth bus, as the case may be) shall be of the same material as the electrode, viz. GI or copper and in the form of wire or strip as specified. The size of earthing conductor shall be as specified.

Neutral earthing of equipment

Neutral terminals of Transformers shall be earthed independently. Each neutral terminal shall be earthed with two independent earth electrodes. Earth electrode shall be 600 x 600 x 3mm thick

copper plate. Copper Strip as earth conductor laid in ground shall be protected for mechanical injury & by providing GI Pipe of required dia as specified.

* Size may vary as per BOQ and layout

Plate earth electrode.

Earthing shall be provided with copper/GI plate electrode as mentioned in BOQ of following.

i. Copper Plate Electrode. :600 mm x 600mm x 3mm thick

ii. GI Plate Electrode.:600mm x 600mm x 6mm thick

The electrode shall be buried in ground with its faces vertical and not less than Three (3) meters below ground level. 20mm dia medium class GI pipe shall be provided and attached to the electrode. A funnel with mesh shall be provided on the top of this pipe for watering and earth electrode. Earth electrode watering funnel attachment shall be housed in masonry enclosure of not less than 300 x 300 x 300mm deep. A cast iron MS frame with cover having locking arrangement shall be provided at top of chamber. Earth electrode may not affect the column footing or foundation of the building. In such cases electrode may be further away from the building.

Artificial treatment of soil

If the earth resistance is too high and the multiple electrode earthing does not give adequate low resistance to earth, then the soil resistivity immediately surrounding the earth electrodes shall be reduced by addition of sodium chloride, calcium chloride, sodium carbonates copper sulphate, salt and soft coke or charcoal in suitable proportions.

Chemical earthing

Ground enhancement materials some with a resistivity of less than 0.1 Ohm meter (about 5% resistivity of Bentonite) are typically placed around the rod in a augured hole in either dry form or pre-mixed in slurry. Some of these enhancement materials are permanent and will not leech any chemicals into the ground.

Use of Sodium Chloride and Magnesium and other salts are permitted subject to Environmental guidelines of the respective geographical areas. The salt treatment must be renewed periodically.

Eco-safe Maintenance Free Earthing system comprising of Earth electrode of low carbon steel electrode with copper bonding & 1 bag of Carbon based Eco-safe environment friendly backfill and suitable clamp with test link-SS.

Hardware items

All hardware items used for connecting the earthing conductor with the electrode shall be of GI in the case of GI pipe and GI plate earth electrodes, and in case of copper plate electrodes.

Location of earth electrodes

Normally an earth electrode shall not be located closer than 1.5 m from any building. Care shall be taken to see that the excavation for earth electrode does not affect the foundation of the building; in such cases electrodes may be located further away from the building, with the prior approval of the Engineering-Charge.

The location of the earth electrode will be such that the soil has a reasonable chance of remaining moist as far as possible. Entrances, pavements and roadways, should be avoided for locating earth electrodes.

The minimum clearance between two adjacent earth pits shall not be less than 3 running meter.

Plate / Pipe type Earthing

A) Plate type Earthing (With or Without CI Cover, Funnel, etc) (EA-EP)

Scope:

Specification No (EA-EP)

Supplying and erecting galvanised cast iron / copper earth plate type / G.I. pipe type earthing with / without C.I. cover as per instructions from the site engineer.

Material:

Earth Plate: Galvanised cast iron / Copper earth plate or G.I. pipe as per specifications given in Table No 9.1/1.

CI Cover: As per specifications given in Table No 9.1/1.

Earthing Conductor: Copper/G.I strip/Annealed bare copper wire/G.I. earth wire of size as per specifications given in Table No 9.1/1.

GI Pipe: As per specification (CW-PLB/GP) mentioned chapter no. 17.5 for watering, and as enclosure for Earth wire, refer specifications given in Table No 9.1/1.

Hardware: Screw / nut bolts with required washer of dimensions, Rawl plug / clip/ 'U' nails and material as per specifications given in Table No 9.1/1.

Filling material: Coal /Charcoal/ salt as per specifications given in Table No 9.1/1. as per specifications given in Table No 9.1/1.

Lugs: As per specification (CB-LG/AL, CB-LG/CU) mentioned chapter 7.9 & 7.10 Copper/ Aluminium lugs as per specifications given in Table No 9.1/1.

Method of construction:

Pit is to be dug of required dimension and depth for the earthing at site, and laying of Galvanised cast iron / Copper earth plate or G.I. pipe shall be as per Table No 9.1/1. The earth connection to equipment/ switch gear and earthing electrode shall be connected as shown in the diagram and as per IS 3043 amended up to-date. The connections shall be made either by strip or double run of earth wire with drilling, welding, riveting, brazing and nut bolting to plate or pipe, where ever required in an approved manner. As far as possible continuous strip shall be used, but where ever jointing of strip is unavoidable, the overlap portion must not be less than 21/2 times the width of the strip either welded/ brazed/soldered by all sides or 6 inches overlap with two nut bolts/ riveting of adequate size with required washer and covered by anti-corrosive paint as per approved jointing practice in the industry and as per directives from site engineer in charge.

Pit shall then be filled with screened soil with alternate layer of coal and salt, and if, necessary brick masonry work (Where ever applicable) shall be done as specified in IS: 3043, with laying wires in PVC/ G.I. pipe and watering arrangement as per drawing no EA-1 and covered with C.I. Cover (Where ever applicable).

Wherever requires or as specified by Site Engineer, a Test link shall be provided for facilitating the testing of resistance of earth electrode.

Testing:

The value of each earth electrode shall be measured by earth tester in presence of site Engineer and record to be submitted.

Mode of Measurement: Executed quantity will be measured on number basis (i.e. each)

B) Low Impedance Earthing (Pipe in pipe technology) (EA-EPP)

Scope:

Specification No (EA-EPP) Supplying and erecting approved type earthing system with Pipe in pipe technology with necessary ancillary materials and complete erection as per instructions from the site engineer.

Material:

GI Pipe: As per specification no. (CW-PLB/GP) mentioned chapter 17.5; 1. 50 mm dia x 3 meter long (In place of traditional GI pipe Earthing), for LV / MV applications.

Or

2. 80 mm x 3 meter long (In place of traditional copper plate Earthing), for HV/EHV applications.

Earthing Conductor: G.I strip/GI earth wire of size as per specifications given in Table No 9.1/1.

GI Pipe: As per specification no. (CW-PLB/GP) mentioned chapter 17.5 for watering and as enclosure for Earth wire, as per specifications given in Table No 9.1/1.

Hardware: Screw / nut bolts with required washer of dimensions, Rawl plug / clip/ 'U' Nails and material as per specifications given in Table No 9.1/1.

Filling material: Coal /Charcoal/ salt as per specifications given in Table No 9.1/1.

as per specifications given in Table No 9.1/1.

Lugs: As per specification no. (CB-LG/AL, CB-LG/CU) mentioned in chapter 7.9 & 7.10 for Copper/ Aluminium lugs and as per specifications given in Table No 9.1/1.

Method of construction:

Earthing Pipe in pipe technology with ancillary materials shall be done by digging an 8" / 10" dia hand bore 10.5' deep sufficient to install the electrode in normal soil conditions. The space between the soil and the electrode is filled up with electrolyte material mixed with the dug out mother soil, along with water and tightly packed up to the base of the terminal. In rocky areas and under hard soil and sandy soil conditions the method of installation will be as specified by manufacturer. Installation shall include drilling, welding, reverting, brazing and nut bolting pipe when ever required in an approved manner with required material such as nut bolts and washer etc. and with necessary brick masonry work as per the specification. (As per IS 3043 amended up to-date). As far as possible continuous GI strip shall be used but when ever jointing of strip is un avoidable, the jointing over lap portion must not be less than 21/2 times the width of the strip either welded/ brazed/soldered by all sides or overlap of 6 inch with two nut bolts/ riveting of adequate size with required washer and covered by anti corrosive paint as per approved jointing practice in the industry and as per directives from site engineer in-charge.

Testing:

The value of each earth electrode shall be measured by earth tester and record to be submitted. (Also refer drawing No. EA-2)

Mode of Measurement: Executed quantity will be measured on number basis i.e.

Lightning protective system

Scope

The scope of work shall cover supply, erecting, installation and testing of Lightning Protection system along with air termination with necessary support, low impedance down conductors, performance recording equipment, earth pits with its termination.

All codes and standards mean the latest. Where not specified otherwise the installation shall generally follow the National Building code of practice or the relevant IS / IEC Standard.

The requirement includes the detailed risk assessment of the structure to be protected, LPS design of structure, engineering, manufacture, testing, packing, forwarding and delivery with test certificate, storage at site, installation, supervision of erection, commissioning and successful handing over. Protection methods of lightning protection system including all necessary accessories and coordination work as required for the work completion and specified in relevant specifications and to the satisfaction of the Customer, Consultant and End User.

References

The publications listed below form part of this specification to the extent referenced. The publications are referred to within this specification by the basic code number alone. Year of publication shall be as per the table furnished below or the latest revision. Also relevant CEIG/CEA guidelines shall be followed wherever applicable.

STANDARDS & CODES	YEAR OF PUBLICATION	DESCRIPTION
IS/IEC 62305 part 1-4	2015	Protection Against Lightning
NBC	2016	National Building Code
NEC	2011	National Electrical Code
IEC 62561 - 1	2017	Lightning protection system components (LPSC) – Part 1: Requirements for connection components
IEC 62561 - 2	2018	Lightning protection system components (LPSC) – Part 2: Requirements for conductors and earth electrodes
IEC 62561 - 4	2018	Lightning protection system components (LPSC) – Part 4: Requirements for conductor fasteners
IEC 62561 - 7	2018	Lightning protection system components (LPSC) – Part 7: Requirements for earthing enhancing compounds
IEC 61643-11	2011	Surge protective devices connected to low-voltage power systems - Requirements and test methods
IEC 61643-21	2012	Surge protective devices connected to telecommunications and signalling networks - Performance requirements and testing methods

System description

This specification gives guidance on how to assess the risk of being struck and it offers a method of compiling an index figure as an aid in deciding whether a particular structure is in need of protection.

The specification also offers guidance on good engineering practice and the selection of suitable materials.

General

There are no devices or methods capable of modifying the natural weather phenomena to the extent that they can prevent lightning discharges. Lightning flashes to, or nearby, structures (or lines connected to the structures) are hazardous to the structures, their contents and installations as well as to lines. This is why lightning protection measures are essential

Lightning Protection System shall be in accordance with IS IEC 62305-3 & NBC-2016. Lightning Protection consists of external Protection for the building with Air termination, Down Conductors and Earthing and Internal protection for power lines with Surge Protective devices.

Generally lightning between cloud and ground creates failures. However inter-cloud and intra-could lightning also can create potential differences and failures in electronic installation. More than 95 % of Lightning strikes are of Negative impulse and less than 5 % are of positive impulse. Positive impulses are mainly due to dry lightning in cold areas.

Current parameters as per IS/IEC 62305 and the effects of lightning are as below

Current Parameters	Symbol	Unit	Lightning Protection Level				Effect
			I	II	III	IV	
First positive Impulse							
Peak Current	I	kA	200	150	100		Mechanical
Impulse charge	QSHORT	C	100	75	50		Thermal (arc)
Specific Energy	W / R	MJ/Ω	10	5.6	2.5		Mechanical & Thermal
Average Steepness	di / dt	kA / µS	20	15	10		Surges and flashover
Time Parameters	T1/T2	µS/µS	10/350				
First Negative Impulse							
Peak Current	I	kA	100	75	50		Mechanical
Average Steepness	di / dt	kA / µS	100	75	50		Surges and flashover
Time Parameters	T1/T2	µS/µS	1/200				

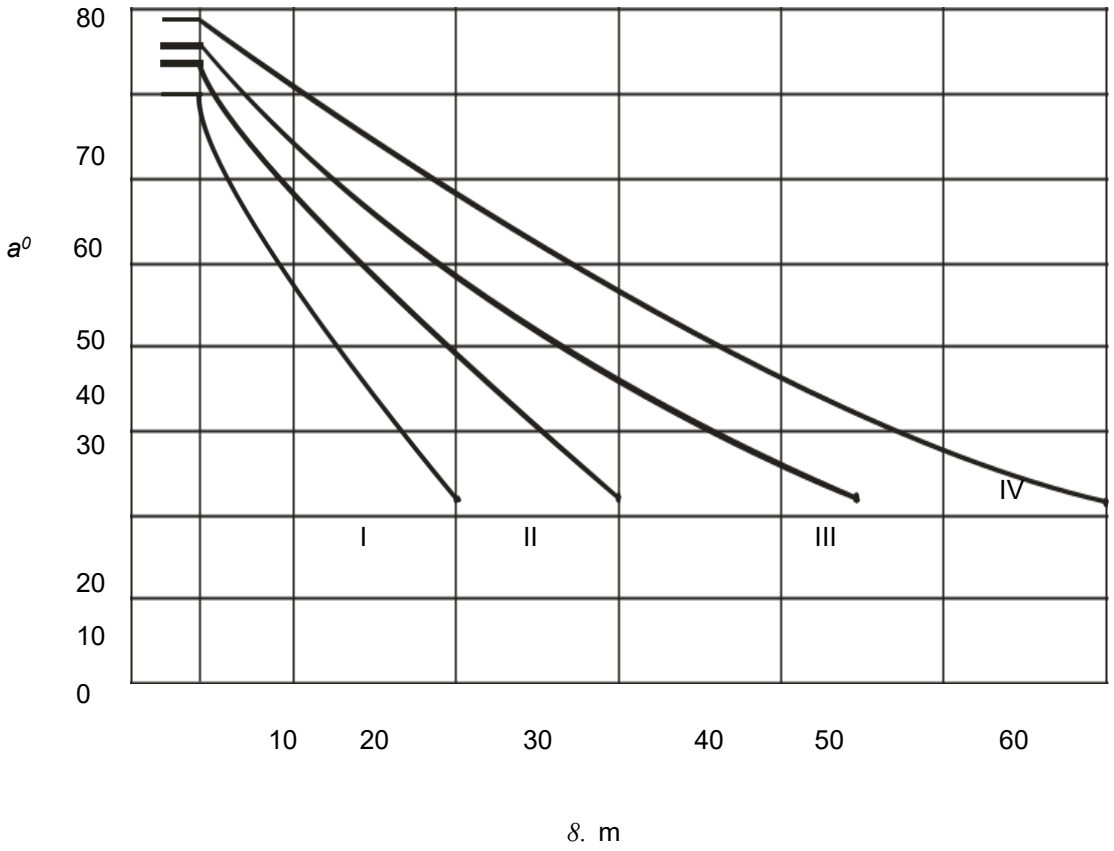
LPS is a number associated with a set of lightning current parameters relevant to the probability that the associated minimum & maximum values do not exceed the normally occurring lightning.
LPS can be determined by Risk analysis as explained in IS IEC 62305-2
Detailed Risk Assessment Report need to be submitted as per the IS/IEC 62305-2 flow chart (procedure for deciding the need of protection and for selecting protection measures) The Risk assessment report consist of following parameters.

- ✓ Risk of the structure without any internal & external lightning protection,
- ✓ Mitigational measures (Internal & External protection) ,
- ✓ Mitigated risk value after providing the internal & external Lightning protection system

Mitigated risk value to be less than the tolerable risk limits. Input data shall be separately recorded in the report. Reference for the values/equation as per IEC 62305-2 & NBC 2016 shall be specified in the Risk assessment Report.

Air termination system

Air Termination mesh conductor and down conductors: 8 mm Aluminium alloy round conductor (50 mm^2) Air Termination Rod: 10 mm, 16 mm & 40 mm solid Aluminium rods (combination of sizes) (tubes are not allowed). Air termination conductors (Vertical & Horizontal Mesh) shall be tested as per IEC 62561- 2
Protection angle w.r.t. height
Class of LPS



Joints / Connectors / Fixing materials:

Connection materials	Connector type	GI fixing materials shall not be used
Aluminum to Aluminum	Aluminum or SS	
Aluminum to Steel	SS	

Aluminum accessories if connection is between Aluminum materials are necessary. SS accessories if connections are between aluminum and copper / copper coated materials.

All connection components (Cross splicer, straight splicer, Test Link, clamps) to be tested as per IEC 62561-1 2017 Cl. 6.3 for conditioning & Ageing Test & 6.4 for Lightning impulse Current withstand test: 100 kA of 10/350µs waveform(Ageing & Electrical test) conducted in a sequence manner & tested in the Govt. accredited Third party laboratory.

Earth Termination Conductor: 10 mm solid copper coated steel conductor (100 microns min coating)

Earth Termination Joints in soil: Exothermic welding / Straight connector/ Cross splicer

If the structure height is more than 60 meters, top 20% of the height of the structure shall be protected with a lateral air termination system. This is needed because the probability of flashes to the side is generally more for structures more than 60 meters in height. More importance need to be provided to Corners, Edges and significant protrusions such as balconies. Metallic handrails/ Aluminum frame of wall cladding if used in balconies shall be conned to air termination / down conductors.
In PEB / Steel buildings where GI sheet roofing, air termination mesh / Rod shall be directly mounted on the sheet. Fixing materials used shall be in good electrical contact with the sheet, shall not create water leakage.
No drilling is allowed in the terrace for fixing the air terminal, if the roof is made of concrete. Parapet wall is exception to this.

Manufacturers

Acceptable Manufacturer: As per approved list of makes for Lightning protection system & associated accessories

Product Data

Materials

Only materials made of Copper, aluminium or stainless steel are recommended for exposed areas on installations as recommended in NBC 2016. The material used in Lightning Protection system should have been tested as per the standard requirement of IEC 62561 - 1 to 7 (as applicable for relevant components)- latest edition in a third party lab. Vendor must submit third party laboratory Test reports for conductors & components to be submitted as per IEC 62561.

Dimensions

The component parts of lightning protective systems should have dimensions not less than those mentioned in IS IEC 62305 Part 3 (Table 3, 6 &7) based on the type of material.

Air terminal holder:

Concrete roof structure:

Conductors shall be securely fixed on the terrace by means of concrete air terminal holders with suitable fixing materials which is fixed on the roof by adhesive or cement mortar taking care of varying weather conditions. Plastic air termination conductor holder is not allowed.

Metal roof structure:

Conductors shall be securely fixed on the terrace by means of air terminal holder which is fixed on the roof by metal conductor holder made of Stainless steel. As metal roof structures are normally tapered at an angle, there are no min height criteria for metal conductor holder. The component shall be tested as per IEC 62561 - 1 Cl. 6.3 for conditioning & Ageing Test.

Recommended fixing distance of air terminal shall as below as per the class of protection required:

Class of LPS required	Recommended distance	
	Rolling sphere	Mesh (Mtrs.)
I	20 M	5 x 5
II	30 M	10 x 10
III	45 M	15 x 15
IV	60 M	20 x 20

If antenna, chillers or any other roof top electrical equipment is present in terrace, the same have to be protected by using vertical air terminal after calculating the safety or separation distance. The vertical air terminal has to have suitable supports to hold it. Wind speed need to be taken into account. Vertical air terminal must be connected to horizontal air terminal by using suitable connectors.

At the crossings of the horizontal air terminals, suitable Cross connector has to be used.

Safety or separation distance:

(Not required for LPS using structural or natural components)To avoid flash over to electrical/electronic apparatus, this equipment shall be kept at a distance away from LPS components more than the safety distance as per the following calculation.

Safety/Separation distance (S) in m = (ki * kc*L) / km

Coefficient ki depends on class of LPL/LPS (ki = 0.08 for LPL1, 0.06 for LPL 2, 0.04 for LPL3 and 4)

Coefficient kc depends on no of down conductors: kc = 0.66 for 2 down conductors, kc = 0.44 for 3 or more down conductors
Value of coefficient km = 1

Value of L is the total distance between the equipment to be protected (for e.g. Antenna) to the equi-potential bonding bar situated just above the ground.

Down conductor system

In order to reduce the probability of damage to electronic/electrical equipment, the down conductors shall be arranged in equi-distance in such a way that from the point of strike to earth, several parallel current paths should exist & length of the current path should be minimum**.** Down conductors should be installed at each exposed corner of the structure as a minimum. Maximum distance between down conductors shall be as per the table below.

Class of LPS Required	Typical Distance
I	10 M
II	10 M
III	15 M
IV	20 M

Test joints:

At the connection to the earth conductor, a test joint should be fitted on each down conductor at a height of 1 m from the ground, except in the case of natural down conductors combined with foundation earth electrode. The purpose of test joint is to measure the earth resistance value. The remaining portion of down conductor (i.e., after the test joint should be mounted inside a plastic pipe of minimum 3 mm thickness.) Test Link shall be tested as per IEC 62561-1 2017 Cl. 6.3 for conditioning & Ageing Test & 6.4 for Lightning impulse Current withstand test: 100 kA of 10/350µs waveform (Ageing & Electrical test) conducted in a sequence manner & tested in the Govt. accredited Third party laboratory.

Earth pits & terminations:

For earth termination system, 2 basic types of earth electrode arrangements are applicable.

Type A & Type B arrangement.

Type A arrangement:

Comprises of horizontal or vertical earth electrode installed outside the structure to be protected connected to each down conductor. Minimum Length of vertical earth electrode shall be as below:

Class of LPS	Typical Length of each vertical earth electrode based on Soil resistivity			
	Up to 500 Ω M	1000 Ω M	2000 Ω M	3000 Ω M
1	2.5 meter	10 meters	25 meters	40 meter
2	2.5 meter	5 meter	15 meters	22 meter
3	2.5 meter	2.5 meter	2.5 meter	2.5 meter
4	2.5 meter	2.5 meter	2.5 meter	2.5 meter

If horizontal electrodes are used, the length shall be double. In type A arrangement, the total number of earth electrodes shall not be less than two. Type A arrangement is suitable in places where electronic equipment are not located.

Type B arrangement:

This type of arrangement comprises either a ring conductor external to the structure to be protected, in contact with the soil for at least 80% of its total length or a foundation earth electrode. Ring earthing must be 1 meter away from the building and 0.5m below the ground as a closed loop. Such earth electrodes can also be meshed. For structures with extensive electronic systems or with high risk of fire, type B earthing is most preferable method. There is no limit in the resistance of Ring Earthing if the ring radius of the ring is larger than 50 meters or 80 meters for LPL 1 and 2. For LPL 3 and 4 this radius is about 5 meters. The overall resistance of earthing system shall not exceed 10 ohms.

Earth Electrode:

The earth electrode is the main component of the earthing system. The electrode shall be of, high tensile, low carbon steel rod having diameter of 17.2 mm. The outer surface of the electrode shall be molecularly bonded with copper having a thickness of 250 microns (average) as per IEC / 62561. The length of the electrode may be increased to reduce the resistance if required. To increase the length, pieces of similar rod shall be joined with coupler or exothermically welded to a basic 3 meter electrode. This coupler shall be of electrolyte grade copper. Copper bonded earth electrode shall confirm to IEC : 62561-2.

When earth rods are used, they should be driven into the ground beneath. Or as close as practicable to the structure and down conductor.

Connections and indicating plates - The connection between the down conductor and the rod should be accessible, if below ground, within an inspection box.

Strips - Strips should be disposed radially from the point of connection with a down conductor, the numbers and lengths of strip required being as found necessary to give the desired resistance to earth.

Distance between each earth rod shall be at least twice the length of rod. (Foe ex, if the rod length is 3m, the second Rod as to be installed at least 6 Meters away to take care of sphere of influence, Soil resistivity values must be available before selecting the length of rod/grid etc.

Highly conductive and Environment friendly corrsoion free backfill material :

The technology to achieve a good earthing mainly depends on soil treatment and the backfill compound. The type and quality of backfill compound determines the long term reliability of the grounding system.

For greater degree of performance the backfill material shall be of superior Environment friendly Carbon based conductive concrete type material or Mineral Compound that improves earthing effectiveness, especially in areas of poor conductivity (rocky ground, areas of moisture variation, filled up soil, sandy soils etc.).

BENTONITE & BENTONITE mixture based compound shall not be used as a back-fill material as they are dependent on moisture for their performance and needs regular watering to obtain & maintain its' beneficial characteristics and hence it may not function well in dry environment.

Environment friendly Carbon based backfill compound or Mineral Compound shall be suitable to be installed in either slurry or dry form and shall not be mixed with any soil while pouring in the bore hole.

The entire bore hole shall be filled with the earth enhancing backfill material only so that it improves the conductivity of the earth electrode and ground contact area. The back-fill material shall have following characteristics….

Tested as per IEC : 62561-7 and the test certificates (Corrosion Test, Leach Test, Sulphur Test & Resistivity Test) shall be submitted.

- Shall not depend on the continuous presence of water / moisture / salt to maintain its conductivity.
- Shall not decompose or leach out with time.
- Shall solidify when mixed with water and set like concrete.
- Shall contain a corrosion inhibitor to mitigate corrosion of copper
- Shall not contain hazardous chemicals and necessary Test certificate from reputed NABL accredited laboratories shall be furnished.
- Shall not be affected by drought and shall be stable between -10˚ to +50˚ C temperature.
- Shall be suitable for any kind of soil
- Shall be supplied in sealed, moisture proof bags. These bags shall be marked with Manufacturer's name or trade name, quantity, batch no & date of manufacture.

Testing

- The entire lighting conductor installation shall be tested in accordance with the Indian Standard Code and the following ground resistance values shall be recorded.
- Lighting protection earthing system resistance to be maintained less **than 5 ohms**
- The continuity of the down conductor's network.
- The contact resistance measurement for connection component as per IEC 62561 - 1, Less than 3 milli ohms for the stainless steel component & less than 1 milli ohm for the Aluminium component.

Quality Assurance

Product requirement:

The system shall be installed by competent installations team approved by the manufacturer/supplier of the product under the supervision of trained engineers. The installation must be strictly adhered to the approved drawing. Any modification/change from original drawing must be approved before installation.

Delivery, Storage & Handling:

Delivery and Acceptance Requirements: Deliver materials to site in manufacturer's original, unopened containers and packaging, with labels clearly identifying product name and manufacturer.

Store products in manufacturer's unopened packaging until ready for installation.

Store and handle in strict compliance with manufacturer's written instructions and recommendations

Protect from damage due to weather, excessive temperature, and construction operations.

Co-ordination:

Coordinate with architects/electrical consultants/contractor for structural earthing/ ring earthing/ proper routing of conductors and earth pit locations.

Warranty

All necessary warranty certificates shall be issued in accordance with the requirements.

Product shall be warranted free of defects in material or workmanship. Product shall be warranted to perform the intended function within design limits. Manufacturer's sole obligation under this warranty is to replace any defective part or component within warranty period.

TECHNICAL SPECIFICATION OF LIGHT FIXTURES:

The lighting fittings shall be installed on the ceiling / column / wall / ceiling cut-out or street light pole as shown in appropriate engineering documents. The supporting arrangements shall be approved by the Engineer – In charge. Location of lighting fittings, switches etc. shall be generally as shown on the drawing.

All structural support / lighting poles, wherever provided, shall be duly painted with 2 coats of zinc phosphate / zinc chromate primer and 2 coats of enamel paint after the installation of fittings (If hot deep galvanized GI poles, then no need of painting). (Vendor to quote for polyurethane quoting for structures and poles, alternatively.)

All cables shall be 1100 Volts grade, PVC insulated, Copper conductor, as per I.S. with appropriate colour coding for phases, neutral and earth connections.

Lighting switches and panels shall be installed on walls / columns at a height of 1.5 m above ground using suitable structural steel wall bracket to ensure that the same are lifted from the wall to the extent of 40 mm. Thickness of the switchboard shall be 16 SWG

Lighting Panels / DB's shall have cable entries from top by providing suitable gland plate/ knock-out plates. Lighting panels / DB's shall be fabricated only after obtaining the approval of general arrangement drawings from the concerned site engineer. The lighting panels shall have terminals for all incoming and outgoing cables.

Flameproof fixtures shall be wired using armoured, copper cables and flameproof double compression cable glands without junction boxes. All fittings shall be earthed by G.I. wire and tinned copper lugs for connections to fittings.

All lighting fittings shall be earthed using 8 SWG G.I. wire and special lugs for connections to fittings.

Installation of lightings shall also include installation of lamps and energizing the same. Light fitting and associated lamps shall be provided as free issue to contractor.

1.6.3 **General specification**

The lighting fittings shall be installed on the ceiling / column / wall/ceiling cut-out or street light pole as shown in appropriate engineering documents. The supporting arrangements shall be approved by the Engineer – In charge. Location of lighting fittings, switches etc. shall be generally as shown on the drawing.

All structural support / lighting poles, wherever provided, shall be duly painted with 2 coats of zinc phosphate / zinc chromate primer and 2 coats of enamel paint after the installation of fittings (If hot deep galvanized GI poles, then no need of painting). (Vendor to quote for polyurethane quoting for structures and poles, alternatively.)

Flameproof fixtures shall be wired using armoured, copper cables and Flame proof double compression cable glands without junction boxes. All fittings shall be earthed by G.I. wire and tinned copper lugs for connections to fittings.

All lighting fittings shall be earthed using 8 SWG G.I. wire and special lugs for connections to fittings.

1.6.4 Street light fixture

The body shall be robust, corrosion resistant superior in finish & without any cracks or through holes, made in a single piece by high pressure die cast LM6 aluminium alloy. The luminaries shall be monolithic construction totally enclosed dust tight & water proof. The luminaries shall be class I luminary. Degree of protection shall be IP66 as defined in Appendix A of IS10322 (Part-I 1982) with latest amendments. Integrated with in luminaire & The dimensions of luminaries shall be adequate to permit sufficient heat dissipation through the body itself, so as to prevent abnormal temperature rise inside the lantern & consequential damage to cover & gasket materials, LEDs, lenses & Electronic Driver.

Drivers should be constant current drivers with separate compartment, preferable top maintainable for ease of maintenance, also driver compartment should be IP66.Driver should also have Double phase protection, no load, open circuit and short circuit protection.

Luminaire efficacy should be min 120 lm/W, CRI≥ 70, CCT 5700± 300 deg. K, IP 66, Min 5KV inbuilt surge protection with driver & 10KV external to driver inside the fixture.
LM79 reports from government approved lab approved by ministry of science for R&D. LM80 report from the source manufacturer for LED's used to be provided.
A 'green' product: 90% recyclable material and 35% recycled content.

1.8.3 Bulk Head type LED Luminaries

Supplying & Erecting LED bulkhead Fitting of appropriate size with 8 W with minimum 50-70 lux level at ground level with p.f. > 0.95 with frosted glass.

Material:

Fitting:

Luminaries comprises of a deep drawn MS sheet body with clear acrylic cover of 3mm thickness or as per manufacturer's specification, along with LED's with 100 lumens per watt mounted on top of aluminum heat sink of appropriate size for excellent thermal dissipation. The constant current driver circuit should be inside the luminary and can be driven between 80V to 260V AC. It should conform to class 1 of IS: 10322. The surface of the canopy should be powder coated / stove enameled. Fitting shall be wired with multi stranded copper wire terminating on suitable connectors.

Driver:

The constant current driver driven at 600mA of constant current should have short circuit protection, thermal protection & should work in the range of 80V to 260Volts.

LED's:

The LED's of approved make having life of minimum 50000 burning hours, must have a color temperature between 5000 - 7000 and of 100 lumens per watt. The angle of illumination of each LED should be 90degrees and should be mounted on star type of metal core PCB's.

Metal Core PCB's: The PCB should be a metal core, copper clad laminate composed of 1 oz Electro deposit copper and 1.5mm 5052 Aluminum Alloy Laminated by 60 um high thermal conductive adhesive of modified epoxy.

Wooden board: As per **(WG-PW/PW)**1.6 specified in chapter for Point wiring.

Hardware*:* Sheet Metal (SM) screws, washers, plugs / wooden gutties, etc.

Method of Construction:

The complete fitting with all the above accessories shall be erected as directed by Site engineer, duly connected and giving necessary testing.

Mode of Measurement: Executed quantity shall be counted on number basis. (i.e each)

1.1.4 Suspended / surface mounted linear led luminaire

Sturdy vandal resistant light grey polycarbonate housing with natural silicone gel gasket .UV stabilized poly-carbonate diffuser with transparent prismatic interior and smooth exterior and suitable for LED

Luminaires. Luminaire efficacy should be min 100 lm/W, LED driver efficacy should be min 85%. Wide operating range voltage from 160-280 V AC.

Ingress protection of IP 65, CCT - 5700±300 deg K, CRI≥ 70, surge protection of 2.5kV.

Waterproof cable gland ensures good ingress protection, Ballast and accessories are mounted on removable gear tray.

1.6.5 Inspection and testing

Representatives of the Owner shall have free access to vendor's works to inspect, expedite and witness shop tests. Any materials or work found to be defective or which does not meet the requirement of the specification shall be rejected and replaced at supplier's cost.

Tests shall be carried out on the lighting fixtures as per the relevant Indian Standard Specifications and the test report shall be submitted to the Owner.

1.6.6 Tools

A complete set of special tools required for maintenance of the fixtures shall be supplied by the vendor free of cost.

1.6.7 Guarantee

All the lighting fixtures shall be guaranteed for trouble free operation for a period of *** months from date of commissioning or *** months from the date of arrival at site whichever is earlier. Any defects discovered during this period shall be rectified by the supplier free of cost.

Technical specification for LT switchgears

1.1.5 Scope of work:

This specification covers design, fabrication, testing, inspection, supply, erection & commissioning of Metal Enclosed Switchgears.

Applicable standards:

The switchgear and its components shall conform to the latest version/issue. In case of conflict between the standards and specification, this specification shall govern.

LT panel	IEC 61439 -1 & 2
Factory built assemblies of SWGR and control gear for voltages up-to and including 1000V AC & 1200V DC.	IS:8623/BS:5486/IEC:439
Air break switches	IS:13947-P3/BSEN 60947/IEC:60947-3
Miniature circuit breakers	IS:8828/BSEN:60898
Low voltage fuses	IS:13703/BSEN 60947-4/IEC:947-1

Contactors	IS:13947/BSEN 60947-4/IEC:947-1
Starters	IS:13947/BSEN 60947-4/IEC:292-1 TO 4
Control switches / Push buttons	IS:6875/BSEN 60947
Current transformers	IS:2705/BS:7626
Voltage transformers	IS:3156/BS:7625/IEC:44, 186
Indicating instruments	IS:1248/BS:89/IEC:51
Marking and identification of conductors and apparatus terminals	IS:11353/BS:159
A.C. electricity meters	IS:722, 8530/BS:5685/IEC 145, 211
Degree of protection	IS:13947/IEC:947-P1
Selection installation and maintenance of switch gear and control gear	IS:10118
Code of practice for phosphating iron and steel	IS:6005/BS:3189
Specification for copper rods and bars for electrical purposes	IS: 613
Control transformers for switch gear and control gear voltage not exceeding1000V AC	IS: 12021
Circuit breakers	IS-13118, BS-5311, IEC-56 & 694 BSEN-60942 (P-2)
Control switches	IS-6875/BSEN60947, IEC-947
Wrought aluminum and aluminum alloy bars, rods, tubes and sections for electrical purposes	IS: 5082
Marking and arrangement for switchgear, bus bars	IS-5578

main connection and auxiliary wiring. IS-11353

Construction details:

(a) The switchgear shall be metal enclosed, modular type suitable for indoor floor mounting and shall have following features.

(i) Shall be fabricated by using cold rolled sheet steel.

(ii) All cubicles / shall comprise of rigid welded structural frames made of pressed and formed cold rolled sheet steel. Cladding of the frames and doors shall be made out of 2.5mm & 2 mm thick sheet steel respectively. All cable gland plates shall be made out of 3 MM thick sheet steel plates.

(iii) All cubicles shall be provided with ISMC-75 channel base frame.

(iv) Height shall not exceed 2375 mm. Normal operating height shall not exceed 1850 mm.

(v) Shall be single front execution as specified in specific requirements and shall be of dead front type. Whenever specified in specific requirements, single front execution shall not need rear access for operation or maintenance purpose.

(vi) Shall have designation labels both on front and rear sides

(vii) Shall be provided with neoprene gaskets for removable covers, doors, between s and base frame and all around the perimeter of adjacent.

(viii) Switchgear shall be extensible on both sides.

(ix) Switchgear shall be suitable for Top, cable/bus bar entry as specified. There shall be adequate space for ease of termination of aluminium conductor multi core cables, selected with 60% derating factor.

(x) Bus Coupler without release shall be incorporated in the Main PCC as per SLD.

(b) Switchgear shall be divided into distinct vertical sections each comprising:
(i) A completely enclosed bus bar compartment running horizontally.
(ii) Enclosed vertical bus bars serving all modules in vertical section.

(iii) A separate horizontal enclosure for all auxiliary power and control buses, if required.

(iv) Vertical cable alley of minimum 300 mm wide covering entire height with undrilled Detachable gland plate

(v) Minimum feeder section width shall be 450mm & height 250mm

(c) Operating devices shall be incorporated only in the front of switchgear.

(d) Each shipping section shall have metal sheets at both ends.

(e) Cable alley shall be provided with suitable hinged doors.

(f) Rear of single front switchgear shall be provided with removable with captive screws. The covers shall be provided with suitable arrangement for removing the cover.

(g) All doors shall be with concealed type hinges and captive screws. Doors shall be provided with right angle turn type door lock.

(h) Each vertical section shall be equipped with a space heater controlled by thermostat.

(i) Each switchgear cubicle shall be provided with interior lighting with a 20 W fluorescent tube or 25 W clear glass lamp with pin type holder with on/off MCB control.

(j) A 240 V, 1-phase, AC Industrial type, metal clad plug point shall be provided in the interior of each cubicle with on-off MCB for connection of hand lamps/blowers.

(k) Interchangeability:

All identical equipment and corresponding parts be fully interchangeable without any modifications.

(l) All live and bare parts in cable alley & cubicles shall be shrouded.

(m) All s shall be extensible from both side in future.

(n) The minimum contactor rating should be 16A.

1.1.6 Main and auxiliary buses:

Switchgear bus bars shall be of uniform cross section throughout the length and made of high conductivity, copper conductor.

Bus bars shall be provided with at least the minimum clearances in air as specified.
All bus bars, bus taps shall be insulated with close fitting sleeve of hard, smooth, dust and dirt free heat shrunk PVC insulation of high dielectric strength to provide a permanent high dielectric non-aging and non-tracking protection, impervious to water, tropical conditions and fungi. The insulation shall be non-inflammable and self-extinguishing and in fast colours to indicate phases. The joints shall be insulated in such a way as to provide for accessibility of contact bolts for maintenance. The dielectric strength and properties shall hold good for the temperature range of 0 to 90 degree centigrade. If the insulating sleeve is not coloured, bus bars shall be colour coded with coloured bands at suitable intervals. Both main horizontal bus bars and vertical bus bars serving modules shall be insulated.

Bus bar joints shall be of the bolted type and shall be insulated. Spring washers shall be provided to ensure good contact at the joints. Bus bars shall be thoroughly cleaned at the joint locations and suitable contact grease shall be applied just before making a joint.
Bus bars shall be located in air-insulated enclosures. Direct access to, or accidental contact with bursars and primary connections shall not be possible. All apertures and slots shall be protected by baffles to prevent accidental shorting of bus bars by the entry of maintenance tools. To provide a tight seal between cubicles, bushings or insulating s shall be provided for bus bars crossing from one cubicle to another.
Each switchgear cubicle shall be fitted with a label on the front and rear of the cubicle. Each switchgear shall also be fitted with a label indicating the switchgear rating and duty.
Each relay, instrument, switch, fuse and contactor shall be provided with a separate label.

Switchgear shall be complete with inter- wiring.

One metal sheet shall be provided between two adjacent vertical sections running to the full height of the switchgear except for the horizontal bus bar compartment. However, each shipping sections shall have metal sheets at both ends.

After isolation of the power and control connections of a circuit, it shall be possible to safely carry out maintenance in a compartment with the bus bars and adjacent circuits alive.

All draw out contacts shall be of silver plated copper.

Clamping arrangement shall be provided for incoming & outgoing cables.

1.1.7 Pre-treatment and painting:

(a) All metal work of the fabricated shall undergo a seven-tank process of degreasing, pickling in acid, cold rinsing, phosphating, passivating etc. in seven-tank treatment plant before painting.

(b) The treated shall be painted in 2 coats of high corrosion resistant primer. The primer shall be baked in oven.

The finishing treatment shall be by synthetic enamel or epoxy paint with powder coated finish, as specified. In case of powder coated finish (b) above is not applicable.

1.1.8 Air break circuit breaker:

(a) ACB shall be air break, draw out type, modular in construction and conforming to IEC947 / IS: 13947 (Part 2). The ACB shall be suitable for operational voltage of 440V, 50Hz supply system. The ACB shall have trip free mechanism which prevents the operating mechanism from interfering with the tripping or opening action. Castell key lock if asked for shall be provided on the ACB itself. It should be possible to remove castell key only when breakers are in OFF condition. All the vital accessories like shunt, motor, under voltage shall be accessible from the front and should not need removing of the breaker from it's for the addition at site. Physical contact wear indicator shall be provided to indicate the erosion of the contacts.

(b) The air break circuit breaker shall be three/four pole, manual/motorized operation, draw out type of circuit breaker as specified with a stored energy closing mechanism, integral spring charging handle, status indicators (closed, open and tripped), close and trip push buttons and provision for pad-locking in open position.

(c) It shall have CT operated microprocessor based release providing overload, short time delay short circuit, instantaneous short circuit, earth fault protection as specified. The release shall have provision of settable current and time as required for respective protection.

(d) It shall have metering display & other features like communication capabilities, data logging past events if specified in specific requirement.

(e) It shall have shunt trip coil for remote tripping as per operating voltage specified.

(f) Circuit breakers of same rating shall be identical and interchangeable.

(g) Two set of auxiliary NO and NC contact blocks shall be available wired up to terminal blocks.

(h) The draw out design of the circuit breaker shall have three positions – 'SERVICE', 'TEST' and 'ISOLATE'. Position indicator shall be provided on the to indicate the position of the circuit breaker trolley viz. 'ISOLATE', 'TEST' and 'SERVICE'.

(i) In 'TEST' position, it shall be possible to check the feeder operation without energizing the power circuit. It shall be possible to withdraw the circuit breaker trolley upto the 'TEST' and 'ISOLATE' position without opening the front door.

(j) The ACB shall be fully rated for 50oC ambient temperature. Vendor to be submitted de-rating chart for 50oC ambient temperature.

(k) The release shall provide zone selective interlocking for short circuit and earth fault protection zones to reduce thermal stress on the system

(l) ACBs should comply to Ics=Icu=Icw.

(m) ACBs release shall have separate each fault indication (o/l, S/c, Inst, N-O/L etc).

(n) ACBs release shall have ready to close indication which shall be taken on panel. (PB need to mention all ready to close check printed on Panels)

(o) ACBs shall have soft rating plug or hard rating plug feature in release. In case of hard rating plug, Switchgear vendor need to offer one set of all component (like ACB CTs) as complementary with ACBs.

1.1.9 Moulded case circuit breakers:

MCCBs shall be current limiting type single / double break with trip time of less than
10 m. sec suitable for 3 phase 415 Volts AC 50 HZ supply with neutral 4P/3P/2P as required and rated for insulation voltage 690V, operating voltage of 415V for 3 Phase, Service short circuit breaking capacity (Ics) i.e Ics =Icu as indicated in SLD and marked with suitability for isolation as specified and required.
The MCCB shall be 3 pole/ 3 Pole and neutral/ 4 pole as per the requirement. In case of 4 pole MCCB, the 4th pole shall be 100% rated. The MCCB shall be available in fixed version. It shall be possible to convert the MCCB from fixed to plug in version. The MCCB shall be manually operated. Moulded case circuit breakers (MCCB) shall have Microprocessor-based release with overload, short circuit & earth fault protection, as specified. The release shall have communication in future if specified. The MCCB shall be suitable for adapting accessories, such as auxiliary contact block, extended terminal cover, phase barrier & insulating shroud etc. Provision shall be made available such that MCCBs can be lockable in OFF position.

(b) The input and output terminals of the MCCB unit shall be extended and separated so that copper flexible cables for process of given sizes can be easily terminated.

(c) The MCCB shall be provided with front drive mechanism with door interlock with interlock defeating facility.

(d) The MCCB shall be provided with variable range operating time on short circuit.

(e) The MCCB shall be provided with auxiliary contact block.

(f) The MCCB shall be fully rated for 50oC ambient temperature.

(g) For microprocessor MCCBs with earth fault protection shall have door mounted display even if MCCB release has display on it. This is required to see parameters without opening the door in case of MCCB running condition.

(h) MCCBs with Microprocessor based release with inbuilt earth fault protection shall have Front door mounted display even if they have display on release.

1.1.10 Switches and fuses:

(a) 415 volts' air break switches shall be of the load break, fault make, group operated type. For use on 3 phase systems, the switches shall be of the triple pole type with a link for neutral wire. For use on single-phase system or DC systems, the switches shall be of the two-pole type.

(b) Switches shall be of heavy duty, quick make and quick break type. Switch contacts shall be silver plated and contact spring shall be of stainless steel. Switch handles shall have provision for locking in both fully open and fully closed positions. Mechanical ON/OFF indication shall be provided on the switches.

(c) Switches for controlling motor circuits shall be of the load break, fault make type and shall be capable of breaking locked rotor current of the associated motor.

415V switches and fuses shall be provided with the following interlocks so that:

(i) The fuses are not accessible unless the switch is in fully open condition.

(ii) It is not possible to close the switch when the fuse cover is open, but an authorized person may override the interlock and operate the switch. After such an operation, the cover shall be prevented from closing if the switch is left in the 'ON' position.

(d) All fuses shall be of HRC cartridge type, mounted on plug-in type of fuse bases. Fuses shall be provided with visible indicators to show that they have operated.

(e) Earthling and neutral lines in main supply circuits shall be of solid silver plated copper and be of bolted pattern.

(f) Fuses and links functionally associated with the same circuit shall be mounted side by side.

1.1.11 Current transformers:

(a) Current transformers shall have polarity markings indelibly marked on each transformer and at the lead termination at the associated terminal block.

(b) Current transformers shall be able to withstand the thermal and mechanical stresses resulting from the maximum short circuit and momentary duties of the switchgear, as indicated in the Technical Specification.

(c) CT core laminations shall be of high-grade silicon steel.

(d) Identification labels shall be fitted giving type, ratio, rating, output and serial numbers. The label shall be visible after opening the front door without dismantling any component.

(e) Current transformers shall be epoxy resin cast type.

(f) Accuracy Class of Current Transformer for

For Protection → 5P20/10 as specified in SLD

For Metering → Class 0.2S / 0.5S / 1 as specified in SLD

For Restricted → Class PS
Earth Fault

1.1.12 Internal wiring:

The internal wiring shall be carried out with 650/1100 V grade, PVC insulated, FRLS stranded copper conductor wires. The minimum size of conductor for power circuits shall be 4 sq.mm. copper. Control circuits shall be wired with copper conductor of at least 1.5 sq.mm. CT secondary circuits shall be wired with 2.5 sq.mm. stranded copper conductor.

All wiring shall be run on the sides and shall be neatly bunched and cleaned without affecting access to equipment mounted.

All wiring shall be taken to terminal blocks without joints or tees in their runs.

All wiring shall be colour coded as follows:

Instrument Transformer	Red, Yellow or Blue determined by the AC circuits' phase with which the wire is associated.
AC phase wire	White
AC neutral	Black
DC circuits	Grey
Earth connections	Green

Engraved core identification ferrules, marked to correspond with the wiring diagram shall be fitted to each wire and core of multicore cables terminated on the s. Ferrules shall fit tightly on wires, without falling off when the wire is removed. Ferrules shall be 'V' type of white or yellow colour with black lettering.

Spare auxiliary contacts of electrical equipment shall be wired to terminal blocks.

1.1.13 Control and selector switches:

Control and selector switches shall be of the rotary type, having enclosed contacts, which are accessible by the removal of the cover.

Control and selector switches for instruments shall be flush mounted on the front of the s and desks. Local / Remote selector switches when located on switchgear cubicles, shall be mounted inside the relay compartment at an accessible location.

All control switches shall be of the spring return to normal type. Circuit breaker control switches on switchgear cubicles shall be lockable in the "trip" position.

Control switches shall have momentary contacts. Circuit breaker control switches shall be provided with a sequencing device to prevent repetitive closing operations without first moving to the trip position.

Selector switches shall be of the stay put, maintained contact type.

1.1.14 Indicating instrument &meters:

Electrical indicating instruments shall be either analogue type or digital type as specified. Analogue instrument shall be 144 sq.mm. With 2400 scale or 96 sq.mm. with 2400 scale as specified in specific requirements. Taut band types of instruments are preferred. Taut band moving coil instruments for use on AC systems shall incorporate built-in transducers.
Instrument dials shall be white with black numbers and lettering. Dials shall be parallax free.

Nominal maximum meter reading shall be of the order of 60% normal full-scale deflection. Ammeters for motor feeders shall have suppressed scale to show current from full load unto six times the full load current.

Instruments shall have an accuracy of Class 1.0, at some places accuracy shall be considered 0.2s wherever clearly specify this requirement in the SLD.

Digital instruments shall be suitable for mounting, true RMS type as per required size.

1.1.15 Indicating lamps:

Indicating lamps shall be LED cluster type, with low watt consumption. Indicating lamp shall be of the double contact; bayonet cap type rated for operation for either a 240 V AC or specified DC system voltage as applicable. Indicating lamps shall be provided with series resistance. Lamps shall be provided with translucent lamp covers.
Bulbs and lenses shall be interchangeable and easily replaceable from the front.

1.1.16 Space heaters:

Adequately rated anti-condensation space heaters shall be provided, one for each vertical cubicle of switchgear, for each separate control, for each distribution board, for each switchboard.
Space heater shall be of the industrial strip continuous duty type, rated for operation on a 240 V, 1-phase, 50 Hz, AC system.
Each space heater shall be complete with single pole MCB with overload and short circuit release in the phase, link in the neutral, and a control thermostat to cut off the heaters at 450 C.

1.1.17 Load manager:

Load Manager shall have VAF+ PF + Power & Energy Meter, Class accuracy 0.2s/0.5s (As mentioned in SLD) with RS485
Shall have higher sampling rate: 32 samples/cycle, true RMS, 4 quadrant power and 2 quadrant energy. Preferably shall have reduced depth for compact: 49 mm
Shall have THD% and relay contact: Measuring harmonics content in voltage and current. Relay contact operable for set limits. Shall have configurable favourite page: Pick and choose your

frequently viewed parameters. Shall have onsite calibration verification: Configurable from 1 to 9999000 pulses/ (kWh, kVAh, or kVARh). Shall have green premium product: RoHS, EOL, REACH, PEP Compliant

1.1.18 Safety arrangements:

All terminals, connections, relays and other components, which may be “live” when front access doors are open shall be adequately screened. It shall not be possible to obtain access to an adjacent cubicle or module when any door is opened.
Components with the cubicles shall be adequately labeled to facilitate testing.

Where provision is made for the padlocking of components under specific condition (e.g. safety shutters, earthling selectors, etc.) one padlock shall be supplied for each cubicle and each shall have a different lock change number with two keys being provided.

1.1.19 Earthing:

Each switchgear shall be provided with an earth bus bar running along its entire length. The earth bus bar shall be located at the bottom/top of the Switchgear.
Control and Distribution Board as specified.

Earth bus bars shall be of tinned copper. Earth bus bar shall be rated to carry the rated symmetrical short circuit current of the associated board / for one second. Earth bus bars shall be supported to withstand stresses induced by the momentary current of value equal to the momentary rating of the associated Switchgear / Switchboard.
Positive connection of all the frames of equipment mounted in the Switchboard to the earth bus bars shall be maintained through insulated conductors of size equal to the ground bus bar or the load current carrying conductor, whichever is smaller. Earthling of draw out equipment frames shall be achieved through a separate plug-in contact.

All instrument and relay cases shall be connected to earth bus bar by means of 660 V grade, PVC insulated, stranded, tinned copper, 2.5 sq.mm. Conductor looped through the case earth terminals.
Electrical system data:

Nominal Operating Voltage	433 V
System Earthing	Solidly grounded
Max. Operating Voltage	460 V
Nominal Frequency	50 Hz
Frequency Variation	+ 3%
Voltage Variation	+ 10%

Power Frequency Withstand	3 KV
Fault Withstand	As specified in SLDs, 1 Sec.
Control Supply	Single phase 230 volts' control supply tapped from R-Phase & Neutral Bus.

TECHNICAL SPECIFICATION OF Distribution boards

Metal clad DB

Scope:

Supplying, erecting Metal clad distribution board of specified ways and rating, suitable 250 V/440 V 50 Hz, AC supply, erected on iron frame/board.

Material:

Distribution board: Fabricated from 18 gauge C.R.C.A. sheet steel of required ways, 250/440 V having kit-kat pattern H.C. type fuse bridges 16 A/32 A and Neutral bar- as per specified rating connector with earth terminal.

Mounting: Required size of angle iron / MS Flat.

Paint: Superior quality enamel paint of specified shade & colour, Red Oxide paint.

Hardware: SM screws, MS Nuts & bolts,rawl plug, wooden gutties etc.

Method of construction:

The switch shall be erected at designated place duly mounted on suitable size of angle iron frame as per Table no. 5.2/3 with the help of required nut bolt, washer, etc on frame/wall. The angle frame to be erected on wall with the help of screws, or to be grouted in wall with the help of cement plaster, and finished as original. The Frame shall be painted prior to erection.

Mode of Measurement: Executed quantity will be counted on number basis. (i.e. each)

Minimum size of angle to be used for fabrication of frames for DB's

Sr. No	Rating of Distribution Boxes	Minimum size of angle iron in mm
1	DB 16 A, 250 V.	25x25x3
2	DB 16 A, 415 V	40x40x3
3	DB 32 A, 415 V	40x40x5
etc.		

Miniature Circuit Breakers (MCB)

SP/SPN/DP/TP/FP MCB'S

Scope:

Supplying MCB of specified poles, current rating, and either of B or C series with required wiring connections & lugs etc. and erecting in provided enclosure / distribution board

General Specifications for MCB's

MCB's shall be of current limiting type, ISI marked confirms to IS 8828 – 1996.

The power loss per pole shall be low and shall be in accordance with IS 8828 – 1996.

All cable entries shall be either from bottom or top.

MCB's shall be of C- curve characteristic & shall have quick make & break non-welding self-wiping silver alloy contacts for 10 kA short circuit both on the manual & automatic operation.

All the active, live parts of MCB's should be out of human reach, ensuring safety & confirms to IP: 54 degree of protection.

The MCB's must house transparent label holder to ensure circuit identification.

The MCB's must have fully insulated safety shutters.

The MCB's shall have lockable switching lever.

The Minimum electrical endurance shall be 20,000 operations.

The housing of the MCB shall be mounted self-extinguishing DMC (Dough Moulding Compound).

The short circuit Current shall be brought to zero within 4 to 5 milliseconds from the time they are established.

All MCB's shall have a minimum short circuit Capacity of 10kA RMS.

Material:

Single Pole / Single pole with Neutral / Double Pole / Triple pole / Four pole: MCB, ISI marked as per IS 8828 : 1996 (IEC 60898) with hammer trip and watch mechanism15 arc plates,10 KA capacity with nominal rating of 240/415V.

Method of construction:

MCB shall be erected in provided enclosure / distribution board and terminating the provided wires by copper lugs (crimping type) and connecting the same.

Mode of Measurement: Executed quantity shall be counted on number basis. (i.e. Each)

Distribution Board suitable for MCB's

Horizontal / vertical type DB's

Scope:
Supplying of MCBDB suitable for 230 V / 415 V, horizontal/vertical, with/without door of specified ways (poles), surface / flush mounting to house incoming and outgoing MCB's, and erected on iron frame.

General specifications for MCBDB's
DB's shall be prewired and shall be fabricated as per IS: 8623.
Suitable for flush mounting & surface mounting, with 100 A copper bus bar (For Horizontal type DB), neutral bar, earth bar & cable ties for cable management.
In case of Vertical DB the bus bar shall be of 200 A rating.
DB's shall be of IP – 43 degree of protection.
All the MCB distribution boards shall be fabricated out of 18 SWG thick sheets steel duly rust inhibited through a process of degreasing, pickling, phosphating & powder coating to an approved colour over primer & shall be of the totally enclosed dust proof type suitable for wall mounting.
All components shall be mounted on DIN rails & covered totally with a sheet steel cover rendering it finger-safe. Access to the internal connections shall be only through removing the cover sheet. All DB's shall be internally prewired using copper insulated high temperature PVC wires. Bus bars & neutral bar shall be fully insulated with standard colour code. Bus bar withstanding capacity shall be 10kA.
DB's must have facility of reversing door without modification, pan assembly for ease of installation & convertible locking.

Material:
Horizontal/Vertical type MCBDB: ISI marked as per IS 8623, of specified ways (poles), surface/flush mounting, with/without door, suitable for 230 V / 415 V.
Iron work: Suitable size of angle/flat.
Hardware: SM screws, rawl plug, gutties, etc.

Method of construction:
MCBDB shall be erected at designated location and directed by site engineer and terminating the provided wires by copper lugs (crimping type) and connecting the same.

Mode of Measurement: Executed quantity shall be counted on number basis. (i.e. each)
Moulded case circuit breaker (MCCB)

Scope:

Providing & erecting 3 Pole/4 Pole MCCB of specified rating and with specified short circuit rupturing capacity in KA, complete erecting in provided enclosure & connected with provided leads on incoming and outgoing side, complete.

General specifications for MCCB's

- MCCB's should comply with IS 13947 part -2, IEC (6094) and IEC 60947-3 & IEC 60947 part – 2.
- The MCCB shall be suitable for universal mounting i.e. the load/line shall be interchangeable with shrouded incoming contacts.
- The MCCB shall be suitable for minimum operating voltage of 415V.
- The thermal setting shall be adjustable from 64 % to 100% of its normal current.
- The magnetic setting shall be adjustable from 3.5 to 10 In (normal current).
- Trip reset should be available Manual / Automatic.
- Isolator switches for electronic circuits to open the MCCB automatically.
- The MCCB's must house transparent label holder to ensure circuit identification.
- The MCCB's must have fully insulated safety shutters.
- Overload Zone adjustable from 0.4 to 1 in with line (For 630 amp.& above MCCB)
- Short circuit zone adjustable from 1.5 to 10 In with time.

Material:

3 poles or 4 poles MCCB Moulded case circuit breaker. Fixed version– front Terminals with current rating & breaking capacity as specified in SLD:

Method of construction:

3 pole /4 pole MCCB shall be erected in provided enclosure & connected with provided leads/strip on incoming & out -going site complete

Mode of Measurement: Executed quantity shall be counted on number basis. (i.e. each)

Residual Current Circuit Breaker (RCCB)

A) Residual Current Circuit Breaker (RCCB)

Scope:

Supplying, erecting, and commissioning of 2/4 Pole RCCB of specified rating, conforming to IS: 12640, duly connected with copper leads, copper lugs, etc., in provided enclosure.

General specifications for RCCB

- RCCBs shall be ISI marked as per IS 12640 (part 1) – 2000 and Confirming to IEC 61008-1.

- It shall work on residual current energy, having 30 milliamp sensitivity for lighting circuits and 100mA for power circuits and shall protect against earth leakage.
- Tripping time shall be maximum 30 milliseconds.
- Breaking capacity shall be 20 kA.
- RCCB shall operate for rated leakage at nominal Ten volts AC, and also in both, Neutral Open & Snapping condition.
- RCCBs shall have trip free mechanism with quick make & break non-welding self-wiping silver alloy contacts for 20 KA short circuit current both on the manual & automatic operation. Test knob facility shall be provided.
- All the active, live parts of RCCBs should be out of human reach, ensuring safety & confirms to IP54 degree of protection.
- The RCCBs must house transparent label holder to ensure circuit identification.
- The RCCBs must have fully insulated safety shutters.
- The Minimum electrical endurance shall be 20,000 operations.

Material:
2 Pole / 4 pole, RCCB, ISI marked as per IS: 12640-2000 (IEC 61008-1) with hammer trip and watch mechanism 15 arc plates, 20 KA breaking capacity of specified rating suitable for 240/415V.

Method of Construction:
2 / 4 Pole RCCB shall be erected in provided enclosure & connected with leads, with necessary testing.

Mode of Measurement: Executed quantity shall be counted on number basis. (i.e. each)

B) Residual Current Circuit Breaker with over voltage cut Off (RCBO)

Scope:
Supplying, erecting, and commissioning of 2 Pole RCBO (RCCB+MCB) of specified rating, conforming to IS: 12640 duly connected with copper leads, copper lugs, etc., in provided enclosure.

General specifications for RCBO
- RCBO's with integral combination of RCCB+MCB, shall be ISI marked as per IS 12640 (part 1) – 2000 and Confirming to IEC 61008-1.
- It shall work on residual current energy, having 30 milliamp sensitivity for lighting circuits and 100mA for power circuits with protection against earth leakage and over voltage up to 290 Volts.
- Tripping time shall be maximum 30 milliseconds.
- Breaking capacity shall be 10 kA.

- RCBO shall operate for rated leakage at nominal Ten volts AC, and also in both, Neutral Open & Snapping condition.
- RCBO's shall have trip free mechanism with quick make & break non-welding self-wiping silver alloy contacts for 10 kA short circuit both on the manual & automatic operation. Test knob facility shall be provided.
- All the active, live parts of RCBO's should be out of human reach, ensuring safety & confirms to IP54 degree of protection.
- The RCBO's must house transparent label holder to ensure circuit identification.
- The RCBO's must have fully insulated safety shutters.
- The Minimum electrical endurance shall be 20,000 operations.

Material:
2 Pole / 4 pole, RCBO with integral combination of RCCB+MCB, ISI marked as per IS: 12640-2000 (IEC 61008-1) with hammer trip and watch mechanism 15 arc plates, 10 kA breaking capacity of specified rating suitable for 240/415V.

Method of construction:
2 /4 Pole RCBO shall be erected in provided enclosure & connected with leads, with necessary testing.

Mode of Measurement: Executed quantity shall be counted on number basis. (I.e. each)

ACB and MCCBs shall be as per below list: -

OEM /Equipment	ACB	MCCB
Schneider	Master Pact NW	NSX
Siemens	3WL	3VA
ABB	Emax	Tmax
L&T	OMEGA	dSine

Deviations
The bidders are not allowed to deviate from the principal requirements of the Specifications. However, the bidder is required to submit the relevant schedule a detailed list of all deviations if at all without any ambiguity. In the absence of a deviation list in the deviation schedules, it is understood that such bid conforms to the bid specifications and no post-bid negotiations shall take place in this regard.

TECHNICAL SPECIFICATION OF WIRING SYSTEM

Rigid PVC Conduits in walls / flooring

Scope : Concealing of Rigid PVC Conduits : In walls / flooring :

Providing specified Rigid PVC Conduits and erecting in wall, flooring by making chases / grooves / entries as per approved Method of Construction along with continuous earth wire and all required material including earth clips hardware such as 'U' nails, binding wire, fish wire; accessories such as PVC junction / inspection boxes, check-nuts, flexible PVC pipe, drawing fish-wires and making all piping rigid, refinishing the surface with cement mortar, removing debris from site.

Material:
Rigid PVC conduit:
Rigid PVC HG conduit minimum 25mm dia. and 2mm thick, ISI mark, HMS grade (2mm thick) using PVC accessories as required e.g. bends, junction box / deep junction box etc.

Earth continuity wire:
GI wire of 2.5 sq. mm, GI earth clips 22g, 10mm width, for fixing earth wire along the conduits.

Junction boxes / Draw-in boxes:
Junction box shall be 5 sided with removable top plate and of suitable size to accommodate No. of entries and should have 2mm thickness. There shall be knockout holes in required numbers and dia. for entry of conduit pipes and arrangement to fix cover plates on it.

Hardware:
'U' nails, plumbing and general use nails of required sizes, steel binding wire 20 gauge, GI fish wire, etc.

Other material for Surface finishing: PVC adhesive solution for fixing pipes to couplers/ junction boxes / bends, Cement, sand, putty and water.

Method of Construction:
Concealing of Rigid PVC Conduits: General:

Work shall be done in co-ordination with civil work to suit final approved layout. Size of conduit shall be correct depending on number of wires to be drawn. (Table No.1/1, for PVC conduits) Separate pipe shall be used for each phase in 1-ph distribution and for power and light distribution and also for wiring for other utilities like data, telephone, TV cabling, etc; for which the distance between pipes shall not be less than 300 mm or anti electrostatic partition is to be provided. Adequate use of conduit accessories shall be made at required locations. Entries in wall shall be at level of corresponding conduit with colour coding as per Table No. 1/4. (For Visual identification) Flexible conduits shall be used at expansion joints. Erection shall be done as per the layout finalized, with minimum sharp bends, with junction boxes at angular junctions and for straight runs at every 4.25 metre, in such manner so as to facilitate drawing of wires. All bending of conduits shall be done approved manner without changing the cross-section.

Concealing of Rigid PVC Conduits in walls/ flooring:
Chases shall be made in walls of adequate width, with cutter and chiselling through it. Necessary finishing of the wall surface shall be done. Work in flooring shall not disturb RCC work, Conduits of adequate size shall be erected with use of appropriate accessories, and hardware like 'U' nails, etc. Draw-in / inspection boxes shall be fixed with flush with surrounding surface and earthed.

Testing : Earth continuity:
Earth continuity shall be ensured at termination point of Earth wire, between the ends of PVC conduit.

Mode of Measurement:
Measurement shall be carried out on the basis per running meter length of conduit.

As per description of item in Schedule-B
PVC Conduits Specification No. (WG-MA/CON)

Scope:
PVC Conduits: Surface
Providing specified PVC Conduits and erecting as per approved Method of Construction; on surface of wall / ceiling, etc. including entries through walls / slabs / flooring as per requirement, and with all necessary hardware, accessories such as Spacers, Saddles, Bends, Tees, Junction boxes, etc.; making conduits erection work rigid and duly finishing, removing debris from site.

Material:
PVC Conduit:

PVC pipe minimum 25mm dia. and above depending on No. of wires to be drawn (refer Table No. 1/2) ISI mark, HMS grade (2mm thick), accessories for PVC pipes of the same make that of pipe; such as Spacers & Saddles, Couplers, Bends, inspection or non inspection type Elbows, Tees, Junction boxes of required ways and resin / adhesive to make all joints rigid. Black pipe shall not be used for surface type wiring.

Hardware:
Sheet Metal (SM) screws of sizes specified in Method of Construction, washers, rawl / PVC / fill type plugs, wooden gutties, etc.

Method of Construction:
Erection of PVC Conduits for Surface type wiring:General:
Erection shall be done as per the final approved layout, in perfect level and plumb. Conduits shall be firmly fixed on spacers with saddles. Fixing of spacers shall be equidistant and at ends, bends, elbows, junction boxes, couplings, boards. CSK screws of minimum 35x8 mm and suitable plugs shall be used for fixing spacers and 12x5 mm, round headed screws for fixing saddles on spacers. In case of stonewalls wooden gutties shall be grouted in wall for fixing of spacers. Distance between 2 spacers shall not be more than 600mm. Size of conduit shall be correct depending on number of wires to be drawn (as per Table No. 1/2 for PVC conduits). Separate pipe shall be used for each phase in 1-ph distribution and for power and light distribution. Also for wiring for other utilities like data, telephone, TV cabling distance between pipes shall not be less than 300 mm. or/and electrostatic partition/separate pipe should be used. Adequate use of conduit accessories shall be made at required locations. Entries in wall shall be at level of surface and with colour coding conduit (For visual identification) as per Table No. 1/4. Flexible conduits shall be used at expansion joints.

Especially for PVC Conduits of surface type wiring:
In addition to general instructions above, all joints shall be made rigid with resin / adhesive. Wherever offsets are necessary, it shall be done with bending spring. Size of conduit shall be as per Table No. ½ for number of wires to be drawn through the conduit.

Mode of Measurement:
Measurement shall be carried out on the basis per running meter length of conduit / Trunking.

Bunch of wires:Specification

Scope:
Bunch of wires:
Providing specified wires and drawing them through provided conduits / trunking and / or as directed; with coded ferrules, harnessing the bunch of wires with necessary material when used

in panel boards, duly connecting / terminating with lugs, and testing for safety and beneficial use.

Material:

Wires: in conduits / trunking / panel boards/ Mains / Sub-mains / Circuit mains (comprising phase and neutral wires):

PVC insulated wire of specified size, minimum FRLSH grade insulation, copper conductor of electrolytic tough pitch (ETP) grade, having insulation of 1.1 kV grade, ISI marked, of required colour coding as per Table No 1/5.

Earth Continuity Wire:

PVC insulated wire minimum FRLSH grade insulation copper conductor of electrolytic grade, having insulation of 1.1 kV grade, of green / green yellow colour, ISI marked, of specified size as per Table No 1/5.

Lugs: Copper lugs of appropriate size & type

Other material: Rubber grommet, bush, harnessing material, flexible conduit etc.

Method of Construction:

Bunch of wires:

Drawing of wires: General Specified wires shall be drawn with adequate care. Correct colour coding as per Table No. 1/5, shall be used for phase, neutral and earth. Wires shall not have intermediate joint in between terminals of the accessories. Earth-wire and Return wire (neutral) may be looped only within circuit. For lighting load or single-phase distribution wires of two different phases shall not be drawn in single pipe. Wires shall be terminated in the terminals of accessories only, with appropriate type and size of lugs.

Drawing of wires: through PVC conduits. Bush shall be used at pipe opening to protect wire insulation from getting damaged due to sharp edges. Number of wires shall not exceed with respect to size of pipe as per Table No. 1/2.

Testing:

Insulation resistance test:

All wiring shall be tested with 500V Meggar between phases, phase – neutral and to Earth. IR value shall not be less than 1M-ohm.

Earth continuity:

Earth continuity shall be ensured between termination points of Earth wire.

Polarity Test:

Test shall be carried out for ensuring the correct polarity in switch and plug.

Mode of Measurement:

Measurement shall be carried out on the basis per running meter length of single wire or bunch as specified.

As per description of item in Schedule-B

Scope:

Point wiring (Surface type):

Providing all required approved specified material including hardware and erecting wiring on surface of wall, ceiling from switch board to outlet for light / fan / bell / independent plug point, in rigid steel / PVC conduit as specified; fixing one board with a 1 way switch for one way point or two boards with a 2 way switch on each board, in case of 2 way point; for controlling power supply and one board / block with accessory for outlet of light / fan / plug and terminating wires within as per approved Method of Construction; removing all debris and testing the installation for safety and beneficial use.

Material:

Point wiring (Surface)

PVC conduit:

PVC pipe of minimum 20mm dia. and above depending No. of wires to be drawn (refer Table No 1/2); ISI mark, HMS grade (2mm thick), accessories for PVC pipes of the same make that of pipe; such as Spacers & Saddles, Couplers, Bends, inspection or non inspection type Elbows, Tees, Junction boxes of required ways and resin / adhesive to make all joints rigid. Black pipe shall not be used for surface type wiring.

Wires: Phase and Neutral

PVC insulated wires of specified size, 1.1 kV, & minimum FRLSH grade insulation, electrolytic tough pitch (ETP) copper conductor, ISI marked, of required colour coding as per Table No 1/5

Earth Wire:

PVC insulated minimum FRLSH grade copper wires of electrolytic grade, having insulation of 1.1 kV grade, of green / green-yellow colour, ISI marked as specified in the Schedule-B

Accessories:

Switch: 1 or 2 way Modular type switch 6/10A.

Outlet: 6A angle / batten lamp holder or 3 plate ceiling-rose or Bakelite / porcelain three way connector or if plug point, 6A, 3-pin plug socket.

Boards:

Switch boards shall be concealed type (with anti rust treatment) of suitable size along with appropriate covering plate of the make same as that of accessories like switches & sockets, to accommodate independent slot for each switch, socket, fan regulator.

Hardware:

Sheet Metal (SM) screws of sizes specified in Method of Construction, washers, rawl / PVC / fill type plugs, wooden gutties, PVC/ rubber bushings etc.

Method of Construction:

Point wiring (Surface)

Erection of conduits:General:

Erection shall be done as per the final approved layout, in perfect level and plumb. Conduits shall be duly screwed and firmly fixed on spacers with saddles. Fixing of spacers shall be equidistant and at ends, bends, elbows, junction boxes, couplings, boards. CSK screws of minimum 35x8 mm and suitable plugs shall be used for fixing spacers and 12x5 mm round headed for fixing saddles on spacers. In case of stonewalls wooden gutties shall be grouted in wall for fixing of spacers and saddles. Distance between 2 spacers shall not be more than 600mm. Separate pipe shall be used for each phase in 1-ph distribution and for power and light distribution. Also for wiring for other utilities like data, telephone, TV cabling distance between pipes shall not be less than 300 mm. Adequate use of conduit accessories shall be made at required locations. Entries in wall shall be at level of surface conduit with colour coding (For Visual identification) as per Table No 1/4. Flexible conduits shall be used at expansion joints. Bushing shall be provided at open ends.

Erection of conduits:PVC pipes for surface type wiring:

In addition to General conditions above, all joints shall be made rigid with resin / adhesive. Wherever offsets are necessary, same shall be done with bending spring. Size of conduit shall be correct depending on number of wires to be drawn as per Table No. 1/2.

Drawing of wires: General

Wires shall be drawn with adequate care. Correct colour coding as per Table No 1/5 shall be used for phase, neutral and earth. Wires shall not have intermediate joint in between terminals of the accessories. Earth-wire and Return wire (neutral) may be looped within circuit. For lighting load distribution wires of two different phases shall not be drawn in single pipe. Wires shall be terminated in the terminals of accessories only. Insulated Earth wire of green or green-yellow colour as per specified shall be erected wherever necessary. In case of 2-way point wiring additional wires of phase conductor shall be provided between the 2-way switches.

Drawing of wires: through PVC conduits for surface type wiring

Insulated Earth wire of green or green-yellow colour shall be drawn through pipe. Number of wires shall not exceed with respect to size of pipe as per Table No. 1/2.

Fixing Switchboards and accessories:

Control switchboards shall generally be erected at 1.35m height or as specified and fixed with minimum 2 Nos. (and more as per size of board) of screws of length not less than 50mm, termination of wires shall be done with lugs on switch and other accessories only by carefully

inserting all strands in lugs, terminals and proper tightening. Switches shall be provided on phase wire only. Bare wire shall not be used for looping incoming supply to switches and for earthing inside switchboards. For plug socket phase wire shall be connected in right side terminal when seen from front. Proper termination of earth wire in Earth terminal shall be ensured.

Testing:
Insulation resistance test:
All wiring shall be tested with 500V Meggar between phases, phase – neutral and to Earth. IR value shall not be less than 1M-ohm.

Earth continuity:
Earth continuity shall be ensured at all earth terminals of plug outlets and at earth terminals of metal enclosures.
Polarity test:
Polarity test shall be carried out for ensuing the correct polarity in switch and plug.

Mode of Measurement:
Measurement shall be carried out on the basis per number of points, for the point length up to 6 metre between switch and outlet. For the length exceeding 6 metre 10% of overall rate shall be added for every 1m.
Scope:

Point wiring (Concealed type):
Providing all required approved specified material including hardware and erecting rigid steel / PVC conduits, junction boxes, provided fan boxes, along with required accessories in RCC slabs before casting and in walls, flooring by making chases, and refilling the same after erection of conduits, fixing concealed type boxes for switch boards in walls, drawing wires through conduits, from switch board to outlet for light / fan / bell / independent plug point fixing modular type switch for controlling power supply and an accessory for outlet of light / fan / bell / plug at other end, with mounting plate, and terminating wires within at both ends, as per approved Method of Construction, closing all junction boxes with plates; removing all debris and testing the installation for safety and beneficial use.

Material:
Point wiring (Concealed):PVC conduit:
PVC pipe of minimum 20mm dia and above depending No. of wires to be drawn (refer Table No 1 / 2); ISI mark, HMS grade (2mm thick), accessories for PVC pipes of the same make that of pipe; such as Spacers & Saddles, Couplers, Bends, deep / normal Junction boxes of required

ways and resin / adhesive to make all joints rigid. Black pipe shall not be used for surface type wiring.

Wires: phase and neutral wires

PVC insulated wires of specified size, 1.1 kV, & minimum FRLSH grade insulation, electrolytic tough pitch (ETP) copper conductor, ISI marked, of required colour coding as per Table No 1/5

Earth Continuity Wire:

PVC insulated minimum FRLSH grade copper wires of electrolytic grade, having insulation of 1.1 kV grade, of green colour, ISI marked as specified in Schedule B.

Lugs: Pin type Copper lugs.

Accessories:

Switch: 1 or 2 way Modular type switch 6/10A.

Outlet:Modular type 6A angle / batten lamp holder or 3 plate ceiling-rose or Bakelite / porcelain 3 way connector or if plug point, 6A, 3-pin plug shuttered socket.

Boards:

Switchboards shall comprise of; concealed type box of required modules made of sheet metal or Polypropylene material, mounting plate and cover plate. The required modules shall be worked out on the basis of points, plug socket/sockets, step type fan regulator, etc are to be fixed. For every blank module, 1 way blank plate shall be fixed. All the above accessories shall be of same make, as that of switch.

Hardware:

Sheet Metal (SM) screws of sizes specified in Method of Construction, washers, rawl / PVC / fill type plugs / wooden gutties, 'U' nails, plumbing nails, steel binding wire, fish wire 20g, rubber / PVC bushes etc.

Other material for Surface finishing: PVC adhesive solution, Sand, Cement, water etc.

Method of Construction: Point wiring (Concealed):Concealing of conduits:General:

Work shall be done in co-ordination with civil work and to suite final approved layout. Size of conduit shall be correct depending on number of wires to be drawn. (Table No 1/2 for PVC conduits) Separate pipe shall be used for each phase in 1-ph distribution and for power and light distribution and also for wiring for other utilities like data, telephone, TV cabling, etc. The distance between pipes shall not be less than 300 mm. Adequate use of conduit accessories shall be made at required locations. Entries in wall shall be at level of corresponding conduit with colour coding as per Table No. 1/4. (For Visual identification) Flexible conduits shall be used at expansion joints. Erection shall be done as per the layout finalized, with minimum sharp bends, with junction boxes at angular junctions and for straight runs at every 4.25m, in such manner so as to facilitate drawing of wires. All the bends shall be done with Bending Spring.

Concealing of conduits: In RCC work

Work shall be commenced after fixing of steel (re-enforcement) on centering material. Conduits shall be firmly fixed on steel of RCC work by binding wire. Fixing of conduits shall be such that it will remain rigid during casting of slab, beam, and column even after use of vibrator. Deep junction boxes and other draw-in boxes shall be such that their open end and centering material will not have gap in between so as to avoid concrete entering inside even after fixing covers to steel re-enforcement; and be filled with dry sand. Open ends of conduits; to be concealed in walls, shall be provided with couplers / sockets at ends and be flush with bottom of beam, and at located at the center of the beam. As far as possible bunching / grouping of conduits shall be avoided so that it will not affect strength of RCC work especially in beams. Suitable steel fish wire shall be drawn through in the conduits for drawing of wires later on.

Concealing of Conduits: In walls

Chases shall be made in walls of adequate width, with cutter and chiseling through it. Necessary finishing of the surface shall be done. Conduits of adequate size shall be erected with use of appropriate accessories and 'U' nails.

Drawing of wires:

Use of Steel fish wire shall be made for drawing of wires. Wires shall be drawn with adequate care. Correct colour coding shall be used for phase, neutral and earth. Wires shall not have intermediate joint in between terminals of the accessories. Earth-wire and Return wire (neutral) may be looped within circuit only. For lighting load distribution, wires of two different phases shall not be drawn in single pipe. Wires shall be terminated in the terminals of accessories only. Adequate extra length shall be left at termination points. In case of 2-way point wiring additional wires of phase conductor shall be provided between the 2-way switches.

Fixing Switchboards and accessories:

Control switchboards shall generally be erected at 1.35m height or as specified and fixed with minimum 2 Nos. of screws of length not less than 50 x 8mm, Boards shall be in line and plum and shall be in level with wall surface so as to fix mounting plate flush with wall, Termination of wires shall be done in switch and other accessories only by carefully inserting all strands in terminals and proper tightening. Switches shall be provided on phase wire only. Bare wire shall not be used for looping incoming supply to switches. Phase wire shall be routed through switch only. For plug socket phase wire shall be connected in right side terminal when seen from front. Proper termination of earth wire in Earth terminal shall be ensured. All blank modules shall be plugged with blanking plates.

Testing:

Insulation resistance test:

All wiring shall be tested with 500V Meggar between phases, phase – neutral and to Earth. IR value shall not be less than 1M-ohm.

Earth continuity:
Earth continuity shall be ensured at all earth terminals of plug outlets and at earth terminals of metal enclosures.

Polarity test:
Polarity test shall be carried out for ensuring the correct polarity in the plug.

Mode of Measurement:
Measurement shall be carried out on the basis per number of points, for the point length up to 6 metre between switch and outlet. For the length exceeding 6 metre 10% of overall rate shall be added for every 1metre.
Same as Item No. 23 in Schedule-C
Same as Item No. 24 in Schedule-C

This item is for Hybrid wiring. In this case, a combination of surface wiring and concealed wiring is used. This item is used for points in the rooms with false ceiling. All the wiring above false ceiling is to be made as a surface wiring using specifications mentioned under WG-PW/SW. Part of the wiring, which is below the false ceiling e.g. drop for switch board or points on wall, is to be concealed as per specifications under WG-PW/CW.
Same as Item No. 24 in Schedule-C

Same as Item No. 23 in Schedule-C
As per Description of Item in Schedule B
Energy efficient LED Street/Flood Light fitting
Scope:
Specification No (FG-ODF/FLS2)
Supplying & erecting Energy efficient LED Street/Flood Light fitting suitable for specified wattage complete with serrated acrylic diffuser & gasket, with necessary control gear and erected on provided bracket.

Material:
Fitting:
ISI marked Energy efficient LED Street/Flood Light fitting complete with electronic driver, transparent cover made out of 3mm thick acrylic sheet, gear cum reflector tray, canopy and lamp holder duly wired for use on 240 volt AC single phase 50 Hz. Canopy shall be made of Aluminium sheet of width 70mm minimum. Gear cum reflector tray (GCRT) shall be made of either CRCA sheet of 0.8 mm thick or Aluminium sheet of 1.25mm thick. Fitting shall be suitable

for mounting up to a height of 15 meters and shall be able to withstand wind load test. It shall confirm to class-1 of IS: 10322 (part 5/sec 3)/87 with amendment 1 and IP-65 protection

i) Various components of fittings shall confirm to IS specification as noted below.

a) Illumination : Not less than 4320 lux.

b) Beam angle : Not less than 130°

c) Operating temperature : -20 to 60° C.

ii) Surface of CRCA Steel and Aluminium sheets used shall be properly phosphatized and stove enamelled white on the reflector side, tray side and other surface stove enamelled grey.

iii) The street light fittings shall be required with socket bore of 30mm or 40 mm or 50mm for side entry/top entry type fittings. The socket bore, however, will be specified by the indenters at the time of placement of supply order.

iv) All wire leads to be adequately covered with sleeves for protection against accidental contracts.

v) All hardware parts used should be zinc coated or nickel/chromium plated so as to be corrosion resistant.

vi) Fitting shall be wired with multi-stranded copper wire terminating on suitable connectors. The wiring shall be properly clamped.

Method of Construction:

The complete fitting with all the above accessories shall be erected with provided bracket, on wall/street light pole or at any place as directed by Site engineer, duly connected and giving necessary testing.

Mode of Measurement: Executed quantity shall be counted on number basis. (i.e. each)

As per Description of Item in Schedule B

Wall Bracket (BKT/WB)

Scope:

Specification No (FG-BKT/WB)

Fabrication of Street light bracket of specified diameter ‘B’ class G.I. Pipe, 1.2 m in length erected on wall for erection of side entry LED fitting(s), duly painted with one coat of red oxide & one coat of Aluminium paint, and duly connected to supply with PVC wire leads.

Material:

GI Pipe: GI Pipe of specified diameter as per (CW-PLB/GP) mentioned in chapter 17.5

Hardware: Grouting MS bolts, nuts of 10 mm dia. & 100 mm length. ‘U” shaped clamps of suitable diameter made of GI.
MS Flat: MS flat 3mm thick 50 mm wide.
Paint: Red oxide & Aluminium paint.
Wire leads: 1.5 mm2, as per (WG-MA/BW) mentioned in chapter 1.3
Miscellaneous: Cement, Sand, Water, etc.

Method of Construction:
The bracket fabricated as per drawing No BKT- 1 (Fig.2) shall be erected on wall as explained below:
i) MS flat of length 15 cm with 10 mm diameter hole shall be welded to the pipe as shown in drawing.
ii) Grouting bolts shall be grouted in wall and finished with cement plaster.
iii) Bracket shall be placed on the grouted bolts with clamps and nut shall be tightened.
iv) Fitting shall then be inserted onto the bracket and connections shall be made.

Mode of Measurement: Executed quantity shall be counted on number basis. (i.e. each)

Bracket welded to Pole Cap (BKT/BPC)
Scope:
Specification No (FG-BKT/BPC)
Fabrication of Street light bracket of specified diameter ‘B’ class G.I. Pipe, of specified length welded to pole cap erected on top of the pole for erection of either single / double, side entry LED fitting(s), duly painted with one coat of red oxide & one coat of Aluminium paint, and erecting the same with provided leads.

Material:
GI Pipe: GI Pipe of specified diameter as per (CW-PLB/GP) mentioned in chapter 17.5
Pole Cap: Pole cap fabricated from 4 mm thick MS Sheet, of 30 cm in length.
Corner support: 3 mm thick MS flat / sheet
Set screws: MS bolts, nuts of 6 mm dia.
Paint: Red oxide & Aluminium paint.

Method of Construction:
The bracket shall be fabricated as per drawing No(s) BKT-1 (Fig.1 Fig.3), BKT-2 (Fig.4, Fig.5) and shall be placed on the pole cap. Inner diameter of pole cap shall be as per the outer diameter of pole with sufficient clearance, so as to facilitate easy placing of the cap on top of pole. Two holes of minimum 6 mm diameter shall be drilled to pole cap. The nuts shall be placed on the pole cap duly aligned with the hole, and shall be butt welded. Bolts shall then be tightened through the nut so as to hold the bracket in vertical position.

Mode of Measurement: Executed quantity shall be counted on number basis. (i.e. each)

As per Description of Item in Schedule B
Specification No. (FG-FN/CF)

Supplying and erecting Ceiling fan of specified sweep with all accessories and necessary materials, erected in provided hook/clamp.

Material:
Ceiling Fan:
Electric Ceiling fan capacitor type with double ball bearing complete with capacitor, 300 mm down rod, canopies, shackles, reel insulator, half threaded bolts of 9.53 mm (3/8") dia. 62.5 mm (2-1/2") to 88 mm (3-1/2") long and 7.94 mm (5/16") dia 44.5 mm (1-3/4") to 57 mm (2-1/4") long with nuts, with lock type split pin, spring & plate washers, etc.; three number blade made of Aluminium alloy, suitable for single phase, AC 210 volts, 50 Hz supply and conforming to class I of IS : 374/1979 with amendment no 1 to 6 except for performance parameters to the extent modified as details in general requirements. The down rod shall be capable to withstand a tensile load of 1000 kg without breakdown and a torsion load of 500 kg.cm without breakage as per Clause 10.14.1 of IS: 374/1979 with amendment no.1 to 6. Electrical motor should be single phase permanent capacitor type with no. of poles 12/14/16/18 (As per sweep), Class-I with basic insulation. Class of insulation shall be B class. The winding wire used for fan should be synthetic enamelled of 30 to 38 SWG.

Connection wire: Flat / round Two core flexible stranded copper wire cord 24/0.2mm ISI marked.

Paint: Superior quality enamel paint of specified colour for marking Sr. No and date of erection.

Method of Construction:
Blades of ceiling fan shall be properly fixed. Down rod, clamp shall be carefully fixed with nut bolt and split pin. Canopies shall be tightened on down rod keeping sufficient clearance. Wiring connections shall be made with required wire leads. Regulator of fan shall be erected on provided switchboard with required wire leads.

Testing:
After erection fan shall be tested by connecting to supply at all positions of regulator. Also Steadiness of fan shall be checked at full speed, so that there is no wobbling.

Mode of Measurement: Executed quantity shall be counted on number basis. (i.e. each)

As per Description of Item in Schedule B

Exhaust Fans

Specification No.(FG-FN/EXF)

Supplying and erecting Exhaust fan of specified sweep and speed, with all accessories and necessary materials, suitable to work on 230 V, AC Supply 50 Hz, erected in position.

Material:

Exhaust Fan:

ISI marked Exhaust fan suitable for Single phase AC 230 Volts 50 Hz, capacitor run with mounting ring, four numbers of fixing hole without regulator and louvers. The weep and speed shall be as per table below. Fan motor with moisture proof treatment and E class insulation, ISI marked, conforming to IS: 2312/67 with amendments 1 to 8. The fan mounting rings shall be proper pre-treatment followed with at least two coats of primer; final finish shall be with two coats of grey colour paint duly baked. The connecting leads shall be brought out for making connections.

Paint: Superior quality enamel paint of specified colour.

Method of Construction:

The Exhaust fan complete with all above accessories and duly wired shall be erected at specified

position, connected to the supply and tested.

Testing:

After erection fan shall be tested by connecting to supply. Also steadiness and vibrations if any, of fan shall be checked at full speed, so that there is no wobbling.

Mode of Measurement: Executed quantity shall be counted on number basis. (i.e. each)

The fan shall be Five star energy rating, along with such mark printed on the fan body.

As per Description of Item in Schedule B

Storage / Pressure type Water Heaters (STWH)

Specification No (AP-WH/STWH)

Scope:

Supplying, erecting and testing of horizontal/ vertical, stove enamelled, storage/pressure type water heater, suitable for wall / floor mounting, of specified capacity, one inlet with non

return valve, one outlet with dead weight, pressure reducing valve, stop cock; suitable to work on 230/250-V single phase AC Supply, heating element of specified wattage, thermostat, control fusible plug, pilot lamp etc. ISI mark only and marking of S No. and date of erection. (IS 2082)

Material:
Outer Casing: Corrosion proof stove enamelled/ powder coated, mild steel / engineering plastic body. Colour of the casing shall be as directed by Engineer in charge.
Inner tank: It should be of electrolytic copper (99% pure) properly fabricated so as to be leak proof and of specified capacity.
Heating Element: Mineral filled / tubular / copper cord & nickel plated, and conforming to IS: 4159, of specified wattage.
Pilot Lamp: A neon gas field / LED indicating lamp shows functioning of heating elements along with thermostat & thermal cut-out.
Thermal Insulation: Resin bonded glass wool slab insulation & should be filled between two casings of storage water heater.
Thermostat: A Stem type snap action thermostat, which should cut off the electric supply automatically as per setting of temperature & should be ISI mark.
Thermal Cut-out: In case of thermostat failure this cut out should cut off the electric supply automatically and should restart only on pressing the reset knob.
Pressure Release Valve: If pressure exceeds above 50 psi, it should release the pressure & should be fitted on the inlet pipe.
Dead weight: It will operate when pressure in inside tank increase beyond specified limit.
Fusible plug: Cast aluminium body with threading, and hole for plug with fusible metal. The metal shall be fused, only all the other safeties fails & at high pressure.
Hardware: 100x10 mm grouting bolts, MS washers, nuts, etc.
Wall Fasteners: 100x10 mm with vertical cuts, and pin at the centre, washer and nut, etc., made of MS. (Similar to Anchor bolt fastener)
Grouting material: Cement, Sand, water, etc.
PaintISuperior quality enamel paint of specified colour.

Method of Construction:
The water heater shall be erected in required position with necessary hardware’s and base is grouted, as per the site situation. The water heater is to be connected to water supply on inlet side by valve, mountings and connected to outlet tap.

Mode of Measurement: Executed quantity shall be counted on number basis. (i.e. each)

As per Description of Item in Schedule B
Indicator DP (BDP)

Scope:

Specification No (SW-SWR/BDP)

Supplying surface/flush mounting Bakelite D.P switch and erecting on filled polypropylene ISI marked board or on screwed board with top of plywood pasted with laminate.

Material:

DP Switch: Bakelite double pole switch 32A 250V, with copper contacts for make & break, and fuse, indicator lamp with shrouded incoming contacts.

Boards: As per (WG-PW/SW) in chapter of Wiring para No. 1.6.

Hardware: SM screws, rawl plug, wooden gutties etc.

Method of Construction:

The DP switch shall be erected on specified board or flush in provided enclosure.

Mode of Measurement:

Executed quantity will be counted on number basis. (i.e. Each)

Cables: (Armoured)

The following list records those Indian Standards in force, which are acceptable as good practice, and accepted standards.

SP 30: 1984 : National Electrical Code

SP 7 (Group 4): 2005 : National Building Code

IS 1255: 1983 Code of practice of Installation & Maintenance of armoured cables up to 33 kV.

IS 3961: Part 2: 1967 : Recommended current ratings of PVC cables.

IS 1554: Part 1; 1988 : PVC Insulated (Heavy duty) Electric Cables; Part 1 for Working voltages up to and including 1100 Volts.

IS 1554: Part 2; 1988 : PVC Insulated (Heavy duty) Electric Cables; Part 1 for working voltages up to and including 3.3 kV to 11 kV.

IS 10810: Part 63; 1993 : Method for Test of cables, Part 63 Smoke density of electric cables under fire condition.

Scope: (Armoured cables)

Specification No. (CB-LT/AL, CB-LT/CU, CB-HT)

Providing armoured cable of specified voltage level, size & specified conducting material (Aluminum / Copper) as per Table no. 7/3 including required material, hardware's for erection and erecting on wall, ceiling, RCC slab or drawing the same through pole, pipe, laying in

provided conduit, trench, ducts, trays as per approved method of construction including glands, lugs, etc.

Material:

Cables:

Cables shall be PVC for LT/MP and XLPE for HT as per Table no. 7/3 and of required construction, colour, shall carry ISI mark, IS No, manufacturer's name, size, duly embossed / screen printed at every metre and having the total count of progressive length in meter at each mark.

Earth wire: Galvanized Iron (G I) wire of appropriate gauge as per Table No 7/1.

Glands: As per specification (CB-GL)

Lugs: As per specification (CB-CL/AL, CB-CL/CU)

Saddles: Saddles fabricated from GI sheet of required gauge and size depending on dia of cable either galvanized or painted with superior quality enamel black paint with necessary shearing mechanical strength, semi circular shaped with extended piece having suitable holes for fixing.

G I Strip: 22 g x 25 mm width G I Strip.

Clamps: MS Clamps fabricated of required length and shape, having the size of 3/6 mm thick mild steel having 25/50 mm width (as per size of cable), rounded ends with wooden / resin cast grip for holding the cable.

Identification tags: For identifying root, connection position GI strip with identification mark / name embossed / painted with arrangement to tie should be fix on cable or arrangement of ferrules to be done.

Hardware: Sheet Metal (SM) screws of required sizes, plugs / wooden gutties, etc.

Method of Construction: General:

Irrespective of method of construction the cable ends shall be terminated with appropriate size & type of glands with lugs duly crimped, as directed by Site engineer.

Wherever the cable has to be bent, the turning radius shall be as mentioned in Table No 7/2. Grouping of cables shall be done with adequate distance between cables as mentioned in IS so as to minimize de-rating. Cables shall be tagged/ferruled with identification name / mark at the point from where distribution starts and at ends. Bare earth wire of appropriate size as per Table no. 7/1 shall run along with the cable. Earth wire running with the cable shall be terminated at the earth terminal nearest to cable termination.

5.1 Erection of Cable on Surface:

Erection shall be done as per the routes and layout finalized, in perfect level and in plumb. Before fixing the cable shall be straightened as far as possible for good aesthetics look, continuous bare GI earth wire of required gauge as per Table No 7/1 shall be run. Cable with G I wire shall be fixed by saddles firmly clipped on cable and shall be fixed to wall with minimum 50 x 8 mm SM screws with plugs/wooden gutties, etc. (Distance between two supports / saddles

shall be maximum 450 mm). Wooden gutties shall be used wherever required (Especially for stone wall). The entries made in wall, floor slab, etc for laying the cable shall be made good by filling and finishing with plastering the same.

5.2 Erection of Cable on Trusses:

Cable along with bare GI earth wire, while erecting on trusses, shall be firmly clamped by wrapping GI strip of 22 g, 25 mm width of required length fixed to truss with nuts and bolts.

5.3 Erection of Cable on Pole:

Cable along with bare GI earth wire, while erecting on pole, shall be firmly clipped by suitable wooden / epoxy resin cast grips, clamped with 25 x 3 mm or50x6 mm MS strip of required length and fixed to pole with nuts and bolts.

5.4 Laying of Cable in provided Trench/Pole:

While laying Cable along with bare GI earth wire, utmost care shall be taken to prevent damage to the insulation of the cable and to the open end. Cable shall be brought out from trench vertically straight (minimum 1.0 meter above G L). Care shall be taken to inspect the trench so that depth of cable shall not be less than as shown in Table No 7/4. Suitable size of cable loops shall be provided near termination point at adequate depth.

Erecting cable in constructed Trench / duct:

Erection of cable/s in constructed trench / duct, shall be as per guide lines of IS 1255.

Erection of cable/s on trays:

Cable/s shall be tied with PVC tags on GI trays. At bending point care shall be taken so that sharp edges of sheet will not damage insulation of cable.

Mode of Measurement:

Executed quantity shall be measured on the basis of running meter per run of cable.

Dismantling

Cable laid underground, or fixed on any surface shall be dismantled carefully without damaging complete with all its accessories, making coil and stored as directed. The surface of the dismantled cable shall be made clear by removing of unwanted material, cement mortar, etc. When cable is dismantled from trench refill back the trench and making the surface proper.

Mode of Measurement: Executed quantity shall be measured on the basis of running meter per run of cable.

TECHNICAL SPECIFICATION Galvanized Octagonal poles.

Design : The Octagonal Poles shall be designed to withstand the maximum wind speed as per IS 875. The top loading i.e. area and the weight of fixtures are to be considered to calculate maximum deflection of the pole and the same shall meet the requirement of BS: 5649 Part VI 1982.

Pole Shaft : The pole shaft shall be made from sheet steel confirming to BSEN 10025. The pole shaft shall have octagonal cross section and shall be continuously tapered with single longitudinal welding. There shall not be any circumferential welding. The welding of pole shaft shall be done by Submerged Arc Welding (SAW) process. All octagonal pole shafts shall be provided with the rigid flange plate of suitable thickness (as per IS 2062) with provision for fixing 4 foundation bolts. This base plate shall be fillet welded to the pole shaft at two locations i.e. from inside and outside.

Door opening : The octagonal Poles shall have door of approximate 500 mm length at the elevation of 500 mm from the Base plate. The door shall be vandal resistance and shall be weather proof to ensure safety of inside connections. The door shall be flush with the exterior surface and shall have suitable locking arrangement. There shall also be suitable arrangement for the purpose of earthing. The pole shall be adequately strengthened at the location of the door to compensate for the loss in section.

Material : Octagonal Poles HT Steel Conforming to grade S355JO.
Base Plate : Fe 410 conforming to IS 226 / IS 2062
Foundation Bolts : EN.8 grade
Pole sections : The Octagonal Poles shall be in single section. There shall not be any circumferential weld joint.
Galvanization : The poles shall be hot dip galvanized as per relevant Indian standards with average coating thickness of minimum 70 micron. The galvanizing shall be done in single dipping.

Fixing Type : The Octagonal Poles shall be suitable for bolting on a foundation with a set of four foundation bolts for greater rigidity.

Bracket for fixing luminaire : The brackets shall be made of specified size NB G.I heavy duty pipe with minimum 1000 mm long, bent at an angle of 120 degree, with necessary holding brackets, hold fasts etc.

Mode of Measurement: Executed quantity shall be counted on number basis. (i.e. each)

Earth electrode shall be of ISI mark. In order to burry electrode in the Ground, Ground shall be bored using portable air compressor and carbide tip drill of 150mm dia. After burring, the electrode in the ground, the space around the electrode shall be filled with earthing compound.

Testing:The value of each earth maintenance free earthing shall be measured by earth tester in presence of site Engineer and record to be submitted.

Mode of Measurement: Executed quantity shall be counted on number basis. (i.e. each)
Plate type Earthing (With or Without CI Cover, Funnel, etc) (EA-EP)

Specification No. (EA-EP)
Scope:
Supplying and erecting galvanised cast iron plate type earthing with C.I. cover as per instructions from the site engineer.

Material:Earth Plate: Galvanised cast iron earth plate as per specifications given in Table No. 9.1/1.
CI Cover: As per specifications given in Table No 9.1/1.
Earthing Conductor: G.I strip / G.I. earth wire of size as per specifications given in Table No. 9.1/1.
Hardware: Screw / nut bolts with required washer of dimensions, Rawl plug / clip/ 'U' nails and material as per specifications given in Table No 9.1/1.
Filling material: Coal /Charcoal/ salt as per specifications given in Table No 9.1/1. as per specifications given in Table No 9.1/1.
Lugs: As per specification (CB-LG/AL, CB-LG/CU) mentioned chapter 7.9 & 7.10 Copper/ Aluminium lugs as per specifications given in Table No 9.1/1.
Method of construction:
Pit is to be dug of required dimension and depth for the earthing at site, and laying of Galvanised cast iron earth plate shall be as per Table No 9.1/1. The earth connection to equipment/ switch gear and earthing electrode shall be connected as shown in the diagram and as per IS 3043 amended up to-date. The connections shall be made either by strip or double run of earth wire with drilling, welding, riveting, brazing and nut bolting to plate, where ever required in an approved manner. As far as possible continuous strip shall be used, but where ever jointing of strip is unavoidable, the overlap portion must not be less than 21/2 times the width of the strip either welded/ brazed/soldered by all sides or 6 inches overlap with two nut bolts/ riveting of adequate size with required washer and covered by anti-corrosive paint as per approved jointing practice in the industry and as per directives from site engineer in charge.

Pit shall then be filled with screened soil with alternate layer of coal and salt, and if, necessary brick masonry work (Where ever applicable) shall be done as specified in IS: 3043, with laying

wires in PVC/ G.I. pipe and watering arrangement as per drawing no EA-1 and covered with C.I. Cover (Where ever applicable).
Where ever requires or as specified by Site Engineer, a Test link shall be provided for facilitating the testing of resistance of earth electrode. Refer Table no. 9.1/1 in PWD Red Book.
Testing:
The value of each earth electrode shall be measured by earth tester in presence of site Engineer and record to be submitted.

Mode of Measurement: Executed quantity will be measured on number basis (i.e. each)

Specification No (WG-TW)
To provide wiring for telephone on surface of wall or ceiling concealed in slab, wall, under flooring, etc., through rigid PVC conduits, with all necessary hardware, material, etc. as specified.

To provide, install, test & commission the instruments / equipments and accessories used in telephone system, such as; Main Distribution Frames (MDF), Krone Modules, Over Voltage Magazine, EPAX / EPABX, CO-axial cable, Rosette box, Jumper wire, etc.

Material:
PVC Telephone cable: PVC insulated Tinned copper solid conductor with minimum 0.5 mm dia. (Single & Multi pair) properly paired and colour coded, shall be terminated on KRONE module with suitable tool.

Saddles: Saddles fabricated from G I sheet of required gauge (16/18 gauge) either galvanized finish or painted with superior quality enamel black paint, with necessary shearing for mechanical strength, semi circular shaped with extended piece having suitable holes for fixing on spacer.

Hardware: Sheet Metal (SM) screws of required sizes, plugs, wooden gutties, etc.

MDF: Manufactured by reputed manufacturer of specified capacity, facility for wall mounting, with door & lock, aluminium frame for fixing of KRONE, duly enclosed in cabinet made from 18 SWG CRCA sheet with powder coating of required colour.

Junction box: Manufactured by reputed manufacturer of specified capacity, facility for + wall mounting, with door & lock, aluminium frame for fixing of Krone, duly enclosed in cabinet made from 18 SWG CRCA sheet with powder coating of required colour. The depth of the box should consider the height of KRONE module plus protection magazine.

Over Voltage protection Magazine: Manufactured by reputed manufacturer of 10 pair capacity, with 3 pole gas discharge tube should be properly fitted on KRONE module in MDF / Junction box.

Jumper wire: Twin twisted PVC insulated with Tinned copper solid conductor minimum 0.5 mm dia.

KRONE Module: Disconnection type KRONE module having capacity to connect 10 pairs with silver-plated terminal contacts.
RG-11 Co-axial low voltage grade cable: PVC insulated with Tinned copper solid conductor minimum 0.5 mm dia, with connector at both ends suitable for termination in RJ type socket.

EPAX (Analogue type): Manufactured by reputed manufacturer and approved by Telephone Engineering Certificate (TEC) of specified extensions, having following
features:
• Direct Inward dialling (DID) with voice guidance facility.
• Caller line Identification (CLI) on Analog as well as digital extension.
• Call Billing software (CB)
• Dynamic STD locking
• Conferencing facility for specified extensions.

EPABX (Hybrid type): Manufactured by reputed manufacturer and approved by Telephone Engineering Certificate (TEC) of specified extensions, having following
features:
• Direct Inward dialing (DID) with voice guidance facility.
• Caller line Identification (CLI) on Analog as well as digital extension.
• Call Billing software (CB)
• Dynamic STD locking
• Conferencing facility for specified extensions.
• Provision of battery back-up and power failure line transfer.

Method of Construction:
Drawing of telephone wire through PVC conduit: As specified in Chapter for Point Wiring.
4.2
Erection of MDF Junction box / EPAX / EPABX, etc: Specified equipment shall be fixed to wall with minimum 50x8 mm SM screws, with necessary plugs, wooden gutties, etc. or may be fixed on Table Top if required.

Mode of Measurement:

Work done for telephone in PVC conduit will be measured on running meter basis, (i.e. per running meter) for each single run. For the other accessories / equipments shall be done as per unit specified. (i.e. Job / each)

As per description of item in Schedule-B
Specification No. (WG-COC/NC)
To lay the cables for Computers on surface of wall or ceiling concealed in slab, wall, under flooring etc., through existing rigid PVC conduits, with all necessary hardware, material, etc. as specified. The cable shall be used only for connections between Information Outlet & Patch/ Multimax Panel. (Exception: For making MDIX patch cord)

Material:
UTP cable:
4 pairs,100 ohms, unshielded twisted pair (UTP), each pair separated by a PE former (Star shaped) solid 23AWG tinned copper conductor rated for temperature of 750 C, PVC insulated grey colour with following types as in the table 1.12/1

Table 1.12/1

Sr. No.	Type	Class	Tested frequency
1.	Cat 6	E	350MHz
2.	Cat 6+	E	500MHz

The Category 6 cable and Category 6 channel components shall be manufactured by a single manufacturer. The manufacturer shall warrant the Category 6 channel cable, components, and applications for a period of 20 years. The Delay Skew on the 100 meter channel shall not exceed 30 ns. The 20 year warranty shall be a transferable warranty and has component replacement policy in case of manufacturing defect Category 6, 100mtr channel, 4-connection model should guarantee 400% margin over standard NEXT specification across swept frequency Category 6, 100mtr channel, 6-connection model should guarantee +4dB margin over standard NEXT. Specification across swept frequency (1~250MHZ). The high performance Category 6 UTP cable 23AWG shall be of the traditional round design with Mylar bisector tape Non-Plenum rated. The cable shall support Voice, Analog Baseband Video/Audio, Fax, Modem,Switched-56, T-1, ISDN,RS-232, RS422, RS-485, 10BASE – T Ethernet, Token Ring, 100Mbps TP-PMD, 100BASE-T Ethernet, 155 Mbps ATM, AES/EBU Digital Audio, 270 Mbps Digital Video, 622Mbps 64-CAP ATM and emerging high-bandwidth applications, including 1 Gbps Ethernet, gigabit ATM, IEEE 1394B S100 and S400, as well as all 77 channels (550 MHz) of analog broadband video. The cable jacket shall comply with Article 800 NEC for use as a non-plenum cable. The 4 pair UTP cable shall be UL□ and c (UL□) Listed Type CM. Performance shall be characterized to 550 MHz to support high-bandwidth video applications.

Non Plenum CAT6 UTP Cable

Sr. No.	Description
1.	Weight=25.3 lb (1000 ft)
2.	Jacket Thickness=.022 in
3.	Outside Diameter=0.232 in
4.	Conductor Diameter=.022 in
5.	Insulation Type=High density Polyethylene
6.	Jacket Material=PVC
7.	Maximum Pulling Tension=25 lbs
8.	Nom. Velocity of Propagation=0.69
9.	Max DC Resistance=9.83 Ohms/100m
10.	Mutual Capacitance @ 1 kHz = 4.95 nF/100m
11.	Operating Temperature= -20 to 60° C

12. The high performance Category 6 UTP cable shall be of the traditional round design with Mylar bisector tape.

13. The 4 pair UTP cable shall be UL Type CM (non-plenum) Performance shall be characterized to 550 MHz to support high-bandwidth video applications.

Method of Construction:

The cable shall be laid in provided separate PVC conduit 400mm away from electrical cables wherever required without sharp bends. The cable shall be spliced at both the ends for punching/ crimping at keystone jacks/UTP connectors.

Mode of measurement: Executed quantity shall be measured on running meter basis.

TECHNICAL SPECIFICATION FOR Excavation:

Description:

Excavation both manual and mechanical means for structures shall consist of removal of materials for the construction of the foundations of approach structures retaining walls, head walls, and other similar structures in accordance with the requirements of this specification on the lines and dimensions shown on the drawings or as directed by the Engineer-in-charge. The work shall include all necessary sheathing, strutting, shoring, bracing, draining, pumping out of water both manual and mechanical; proper supporting underground service lines like gas, water pipe, drainage line, electric cables, telephone cables as directed by Engineer-in-charge, and the removal of all logs, stumps, shrubs and other deleterious matter and obstructions etc. necessary for placing the foundations, trimming bottoms of excavation.

In firm soils, the sides of the trenches shall be kept vertical up-to a depth of 2 metres from the bottom. For greater depths, the excavation profiles shall be widened by allowing steps of 50 cms on either side after every 2 metres from the bottom. Alternatively, the excavation can be done so as to give slope of 1:4 (1 horizontal: 4 vertical). Where the soil is soft, loose or slushy, the width of steps shall be

suitably increased or sides sloped or the soil shored up as directed by the Engineer-in- Charge. It shall be the responsibility of the contractor to take complete instructions in writing from the Engineer-in-Charge regarding the stepping, sloping or shoring to be done for excavation deeper than 2 metres.

Excavation shall be taken to the width of the lowest step of footing and the sides shall be left plumb where the nature of the soil allows it. Where the nature of the soil or the depth of excavated trench/pit does not permit vertical sides, the contractor at his own expense shall put up necessary shoring, strutting and planking or cut slopes to a safe angle or both with due regard to the safety of personnel including labourers etc. and the works and to the satisfaction of the Engineer-in-charge. Non-compliance of these requirements would amount to negligence on the part of the contractor.

Excavation in hard rock in foundation should be including dressing of area and without blasting but with chipping, chiselling and cutting by jack hammer or by Pneumatic machine.

Dewatering and protection:

All foundations shall be laid in dry condition. Where water is met with in excavation due to seepage, rain or other reasons, the contractor shall take adequate measures such as bailing, pumping, construction of diversion channels, drainage channels, bunds and any other necessary works to keep the foundation trenches/pits dry to lay foundation and to keep the green concrete/all foundations shall laid in dry protected against damage by or undermine its strength including erosion. In this regard and other details thereof, it shall be left to the choice of the contractor but subject to the approval of the Engineer-in-charge. Approval of the Engineer-in-charge shall however, not relieve the contractor of his responsibility for the adequacy of dewatering and protection arrangements and the safety of the works.

Pumping from inside of any foundation enclosures shall be done in such a manner as to preclude the possibility for the movement of water through any freshly placed concrete. No pumping shall be permitted during the placing of concrete or for any period of at least 24 hours thereafter. Unless it is done from a suitable sump separated from the concrete work by a water tight wall or similar means.

At the discretion of the contractor and at his cost, cement grouting or other approved methods may be used to prevent or to reduce seepage and to protect the excavation area. The contractor shall take all precautions in diverting channels and in discharging the drained water so as not to cause damage to the works or to adjoining property or hindrances to moving traffic on adjoining roads.

Preparation of foundation:

The bottom of the foundation shall be leveled both longitudinally and transversely and stepped as directed by the Engineer-in-charge. Before the footing is laid, the surface shall be slightly watered and rammed. In the event of the excavation having been made deeper that than shown on the drawing or as otherwise ordered by the Engineer-in-charge, the extra depth shall be made up with concrete,

foundation shall laid in dry of the foundation grade at the cost of the contractor. Ordinary soil filling shall not be used for the purpose to bring the foundation to level as per the design. When rock or other hard strata is encountered it shall be freed of all loose and soft materials cleaned and cut to a firm surface either level, stepped or serrated as directed by the Engineer in charge.

If there are any slips or blows in the excavation these shall be removed by the contractor at his own cost.

Measurement: **Will be done in Cubic meter.**

Backfilling:
To the extent available, selected surplus soils from the excavation shall be used as backfill as may be directed by the Engineer in charge and after obtaining his concurrence before actually taking any action in the re-use of this excavated stuff from foundation. Fill material shall be free from clods of earth shall be broken or removed. When the excavated material is mostly rock, the boulders shall be broken into pieces not larger than 150 mm size mixed with properly graded finer materials consisting of murrum or earth to fill up the voids and mixture used for filling.

If any selected fill material is required to be borrowed the contractor shall make arrangement for bringing the material from outside borrow pits. The material sources shall be subject to the prior approval of the Engineer in charge. The contractor shall make necessary access roads to such borrow areas at his own cost, if such access roads do not exist.
Backfilling of the foundation trenches/pits shall be done as soon as foundation work has been completed to the satisfaction of Engineer in charge and measured but not earlier than the full setting period of the concrete or masonry work. Backfilling shall be carried out in such a manner as not to cause undue thrust on any part of the structure. Annular space around foundations shall be back filled with coarse sand after clearing it of all debris and in layers of 200 mm. loose thickness, watered and compacted by vibratory roller to the satisfaction of the Engineer in charge and up to the original surface level. Watering, consolidating, compacting to achieve not less than 97% Modified Proctor density conforming to relevant IS. The remaining back filling shall be done in like manner as aforesaid, using excavated earth if approved or by borrowed earth from approved source.

Measurement
Will be done in Cubic meter.
Safety during excavation

Excavation where directed by the Engineer-in-Charge shall be securely barricaded and provided With proper caution signs, conspicuously displayed during the day and properly illuminated with red lights and/or written using fluorescent reflective paint as directed by engineer in charge during the night to avoid accident.

The Contractor shall take adequate protective measures to see that the excavation operations do not damage the adjoining structures or dislocate the services. Water supply pipes, sluice valve chambers, sewerage pipes, manholes, drainage pipes and chambers, communication cables, power supply cables etc. met within the course of excavation shall be properly supported and adequately protected, so that these services remain functional. However, if any service is damaged during excavation shall be restored in reasonable time at the cost of contractor.

Excavation shall not be carried out below the foundation level of the adjacent buildings until under pinning; shoring etc. is done as per the directions of the Engineer-in-Charge for which payment shall be made separately.
Any damages done by the contractor to any existing work shall be made good by him at his own cost. Existing drains pipes, culverts, overhead wires, water supply lines and similar services encountered during the course of execution shall be protected against damage by the contractor. The contractor shall not store material or otherwise occupy any part of the site in manner likely to hinder the operations of such services.

Working in extreme weather

When depositing concrete in very hot weather, precautions shall be taken so that the temperature of wet concrete does not exceed 38 deg. C while placing. This shall be achieved by stacking aggregate under sheds and keeping it moist using cold water or crushed or flaked ice if specified and permitted by the Engineer, reducing the time between mixing and placing to the minimum, cooling formwork by sprinkling water on the exterior, starting curing before the concrete dries out and restricting concreting, as far as possible, to mornings and evenings.

During hot weather and rains the concrete shall be covered with tarpaulin and transported and placed in the forms and consolidated to final state. Commencement of concrete pours shall be avoided during heavy rains, storms and high winds.

On Line UPS (UPS)

General : This part of the specifications covers the technical aspects of the Online UPS system for 3 kVA capacity.

Scope: Specification No (AP-UPS)

Supplying, erecting, testing & commissioning of Online UPS with necessary safeties, etc.

Material:

Equipment manufactured as per standard manufacturer's specification and as tabulated in Table No. 3.7/2. The unit housed in powder coated CRCA sheet enclosure with following fault protection on mains / UPS mode:

- Under voltage on mains mode.
- Over voltage on mains mode.
- Charger protection on mains mode.
- Overload on UPS mode.
- Short circuit on UPS mode.
- Low battery on UPS mode.
- Battery reverse on UPS mode.
- Under voltage on UPS mode.
- Over voltage on UPS mode.
- LED & LCD display for above fault protection.
- Alarm for above fault protection.
- Batteries shall be of Sealed Maintenance Free type (Tubular). The selection of number of batteries required shall be as per

kVA rating	**DC Voltage**	**Output pf**	**No of SMF Batteries**	**Back Up Period**				
				15 mins.	**30 mins.**	**1 Hr**	**2 Hr**	**3 Hr**
3kVA	192V	0.8	16	17AH	17AH	26AH	42AH	65AH

A) The Batteries considered are Sealed Maintenance Free Batteries (SMF)

B) The Batteries need to be placed in Ambient Temperature of 20Deg C-25 Deg C

C) The UPS is considered to be working @ 90% Load of its capacity

Table No. 3.7/2

Specifications & Standard Parameters of On Line UPS

The UPS shall comply with specifications as indicated in the following table:

Sr. No.	**Specifications / Features**	**Standard Parameters**

	1	**Technology**	True online Double Conversion design (DSP / Microprocessor based)
	2	**Input voltage range**	160 V to 270 V for **1 Phase Input** 335 V to 477 V for **3 Phase Input**
	3	**Input power factor**	Near unity Power factor > 0.93 for **1 Phase input**
	4	**Generator compatibility**	Yes (**1.2 times the UPS rating**)
	5	**Nominal input frequency**	50 Hz +/- 6 %
	6	**Rectifier type**	Advance Rectifier with inbuilt APFC (Advance Power Factor Compensated) for **1 Phase.** IGBT charger Advance Rectifier with in built PFC (Advance Power Factor Compensated) for **3 Phase.**
	7	**Output Voltage**	230 V AC +/- 1 % for **1 Phase Output**. 400 V AC (380/415 selectable) for **3 Phase & Neutral.**
	8	**Total Harmonic distortion**	**1 Phase Output** < 3 % for Linear load < 5 % for Non-linear load **3 Phase Output** < 2 % for Linear load < 5 % for Non-linear load
	9	**Overload Capacity**	125 % for 10 Minutes & 150 % for 60 Seconds for **3 to 10 kVA UPS.**
	10	**Inverter**	IGBT based PWM with Digital control (Microprocessor based)
	11	**Crest Factor**	5:1 for **3 to 10 kVA UPS.**
	12	**Static Bypass**	Automatic bypass switch facility
	13	**Display**	Should be User friendly with LED & LCD display with showing important parameters.
	14	**Output Power factor**	0.7 lag to Unity within kVA & kW rating.
	15	**Battery type**	SMF / Thick plate / Tubular

16	**DC Voltage**	3 & 5 kVA – 192 V
17	**Battery charger current limit**	3 kVA – 4A.
18	**Ambient temperature**	45 degree C
19	**Noise level**	< 50 db @ 3 metres
20	**Testing standards**	IEC 62040 Part III
21	**Isolation Galvanic**	Isolation transformer from 3 to 10 kVA

Mode of Measurement: Executed quantity will be measured on number basis. (i.e. each.

List of approved makes / agencies

1	Switch fuse Disconnector	:	Siemens /L & T/ ABB/Schneider
2	HRC Control Fuses	:	Siemens /L & T/ ABB/Schneider
3	Contactor, Timer	:	Siemens /L & T/ ABB/Schneider
4	Indicating Lamps	:	Siemens /L & T/ ABB/Schneider
5	Push Buttons	:	Siemens /L & T/ ABB/Schneider
6	Selector Switches	:	Schneider/ Kaycee
7	CTS	:	Gilbert & Maxwell/ AE/ Kappa
8	Indicating meter (Analogue)	:	Auto Electric/ Rishabh
9	Digital meters	:	Schneider/ AE/ Enercon/ Conserv
10	Digital Power Manager	:	Schneider/ Enercon/ ABB
11	PVC Insulated Wires	:	Polycab/ RR Cables/ Havells/ KEI
12	Terminals	:	Schneider/ Elmex / Connectwell / Wago
13	Power Capacitor	:	Schneider Meher
14	Under / Over Voltage Relay	:	Minilec
15	Lighting Fixture (Flameproof)	:	Explosion Proof/FCG/Sudhir/Hitech
16	Lighting Fixture (Non-flameproof)	:	Wipro/Bajaj//Philips/Panasonic
17	Lamps	:	Wipro/Bajaj//Philips/Panasonic
18	Cables	:	Polycab/ KEI & RR Cables/Vishal

19	Wires	:	Polycab/ KEI & RR Cables/Vishal
20	HDPE / DWC Pipe		Reputed make (design as per IS)
21	Equipment Power & Control Cabling		Lapp India OR Equivalent
22	Battery	;	Amara Raja Quanta/Panasonic/ /Amaron
23	Battery Charger	:	Chhabbi Electricals/Hansu/Mastech
24	Gland	:	Comet
25	Cable Lugs	:	Dowell's
26	Distribution Board	:	L&T/ ABB / SEIMENS / SCHNEIDER/ LEGRAND
27	Cable Tray	:	Profab / Indiana / Om Industries/ Legrand
28	GI Conduit/ Raceway	:	Bharat / BEC/ PROFAB/INDIANA
29	PVC Conduit & Accessories	:	Precision/ Presto-Plast
30	Modular Swicth Socket, telephone Jack, Computer socket	:	Anchor-Roma/MK / North East
31	MCB// RCCB / RCBO/ ELCB / ISOLATORS		L&T/ ABB / SEIMENS / SCHNEIDER/ LEGRAND
32	FLP Switch Socket Boards	:	Explosion Proof/FCG/Sudhir/ Hitech
33	Industrial Plug Socket	:	MDS (Legrand)/ L&T/Legrand/ABB
34	Door Interlock System	:	M/s. Honywell, Avon System
35	Telephone wires and data cables	:	Tyco Systimax,AMPS,Polycab,D-link
36	Insulator	:	BHEL, Jyoti,Jayshrre insulators ltd.
37	LAN cables	:	Tyco Systimax,AMPS,Polycab,D-link
38	Portable Fire Extinguishers CO2 Type - 4.5kg	:	Minimax / Safeguard / Eversafe /ASKA / HNE / AFT
39	Circuit Breaker Panel		L&T/ ABB / SEIMENS / SCHNEIDER
40	Isolator		AMEI / ELLPRO / STERLING
41	ACB/MCCB		L&T/ ABB / SEIMENS / SCHNEIDER
42	Meters / Voltage Transformers / Relays / Starters / Contactors / Selector Switch / Indicating Lamps		L & T / SIEMENS / AUTOMATIC ELECTRIC / CONTROL & SWITCH GEARS / ABB/ SCHNEIDER
43	Television Coaxial Cable		POLYCAB / RR /RPG
44	MS Conduits And Accessories		B.E.C./AKG/MK/Precision /Modi
45	UPS		Socomec/APS/Numeric
46	Electronic Energy Meters		SECURE / L&T/ ABB / SEIMENS / SCHNEIDER
47	Light Pole		Bajaj / Volmont / Transrail / equivalent
48	Ceiling Rose Holders		ANCHOR
49	Buzzers/Bell Push Bell		ANCHOR

50	Electronic Regulator		MK/ANCHOR/ROMA/DEGRAND/MDS
51	Contactors		SIEMENS/L&T/ABB/SCHNIEDER
52	FRLS Copper Wire		Gemscab/Polycab/Havells/KEI & RR Cables
53	Timers		MERLIN GERIN, L&T
54	CT's / PT's		L&T/ Siemens/ AE/ Kappa / Pragati
55	Surge Protection Device		L&T/ABB/Legrand/JEF/Dehn
56	Relays		L&T/ ABB / Schneider/ Seimens
57	Ammeter / Voltmeter / Power factor meter / Frequency meter / Energy meter		ABB/ L&T/ Legrand/ Schnieder/ Seimens/Secure
58	Lightning Pro. System		ABB/ Synergy / Indelec / Stormaster(LPI)/ JEF / Dehn
59	Solar System		Waree/Tata
60	Cable Jointing		Raychem / M Seal
61	PVC pipes and accessories		Precision / Avonplast / AKG / Modi / Polycab
62	GI pipes		Zenith / Tata / Jindal
63	Water Cooler		Voltas/Daikin/BlueStar
64	Outdoor Boxes		MK/ Clipsal / Henzel / Hunter / Sintex / National
65	Ceiling fans		CGL/Crompton/Havells/Bajaj/Usha/BLDC/SMART-EK
66	Exhaust / Pedestal Fan		CGL/Crompton/Havells/Bajaj/Usha
67	Telephone Tag Box		ITL or any equivalent approved make
68	Annunciator		Areva/ Minilec / Alan
69	Terminal Blocks		Connect well/ Elmex / Technoplast
70	Ethernet switch		Sony / Bosch / AVAYA/ Cisco/ Dlink / DigiSol
71	Patch Panel		AVAYA/ Siemens / Dlink / DigiSol / Legrand
72	Rack for patch panel & switches		HCL/ Rittal / President / Valrack / Legrand / Digilink
73	Cat 6 UTP wire		Legrand, d-link, amps, polycab
74	UTP Patch cord		D-LINK or any other equivalent make
75	Telephone/ TV/ Network port (modular)-		Legrand/L&T/systimax or Equivalent
76	EPABX		Panasonic/ Systimax/ Avaya / NEC / LG Aria / Siemens / Alcatel

77	Telephone Instrument		Panasonic/ Systimax/Avaya / Beetel
78	POE layer 2 Switch		CISCO/ D-LINK/ ALLIED TELESIS
79	Pumps		Kirloskar/Grundfos/Crompton/KSB
80	Hard disk		WD/ SEAGATE/ Honey well
81	40" LED Monitor, Display Resolution : Full HD		LG/ Samsung / Sony
82	I.S.I. mark Rigid P.V.C. conduit		Precision
83	POE injector		CISCO or any other equivalent make
84	Router		D-LINK or any other equivalent make

TECHNICAL SPECIFICATIONS

FOR

FIRE FIGHTING

FIRE HYDRANT AND SPRINKLER SYSTEM

SECTION 01: BASIS OF DESIGN

1.1 BASIS OF DESIGN

1.1.1 The execution of works and materials used shall be as per the latest relevant I.S. specifications and TAC guidelines.

1.1.2 Wherever reference has been made to Indian Standard or any other specifications, the same shall mean to refer to the latest specification irrespective of any edition of such specification being mentioned in the specifications below or Schedule of Quantities.

The firefighting installation on completion will have to be cleared from the local firefighting authorities (Fire Service) for its efficacy, suitability, and usability by the Fire Service in the event of a fire and to obtain fire NOC.

The contractor should have a valid license from Directorate of Maharashtra fire services in required fields.

1.2. CONCEPT OF THE SYSTEM

The following services are envisaged:

1.2.1 Fire Fighting system for the building comprising Hydrant, Hose Reels, Sprinklers, Fire detection and alarm and portable fire extinguishers.

1.3. WATER STORAGE

The static storage for Fire Fighting is at present sized i.e.,200 cum.

1.4. WORKMANSHIP

The workmanship shall be best of its kind and shall conform to the specifications, as below or Indian Standard Specifications in every respect or latest trade practices and shall be subject to approval of Engineer in charge. All materials and/or Workmanship that is defective or unsuitable shall be removed immediately from the site and shall be substituted with proper materials and/or workmanship forthwith.

1.5. MATERIALS

All materials shall conform to the latest Indian Standards.

All materials shall be of approved quality as per samples and origins approved.

SECTION 02: FIRE FIGHTING SYSTEM

2.1 SCOPE

The scope of this section consists of supply, installation, testing and commissioning of the fire-fighting system. The philosophy of the system is as follows:

2.1.1 The Fire fighting System shall comprise the Fire Hydrants System, the Sprinkler System and associated equipment's overall.

2.1.2 Water from the Fire Water Storage Tank shall be supplied for the uses listed below.

a. Fire Hydrant System (Pressurized) both for the external hydrants, the internal landing valves, and the hose reels at landings.

b. Sprinkler System (Wet Type) & foam flooding system

2.1.3 The Hydrant System and the Sprinkler System, under normal conditions, shall be pressurized by means of the electric motor driven Jockey Pump.

2.1.4 The Hydrant System and sprinkler system shall be provided with pump sets, one of which will be diesel engine driven and the other electric motor driven.

2.1.6 The starting and stopping of the Jockey pump shall be automatic based on the pressure switches at preset low and high pressure.

2.1.7 The electric motor driven Hydrant Pump starts automatically at a preset pressure by means of a pressure switch. As soon as the Hydrant Pump starts, the Jockey Pump Stops. If for any reason the electric motor driven Hydrant Pump does not start at the preset pressure or is unable to maintain the pressure, the diesel engine driven Hydrant Pump starts at the preset pressure.

2.1.8 The fire Pumps, whether electric motor driven or the diesel engine driven shall be stopped only manually.

2.1.9 Contractor shall ensure that all false ceiling voids depth greater than 0.8 m are provided with upright sprinkler.

2.1.10 Tenderer shall ensure Hydro Testing for the complete system.

2.1.11 The Tenderer shall obtain the necessary approval of the drawings and the schemes from the local authority as called for.

2.1.12 The tenderer shall design and after approval display near each staircase landing at floor levels, a glass covered framed floor plan clearly showing the locations of all landing valves, hose reels, hand appliances, as well as the DO's and DON'T's for the personnel and the exit direction in case of an emergency. The dimensions of the floor plan, its scale, lettering size, color scheme etc. shall be as per approval.

2.2 PIPE WORK

2.2.1 SCOPE

This chapter covers the requirements of pipe work in fire fighting installations.

2.2.2 DESIGN

(i) Pipe sizes shown in tender documents are purely for contractor's guidance. The contractor shall be responsible for the selection of sizes as per detailed engineering to be done by him. Design to be done by the contractor shall incorporate the following:

- (a) Butterfly/sluice valves shall be provided at delivery sides of pumps.
- (b) External hydrant
- (c) Fire service connection/inlet.
- (d) Test valve
- (e) Drain connections.

(ii) For testing the system healthiness and automatic operation on daily basis, one test pipe with butterfly/sluice valve shall be provided in common discharge header. For avoiding wastage of water, this pipe shall discharge water in the tank.

(iii) Non return valve shall be provided at the delivery of each pump and fire service inlet.

(iv) Air release valves with ball valve shall be provided in the piping system for venting trapped air with a size of 25 mm for pipes up to 100 mm and 40 mm for larger pipes.

2.2.3 PIPE MATERIALS

(i) Pipes shall be of the following materials.

G.I heavy class(C-class) conforming to IS: 1239 for sizes up to 150 mm.

Welded black steel pipe, class 2, conforming to IS: 3589, for sizes greater than 150 mm. These pipes shall be factory rolled and fabricated from a minimum of 6 mm thick M.S. Sheet for pipes upto 350 mm dia.

2.2.4 PIPE JOINTS

(i) Electric welding joints shall be provided in the pipe work. Flanged joints shall be provided for connections to valves, pumps, air vessels etc. and on straight lengths at suitable points to facilitate erection and subsequent maintenance.

(ii) Mild steel flanges shall be in accordance with Table - 17 of IS: 6392. "Plate Flanges for Welding". Gasket thickness shall not be less than 3 mm.

All hardware items such as Nuts, Bolts, Washers shall be of appropriate size.

Washers shall be used on both sides of the bolt.

2.2.5 BUTTERFLY VALVES

Sluice valve conforming to IS: 780 or butterfly valve conforming to IS: 13095 shall be provided. All valves shall be suitable to withstand the pressure in the system and rating shall be PN 16. All valves shall be right-handed (i.e., handle or key shall be rotated clockwise to close the valve), the direction of opening and closing shall be marked, and an open/shunt indicator fitted.

(i) The material of valves shall be as under:

Body -	Cast iron
Disc -	Cast Bronze or Stainless Steel
Seat -	Either integral or Nitrile rubber
O-ring -	Nitrile / Silicon

(ii) Non return valves shall be swing check type in horizontal run and lift check type in vertical run of pipes.

(iii) Air release valves shall be of gunmetal body.

2.2.6 BALL VALVE

The ball valve shall be made of forged brass and suitable for testing pressure of pipeline. The valve shall be internally threaded to receive pipe connections.

The ball shall be made from brass and machined to a perfect round shape and subsequently chrome plated. The seat of the valve body-bonnet gasket and gland packing shall be of Teflon.

The handle shall be provided with a PVC jacket. The handle shall also indicate the direction of 'open' and 'closed' situations. The gap between the ball and the Teflon packing shall be sealed to prevent water seeping.

The handle shall also be provided with a lug to keep the movement of the ball valve within 90°. The lever shall be operated smoothly and without application of any unnecessary force.

2.2.7 GUN METAL VALVES

Gun metal Valves shall be used for smaller dia pipes, and for threaded connections. The Valves shall bear certification as per IS: 778

The body and bonnet shall be of guns metal to IS:3 18. The stem gland and gland nut shall be of forged brass to IS: 6912. The hand wheel shall be of cast iron to IS: 210.

The Hand wheel shall be of high-quality finish to avoid hand abrasions. Movement shall also be easy. The spindle shall be non-rising type.

2.2.8 NON-RETURN VALVE

Non-Return valves shall be cast iron double flanged with cast iron body and gunmetal internal parts conforming to IS: 5312.

2.2.9 PRESSURE RELIEF VALVE

Each System shall be provided with a Pressure Relief Valves. The Valve shall be spring actuated and set to operate as per field requirement. The Valve shall be constructed of bronze and provided with an open discharge orifice for releasing the water. The Valve shall be open lift type.

2.3 PRESSURE SWITCH

The pressure switches shall be employed for starting and shutting down operation of pumps automatically, dictated by line pressure. The Pressure Switch shall be diaphragm type. The set pressure shall be adjustable.

The Switch shall be suitable for consistent and repeated operations without change in values. It shall be provided with IP:55 water and environment protection.

2.4 PRESSURE GAUGE

Pressure gauge shall be provided near all individual connections of the hydrant system with isolation valves and near each flow switch assembly of the sprinkler system. Pressure gauge shall be 50 mm Dia gunmetal bourdon type with gunmetal isolation ball valve, tapping and connecting pipe and nipple. The gauge shall be installed at an appropriate height for easy readability.

2.5 PAINTING

All Hydrant and Sprinkler pipes shall be painted with post office red color paint. All pipes shall first be cleaned thoroughly before application of primer coat. After application of primer coat (etch primer for GI and zinc chromate for M S) two coats of enamel paint shall be applied. Each coat shall be given a minimum of 24 hours' drying time. No thinners shall be used. Wherever required all pipe headers shall be worded indicating the direction of the pipe and its purpose such as "TO RISER NO.1" etc.

Painting shall be expertly applied; the paint shall not overrun on surfaces not requiring painting such as walls, surfaces etc. Nuts and bolts shall be painted black, while valves shall be painted blue.

2.6 EXCAVATION

Excavation for pipelines shall be in open trenches to levels and grades shown on the drawings or as required at site. Pipelines shall be buried with a minimum cover of 1 meter or as shown on drawings. On completion of testing pipe protection, trenches shall be backfilled in 150 mm layers and consolidated.

2.7 ANCHOR/ THRUST BLOCK

Tenderer shall provide suitably designed anchor blocks in cement concrete/steel support to cater to the excess thrust due to work hammer and high pressure.

Thrust blocks shall be provided at all bends, tees and such other locations.

Exact location, design, size and mix of the concrete blocks/steel support shall be as shown on the drawings and as approved prior to execution of work.

2.8 STRAINERS

Stainless steel strainers shall have a minimum of 1 mm thick screen with 3 mm perforations. Strainers shall be provided with flanges.

2.9 ORIFICE PLATE

Orifice plate shall be made of 6 mm thick stainless steel and shall have an identification tag projecting beyond any flange between which it is damped. The orifice shall be plain central hole without burs and diameter not less than one-half of the internal diameter of the pipe to which it is fitted.

2.10 INSTRUMENTS

(i) Pressure gauge of appropriate range and 100 mm. dia size shall be provided.

(ii) The pressure gauge shall be duly calibrated before installation and shall be complete with shut off valve.

2.11 AIR VESSEL

An air vessel shall be provided and shall be fabricated out of 6 mm. thick M.S. Sheet. The ends shall be dished. This shall be of 300 mm.dia, 1.5 meter high and installed vertically on suitable legs. The legs shall be provided with M.S. Plate of size 75 mm x 75 mm x 5 mm at the bottom so that the legs do not puncture the roof. The legs shall be grouted in CC foundation. Air release valve and pressure gauge with shut off valve shall be provided. The air vessel shall be tested at 25 kg/cm^2 pressure before installation.

2.12 INSTALLATION

(i) The installation work shall be carried out in accordance with the detailed drawings prepared by the contractor and approved by the Engineer-in-charge.

(ii) In pipes above ground level, expansion loops or joints shall be provided to take care of expansion or contraction of pipes due to temperature changes.

(iii) Tee-off connections shall be through equal or reducing tee, otherwise ferrules welded to the main pipe shall be used. Drilling and tapping of the walls of the main pipe shall not be resorted to.

(iv) Open ends of piping shall be blocked as soon as the pipe is installed to avoid entrance of foreign matter.

(v) Piping installation shall be supported on or suspended from structure adequately. The contractor shall provide clamps, hangers etc. Proper lines and levels shall be maintained while installing exposed pipes.

(vi) Pipe supports in pump house shall be floor mounted and of mild steel.

Spacing of pipe supports shall not be more than that specified below:

Nominal Pipe Size (mm)	Spacing (m.)
20 and 25	2.00
32 to 125	2.50
150 and above	3.00

Extra supports shall be provided at the bends and at heavy fittings like valves to avoid undue stress on the pipes.

(vii) Anti vibration pads, springs or liners of resilient and non-deteriorating material shall be provided at each support, to prevent transmission of vibration through the supports.

(viii) Pipe sleeves of diameter larger than the pipe by least 50 mm shall be provided wherever pipes pass through walls and the annular spaces shall be filled with felt and finished with retaining rings.

(ix) a) Vertical risers shall be parallel to walls and column lines and shall be straight and in plumb. Risers passing from floor to floor shall be supported at each floor by clamps.

(b) The space in the floor cut outs around the pipe work shall be closed using cement concrete (1:2:4 mix) or steel sheet, from the fire safety considerations, taking care to see that a small annular space is left around the pipes to prevent transmission of vibration to the structure.

(c) Riser shall have suitable support at the lowest point.

(x) Where mild steel GI pipes are to be buried underground the same shall be treated in accordance with Para 14 of this Section before laying. The top of the pipes shall be not less than 100 CMS below the ground level. Where this is not practicable, permission of the Engineer-in charge shall be obtained for burying the pipes at lesser depth. Masonry or C.C. blocks shall be provided for supporting the pipes at intervals in accordance with Para 12 (vi) of this Section. After the pipes have been laid, the trench shall be refilled with the excavated soil in layers of 20 cm. and rammed and any extra soil shall be removed from the site of work by the contractor.

(xi) Underground pipes shall be laid at least 2 m. away from the face of the building, preferably along the roads and foot paths. As far as possible laying of pipes under road, pavement and large open spaces shall be avoided. Pipes shall not be laid under buildings and where unavoidable, these shall be laid in masonry trenches with removable covers.

(xii) To facilitate detection of leaks and isolation of defective portions of pipe, valves shall be provided in underground pipe at suitable locations. As far as possible such valves shall be provided over ground. If the valves are to be provided below ground, a suitable masonry chamber with cover plate shall be provided. Locations where vehicles can pass shall be avoided for provision of valve below ground.

(xiii) Pipe over ground shall be painted in red color shade no. 536 of IS: 5. The pump, motor and engine shall be painted with red color shade no. 536 of IS: 5. Suitable identification shall be provided to indicate the run of underground pipe wherever the route of underground pipe cannot be ascertained from the location of yard hydrant/isolating valves.

(xiv) It shall be made sure that proper noiseless circulation is achieved in the system. If proper circulation is not achieved due to air-bound connections, the contractor shall rectify the defective connections. He shall bear all the expenses for carrying out the above rectification, including the tearing up and refinishing of floors, walls, etc. as required.

2.13 PRESSURE TESTING

(a) All piping shall be tested to hydrostatic test pressure of at least one and a half times the maximum operating pressure, but not less than 10 kg./ sq. cm for a period not less than 24 hours. All leaks and defects in joints revealed during the testing shall be rectified to the satisfaction of the Engineer-in-Charge.

(b) Piping repaired after the above pressure test shall be re-tested in the same manner.

(c) System may be tested in sections and such sections shall be securely capped

(d) Pressure gauges may be capped off during pressure testing of the installation.

2.14 ANTI-CORROSIVE PROTECTION ON UNDER GROUND PIPE

Corrosion protection tape shall be wrapped on M.S. / G.I. Pipes to be buried in the ground. This corrosion protection tape shall comprise of coal tar/asphalt component supported on fabric of organic or inorganic fiber and minimum 4 mm. thick and conform to requirement of IS: 10221-Code of practice for coating and wrapping of underground mild steel pipeline. Before application of corrosion protection tape all foreign matter on pipe shall be removed with the help of wire brush and suitable primer shall be applied over the pipe thereafter. The primer shall be allowed to dry until the solvent evaporates, and the surface becomes tacky. Both primer and tape shall be furnished by the same manufacturer. Corrosion protection tape shall then be wound around the pipe in spiral fashion and bound completely to the pipe. There shall be no air pocket or bubble beneath the tape. The overlaps shall be 15 mm. and 250 mm. shall be left uncoated on either end of pipe to permit installation and welding. This area shall be coated in situ after the pipeline is installed. The tapes shall be wrapped in accordance with the manufacturer's recommendations. If application is done in cold weather, the surface of the

pipe shall be pre-heated until it is warm to touch, and traces of moisture are removed and then primer shall be applied and allowed to dry.

2.15 PIPE SUPPORTS

For installing pipes vertically or horizontally inside the building standard pipe supports of reputed make shall be used. The following supports shall be used.

(i) Split pipe support clamps with rubber lining far vertical, horizontal and roof hanging.

(ii) *Clevis Hangers* far horizontal supports to adjust varying heights.

(iii) *Sprinkler Hangers* far horizontal supports far pipes from 25 mm dia to 150 mm dia.

Fasteners and fully threaded rods shall be used for installing the pipe supports. The size of pipe supports, and installation shall be in accordance with the manufacturer's recommendations. For pipes of size 100 mm and above, with the prior approval of Engineer-in-Charge, 'U' clamp with dash fastener may be used for supporting horizontal pipe from ceiling. All the dash fasteners shall be two hooks fire rated.

2.16 MEASUREMENT

Measurements of fire fighting work shall be on fallowing basis:

(a) Piping shall be measured along the centre line of installed pipes including all pipe fittings and accessories but excluding valves and other items far which quantities are specifically indicated in the schedule of work. No separate payment shall be made for fittings and accessories.

(b) The rates far piping work shall include all wastage allowances, flanges pipe supports, hangers, excavation, refilling, testing, nuts and check nuts, vibration isolators, suspension where specified or required, and any other item required to complete the piping installation. None of these items will be separately measured and paid.

2.17 SYSTEM DRAINAGE

The system shall be provided with suitable drainage arrangement with drain valves complete with all accessories.

2.18 VALVE CHAMBERS

Provision of suitable brick masonry chambers in cement mortar 1:5 (1 cement: 5 coarse sand) on cement concrete foundations 150 mm thick 1:5:10 mix (1 cement: 5 fine sand: 10 graded stone aggregate 20 mm nominal size) with 15 mm thick cement plaster inside and outside finished with a plaster inside and outside finished with a floated coat of neat cement inside with cover approved by fire brigade including excavation, back-filling complete shall be made.

SECTION 03: FIRE FIGHTING ACCESSORIES

3.1 SCOPE

This chapter covers landing valves, first aid hose reels, hose pipes, branch pipes etc. which are vital tools for fire fighting.

3.2 LANDING VALVE

Landing valves are provided in the system for connection of hose pipes for discharging water for fighting fire by fire brigade or trained personnel.

3.2.1 The landing valves shall be as per I.S.: 5290

3.2.2 The landing valves are of single and double head outlet types.

3.2.3 Material of construction

(i) Body, outlet and cap etc: Gunmetal or stainless steel

(ii) Spindle : Brass for Bronze body, stainless steel for stainless steel body.

(iii) Hand wheel : Mild steel or cast iron.

3.2.4 The water discharge shall be not less than 900 lpm for single head and 1800 lpm for double head valves at 7 kg/cm2 pressure.

3.2.5 Installation

3.2.5.1 The landing valve shall be fitted to a T connection of the riser at the landing in such a way that the valve is in the centre of the internal hydrant opening and at a height of 1 m. from floor level.

3.2.5.2 The valve base shall be vertical and the valve facing outside. There should be no hindrance in operation of the handle.

3.3 FIRST AID HOSE REEL

First Aid Hose Reel is meant for delivering small quantity of water in early stage of fire and can be operated even by untrained personnel, and thus provides a most effective fire fighting facility. It consists of a length of 20 mm (nominal internal) diameter hose tubing warped around a reel with water inlet pipe, stop valve and shut off nozzle. The entire assembly is mounted on a wall bracket and can swing 180 degree. The water inlet is connected to the riser pipe by means of 37 mm socket and valve. The hose tube can be pulled out easily for the purpose of discharge of water on fire.

3.3.1 First aid hose reel shall be as per IS: 884.

3.3.2 Material of Construction:

(i) Hub and sides : Mild steel

(ii) Wall Bracket : Cast iron / Mild steel.

(iii)	Hose tube (20 mm)	:	Nylon braided high pressure rubber Hose as as per IS 884
(iv)	Nozzle with branch Pipe	:	Brass
(v)	Stop Valve (Ball Valve)	:	Gun metal

Normally M S construction is used. Other material may be used in areas having corrosive atmosphere.

3.3.3 The water flow rate shall be not less than 24 lpm and the range of jet shall be not less than 6m.

3.3.4 INSTALLATION

3.3.4.1 The length of hose tube shall be such that the nozzle of the hose can be taken into every room and within a range of 6 M from any part of the room.

3.3.4.2 There shall be no obstruction in swinging the hose reel and should be installed above landing valve where provided.

3.3.4.3 The inlet valve shall be 900 mm above floor level.

3.3.4.4 Hose reel bracket should be firmly grouted on the wall with the help of rawal bolts.

3.4 FIRE HOSE DELIVERY COUPLING, BRANCH PIPE AND NOZZLES:

3.4.1 These are important accessories used for firefighting operations.

3.4.2 Material of Construction

Gun Metal /Stainless Steel

3.4.3 Delivery Hose Coupling's

3.4.3.1 The delivery hose couplings consist of male half coupling and female half coupling. Groves are provided on outer side on both coupling for binding hose pipes with wires. In female coupling spring loaded cam tooth is provided for holding male half coupling in position. Male half coupling and female half coupling are provided on both sides (i.e. on one side male and on other side female) of hose pipes. Two or more pipes can be joined together with the help of these couplings instantaneously.

3.4.3.2 *Sizes:* -normally size 63 mm is used.

3.4.4 Branch Pipe and Nozzle: Branch Pipes with nozzle are mounted at the end of hose pipe. Branch pipe is properly finished and free from sharp edges. During operation, a fireman must hold the branch pipe. One end of branch pipe is fixed with hose coupling and the other end is threaded to fit the nozzle.

The nozzle is tapered pipe with one end threaded internally which is fixed on branch pipe. The size of other end i.e. nozzle shall be 20 mm. (nominal internal diameter)

3.5 FIRE SERVICE INLET AND FIRE SERVICE CONNECTION

3.5.1

These are provided for connection of fire service hose pipes for either directly pressurizing the system with their pumps or filling water in the tank from a distance. In the first case non return valve with butterfly valve shall be provided for holding water pressure. Fire service inlet shall be provided with each wet riser/down comer and the ring main. These are fixed to 150 mm dia pipe.

3.5.2 These shall be as per IS: 904.

3.5.3 Material of Construction

Copper Alloy

3.6 HOSE PIPES

3.6.1 Hose pipes shall be rubber lined woven jacketed and 63 mm in diameter. They shall conform to Type A (Re-inforced rubber lined) of IS: 636. They shall be flexible and capable of being rolled. Length of hose pipe will be 15 /7.5 m.

3.6.2 The hose pipe shall be complete with male and female coupling at the ends as per Para 4.3 of this Section, Fire Fighting Accessories.

3.6.3 Besides keeping hose pipe with internal hydrant and yard hydrant, spare hose pipes along with branch pipes shall be kept in fire control room/pump room.

3.7 HOSE CABINET

Hose cabinet shall be provided for all internal and external fire hydrants. Hose cabinets shall be fabricated from 16 gauge MS powder coated sheet of fully welded construction with hinged double front door partially glazed (3 mm glass panel) with locking arrangement, stove enameled fire red paint (shade No. 536 of IS:5) with “FIRE HOSE” written on it prominently (size as given in the schedule of quantities). Cabinet surfaces in contact with the walls shall be provided with two coats of anti-corrosive bitumastic paint.

3.7.1 INTERNAL / EXTERNAL HOSE CABINET

Hose cabinet shall be of glass fronted with hinged door & lock. The cabinet shall be made of 16 gauge thick MS sheet and spray painted to shade No. 536 of IS: 5. The hose cabinet shall be of size to accommodate the following:

i. Landing Valves (Single)

ii. Hose pipe (2 length of 15/7.5 m)

iii. Branch pipes, nozzles (1 set)

ANNEXURE-1	
Common Auto control Panel	
Specification No. Fire Main Panel	
1) Mounting	: Floor Mounted
2) Type	: Floor mounted and cubical compartmentalized type
3) Panel	: 12/14/16 gauge CRCA stove enamel
4) Incoming	: 320 AMP, TP+N MCCB overload short circuit earth fault
5) Bus Bar	: TP+N 36kA Aluminum bars of 320 Amps rating
	@ 0.8 A/sq.mm
6) Accessories (Incoming side)	: Ammeter 0-400 Amps with ASS
	: Voltmeter 0-500 Volts with VSS
	: Phase indicating lights with control fuse
7) Outgoings	**1) Star delta starter with**
	: 160 Amps TP MCCB – 2 No.
	: TP contactor – 6 No.
	: Overload relay - 2 no.
	2) Star delta starter with
	: 32 Amps TP MCCB – 2 No.
	: TP contactor – 6 No.
	: Overload relay -2 no.
8) Power and control wiring	: As per IS Code of Electrical
9) Accessories with each MCCB	: Single phase preventer
(On outgoing side)	
On starter feeder	: start/stop push button/auto/manual switch
	: ON / OFF indicator
10) Earthing	: 25 x 6 mm GI Strip
11) Other Accessories	: Audio visual Alarm with flasher and Hooter and for hydrant
	Pump tripped, Jockey pump tripped, (both and stand by)
	Hydrant mains pressure low and other off normal condition.
Note: - Push Buttons for stop and lamps for ON/OFF and TRIP and terminals both power and	
Control, power contactors and OLR to be considered.	
All other switchgear item like MPCB/ Contactor/ SPR/ OLR/ Timer /CT /Ammeter/etc.	
To be considered. AC3 DUTY, TYPE 2 CORDINATED SWITCHGEAR	
1) All breaker selection shall be done as per type-2 coordination chart.	
2) Breaker coordination shall be done properly.	
3) OLR selection shall be as per type-2 coordination chart.	
4) Bus-bar selection: Current density shall be considered as 0.8 A/sq.mm for Al. and 1.6 A/sq.mm for Cu.	
5) All live parts shall be shrouded properly.	
6) Panel shall have adequate space and height for proper heat dissipation.	
7) Panel shall have thermostat space heater and maintenance purpose LED lamp controlled by MCB.	
8) KWh Meter shall be installed at incomer of MCC Panel.	
9) Cable entry / exit shall be from TOP. (If trench considered in Panel Room then Bottom entry / exit shall be considered)	
10) Battery charger of 10A, 12VDC for Diesel Engine controller shall be provided.	

SECTION 04: AUTOMATIC SPRINKLER SYSTEM

4.1 SCOPE

This chapter covers the general requirement of selection, design, installation, testing, commissioning, and maintenance of automatic sprinkler system for fire fighting in buildings used for other than industrial and storage purposes.

4.1.1 References: For additional information regarding definitions, planning, design, hydraulic calculations, tables etc. the following documents are to be referred to.

(i) IS: 15105: -Design and Installation of Fixed Automatic Sprinkler, Fire Extinguisher Systems-Code of Practice.

(ii) IS: 9972: -Specification for Automatic Sprinkler Heads for Fire Protection Service.

4.2 INTRODUCTION

Fire fighting installations for wet risers, down comers, wet riser cum down comer and automatic sprinklers are to be operated manually. Delay in undertaking manual operation due to late detection and or response, may result in spread of fire. In automatic sprinkler system, sprinkler heads are provided through out the areas to be protected at specified locations such as roof or ceiling, walls, between racks, below obstructions and fitted with water supply lines permanently charged with water under specified pressure. The sprinklers operate at pre-determined temperatures to discharge water over the affected area below and provide an adequate distribution of water to control or extinguish fires. Only those sprinklers which are in the vicinity of fire that is those become sufficiently heated operate. Operation of sprinkler results in flow of water which initiates fire Alarm. Thus, sprinklers perform two functions i.e., first to detect fire and then to provide an adequate distribution of water to control or extinguish it. Water distribution from ceiling level cools down the hot gas which forms beneath the ceiling of enclosure in which fire is developing. This will prevent the spread of fire to adjoining areas and contain damage to limited area.

It should not be assumed that the provision of the sprinkler system entirely obviates the need for other means of fighting fire, and it is important to consider fire precautions in the premises. The system shall be installed only where there is no danger of freezing water in the pipes at any time.

4.3 PLANNING

4.3.1 Extent of Sprinkler Protection: - But for the following exceptions, sprinklers shall be provided in the entire building.

(a) Areas, rooms, or places where the water discharged from a sprinkler may pose a hazard.

(b) Staircase and lift well.

(c) Washrooms, toilets, W.C.

(d) Rooms or compartments where electric switch gear, transformer, DG sets and A.C.

plants have been installed.

In areas under (a) alternative arrangement shall be made. Any part of the building not provided with sprinkler protection shall be separated by walls (225 mm brick or 100 mm RCC). Fire doors not less than 1 h in fire resistance shall be provided in the opening of such walls.

4.3.2 Design, Density and Assumed Maximum Area of Operation (AMAO): -This is different. for different hazards. . For Moderate hazard, water discharge shall at least 5 ltrs. /Min/m^2 over an assumed area of operation covering 360 m2

4.3.3 Sprinkler Spacing, Arrangement and Locations: -Sprinkler heads may be installed on ceiling and or side walls. For selection of the number of sprinklers and their location in each area, the following factors shall be considered.

i.	Maximum Area Coverage per Sprinkler	
	(a) Side wall sprinkler:	9 m2
	(b) Ceiling sprinkler	12 m2
	(c) Extended Coverage Sidewall Sprinkler	30 m2
ii.	Maximum Distance between Sprinklers.	
	(a) Side wall sprinkler:	3 m
	(b) Ceiling sprinkler:	4 m
	(c) Extended coverage Sidewall Sprinkler	4.8 m
iii.	Minimum Distance between Sprinklers:	2m
iv.	Maximum distance between Sprinklers and Boundary:	2 m

While designing sprinklers installation, the recommendation of sprinkler manufacturer shall be considered.

4.3.4 Spacing below Sprinkler Heads: -Clear minimum space of 0.5 m shall be maintained below the deflector of sprinkler head.

4.3.5 Location of Sprinkler in relation to Building Structure:

(i) Ceiling Sprinklers Deflector shall not be less than 150 mm and more than 300 mm below the ceiling.

(ii) Side wall sprinkler defectors shall not be less than 100 mm. and not more than 150 mm. below the ceiling.

(iii) If the depth of a beam in an area is less than 450 mm. distance at (i) and (ii) shall be maintained and provision of beam shall not be considered. If the depth of a beam in an area is more than 450 mm, then the beam shall be regarded as a boundary.

4.3.6 *Concealed Spaces:* -S paces between roofs and ceiling more than 0.8 m deep shall be sprinkler protected.

4.3.7 Obstruction below Sprinklers: Sprinklers shall be fitted under the following types of obstruction which are either.

(a) More than 0.8 m. wide and less than 150 mm. from the adjacent walls or partitions.
OR

(b) More than 1 m. wide.

4.3.8 Pipe Sizing and Design: -Sprinkler heads located shall be connected with pipelines permanently charged with water. Depending upon location of sprinkler heads and site conditions, sprinkler heads may relate to range and distribution pipes.

The pipes connecting the sprinkler heads are to be sized depending upon the number of sprinkler heads and arrangement of their connection. Various pipes connecting the sprinkler heads are termed as below.

(a) Range Pipe.

(b) Distribution Pipe.

(c) Main Distribution Pipe.

(d) Riser.

Sizes of pipes are to be calculated from various tables given in IS: 15105

4.3.9 Installation and Alarm Valve: -A sprinkler installation shall be fitted with suitable main installation valve to control water supply to the installation. The valve set shall comprise of following:

(a) A main stop valve.

(b) An Alarm valve.

(c) A water monitor Alarm gong.

The main stop valve shall be placed in the vicinity of the main entrance of the protected area at an easily accessible place. The valve shall be secured open by a pad locked and protected against damage. A location plate shall be fixed near the valve bearing the following words in raised letters:

4.3.9.1 SPRINKLER STOP VALVE

Alarm valve shall be fitted on the main supply pipe immediately after the main control valve and before any connection is taken off to supply any part of the installation.

Alarm Device: -Water monitor Alarm suitable for sprinkler service shall be provided very close to the installation and Alarm valve. This Alarm shall be provided on the outside of an external wall. The strainer shall be fitted between the motor nozzle and the alarm valve connection. The water outlet shall be positioned so that any flow of water can be seen. The alarm device shall provide an audibility level of 85 dB above the background noise level.

Pressure Gauges: -Pressure gauges shall be provided at each of the following points.

(a) Immediately downstream of the alarm valve.

(b) Immediately up stream of the main stop valve.

Stop cock shall be provided before pressure gauges for removal without interruption of water supply of the installation. Pressure gauges shall be as per IS: 3624.

4.3.10 INSPECTION AND TEST VALVE ASSEMBLY

Inspection and testing of the automatic starting of the sprinkler system shall be done by providing an assembly consisting of gunmetal valves, gunmetal sight glass, bye-pass valve, and orifice assembly as per approved drawing.

4.4.1 FLOW SWITCH

The flow switch shall have a paddle made of flexible and sturdy material of the width to fit within the pipe bore. The terminal box shall be mounted over the paddle/ pipe through a connecting socket. The Switch shall be potential free in either N O or N C position as required. The switch shall be able to trip and make / break contact on the operation of a single sprinkler head. The terminal box shall have connections for wiring to the Annunciation Panel. The flow switch shall have connections for wiring the seat shall be of S.S to the Annunciation Panel. The flow switch shall have IP: 55 protections.

The flow switches work at a triggering threshold bandwidth (flow rate) of 4 to 10 GPM. Further, it shall have a 'Retard' to compensate for line leakage or intermitted flows.

4.4.2 PIPES FOR DRAINAGE:

Sprinkler pipes should be installed so that the system can be thoroughly drained. As far as possible all pipes shall be arranged to drain to the installation drain valve as shown in the drawing for ordinary hazard system.

In the case of basement & other areas where sprinkler pipework is below the installation drain valve & in other trapped points in the system, auxiliary valves of the following sizes shall be provided.

-20 mm valves for pipes upto 50mm dia.

-25 mm valves for 80mm dia pipe.

-50 mm valves for pipes larger than 80mm dia.

4.5 SPRINKLERS TYPE

Sprinklers shall be as per IS: 9972 and the following types.

4.5.1 According to type of discharge

(a) Conventional pattern

(b) Spray pattern

(c) Side wall pattern

4.5.2 According to mounting pattern

(a) Pendent sprinkler

(b) Up right sprinkler

(c) Horizontal sprinkler

(d) Ceiling sprinkler

4.5.5 *According to Temperature Rating*

The sprinkler shall have one of the following temperature ratings and shall be correspondingly color coded.

(a) Glass Bulb type Temp. Rating 57 68 79 93

(Natural White. Blue, Yellow. Red. Color of bulb Liquid. Orange. Red. Yellow. Green. Blue. Marine. Black)

4.6 SELECTION OF TEMPERATURE RATING

The temperature rating of a sprinkler should not be less than 30° C more than the highest anticipated temperature of the location of installation. Under glazed roofs or where there are roof sheets of PVC or similar plastic material, sprinkler shall be rated 79° C to 100° C.

4.7 SELECTION OF ORIFICE SIZE

In moderate hazard applications, sprinklers of orifice size 15 mm. shall be used.

4.8 PROTECTION OF SPRINKLERS

Any sprinkler installed in a position of risk or accidental damage shall be fitted with a metal guard suitable for sprinkler service.

4.9 WATER SUPPLY ARRANGEMENT FOR SPRINKLER

4.10.1 All pumps shall have a common discharge header.

The sprinkler pump will start on pressure loss in the sprinkler header.

Diesel pumps will start and feed water only in case supply to main electric pump is not available or within a preset time the main electric pump fails to start or fails during operation. No other pump will be working when the diesel pump is in operation. Audio-visual alarm shall be available to indicate failure of both sprinkler and main electric pump.

4.10.2 Water Storage Tank-The water storage tank shall be combined for other fire fighting system and sprinkler installation.

4.11 INSTALLATION

The following additional points are to be taken care of for sprinkler installations.

4.11.1 For fixing sprinkler heads, 15 mm. dia M.S. Socket is to be welded to range pipes at the locations as per drawings. The dead plug shall be fixed in the socket.

4.11.2 If sprinkler head is to be provided away from range pipe, M.S. Pipe nipple of suitable size be used to extend the sprinkler head and socket is welded at desired location.

4.11.3 After completion of work in sections, pressure testing at 7.5 kg/cm2 pressure shall be carried out for 24 hrs.

4.11.4 After completion of the entire work, pressure testing of entire pipe work shall be carried out for 24 hrs. at a pressure of 7.5 kg/cm^2. The drop of pressure up to 0.5 kg/cm^2 shall be accepted.

4.11.5 The lines shall be flushed before completion of building work so that any foreign matter which might have entered the system is taken out. The pressurization pump (Jockey Pump) be operated, and valves are opened at different locations.

4.11.6 During occupation of the building, sprinkler heads shall be provided in place of dead plugs. Teflon tape shall be used on threaded portion. The sprinkler heads shall be properly tightened in the socket.

4.11.7 When all sprinklers' heads are installed, pressure is built up in the system by pressurization pump slowly and in case no leak is found, desired pressure is developed and maintained. In case any leak is detected, the same shall be attended before pressurizing the system further.

4.12 COMMISSIONING

As soon as the work is complete, the system shall be commissioned and made available for use in accordance with following:

4.12.1 Flushing the system: Before commissioning, the entire system shall be flushed to ensure that any earth/ foreign matters which might have entered during installation are taken out. For this, pump may be operated, and valves opened at different locations.

4.12.2 As soon as the work is complete, system shall be commissioned and made available for use. Requirement of fire fighting installations is equally important during occupation of the building. If the building is to be occupied in part, fire fighting system of building completed shall be commissioned by isolating the system of under construction portion of the building.

4.12.3 The fire fighting system shall be maintained and manned from the very first day of its commissioning.

4.12.4 Any defects noticed during the warranty period shall be promptly attended by the contractor and availability of the system at all time is to be ensured.

SECTION 05: HAND HELD FIRE EXTINGUISHERS

5.5.1 PORTABLE FIRE EXTINGUISHERS

Scope

Work under this section shall consist of furnishing all labour, materials, appliances and equipment necessary and required to install fire extinguishing hand appliances as per relevant specification of various authorities.

Without restricting to the generality of the foregoing, the work shall consist of the following:

Installation of fully charged and tested fire extinguishing hand appliances as required and specified in the schedule of rates.

1.0 GENERAL REQUIREMENTS

Hand appliances shall be installed in easily accessible locations with the brackets fixed to the wall by suitable anchor fasteners at @ 1 meter height.

Each appliance shall be provided with an inspection card indicating the date of inspection, testing, change of charge and other relevant data.

All appliances shall be fixed in a true workmanlike manner truly vertical and at correct locations.

Distribution / installation of fire extinguisher to be in accordance to IS: 2190.

SECTION 6: FIRE PUMPS AND ALLIED EQUIPMENTS

6.1 SCOPE

Work under this section shall consist of furnishing all labour, materials, equipment and appliances necessary and required to completely install electrically operated and diesel driven pumps and as required by drawings and specified hereinafter or given in the schedule of rates.

a. Electrically operated pumps with motors and diesel engine driven pumps with diesel engines, common base plates, coupling, coupling guard and accessories.
b. Automatic starting system with all accessories, wiring and connections and pressure switches.
c. Motor control centre.
d. Annunciation system with all accessories wiring and connections.
e. Pressure gauges with isolation valves and piping, bleed and block valves.
f. Suction strainers and accessories.
g. Vibration eliminator pads and foundation bolts.

h. Leak-off drain shall be led to the nearest floor drain.

6.2 GENERAL REQUIREMENTS

Pumps shall be installed true to levels on suitable concrete foundations. Base plate shall be firmly fixed by properly grouted foundation bolts.

Pumps and motors shall be truly aligned by suitably instruments. Record of such alignment shall be furnished to Engineer in charge.

All pump connections shall be of standard flanged type with number of bolts as per relevant standard requirement for the working pressure. Companion flanges shall be provided with the pumps.

Tenderer shall provide necessary test certificates, type test certificates, performance curves and NPSH curves of the pumps from the manufacturer when called for. The tenderer shall provide facilities for inspection of equipment during manufacturing and also to witness various tests at the manufacturer's works without any cost

Seismic isolation and clamping for each pump and flexible connection on the suction as well as the discharge side shall be provided.

The tenderer shall submit with this tender a list of recommended spare parts for three years of normal operation.

6.3 ELECTRIC FIRE PUMP

6.3.1 General

The electric fire pump shall be suitable for automatic operation complete with necessary electric motor and automatic starting gear, suitable for operation on 415 volts +10%, 3 phase, 50 Hz. A.C. motor. Both the motor and the pump shall be assembled on a common base plate, fabricated M.S. channel type or cast-iron type. The pump may be either horizontal split casing (HSC) type with operating speed not exceeding 1500 RPM or solid casing with operating speed not exceeding 3000 RPM as specified in tender documents.

6.3.2 Drive

The pump shall be direct driven by means of a flexible coupling. Coupling guard shall also be provided.

6.3.3 FIRE PUMP

The fire pump shall be horizontally mounted centrifugal type. It shall have a capacity to deliver flow as specified, and developing adequate head so as to ensure a minimum pressure of 3.5 Kg/Sq.cm at the highest and the farthest outlet.

The main fire pump shall be suitable for continuous operation in the system. The jockey pump shall be suitable for intermittent operation to built up pressure in the system on account of leakage. The head and discharge requirements shall be as specified in the tender documents. The head shall be suitable for the system and shall take into

consideration the pressure drops across the various components in the Water circuit as well as the frictional losses.

The pump shall be capable of giving a discharge of not less than 150 per cent of the rated discharge, at a head of not less than 65 per cent of the rated head. The shut off head shall be within 120 per cent of the rated head.

The pump casing shall be of cast iron to grade FG 200 to IS: 210 and parts like impeller, shaft sleeve, wearing ring etc. shall be of non-corrosive metal like bronze/brass/gun metal. The shaft shall be of stainless steel. Provision of mechanical seal shall also be made.

Bearings of the pump shall be effectively sealed to prevent loss of lubricant or entry of dust or water. The pump shall be provided with a plate indicating the suction lift, delivery head, discharge, speed and number of stages. The pump casing shall be designed to withstand 1.5 times the working pressure.

Provision of Jockey Pump for low and high zone shall be made. The pump shall be **vertical SS type** and of detail as in schedule of quantity. Tenderer shall verify that the capacity of the Jockey pump shall not be less than 3% (Minimum 180 LPM) and not more than 10% of the installed pump capacity.

6.3.4 MOTOR

The motor shall be squirrel cage A.C. induction type suitable for operation on 415 volts 3 phase 50 Hz. system. The motor shall be totally enclosed fan cooled type conforming to protection clause IP 55. The class of insulation shall be F. The synchronous speed shall be 1500 RPM as specified. The motor shall be rated for continuous duty and shall have a horse power rating necessary to drive the pump at 150 per cent of its rated discharge with at least 65 per cent rated head. The motor shall conform to I.S.325-1978.

6.3.5 MOTOR STARTER

The motor starter shall be as per detail in MCC. The unit shall include suitable current transformer and ammeter of suitable range on one line to indicate the current. The starter shall not incorporate under voltage, no voltage trip overload or SPP.

The starter assembly shall be suitably integrated in the power and control panel for the wet riser system & sprinkler system.

6.3.6 MATERIAL AND CONSTRUCTION

(i) The centrifugal pumps shall conform to IS 1520.

(ii) The pump casing shall be of heavy section close grained cast iron and designed to withstand 1.5 times the working pressure. The casing shall be provided with shaft seal arrangement as well as flanges for suction and delivery pipe connections as required.

(iii) The impeller shall be of bronze or gunmetal. This shall be shrouded type with machined collars. Wear rings, where fitted to the impeller, shall be of the same material as the impeller. The impeller surface shall be smooth finished for minimum frictional loss. The impeller shall be secured to the shaft by a key.

(iv) The shaft shall be of stainless steel and shall be accurately machined. The shaft shall

be balanced to avoid vibrations at any speed within the operating range of the pump.

(v) The shaft sleeve shall be of bronze or gunmetal.

(vi) The bearings shall be ball or roller type suitable for the duty involved. These shall be grease lubricated and shall be provided with grease nipples/cups. The bearings shall be effectively sealed against leakage of lubricant or entry of dust or water.

(vii) The shaft seal shall be mechanical type, so as to allow minimum leakage. A drip well shall be provided beneath the seal.

(viii) The pumps shall be directly coupled to the motor/diesel engine shaft through a flexible coupling protected by a coupling guard.

(ix) The pump and motor/diesel engine shall be mounted on a common base plate fabricated from mild steel section. The base plate shall have rigid, flat and true surfaces to receive the pump and motor/diesel engine mounting feet. The pump will be perfectly aligned with the motor/engine to avoid any vibration during operation.

6.3.7 ACCESSORIES

Each pump shall be provided with the following accessories:

(a) Butterfly/sluice valves on suction and discharge (If positive suction is not provided butterfly valve at suction is not to be provided).

(b) Reducers, as may be required to match the sizes of the connected pipe work.

(c) Non-return valve at the discharge.

(d) Pressure gauge at discharge side between pump and the non-return valve.

6.3.8 INSTALLATION

(i) The pump and motor/engine assembly shall be mounted and arranged for ease of maintenance and to prevent transmission of vibration and noise to the building structure or to the pipe work.

(ii) The pump and motor/engine assembly shall be installed on suitable RCC foundation. The length and width of the foundation shall be such that 100 mm space is left all around the base frame. The height of foundation shall be decided that the total weight of foundation block is 1.5 times the operating weight of the pump assembly. The foundation shall be isolated from the floor by vibration isolating pads. Angle iron frame of size 35 mm x 35 mm x 3 mm shall be provided on the top edges of the foundation. More than one pump and motor assembly shall not be installed on a single base or cement concrete block.

(iii) The suction/discharge pipe shall be independently supported, and their weight shall not be transferred to the pump. It should be possible to disconnect any pump for repairs without disturbing the connecting pipeline.

(iv) Sufficient space is to be left in front for the radiator of diesel engine for free discharge of hot air. Arrangement for discharging hot air to outside the pump house shall be provided so that hot air does not stagnate in the pump house.

6.4 DIESEL FIRE PUMP

6.4.1 GENERAL

The diesel pump set shall be suitable for automatic operation, complete with the necessary automatic starting gear, for starting on wet battery system and shall be complete with all accessories. Both engine and pump shall be assembled on a common base plate.

6.4.2 DRIVE

The pump shall be only direct driven by means of a flexible coupling. Coupling guard shall also be provided. The speed shall be 1500 RPM as specified.

6.4.3 FIRE PUMP

The fire pump shall be horizontally mounted centrifugal type. It shall have a capacity to deliver as specified and develop adequate heads to ensure a minimum pressure of 3.5 Kg/Sq.cm at the highest and the farthest outlet. The pump shall be single/multistage as specified. **The pump shall be capable of giving a discharge of not less than 150% of the rated discharge at a head of not less than 65% of the rated head.** The shut off head shall be within 120% of the rated head.

The pump casing shall be of cast iron to grade FG 200 to IS 210 and parts like impeller, shaft sleeves, wearing ring etc. shall be of non-corrosive metal like bronze/brass/gun metal. The shaft shall be stainless steel. Provision of mechanical seal shall also be made.

The pump casing shall be designed to withstand 1.5 times the working pressure.

The bearing of the pump shall be effectively sealed to prevent loss of lubricant or entry of dust or water.

6.4.4 DIESEL ENGINE

Engine Rating - The engine shall be cold starting type without the necessity of preliminary heating of the engine cylinders or combustion chamber (for example, by wicks, cartridge, heater, plugs etc.). The engine shall be a multi cylinder/vertical 4 stroke cycle, air-cooled, diesel engine, developing suitable HP at the operating speed specified to drive the fire pump. Continuous capacity available for the load shall be exclusive of the power requirement of auxiliaries of the diesel engine, and the after correction for altitude, ambient temperature, and humidity for the specified environmental conditions. This shall be at least 20% greater than the maximum HP required to drive the pump at its duty point.

It shall also be capable of driving the pump at 150% of the rated discharge at 65% of rated head. The engine shall be capable of continuous non-stop operation for 8 hours and major overhaul shall not be required before 3000 hours of operation. The engine shall have 10% overload capacity for one hour in any period of 12 hours continuous run. The engine shall accept full load within 15 seconds from the receipt of signal to start. The diesel engine shall conform to BS 649/IS 1601/IS 10002, all amended up to date.

a. Engine Accessories - The engine shall be complete with the following accessories: -

Fly wheel dynamically balanced.

Direct coupling for pump and coupling guard.

Corrosion Resistor.

Air cleaner.

Fuel service tank support and fuel oil filter with necessary pipe work.

Elect. starting battery (2X12 v).

Exhaust silencer with necessary pipe work.

Governor.

Instrument panel housing all the gauges, including Tachometer, hour meter and starting switch with key (for manual starting)

Necessary safety controls.

b. Fuel System - The fuel shall be gravity fed from the engine fuel tank to the engine driven fuel pump. The engine fuel tank shall be mounted either over or adjacent to the engine itself or suitably wall mounted on bracket. The fuel filter shall be suitably located to permit easy servicing.

All fuel tubing to the engine shall be copper, with flexible hose connections where required. Plastic tubing shall not be permitted.

The fuel tank shall be of welded steel construction (3 mm thick) and of capacity sufficient to allow the engine to run on full load for at least 8 hours. The tank shall be complete with necessary wall mounted supports, level indicator (protected against mechanical injury) inlet, outlet, overflow connections and drain plug and piping to the engine fuel tank. The outlet shall be so located as to avoid entry of any sediment into the fuel line to the engine.

As semi rotary hand pump for filling the daily service tank together with hose pipe 5 mtr. long with a foot valve etc. shall also form part of the scope of supply.

c. Lubricating Oil System- Forced feed Lub. Oil system shall be employed for positive lubrication. Necessary Lub. oil filters shall be provided, located suitably for convenient servicing.

d. Starting System- The starting system shall comprise necessary batteries (2x12v), 24 volts starter motor of adequate capacity and axle type gear to match with the toothed ring on the fly wheel. Bi metallic relay protection to protect starting motor from excessively long cranking runs suitably integrated with engine protection system shall be included within the scope of the work.

The capacity of the battery shall be suitable for meeting the needs of the starting system.

The battery capacity shall be adequate for 10 consecutive starts without recharging with cold engine under full compression.

The scope shall cover all cabling, terminals, initial charging etc.

e. Exhaust System - The exhaust system shall be complete with silencer suitable for outdoor installation, and silencer piping including bends and accessories needed for a run of 15 meter from the engine manifold.(Extra lengths, if any, shall be paid separately).The total back pressure shall not exceed the engine manufacture's recommendation. The exhaust piping shall be suitably supported.

f. Engine shut down mechanism- This shall be auto/ manually operated and shall return automatically to the starting position after use.

g. Governing System- The engine shall be provided with an adjustable governor to control the engine speed within 5% of its rated speed under all conditions of load up to full load. The governor shall be set to maintain rated pump speed at maximum pump load.

h. Engine Instrumentation- Engine instrumentation shall include the following: -

i) Lub. oil pressure gauge.
ii) Lub. oil temperature gauge.
iii) Water pressure gauge.
iv) Water temperature gauge.
v) Tachometer.
vi) Hour meter.

The instrumentation panel shall be suitably resident mounted on the engine.

Engine Protection Devices- Following engine protection and automatic shut down facilities shall be provided: -

i) Low lub.oil pressure.
ii) High cooling water temp.
iii) High lub.oil temperature.
iv) Over speed shut down.

i. Pipe Work - All pipe lines with fittings and accessories required shall be provided for fuel oil, lub.oil and exhaust systems, copper piping of adequate sizes, shall be used for Lub.oil and fuel oil. M.S. piping will be permitted for exhaust.

j. Anti Vibration Mounting- Suitable vibration mounting duly approved by Engineer in charge shall be employed for mounting the unit so as to minimize transmission of vibration to the structure. The isolation efficiency achievable shall be clearly indicated.

k. Battery Charger-Necessary float and boost charger shall be incorporated in the control section of the power and control panel, to keep the battery in trim condition. Voltmeter to indicate the state of charge of the batteries shall be provided.

6.4.5 PUMP SETS ASSEMBLY

On the main fire sprinkler and hydrant headers near pump sets a 150 mm dia by-pass valve located in an accessible location shall be provided along with a rate of flow rotameter calibrated in 1 pm and able to read 200% of the rated pump capacity. The delivery shall be connected to the fire tank.

Each and every pump set assembly shall be provided with suction valve (only for positive suction head), discharge valve, non-return valve and 150 mm dia Bourdon type pressure gauge with isolation valve.

6.4.6 INTERLOCKING

The following inter-locking between the main fire pump, the jockey pump and the diesel engine driven pump:

Only one category of pumps will work at a time i.e. either jockey pump or main fire pump or diesel driven pump.

The above category of pump and sprinkler pump could work at a time.

6.4.8 VIBRATION ISOLATION

The pump set shall be mounted on rolled steel channels and 150 mm thick inertia block spring and ribbed neoprene vibration isolation mounting shall support the inertia block onto 100 mm thick concrete plinths. The spring mountings shall have a maximum deflection of15 mm. Reference shall be made to the section on “Nose and Vibration” for further technical requirements.

SECTION 07: COMMISSIONING & GUARANTEE

7.1 SCOPE OF WORK

Work under this section shall be executed without any additional cost. The rates quoted in this tender shall be inclusive of the works given in this section.

Tenderer shall provide all tools, equipment, metering and testing devices required for the purpose including supply of diesel for diesel pump.

In general, electricity shall be provided free of charge.

All tests shall be made in the presence of Engineer in Charge. At least five working days notice in writing shall be given to the inspecting parties before performing any test.

Water flow rates of all equipment and in pipe lines through valves shall be adjusted to design conditions. Complete results of adjustments shall be recorded and submitted.

Tenderer shall ensure proper balancing of the hydraulic system and for the pipes / valves installed in his scope of work by regulating the flow rates in the pipe line by valve operation. The tenderer shall also provide permanent Tee connection (with plug) in water supply lines for ease of installing pressure gauge, temperature gauge & rotameters. Tenderer shall also supply all required pressure gauge, temperature gauge & rotameter for system commissioning and balancing. The balancing shall be to the satisfaction of Engineer in charge.

Three copies of all test results shall be submitted to the Engineer in Charge in A4 size sheet paper within two weeks after completion of the tests.

7.2 PRE-COMMISSIONING

On completion of the installation of all pumps, piping, valves, pipe connections, etc. the Tenderer shall proceed as follows:

a. Prior to start-up and hydraulic testing, the Tenderer shall clean the entire installation including all water tanks, fitments and pipe work and the like after installation and keep them in a new condition. All pumping systems shall be flushed and drained at least once through to get rid of contaminating materials. All pipes shall be rolled to ensure clearance of debris, cleaning and flushing shall be carried out in sections as the installation becomes completed.

b. All strainers shall be inspected and cleaned out or replaced.

c. When the entire systems are reasonably clean, a pre-treatment chemical shall be introduced and circulated for at least 8 hours. Warning signs shall be provided at all outlets during pre-treatment. The pre-treatment chemical shall:

- Remove oil, grease and foreign residue from the pipe work and fittings;
- Pre-condition the metal surfaces to resist reaction with water or air.
- Establish an initial protective film;
- After pre-treatment, the system shall be drained and refilled with fresh water and left until the system is put into operation.
- Details and procedures of the pre-treatment shall be submitted to the Architect

for approval.

d. Check all clamps, supports and hangers provided for the pipes.

e. Check all the equipment, piping and valves coming under hot water system and operate each and every valve on the system to see if the valves are functioning properly. Thereafter conduct & hydro test of the system as for (b) above.

f. Fill up pipes with water and apply hydrostatic pressure to the system as given in the relevant section of the specification. If any leakage is found, rectify the same and retest the pipes.

7.2.1 FIRE FIGHTING SYSTEM

a. Check all hydrant valves by opening and closing: any valve found to be open shall be closed.

b. Check all the piping under hydro test.

c. Check that all suction and delivery connections are properly made for all pumps.

d. Check rotation of each motor after decoupling and correct the same if required.

e. Test run each pump set.

7.2.2 **COMMISSIONING AND TESTING**

Pressurize the fire hydrant system by running the jockey pump and after it attains the shutoff pressure of the pump, then

Open bypass valve and allow the pressure to drop in the system. Check that the jockey pump cuts-in and cuts-out at the preset pressure. If necessary, adjust the pressure switch for the jockey pump. Close by-pass valve.

Open hydrant valve and allow the water to below into the fire water tank in order to avoid wastage of water. The main fire pump shall cut-in at the preset pressure and shall not cutout automatically on reaching the normal line pressure. The main fire pump shall stop only by manual push button. However the jockey pump shall cut-out as soon as the main pump starts,

Switch off the main fire pump and test check the diesel engine driven pump in the same manner as the electrically driven pump,

When the fire pumps have been checked for satisfactory working on automatic controls, open fire hydrant valves simultaneously and allow the hose pipes to discharge water into the fire tank to avoid wastage. Check each landing valve, male and female couplings and branch pipes, for compatibility with each other. Any fitting which is found to be incompatible and do not fit into the other properly shall be replaced by the Tenderer. Each landing valve shall also be checked by opening and closing under pressure.

Check all annunciations by simulating the alarm conditions at site.

7.2.3 SPRINKLER SYSTEM

a. Start the sprinkler pump and develop the required pressure in the sprinkler pipes.

b. Open the test valve to test the automatic starting of the pump. If necessary, make necessary adjustments in the setting of pressure switch. The sprinkler water gong alarm shall also operate when the test valve is open. This operation is to be done for each section of the sprinkler system and the alarm for each section (via flow switch) shall be checked for operation.

c. After satisfactory operation of the pump the Tenderer shall set up mock fire and test the system.

d. Check all annunciations by simulating the alarm conditions at site.

7.3 STATUTORY AUTHORITIES' TESTS AND INSPECTIONS

On completion of works, the Tenderer shall submit shop/as built drawing and attend all tests and inspections carried out by Local Fire Authorities, Water Authority and other Statutory Authorities, and shall forthwith execute free of charge any rectification work ordered as a result of such tests and inspections where these indicate non-compliance with Statutory Regulations. Some of these tests may take place after the issue of Practical Completion of the Main Contract and the Tenderer shall make all allowances in this respect.

The Tenderer shall be responsible for the submission of all necessary forms and shop drawings to the Statutory Authorities which shall conform in layout to the latest architectural plans submitted to and kept by these Authorities and obtaining necessary clearances.

The submission shall comply with the requirements set forth in the current Codes of Practice and circular letters of the Statutory Authorities. The shop drawings to be submitted shall be forwarded to Engineer in Charge for checking before submission.

The Tenderer shall allow for at least two submissions of complete sets of shop drawings to the Authorities, one to be made within six months after the award of the Contract but not less than six weeks before the inspection.

7.4 FINAL ACCEPTANCE TESTS

Following commissioning and inspection of the entire installation, and prior to issue of the Completion Certificate, the Tenderer shall carry out final acceptance tests in accordance with a program to be agreed with the Architect.

Should the results of the acceptance tests show that plant, systems and/or equipment fail to perform to the efficiencies or other performance figures as given in this Specification, the Tenderer shall adjust, modify and if necessary, replace the equipment without further payment in order that the required performance is obtained.

Where acceptance tests are required by the relevant Authorities having jurisdiction, these tests shall be carried out by the Tenderer prior to the issue of Completion Certificate to the acceptance of the Authorities.

7.5 WARRANTY AND HANDOVER

The Tenderer shall warrant that all plant, materials and equipment supplied and all workmanship performed by him to be free from defects of whatsoever nature before handover.

7.6 HANDING OVER OF DOCUMENTS

All testing and commissioning shall be done by the Tenderer to the entire satisfaction of Engineer in charge and all testing and commissioning documents shall be handed over to Engineer in charge.

The Tenderer shall also hand over all maintenance and operation manuals, all certificates and all other documentation as per the terms of the contract to Engineer in charge.

ADDRESSABLE FIRE DETECTION AND ALARM SYSTEM

1. **BASIS OF DESIGN**

An Intelligent Fire Alarm System (IFAS) shall be provided to effect total control over the life safety services required in the building. The IFAS shall be of the digital, distributed processing, real time, multi-tasking, multi-user and multi-location type.

The IFAS provided shall be able to tie-up the following Mechanical, Electrical & Low Voltage Services into an integrated system.

a. Air Handling Units

b. Lifts

The system shall be provided with Addressable and Analog fire alarm initiating, annunciating and control devices.

The addressable and intelligent system shall be such that smoke sensors, thermal/heat sensors, manual call points etc., can be identified with point address. The system shall be capable of:

a. Setting smoke sensor sensitivity remotely to either high sensitivity manually or on a pre-programmed sequence e.g. occupied/unoccupied period. The FAS shall be able to recognize normal and alarm conditions, below normal sensor values that reveal trouble condition, and above normal values that indicate either a pre alarm condition or the need of maintenance.

b. The operator shall also be able to adjust alarm and pre alarm thresholds and other parameters for the smoke sensors.

c. Provide a maintenance/pre-alert alarm capability at smoke sensors to prevent the detectors from indicating a false alarm due to dust, dirt etc.

d. Provide alarm verification of individual smoke sensors. Systems that perform alarm verification on a zone basis shall not be acceptable. Alarm verification shall be printed on the printer at the Control Station's printer to enhance system maintenance and identify possible problem areas.

e. Provide local numeric point address and Indicating display of device and current condition of the point. Local annunciation shall not interfere with annunciation from

the Fire Control System.

f. Provide outputs that are addressable, i.e. outputs shall have point address. The operator shall be able to command such points manually or assign the points to Logical Point Groups (Software Zones) for pre-programmed operation.

In the event of a fire alarm, but not in a fault condition, the following action shall be performed automatically.

a. The System Alarm Indication on the main fire alarm control panel shall flash.

b. A local piezo-electric sounder in the control panel shall be sounded.

c. The LCD display on the main fire alarm control panel shall indicate all information associated with Fire Alarm condition including the type of alarm point and its location within the premises.

d. History storage equipment shall log the information associated with the Fire Alarm Control Panel condition, along with the time and date of occurrence.

e. All system output programs assigned via control-by-event programs that are to be activated by a particular point in alarm shall be executed, and the associated system outputs (alarm notification appliances and/or relays) shall be activated.

f. All lifts initiated through the systems will automatically be returned to Ground Floor.

g. Air handling units on affected floors shall automatically be switched OFF and simultaneously respective fire dampers shall also be closed.

h. Shall give output for staircase pressurization fans to put on.

i. Shall give signal for start smoke evacuation system.

2. FIRE ALARM CONTROL PANEL (F A C P)

2.1 The distributed Intelligent Fire Alarm Control Panel (FACP) shall function as fully stand-alone panel as well as providing a communication interface to the central station. FACP shall have its own microprocessor, software and memory and should be listed under UL864 or EN54. In the event of failure of the central or communication breakdown between the central station and the FACP, the FACP shall automatically operate on stand-alone mode without sacrificing any functions.

2.2 The memory data for panel configuration and operation shall reside in non-volatile memory (EPROM). The card containing the memory shall have battery back-up for upto 100 hours on the board itself, if required.

2.3 FACPs shall supervise detection circuits and shall generate an alarm in case of abnormal condition.

2.4 FACPs shall provide general purpose inputs for monitoring such functions as low battery or AC power failure. FACPs shall provide tamper protection and commandable outputs, which can operate relays or logic level devices. Output commands shall take any of, but not limited to, maintained command, Momentary Command, Alarm Follow, or Alarm latch as required. Any relay in the FACP which is intended to be removable shall be supervised against removal.

2.5 Smoke detectors shall be powered using the FACP-based smoke detection circuits. FACPs shall provide for resetting smoke detectors, fault-isolation and sensor loop operation. It shall be possible to mix different fire devices within the same FACP to optimize field wiring.

2.6 FACPs shall provide indication for communication with the central console and alarm/trouble conditions in each sensor loops.

2.7 FACPs shall provide monitoring and control of one floor or area or for multiple floors or areas. FACPs shall meet the following requirements to assure the integrity and reliability of the system.

a. The FACP shall be UL (9th Edition) listed independently as a fire alarm control panel.

b. FACP electronics shall be contained in an enclosure made of minimum 16 gauge steel. Access to FACP switches and electronics shall be by key-lock. Usage of no other tools should be required. Visual indicators of FSP status for each zone shall be visible without opening the key-locked cover.

2.8 All hardware and software to allow the FACP configuration and operation to be changed shall be provided. Memory data shall be contained in non-volatile memory (EPROM).

Alarm verification with field-adjustable time from 0 to 60 seconds for individual smoke detector shall be provided. During the alarm verification, the panel shall retard the alarm until the end of the period. If the alarm is only a transient smoke alarm, the panel shall automatically reset the alarm. Only a verified alarm shall initiate the alarm sequence for the software zone (Logical Point Group) or point. Final time setting shall be as per approval of the fire authorities. When alarm verification is being performed on a smoke detector, the action shall be printed on the listed printer(s).

2.10 Display at the FACP shall be provided to indicate point in alarm or trouble. In such systems, means for manually scanning the points in trouble shall be provided and a trouble and alarm LED shall be used to indicate that there are points in alarm/trouble. The alarm/trouble LED shall only extinguish when all alarm/troubles are cleared from the loop.

2.11 It shall be possible to command test, reset and alarm silence from both the FACP and the central console.

2.12 FACP switches shall allow authorized personnel to accomplish the following, independent of the central console:

a. Initiate a general alarm condition.

b. Silence the local audible alarm.

c. It shall be possible to acknowledge (Silence the local FACP audible without silencing the alarm indicating devices (hooters).

d. Reset all zones (Logical Point Group) / points, after all initiating devices have returned to normal.

e. Perform a complete operational test of the microprocessor and memory with a visual indication with each board.

f. Test all panel LEDs for proper operation without causing a change in the condition of

any zone (Logical Point Group)

g. Walk Test

2.13 Software zones/loops shall be circuited and protected by Fault Isolation Modules such that in the event of a zone/loop short-circuit, not more than twenty (20) devices shall be left non-functional.

2.14 Intelligent Smoke and thermal sensors shall be located as shown and shall report sensed levels in analog form.

2.15 Monitor modules shall be provided to monitor and address contact-type input devices. The monitor module shall be supervised by FACP.

2.16 The FACP shall process the true continuous analog signal from the sensors. In addition, the FACP shall further process all analog values for pre-alarm limits to prompt the operator for early maintenance. If a sensor value increases to an above normal level or a pre-alarm limit for an extended duration, the FACP shall communicate maintenance pre-alarm.

a. Any time sensor value transitions beyond the secondary and higher limit value, an alarm initiation and report shall be issued.

b. Limits and sensor values shall be displayed, modifiable, and reported in decimal values.

c. The FACP shall have Drift Compensation facility to compensate for environment. The FACP shall have the ability to recalibrate Pre-alarm and Alarm limits if required, after comparing each sensor's operating characteristics with the set sensitivity. This should be carried out at least once in every 24 hours. FACP should annunciate trouble conditions when sensor(s) is beyond compensation range (excessively dirty sensor).

d. The FACP should be UL listed / FM approved / LPCB or EN 54 approved to provide the sensitivity measurement and documentation required by NFPA72E.

2.17 FACP shall be backed up UPS power and shall also be connected to central DG Power available in the building.

2.18 FACP shall be provided with following features :

Charger Rate Control

Control-by-Time	Non-Alarm Module Reporting
Day/Night Sensitivity	Periodic Detector Test
Device Blink Control	Remote Page

Drift Compensation	Trouble Reminder
NFPA 72 Sensitivity Test	Verification Counters
System Status Reports	Walk Test
Security Monitor Points	Maintenance Alert
Alarm Verification	System Configuration Report
Printer Interface	System Point Report
Event Historical log	Programmable Automatic Timed and Manual Signal Silence
Programmable Manual Signal	Control-By-Event with Boolean Logic Silence Inhibit Timer and Timer Control

2.19 FACP shall have real-time clock to prevent loss of time and date in case of failure of power supplies.

2.20 The display on FACP shall provide indication for AC Power, System Alarm, System Trouble/Security Alarm, Display Trouble and Signal Silence.

2.21 Minimum two different password levels will be provided to prevent unauthorized System control or programming.

2.22 Operator control switches for Signal Silence, lamp Test, Reset, System Test and Acknowledge shall be provided.

2.23 The FACP should truly field programmable. This would mean that in the event of change of any logic, detector / zone sequence alteration, the operator can initiate the FACP panel to reconfigure the above parameters.

2.24 The FACP should have a degraded mode of operation. In the event of the CPU failure the field devices (detectors & modules) should be able to take a decision degrade mode to ensure reliability even during failure.

2.25 Power supply unit of FACP shall have following characters:

a. The main power supply shall be 230 VAC±10%, 50 Hz±1% and shall in turn provide all necessary power of the FACP.

b. It shall provide a battery charger for 24 hours for standby power using dual-rate charging technique for fast battery recharge.

c. It shall provide a very low frequency sweep earth fault detect circuit, capable of detecting earth faults on sensitive addressable modules.

d. It shall provide indication for battery voltage and charging current.

2.26 For ease of service, all wiring terminal blocks shall be plug-in type and shall have sufficient capacity for 18 to 12 AWG wire termination. Fixed terminal blocks shall not be acceptable.

3. DETECTORS & ADDRESSABLE DEVICES

3.1 GENERAL FEATURES COMMON TO ALL DETECTORS

a. Compatibility: All automatic fire detectors shall be interchangeable without requiring different mounting bases or alterations in the signal panel.

b. Sensitivity: On average 30 mgs of burned material per cu.m. (as measured in a 1 cu.m. chamber or .5% obs/ft) shall release an alarm sensitivity which shall be adjustable according to the use of the space.

c. Power Consumption: Each detector shall use the minimum of power, for economic circuits, so that it shall have capacity to connect at least 240 devices & detectors (120 detectors+120 devices) in one loop.

d. Built-in-response indicator: Each detector shall incorporate indicator “LED” at the detector which shall blink during normal condition and light up on actuation of the detector to locate the detector which is operated. The detector shall not be affected by the failure of the response indicator lamp.

e. The detectors meeting the calibrated sensitivity test requirements of NFPA Standard 72.

e. Maintenance: All detectors shall be fitted either with plug-in system or bayonet type connections only, from the maintenance and compatibility point of view.

f. Construction: The detector shall be vibration and shock proof. When disassembling for cleaning purposes, its components must not be damaged by static over voltage.

g. Atmospheric and Thermal Disturbance: The detector shall so design as to be practically immune to environmental criteria such as air currents, humidity, temperature fluctuations, pressure and shall not trigger false alarm, due to the above conditions.

h. Continuous Operation: An alarm release shall not effect a detector’s functioning. After resetting the alarm, the detector shall resume operation without any readjustment.

i. Adaptability to ambient conditions: Detectors shall be designed for adaptability to humid locations. No performance deterioration shall be acceptable.

3.2 ADDRESSABLE HEAT DETECTORS

Heat detectors shall be intelligent and addressable devices and shall connect with two wires to one of the Fire Alarm Control Panel loops. Minimum to 120 intelligent detectors should connect

to one loop.

Heat Sensors shall be intelligent and addressable devices and shall connect to one of the C.I.E. loops.

The Sensors shall use an electronic sensor to measure thermal conditions caused by a fire and shall, on command from the C.I.E., send data to the C.I.E. representing the analogue level the temperature at the sensor.

3.3 **ADDRESSABLE SMOKE DETECTOR**

The intelligent smoke detector shall be an addressable device that is designed to monitor a minimum of photoelectric technologies in a device. The design shall include the ability to adapt to its environment by utilizing a built-in microprocessor to determine its environment and choose the appropriate sensing settings. The detector design shall allow a wide sensitivity window, no less than 1 to 4% per foot obscuration. This detector shall utilize advanced electronics that react to slow smoldering fires.

The microprocessor design shall be capable of selecting the appropriate sensitivity levels based on the environment type it is in (office, manufacturing, kitchen etc.) and then have the ability to automatically change the setting as the environment changes (as walls are moved or as the occupancy changes).

An output connection shall be provided in the base to connect an external remote alarm LED.

3.5 **ADDRESSABLE MANUAL STATIONS**

Addressable manual stations shall be provided to connect to the Fire Alarm Control Panel loops. Minimum 120 addressable manual stations may be connected to one loop.

The manual stations shall on command from the Control Panel send data to the panel representing the state of the manual station.

Stations shall be suitable for surface mounting as shown on the plans, or semi-flush mounting, and shall be installed not less than 42 inches, nor more than 48 inches above the finished floor unless otherwise specified by applicable building codes.

3.6 **ADDRESSABLE MONITOR MODULE**

The monitor module shall provide address-setting and shall also store an internal identifying code which the Fire Alarm Control Panel shall use to identify the type of device. Modules using binary jumpers are not acceptable. An indication shall be provided which shall flash under normal conditions, indicating that the monitor module is operational and in regular communication with the control panel.

3.7 **RESPONSE INDICATOR**

In addition to built-in response indicator in each detector, secondary response indicator of LED type shall be provided outside the rooms wherever asked for by the Architect/Interior

Designer, for indication of fire through detector in the room. The design & colour shall be as per Interior Designer approval.

3.8 **CONTROL MODULE**

The control module shall provide address-setting and shall also store an internal identifying code which the control panel shall use to identify the type of device. Modules which use binary jumpers are not acceptable. An indication shall be provided which shall flash under normal conditions, indicating that the control module is operational and is in regular communication with the control panel.

3.9 **ADDRESSABLE HOOTERS**

All field hooters should preferably be addressable and software configurable. All hooters should be able to provide at least a minimum of 3 different tones, which should be user configurable. The minimum decibel level of each hooter should be 90db. All hooters should be UL/FM listed.

3. FUNCTIONAL REQUIREMENTS

4.1 **INTELLIGENT SYSTEM DEVICES**

a. Each device shall be assigned a unique address via electronic addressing. Address selection via rotary switch are also acceptable.

b. Devices shall receive power and communication from the same pair of conductors.

4.2 **SENSORS**

a. All fire sensors shall mount on a common base to facilitate the changing of sensor type if building conditions change. The base shall be incompatible with conventional detectors to preclude the mounting of a non-intelligent device.

b. Each sensor shall contain an LED which shall blink each time the sensor is scanned by the FACP. If the FACP determines that the sensor is in alarm, the FACP shall command the sensor LED to get latched on.

c. Each sensor shall be capable of being tested for alarm via command from the FACP.

d. Each sensor shall respond to FACP scan for information with its type identification to preclude inadvertent substitution of another sensor type. The FACP shall continue operation with the detector installed but shall initiate a mismatch (trouble) condition until the proper detector is installed.

e. Each sensor shall respond to FACP scan for information with an analog representation of measured fire-related phenomenon (smoke density, particles of combustion, temperature). Systems which only monitor the presence of conventional detector in an addressable base shall not be acceptable.

4.3 **INPUT DEVICES**

a. The input device shall provide an addressable input for N.O. or N.C. contact devices such as manual stations etc.

b. The input device shall provide a supervised initiating circuit. An open-circuit fault shall annunciate at the FACP (subsequent alarms shall be reported).

c. The device shall contain an LED which will blink upon being scanned by the FACP. Upon determination of an alarm condition, the LED shall be latched on.

4.4 **AUTOMATIC FUNCTIONS AT FACP**

The alarms shall be displayed at the FACP on an LCD display. The display shall indicate the device in alarm by ID number, the appropriate alarm state, and the current time and date. It shall also display a point description of minimum 32 characters and, the respective analog value. The display shall also contain a minimum 40 characters alarm message. It shall be possible to see the number of acknowledged alarms, number of current fire alarms, number of trouble conditions and number of other miscellaneous alarms in the system. The FACP printer shall print out same information displayed on the LCD display. The LCD display and printer shall be powered directly from the panel.

4.5 **MANUAL FUNCTIONS AT FACP**

i. At any given time, operator shall have the following manual capabilities at FACP by means of switches located behind a key-locked cover:

   a. Initiate an alarm summary display on the FACP LCD display. This display shall step through all currently active alarms in the system.

   b. Initiate a summary printout of all currently active alarms on the FACP printer.

   c. Initiate an “all-point summary” printout on the FACP printer recording the status of each system point (initiating circuits, indicating circuits etc.)

   d. If the alarm is ignored by an operator than the history of same to be available

ii. At any time, the operator shall have the following manual capabilities at the FACP under password control; Operator privileges and ID numbers of upto four digits shall assignable by the main operator or designated alternate. Actions taken by operators shall automatically be printed on the FACP printer with operator initials, time and date.

   a. Commands output points to different mode. Such commands shall be printed with selected descriptors ON/OFF/AUTO, OPEN/CLOSE, DAY/NIGHT etc. In addition, command shall be used to ISOLATE or DISCONNECT points. When isolated, alarms and troubles shall be received but not acted upon.

   b. Modify system parameters. Alphanumeric key pad shall be provided for operators to modify the following parameters :

      - Change sensor alarm and pre-alarm threshold
      - Update date and time

- Change point descriptors
- Change action message
- Disable a point
- Change sensor verification time
- Change password
- Activate/deactivate indicating output control point
- Control-by-event programs on line

c. Select a system status report for printing on the printer from the control station. The following real time reports shall be provided:

- All point log.
- Alarm summary
- Trouble summary
- Status summary
- Sensitivity log
- Disabled points log.
- Isolated points log
- Disconnected points log
- Logical group points log

The sensitivity log shall print the analog value of each addressable analog sensor.

d. Select printing of a trend sensitivity log which when enabled, shall print minimum last 24 analog values for every addressable analog sensor taken at predetermined intervals. Systems which limit the number of addressable analog sensors which can be trended are not acceptable.

e. Select a sequence of programmed commands which can be automatically executed, in sequence, via a single command.

f. Perform a walk-test function such that a operation can be periodically checked out for all initiating devices on a zone. In walk test mode, all initiators on the selected zone shall automatically be isolated. As each device is placed into an alarm or trouble condition, the FACP shall print the condition and automatically reset the device. No audible signals shall be initiated from the zone to prevent disruption of building occupants. If a zone is inadvertently left in the walk-test mode, it shall automatically reset to normal after a five-minute idle time is exceeded.

4.6 **SYSTEM SUPERVISION**

a. In the normal supervisory condition, only the “POWER” ON, and “RUN” conditions, shall be illuminated. The LCD display shall display “System Normal” and the current time and date.

b. The LCD display shall indicate the loss of power condition and the printer shall record

the same. Following restoration of normal AC power, the trouble indicators shall be automatically reset and the printer shall record the 'return to normal condition'.

c. The LCD display shall indicate the loop in trouble and the printer shall record same.

d. The LCD display shall indicate trouble and the printer shall record same. Operation of a momentary "Silence" switch shall silence the audible trouble signal but the visual "Trouble" LEDs shall remain ON until the malfunction has been corrected and the system has reset. The FACP printer shall record this action.

4.7 **PROGRAMMING OF FACP**

The LCD display and printer programming shall be accomplished on site by means of keypad inbuilt in panel which shall plug into the FACP. Modules requiring off-site programming are not acceptable. LCD shall initiate test of all addressable sensors in the system.

Programming functions shall include alarm/trouble type assignment, point descriptor assignment, alarm message assignment etc. Data file for the LCD display and a printer shall be stored in EEPROM.

4.8 **OTHER DEVICES**

Fault-isolation of fire zones (Logical Point Group) / circuit modules shall be provided to enable part of a fault-tolerant loop to continue operating when a short occurs in the loop.

4.9 **FIRE CONTROL SEQUENCES**

Upon activation of fire alarm devices:

FACP will display the exact address & alarm in the panel.

The Central Control Station shall switch OFF the AHUs of the affected floor fire damper and toilet exhaust fans while the AHUs on the other floors shall remain operational so as to keep the area under positive pressure. Staircase pressurization fans shall be operated through the fire alarm system.

The lifts alarms (provided by lift) shall be tied to the Fire Alarm System. The Fire Alarm System shall function as follows:

In the event of a fire, a signal will be provided by the Fire Alarm System to return all lifts to ground floor.

Should an emergency alarm originate from an individual lift, an audible alarm shall sound at both Fire Control Stations.

When an alarm is detected

- All include annunciating devices on the floor one above and one below shall sound.
- Stairwell pressurization fans shall be started.
- The air handling unit for the floor shall be stopped.
- The air handling unit on the floor above and the floor below shall be started unless those floors are also in alarm.
- Smoke extraction.

If the alarm has not been acknowledged at the central panel within one minute, all audible annunciating devices on the floor above and the floor below shall sound.

It the alarm has not been acknowledged at the central panel within three minutes, all audible annunciating devices on the building shall sound.

It shall be possible to accomplish the following, independent of the central console:

a. Initiate a general alarm condition.
b. Silence the local audible.
c. Silence the alarm signals. It shall be possible to acknowledge (silence) the local FACP audible without silencing the alarm indicating devices (hooters).
d. Reset all zones, after all initiating devices have returned to normal.
e. Perform a complete operational test of the microprocessor and memory with a visual indication of satisfactory communication with each board.
f. Test all panel LED's for proper operation without causing a change in the condition of any zone.
g. Print reports of all points based on Historical data.
h. Read the status of each point based on LCD display and print the status information.
i. Change passwords.
j. Disable points/zones.
k. Change sensitivity of sensors.
l. Perform a walk test and generate walk test report.

ANNEXURE FF

BOQ