KERALA STATE CO-OPERATIVE MARKETING FEDERATION
Maveli Rd, Gandhi Nagar, Kadavanthra, Kochi 682 020.
Phone: +91 484 2203879, +91 484 2203375
E-mail: mdmarketfed@gmail.com
Website: www.marketfed.com

Date : 05.06.2025

TENDER NOTICE

Kerala State Co-Operative Marketing Federation (MARKETFED) invites e-Tenders for the following work from eligible Contractors possessing appropriate class registration in CPWD/ State PWDS/ Government Undertakings for executing this work. A certified copy of the Contractor's License shall be enclosed with the Tender. Partnership firms shall furnish full names of all partners in the tender. It may, however, be signed in the partnership name by one of the partners or by a duly authorized representative, followed by the name and designation of the persons signing.

TENDER NO: MARKETFED/CL/01/2025

1.	Name and address of Owner	Kerala State Co-Operative Marketing Federation, Maveli Road, Gandhi Nagar, Kadavanthra, Kochi 682 020. Phone: 0484 2203879, 0484 2203375 E-mail: mdmarketfed@gmail.com Website: www.marketfed.com
2.	Name of Work	Construction of Godown Building at Thaliparamba.
3.	Estimate Amount	Rs. 283.00 Lakhs.
4.	Earnest Money Deposit (EMD)	Rs. 1,00,000/- (Rupees One Lakh only)
5.	Tender Submission Fee	Rs.7,500/- + GST 18% extra
6.	Period of completion	6 months
7.	Tender Documents	Can be downloaded from the website **www.etenders.kerala.gov.in**
8.	Last date and time of Receipt of Tender/Bids	27.06.2025 at 3.00pm
9.	Date and Time of Opening of Tender	28.06.2025 at 03.30pm
10.	Form of Contract	Item rate

GENERAL TERMS AND CONDITIONS OF E-PROCUREMENT

This tender is an e-Tender and is published online for the above work. This tender is invited in 2 cover system from the registered and eligible firms / contractors through e-procurement portal of Government of Kerala (https://www.etenders.kerala.gov.in). Prospective bidders willing to participate in this tender shall necessarily register themselves with above mentioned e-procurement portal.

The tender timeline is available in the critical date section of this tender published in www.etenders.kerala.gov.in

A) Online Bidder registration process:

Bidders should have a Class II or above Digital Signature Certificate (DSC) to be procured from any Registration Authorities (RA) under the Certifying Agency of India. Details of RAs will be available on www.cca.gov.in. Once, the DSC is obtained, bidders have to register on www.etenders.kerala.gov.in website for participating in this tender. Website registration is a one-time process without any registration fees. However, bidders have to procure DSC at their own cost.

Bidders may contact e-Procurement support desk of Kerala State IT Mission over telephone at 0471-2577088, 2577188, 2577388 or 0484-2336006, 2332262 – through email:etendershelp@kerala.gov.in for assistance in this regard.

B) Online Tender Process:

The tender process shall consist of the following stages:

i. **Downloading of tender document**: Tender document will be available for free download on www.etenders.kerala.gov.in. However, tender document fees shall be payable at the time of bid submission as stipulated in this tender document.

ii. **Pre-bid meeting**: Nil

iii. **Publishing of Corrigendum**: All corrigenda shall be published on www.etenders.kerala.gov.in and shall not be available elsewhere.

iv. **Bid submission**: Bidders have to submit their bids along with supporting documents to support their eligibility, as required in this tender document on www.etenders.kerala.gov.in. No manual submission of bid is allowed and manual bids shall not be accepted under any circumstances.

v. **Opening of Technical Bid and Bidder short-listing**: The technical bids will be opened, evaluated and shortlisted as per the eligibility and technical qualifications. All documents in support of technical qualifications shall be submitted (online). Failure to submit the documents online will attract disqualification. Bids shortlisted by this process will be taken up for opening the financial bid.

vi. **Opening of Financial Bids**: Bids of the qualified bidder's shall only be considered for opening and evaluation of the financial bid on the date and time mentioned in critical date's section.

C) DOCUMENTS COMPRISING BID:

(i). The First Stage (Cover 1- Prequalification cum Technical Bid Document):

Pre-Qualification cum Technical bid proposal shall contain the scanned copies of the following documents which every bidder has to uplod:

i. Document proof of Eligibility Criteria mentioned in clause 1.01 of Notice Inviting Tender.

ii. Online Tenders/bids are to be accompanied with a preliminary agreement executed in Kerala stamp paper worth Rs. 200/-.

iii. The format for information about the tenderer attached in special conditions of contract and tender form in NIT shall be duly filled by the tenderer and should upload the same as pdf format with technical bid.

The department doesn't take any responsibility for any technical snag or failure that has taken place during document upload. Hard copy of Preliminary agreement shall be submitted to the office of Kerala State Co-Operative Marketing Federation (MARKETFED), Ernakulam before the price bid opening. The other credentials shall be submitted to the above office as and when requested from our end.

(ii). The Second Stage (Cover 2- Financial Bid):

The Bidder shall complete the Price bid as per format given for download along with this tender.

Note: The blank price bid should be downloaded and saved on bidder's computer without changing file-name otherwise price bid will not get uploaded. The bidder should fill in the details in the same file and upload the same back to the website.

Fixed price: Prices quoted by the Bidder shall be fixed during the bidder's performance of the contract and not subject to variation on any account. A bid submitted with an adjustable/ variable price quotation will be treated as non - responsive and rejected.

D) Tender Document Fees and Earnest Money Deposit (EMD)

The Bidder shall pay a tender document fees of Rs.7,500/- + GST 18% and Earnest Money Deposit or Bid Security of Rs.1,00,000/-. The Bid security is required to protect the purchaser against risk of Bidder's conduct, which would warrant the forfeiture of security.

Online Payment modes: The tender document fees and EMD can be paid in the following manner through e-Payment facility provided by the e-Procurement system:

i. **State Bank of Travancore (SBT) Internet Banking**: If a bidder has a SBT internet banking account, then, during the online bid submission process, bidder shall select SBT option and then select Internet banking option. The e-Procurement system will re-direct the bidder to SBT's internet banking page where he can enter his internet banking credentials and transfer the tender document and EMD amount.

ii. **National Electronic Fund Transfer (NEFT)/Real Time Gross Settlement (RTGS)**:

If a bidder holds bank account in a different bank, then, during the online bid submission process, bidder shall select NEFT/RTGSoption. An online remittance form would be generated, which the bidder can use for transferring amount through NEFT/RTGS either by using internet banking of his bank or visiting nearest branch of his bank. After obtaining the successful transaction receipt no., the bidder has to update the same in e-Procurement system for completing the process of bid submission. Bidder should only use the details given in the Remittance form for making a NEFT/RTGS payment otherwise payment would result in failure in e-Procurement system.

As NEFT payment status confirmation is not received by e-Procurement system on a real-time basis, bidders are advised to exercise NEFT mode of payment option at least 48 hours prior to the last date and time of bid submission to avoid any payment issues.

For RTGS the timings that the banks follow may vary depending on the customer timings of the bank branches and settlement from RBI. Bidders are advised to exercise RTGS mode of payment at least 24 hours prior to the last date and time of bid submission to avoid any payment issues.

NEFT/RTGS payment should done according to following guidelines:

i. **Single transaction for remitting Tender document fee and EMD**: Bidder should ensure that tender document fees and EMD are remitted as one single transaction.

ii. **Account number as per Remittance Form only:** Account no. entered during NEFT/RTGS remittance at any bank counter or during adding beneficiary account in Internet banking site should be the same as it appears in the remittance form generated for that particular bid by the e-Procurement system. Bidder should ensure that tender document fees and EMD are remitted only to the account number given in the Remittance form provided by e-Procurement system for that particular tender.

Bidders must ensure that the banker inputs the Account Number (which is case sensitive) as displayed in the Remittance form. No additional information like bidder name, company name, etc. should be entered in the account no. column along with account no. for NEFT/RTGS remittance.

iii. **Only NEFT/RTGS Remittance Allowed:** Account to Account transfers, State Bank Group Transfers (GRPT), Payments from NRE Accounts, SWIFT Transfers, IMPS or Cash payments are not allowed and are treated as invalid mode of payments. Bidder must ensure that the banker does NEFT or RTGS (for above 2 lakhs payments as per RBI Guidelines) transaction only and specially instruct the banks not to convert the payment type to GRPT or any other payment mode.

iv. **Amount as per Remittance form**: Bidder should ensure that the amount being remitted is neither less nor higher than the amount shown in remittance form.

v. **UTR Number:** Bidders should ensure that the remittance confirmation (UTR number) received after NEFT/RTGS transfer should be updated as it is, in the

e-Procurement system for tracking the payment.

vi. **<u>One Remittance Form per Bidder and per Bid:</u>** The remittance form provided by e-Procurement system shall be valid for that particular bidder and bid and should not be re-used for any other tender or bid or by any other bidder.

Any transaction charges levied while using any of the above modes of online payment has to be borne by the bidder. The supplier/contractor's bid will be evaluated only if payment status against bidder is showing "Success" during bid opening.

E) SUBMISSION PROCESS:

For submission of bids, all interested bidders have to register online as explained above in this document. After registration, bidders shall submit their Technical bid and Financial bid online on www.etenders.kerala.gov.in along with online payment of tender document fees and EMD.

For page by page instructions on bid submission process, please visit www.etenders.kerala.gov.in and click "Bidders Manual Kit" link on the home page.

It is necessary to click on "Freeze bid" link/ icon to complete the process of bid submission, otherwise the bid will not get submitted online and the same shall not be available for viewing/ opening during bid opening process.

Tenders/bids received online without the preliminary agreement will not be considered and shall be summarily rejected. Further details can be had from the Notice Inviting Tender (NIT) or Office of the Kerala State Co-Operative Marketing Federation (MARKETFED), Ernakulam during working hours.

Sd/-
Managing Director

SECTION -I

NOTICE INVITING TENDER (NIT)

1.01 The tenderer should submit the following eligibility criteria documents as PDF format in designated covers.

Eligibility Criteria

i. The bidder should be a well-established reputed civil contractor based in India, and experience of minimum 7 years and previous experience on similar works in India

ii. Experience of having successfully completed similar works during last five years which should be either of the following:

- Three similar completed works each costing not less than 40 percent of estimated cost of work, which includes supply of materials and installation works.

Or

- Two similar completed works each costing not less than 60 percent of estimated cost of work, which includes supply of materials and installation works.

Or

- One similar completed work costing not less than 80 percent of estimated cost of work, which includes supply of materials and installation works.

iii. The bidder should have an average annual turnover of value equal to the estimated cost of work for the last three financial years (FY 2021-22, 2022-23, 2023-24).

iv. The bidder should be a profit making organization for the last three consecutive financial years (FY 2021-22, 2022-23, 2023-24).

v. Work Experience from private sector shall be supported with TDS Certificate.

vi. The bidder should have valid Registration Certificate, PAN, GST registration, ESI and PF Registration.

vii. Offers from joint venture shall not be accepted.

viii. The bidder should also have valid 'A' grade Electrical Tenderers license issued by KSELB or should associate a person with the above license.

ix. Offers from bidders facing any recovery proceedings pending before any judicial forums or quasi judicial forums will not be accepted.

(The proof of the above shall be submitted in designated covers)

The schedule of quantities, tender drawings, specifications and commercial conditions of the Contract are appended.

1.02 The general information of the project is given in Annexure to this NIT. The information is only indicative. The tenderers are required to visit the site and familiarise themselves with the site conditions, nature of strata, availability of construction materials, etc., before quoting. The drawings, general & special conditions of contract, schedule of quantities and the technical specifications may be carefully studied before they offer their prices. No claims for extra compensation over and above the quoted rates will be entertained by ACCEPTING AUTHORITY on the ground that the tenderer have misjudged site conditions, nature of strata, tender conditions or any item of tender.

1.03 The offer shall be valid for 90 days from the tender opening date.The firm period of a tender is the period from, the date of opening of the tender to the date upto which the offer given in the tender is binding on the bidder. The firm period is fixed as the maximum time required within which a decision can be taken on the tender and order of acceptance issued in writing to the bidder which shall not exceed 90days in the normal course. The consideration of tenders and decision there on shall be completed well before the date of expiry of the firm period noted in the tender so that the letter of acceptance is sent before the expiry of the firm period. If delay is anticipated, the officer who invited the tenders shall get the consent of the lowest two bidders for extending the firm period by one month or more as required. In case the lowest or any bidder refuses to extend the firm period that tender cannot be considered. All officers concerned with the consideration of tenders, shall deal with them expeditiously to settle the contract before the expiry of the firm period.

1.04 After the public opening of the tenders, the information relating to the examination, clarification, evaluation and comparison of tenders and recommendations concerning the award of Contract all shall be online.

1.05 Subject to ACCEPTING AUTHORITY's right to accept any tender and reject any or all tenders; the work will be awarded to the tenderer whose bid has been determined to be substantially responsive to the tender documents and who has offered the lowest Evaluated Tender Price provided further that the tenderer has the capability and resources to carry out the contract effectively.

1.06 Prior to the expiry of the period of validity of the tender ACCEPTING AUTHORITY will notify the successful tenderers in writing their name, the sum which ACCEPTING AUTHORITY will pay to the contractor in consideration of the execution, completion, operation, maintenance and guarantee of the work by the contractor as specified by the contract (hereinafter called the contract price). This letter of acceptance will constitute the formation of a contract.

1.07 Before commencing the work and 15 days after the letter of acceptance of the tender has been intimated to him, the tenderer shall make a performance security deposit as given in clause 1.13 of this notice and furnish the same for the proper

fulfilment of the contract and shall execute an agreement for the work in required non-judicial stamp paper of value not less than Rs.200/- in the prescribed format.

1.08 If the tenderer fails to execute the agreement as stated above within the specified period, the earnest money deposit shall be forfeited to ACCEPTING AUTHORITY and fresh tenders called for or the matter otherwise disposed of. If as a result of such measures due to the default of the tenderer to pay the required deposit, execute the agreement or take possession of the work site, any loss to ACCEPTING AUTHORITY results, the same will be recovered from the tenderer by deducting from any amount due to him from other works or revenue recovery or by suitable course of action including legal proceedings.

1.09 Tenders not properly filled, mutilated with incorrect calculations or generally not complying with the conditions are susceptible to be rejected.

1.10 In the case of percentage rate contract only a single rate as an overall percentage above or below or at par with the rate given in the schedule by a single entry at the specified column of the schedule under the head quoted rate, may be made. The overall percentage rate accepted and specified in the agreement shall not be varied on any account whatever. In case of item rate tender, only the rate quoted shall be considered. In event no rate has been quoted for any item(s) leaving space both in figure(s), word(s), and amount blank, it will be presumed that the contractor has included the cost of this / these item(s) in other items and rate for such item(s) will be considered as zero and work will be required to be executed accordingly. The bidder should quote each and every items. The rate thus quoted will deemed to include the cost of all materials, labour, hire charges for all machinery's, cost of fuel, power, all leads and lifts, taxes, levies, royalties all over heads contingencies, profits, etc. and the quoted price is all inclusive. The total contract price shall also be worked out and entered in.

1.11 If the tender is made by an individual it shall be signed with his full name and his complete address shall be given. If it is made by partnership firm it shall be signed with the co-partnership name by a member of the firm who shall sign his own name and give the name and address of each partner of the firm and attach a copy of 'Power of Attorney' with the tender authorising him to sign on behalf of the other partners. A certified copy of the 'Registered Partnership Deed' shall also be submitted along with the tender. A certified copy of the registered deed shall also be submitted along with the tender.Joint ventures were not permitted to bid.

1.12 EMD

1.12.01 The EMD of **Rs.1,00,000/-** shall be remitted through online payment mechanism for e-procurement system of Govt. of Kerala **www.etenders.kerala.gov.in**. As per present system EMD should remitted through NEFT/RTGS through SBT. Bidders, who have secured exemption from individual EMD payments, need not do this except when special Earnest Money is asked to be deposited. Such EMD exemption certificate/document needs to be scanned and submitted online along

with the bid, failing which, the bid shall be rejected summarily. The original EMD exemption document may have to be produced, if required, failing which, the bid shall be rejected summarily.

1.12.02 Bidders shall remit the tender fees and EMD by using the online payment options of e-Procurement system only. As described in condition 'D' of General Terms and Conditions of E-Procurement.

1.12.03 EMD deposited with ACCEPTING AUTHORITY will be forfeited,

i) if a bidder withdraws his bid during the period of validity specified.
ii) if the successful bidder fails within the time limit to sign the contract document or fails to furnish the required security deposit.

1.12.04 EMD will be refunded to the Contractor after remittance of the security deposit and execution of the agreement.

1.13 PERFORMANCE SECURITY DEPOSIT

1.13.01 Within 15 days of issue of letter of acceptance, the Contractor should submit 5% of the Contact Value as Performance Guarantee. Of this, 50% of the Performance Guarantee shall be in the form of DD in favour of Kerala State Co-Operative Marketing Federation (MARKETFED), payable at Ernakulam from Nationalised \Scheduled Bank. Balance 50% of Performance guarantee shall be in the form of Bank Guarantee.

1.13.02 In addition to Performance Guarantee, Security Deposit shall be collected by deduction from the running/final bill of the Contractors @ 2.5% of the gross amount of each running and / or final claims.

1.13.03 All the deposits of EMD, PERFORMANCE GUARANTEE AND SECURITY DEPOSIT will not bear any interest whatsoever.

1.14 REFUND OF PERFORMANCE SECURITY DEPOSIT

1.14.01 On satisfactory completion of the work and after obtaining the completion certificate the 50% of Performance Guarantee kept in the form of Bank Guarantee will be refunded to the Contractor based on the report from the Engineer-in-Charge.

1.14.02 On completion of Defects Liability Period, the Engineer-in-Charge, shall recommend, on demand from the Contractor to refund to him the 50% of Performance Guarantee kept in the form of DD and the Security Deposit deducted from RA Bills, and the same will be refunded by the Accepting Authority provided that the Engineer-in-Charge is satisfied that there is no demand outstanding against the Contractor.

1.15 STATUTORY DEDUCTIONS

1.15.01 Income-tax at the rate prevailing at the time of payment will be deducted from each running account bill and final bill.

1.15.02 All statutory payments in connection with the employment of the workmen for this work will be borne by the Contractor.

1.15.03 The Contractor is the employer of all the worker's engaged for this work and should therefore take all required registrations and pay premium correctly to labour welfare funds constituted by the Union Government and Government of Kerala from time to time as per the existing rules.

1.15.04 All statutory deductions shall be made from the amount eligible to the Contractor in each part bill at current rates. The deduction towards the GST shall be as per the prevailing rates of Kerala Government Rules. Any tax omitted, to be deducted in any part bill shall be deducted in the subsequent bills/final bill.

1.16 QUANTUM OF WORK

1.16.01A schedule of approximate quantities for various items accompanies this tender. It shall be definitely understood that ACCEPTING AUTHORITY do not accept any responsibility for the correctness or completeness of this schedule in respect of items and quantities and this schedule is liable to alteration by deletions, deductions or additions at the discretion of ACCEPTING AUTHORITY without affecting the terms of the Contract.

1.16.02ACCEPTING AUTHORITY reserves the right to increase or decrease the quantum of work at site without assigning any reason.

1.16.03Variations in the quantities put to tender will not be the basis of any claim or disputes. The rates agreed by the Contractor shall hold good for any amount of variation in the quantities and no claims whatsoever will be entertained on this amount. The Contractor shall carry out all works as directed by ACCEPTING AUTHORITY at the same agreed rates.

1.17 ALL INCLUSIVE RATES

The quoted rate of Contractor must be firm and shall be inclusive of cost of transportation of material to the site and all applicable taxes and dutiesof State Government as well as Central Government including GST.

The rates quoted by the Contractor shall be firm throughout the Contract period and there shall be no upward revision of the rates quoted by the Contractor for any reasons whatsoever. It should be clearly understood that any claims for extra GST, Excise duty, or any Additional tax, etc., shall not be entertained in any case whatsoever once the tenders are opened.

1.18 INTERPRETING SPECIFICATIONS

1.18.01 In interpreting the specifications, the following order or decreasing importance shall be followed:

a. Specification mentioned in Schedule of Quantities
b. Unit Rate Specifications and Technical Specifications,
c. Special Conditions of Contract,
d. Drawings,

1.18.02 Matters not covered by the specifications given in the Contract, as a whole shall be covered by the relevant Indian Standard Codes. If such codes on a particular subject have not been framed, the decision of ACCEPTING AUTHORITY shall be final.

1.19 ALTERATIONS

No alterations shall be made by the tenderer in the Notice Inviting Tender, Instructions to the Contractors, Contract form, General Conditions of the Contract, Special Conditions of Contract, drawings and specifications and if any such alterations are made or any conditions attached, the tender is liable to be rejected.

1.20 ACCEPTANCE OF THE TENDER

1.20.01 The acceptance of a tender rests with the Authorised Representative of ACCEPTING AUTHORITY who does not bind himself to accept the lowest tender and reserves to himself the authority to reject any or all the tenders received without assigning any reason(s) whatsoever.

1.20.02 Theauthorised representative of ACCEPTING AUTHORITY reserves the right of accepting the whole or any of the tenders received and the tenderer shall be bound to perform the same at the rates quoted.

1.20.03 The work shall be carried out under the direction and supervision of ACCEPTING AUTHORITY or their representative at site. On acceptance of the tender, the Contractor shall intimate the name of his accredited representative who would be supervising the construction and would be responsible for taking instructions for carrying out the work.

1.20.04 ACCEPTING AUTHORITY's decision with regard to the quality of the material and workmanship will be final and binding, any material rejected thus shall be immediately removed by the Contractor and replaced by materials as per specifications and standards.

1.21 DEFECTS LIABILITY PERIOD

Defect Liability Period will be 1 year from the date of completion of work. Any defect developed within 'Defect Liability Period' will have to be rectified by the Contractor at their own cost and in case the defects are not rectified by the Contractor, ACCEPTING AUTHORITY or their representative shall get the work done at the risk and cost of the Contractor.

1.22 DELAYS IN COMMENCEMENT

The Contractor shall not be entitled to any compensation for any loss suffered by him on account of delays in commencing or executing the work, whatever the cause for such delays may be including delays in procuring Government Controlled or other materials.

1.23 **OCCUPATION IN PART & CO-OPERATION**

1.23.01 If ACCEPTING AUTHORITY wants to occupy areas in part, the Contractor shall complete the work of these areas in conjunction with ACCEPTING AUTHORITY and hand over the same to ACCEPTING AUTHORITY without affecting any of the clause of Contract agreement.

1.23.02 The Contractor must co-operate and co-ordinate with other Contractors involved in other works at the site. The Contractor should also note that they shall have to clear the site of vegetation, debris, etc. before the commencement of the work and that no extra payment is permissible on this account.

1.24 ISSUE OF MATERIALS, TOOLS AND PLANT

1.24.01 The Contractor should inspect the source of materials, their quality, quantity and availability.All materials must strictly comply with the relevant B.I.S. specifications.

1.24.02 ACCEPTING AUTHORITY shall issue the following material or Tools and Plants required for the execution of the works.

a) Materials **Nil**
b) Tools and Plants **Nil**

1.25 **PERIOD OF CONSTRUCTION**

Time is the essence of this contract. The construction period shall be **12** months. Commencement of the work shall be considered from the 15th day after the date of receipt of letter of acceptance or handing over of the site, whichever is later. The Contractor shall draw a detailed schedule of programme in the form of a Bar Chart on whole work, within one week of award of work and submit to the Owner for their approval.

1.26 **INSURANCE**

The successful tenderer shall take out Contractor's All Risk (CAR) insurance policy, jointly in the name of ACCEPTING AUTHORITY and the Contractor, and the original policy shall be deposited with ACCEPTING AUTHORITY.

1.27 This Notice Inviting Tender will form part of the tender document and the agreement executed by the successful tenderer.

1.28 The format for information about the tenderer attached in special conditions of contract and tender form in NIT shall be duly filled by the tenderer and should submit the same along with the tender.

Managing Director,
Kerala State Co-Operative Marketing Federation (MARKETFED)

ANNEXURE TO NIT

GENERAL INFORMATION OF THE PROJECT

1. Name of Project	:	Construction of Godown Building at Thaliparamba.
2. Site and location	:	Thaliparamba.
3. Nature/scope of work	:	Construction of Godown Building.
4. Nearest Railway Station	:	Kannur
5. Nearest Airport	:	KIAL, Kannur
6. Owner/Client	:	Kerala State Co-Operative Marketing Federation, Maveli Road, Gandhi Nagar, Kadavanthra, Kochi 682 020.
7. Accepting Authority	:	Managing Director, Kerala State Co-Operative Marketing Federation, Maveli Road, Gandhi Nagar, Kadavanthra, Kochi 682 020.
8. Payment Authority	:	Managing Director, Kerala State Co-Operative Marketing Federation, Maveli Road, Gandhi Nagar, Kadavanthra, Kochi 682 020.
9. Period of completion of work	:	As per NIT

TENDER FORM

TENDER NO: MARKETFED/CL/01/2025

To

The Managing Director,
Kerala State Co-Operative Marketing Federation,
Maveli Road, Gandhi Nagar,
Kadavanthra, Kochi 682 020.

Dear Sirs,

Sub: Tender for Construction of Godown Building at Thaliparamba.

With reference to the tender invited by you for the above proposed work, I/We do hereby Tender for the same after having:

a) Examined the designs, drawings, details, specifications schedule of quantities, instructions to tenders, agreement and the conditions of contract annexed thereto (hereinafter called the Contract Documents).

b) Visited the site of work, studied the site conditions, nature of strata, availability of construction materials etc., and

c) Acquired the requisite information on all prevailing factors affecting the tender.

I/We undersigned hereby offer to construct the proposed work in strict accordance with the Contract document for the consideration to be calculated in terms of the priced schedule of quantities.

I/We have noted that time is the essence of the contract and ready to undertake and complete the whole of the works as per the attached schedule from the date of issue of an intimation by you that our tender has been accepted and upon receiving possession of site. I/We further undertake that on failure subject to the conditions of the contract relating to extension of time, I/We are willing to pay the agreed Liquidated Damages/Penalty for the period during which the work remains incomplete beyond the due date of completion.

I/We further agree to the deduction of security deposit mentioned in NIT which will be returned to me/us as per the relevant clauses in the agreement. The deduction will be as explained in clause 1.13 of Notice Inviting Tender.

I/We undertake to execute the work of electrification of various facilities if any, through a licensed electrical contractor of appropriate class as given in the tender condition. All the requirements of supervision, testing, commissioning and energizing will be fulfilled by us.

We have also executed the preliminary agreement as is enclosed.

Further we undertake to execute the works which will be entrusted to us in the most workman like manner within the stipulated completion period. If our Tender is found acceptable, we agree to enter into a contract as specified by you within 15 days of this receipt of intimation of acceptance of our tender.

Our Bankers are:

1.....

2.....

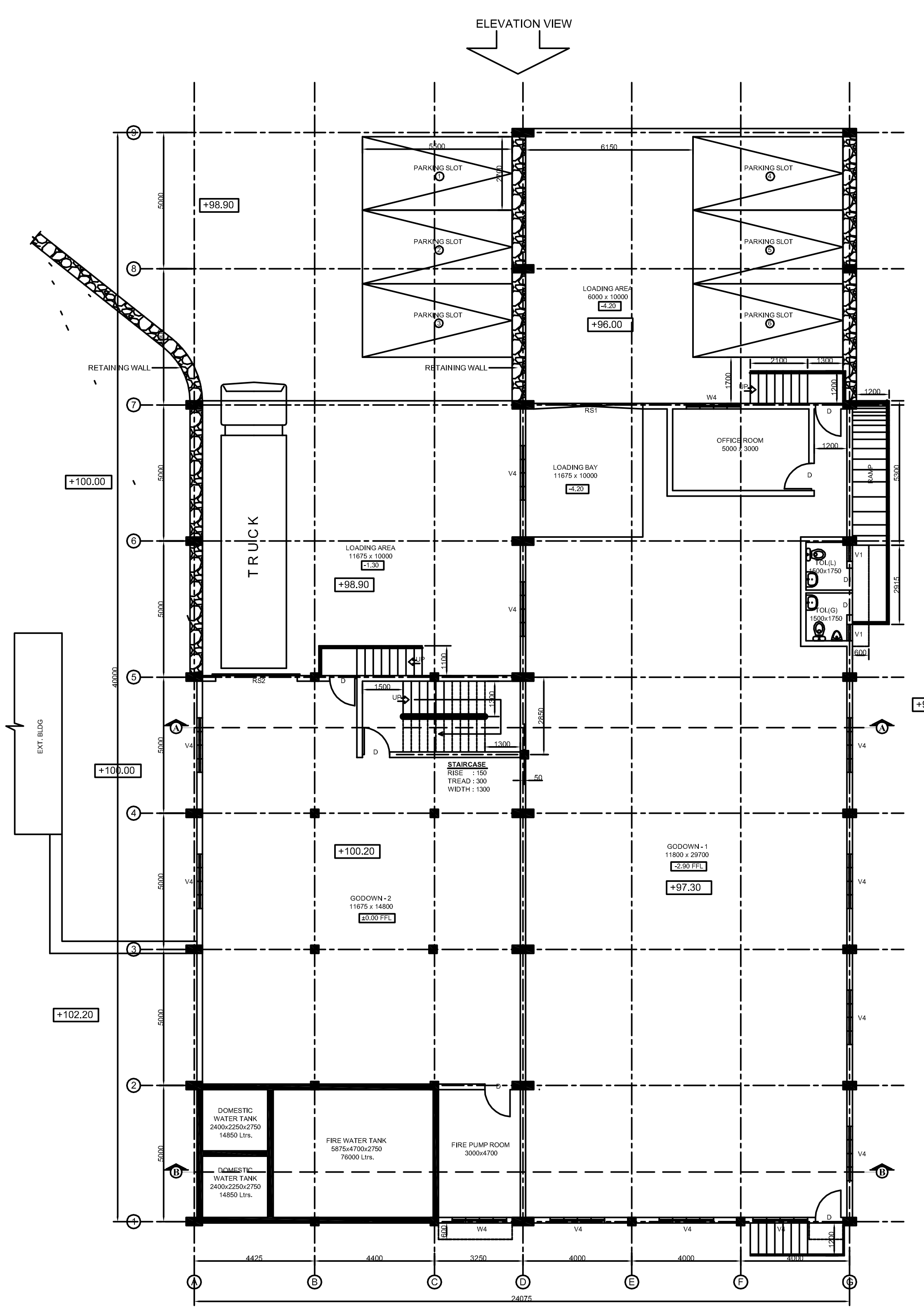
Place:
Date :

Signature of tenderer

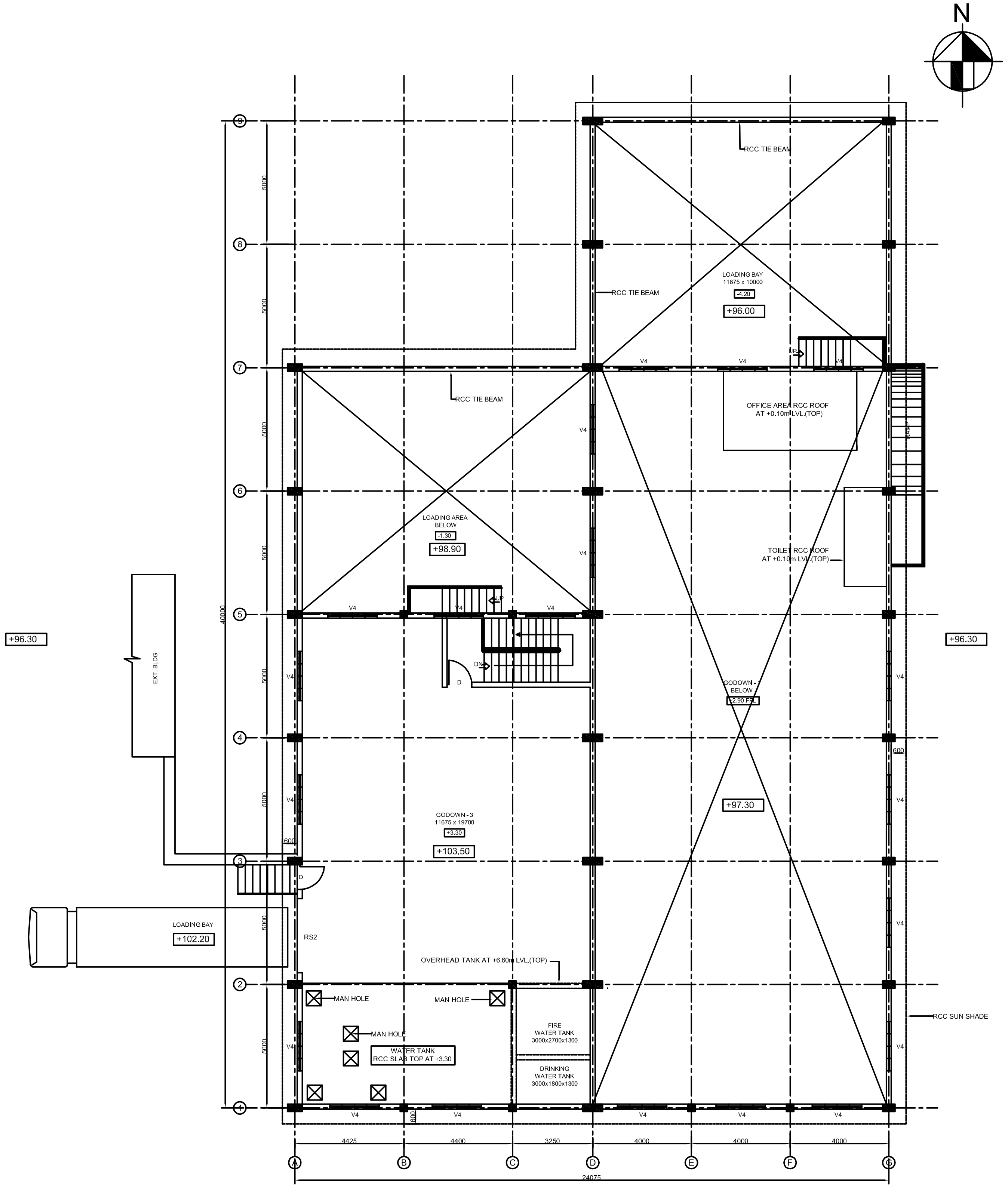
Name of the partners of the firm
OR
Name of the person having power of
Attorney to sign the contract.

Postal Address :

Telephone Number
i) Land :
ii) Mobile :
Email:
Income Tax PAN No. :
GST Registration No. :



GROUND FLOOR PLAN
Plinth Area: 605.20 Sq.m
Loading/Parking Area: 240.00 Sq.m



FRIST FLOOR PLAN AT +3.30m LVL.(TOP)
Area: 242.70 Sq.m

DETAILS OF JOINERIES		
RS 1	ROLLING SHUTTER	4000 x 4500
RS 2	ROLLING SHUTTER	3000 x 2700
D	AL. PANELLED DOOR	1000 x 2100
D1	FRP DOOR	800 x 2100
W4	AL. GLAZED WINDOW	2000 x 1350
V1	VENTILATOR	600 x 600
V4	VENTILATOR	2000 x 600

NOTES:-
1. ALL DIMENSIONS ARE IN MILLIMETRES AND LEVELS ARE IN METRES
2. ONLY WRITTEN DIMENSIONS SHOULD BE FOLLOWED
3. ±0.00 Lvl. CORRESPONDS TO GODOWN No: 2 FINISHED FLOOR LEVEL. (SY. INTIAL LEVEL AT +100.20)

NOTES:-
1. All dimensions are in centimetres, and all levels are in metres unless otherwise specified. All dimensions to be verified on site & approved by the Engineer.
2. Do not scale from this drawing. Only written dimensions should be followed. For centre line dimensions, refer Architectural drawings.
3. This drawing should be read in conjuction with other relevant Architectural, Structural, mechanical and Electrical Drawings and all relevant sections of the specifications. Any discrepancy found in the drawing shall be brought to the nitice of the consultants immediately.
4. Drawings issued in digital form shall be used only for tender / estimate purposes. Only hard copies sealed / signed by the Consultants shall be used for execution of the work.

S.No.	DESCRIPTION	DATE

REVISIONS

SCALE	DATE	DRAWN	CHECKED
1:100	02.11.2020		
JOB No.	DRG. No.	SHEET	REV
TS-394	TS-394:CL-01:001	1OF2	1

ISSUED FOR: TENDER-PURPOSE

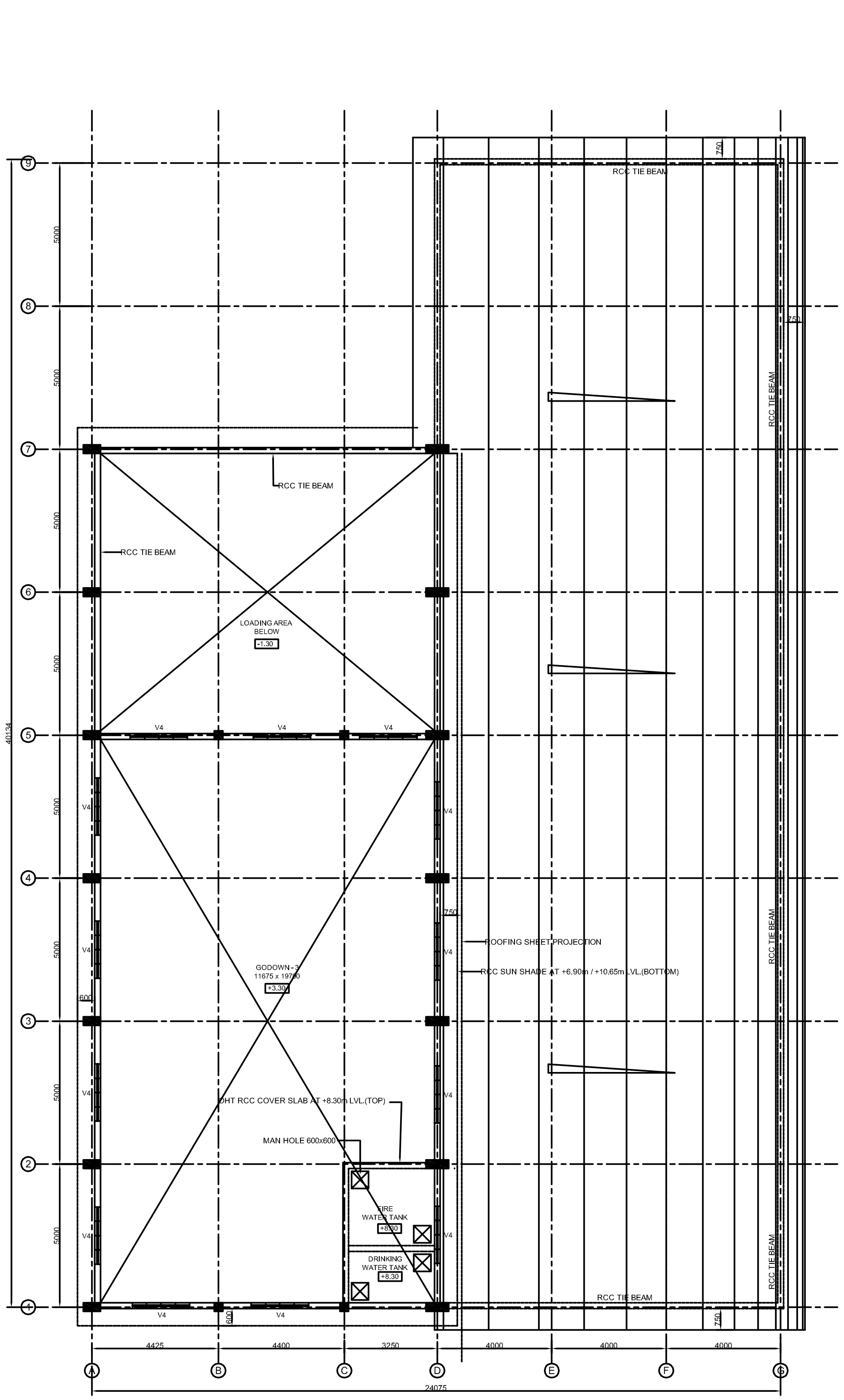
TITLE: PLAN ELEVATION & SECTION OF GODOWN BUILDING

PROJECT: CONSTRUCTION OF GODOWN BUILDING AT THALIPARAMBA

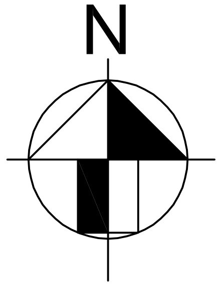
CLIENT: THE KERALA STATE CO-OPERATIVE MARKETING FEDERATION LTD.
Head Office, Gandhi Nagar, Kochi - 682 020

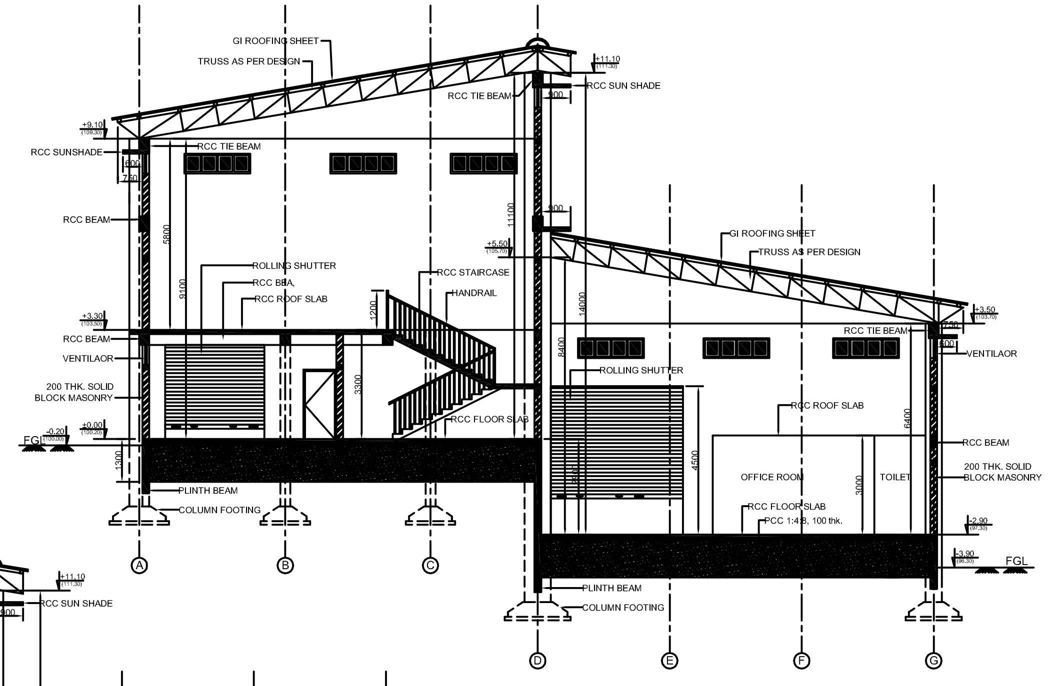
STRUCTURAL CONSULTANT: Associated STRUCTURAL CONSULTANTS

PROJECT CONSULTANT: feats
Feat Technical Services Pvt.Ltd.
First Floor, G-17, Panampilly Nagar, Cochin 682 036
Tel: 0484 - 4010463 Email: featscochin@gmail.com

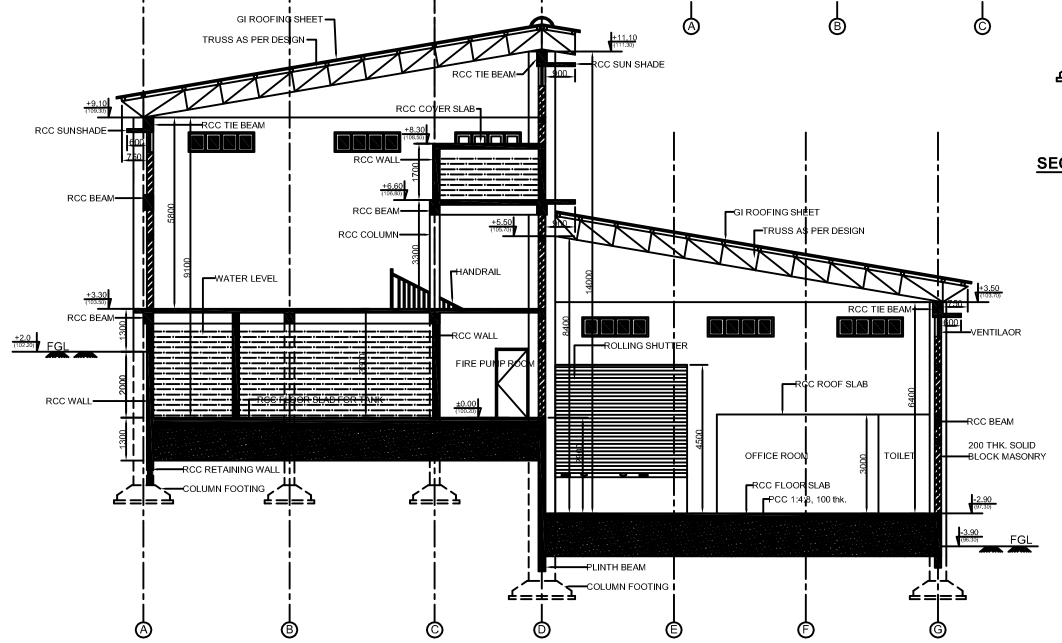


OVER HEAD TANK PLAN AT +8.30m LVL.(TOP)

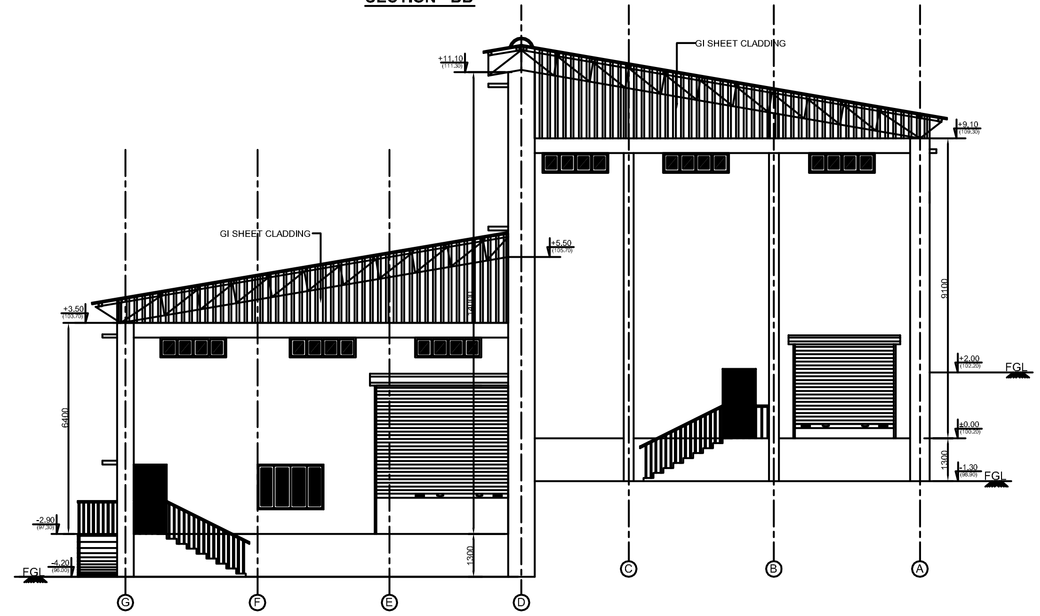




SECTION - AA



SECTION - BB



ELEVATION

DETAILS OF JOINERIES		
RS 1	ROLLING SHUTTER	4000 x 4500
RS 2	ROLLING SHUTTER	3000 x 2700
D	AL. PANELLED DOOR	1000 x 2100
D1	FRP DOOR	800 x 2100
W4	AL. GLAZED WINDOW	2000 x 1350
V1	VENTILATOR	600 x 600
V4	VENTILATOR	2000 x 600

NOTES:-

1. ALL DIMENSIONS ARE IN MILLIMETRES AND LEVELS ARE IN METRES
2. ONLY WRITTEN DIMENSIONS SHOULD BE FOLLOWED
3. ±0.00 Lvl. CORRESPONDS TO GODOWN No: 2 FINISHED FLOOR LEVEL. (SY. INTIAL LEVEL AT 100.20)

NOTES:-

1. All dimensions are in centimetres, and all levels are in metres unless otherwise specified. All dimensions to be verified on site & approved by the Engineer.
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S.No.	DESCRIPTION	DATE

REVISIONS

SCALE	DATE	DRAWN	CHECKED
1:100	02.11.2020		
JOB No.	DRG. No.	SHEET	REV
TS-394	TS-394:CL-01:001	2OF2	1

ISSUED FOR:
TENDER-PURPOSE

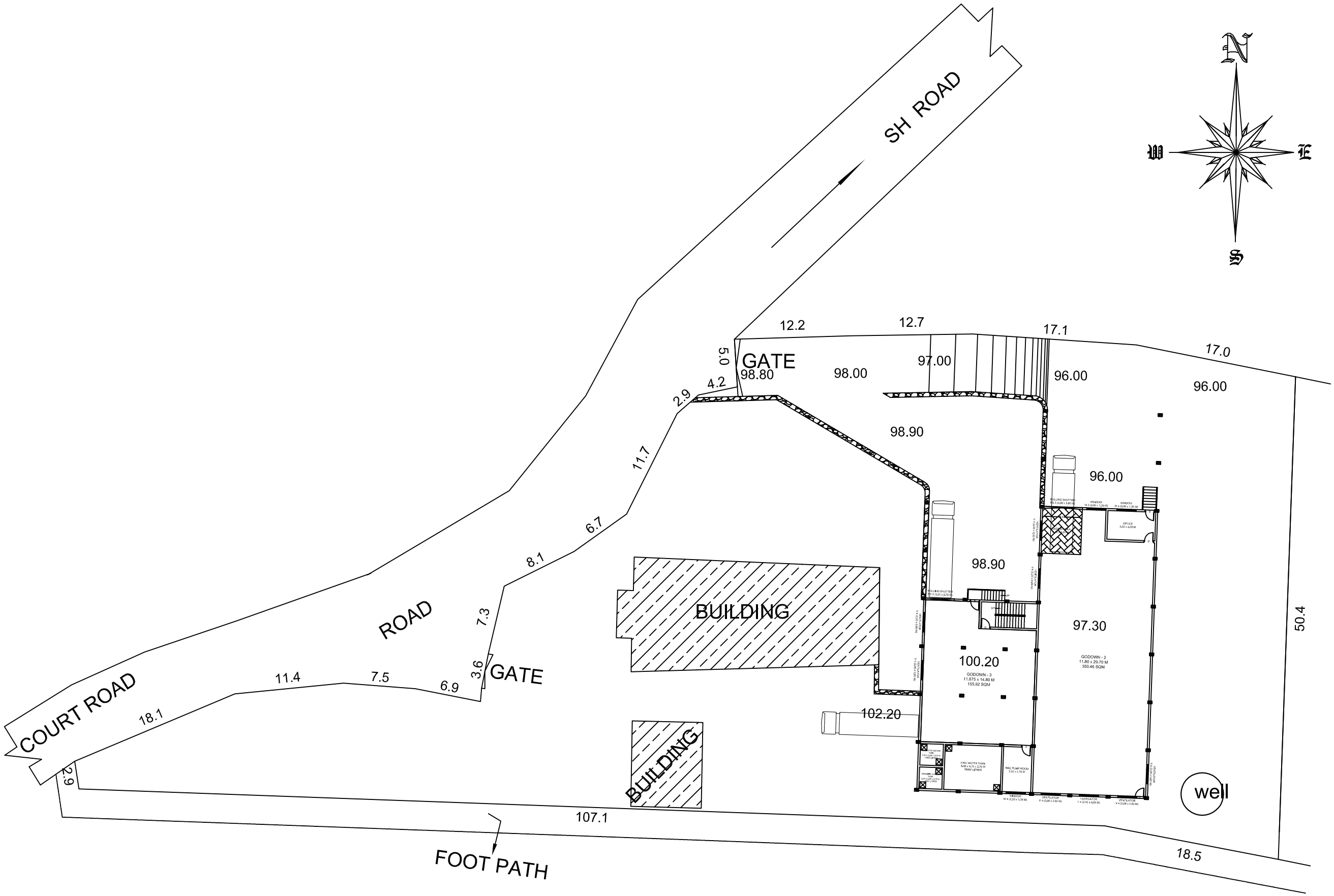
TITLE
PLAN ELEVATION & SECTION OF GODOWN BUILDING

PROJECT
CONSTRUCTION OF GODOWN BUILDING AT THALIPARAMBA

CLIENT
THE KERALA STATE CO-OPERATIVE MARKETING FEDERATION LTD.
Head Office, Gandhi Nagar, Kochi - 682 020

STRUCTURAL CONSULTANT
Associated STRUCTURAL CONSULTANTS

PROJECT CONSULTANT
feats
Feat Technical Services Pvt.Ltd.
First Floor, G-17, Panampilly Nagar, Cochin 682 036
Tel: 0484 - 4010463 Email: featscochin@gmail.com



LAYOUT PLAN OF GODOWN BUILDING

NOTES:-

1. All dimensions are in centimetres, and all levels are in metres unless otherwise specified. All dimensions to be verified on site & approved by the Engineer.
2. Do not scale from this drawing. Only written dimensions should be followed. For centre line dimensions, refer Architectural drawings.
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S.No.	DESCRIPTION	DATE
	REVISIONS	

SCALE	DATE	DRAWN	CHECKED
NTS	02.11.2020	VJJ&JJ	JJ

JOB No.	DRG. No.	SHEET	REV
TS-394	TS-394:CL-01:004	1OF2	0

ISSUED FOR:
TENDER-PURPOSE

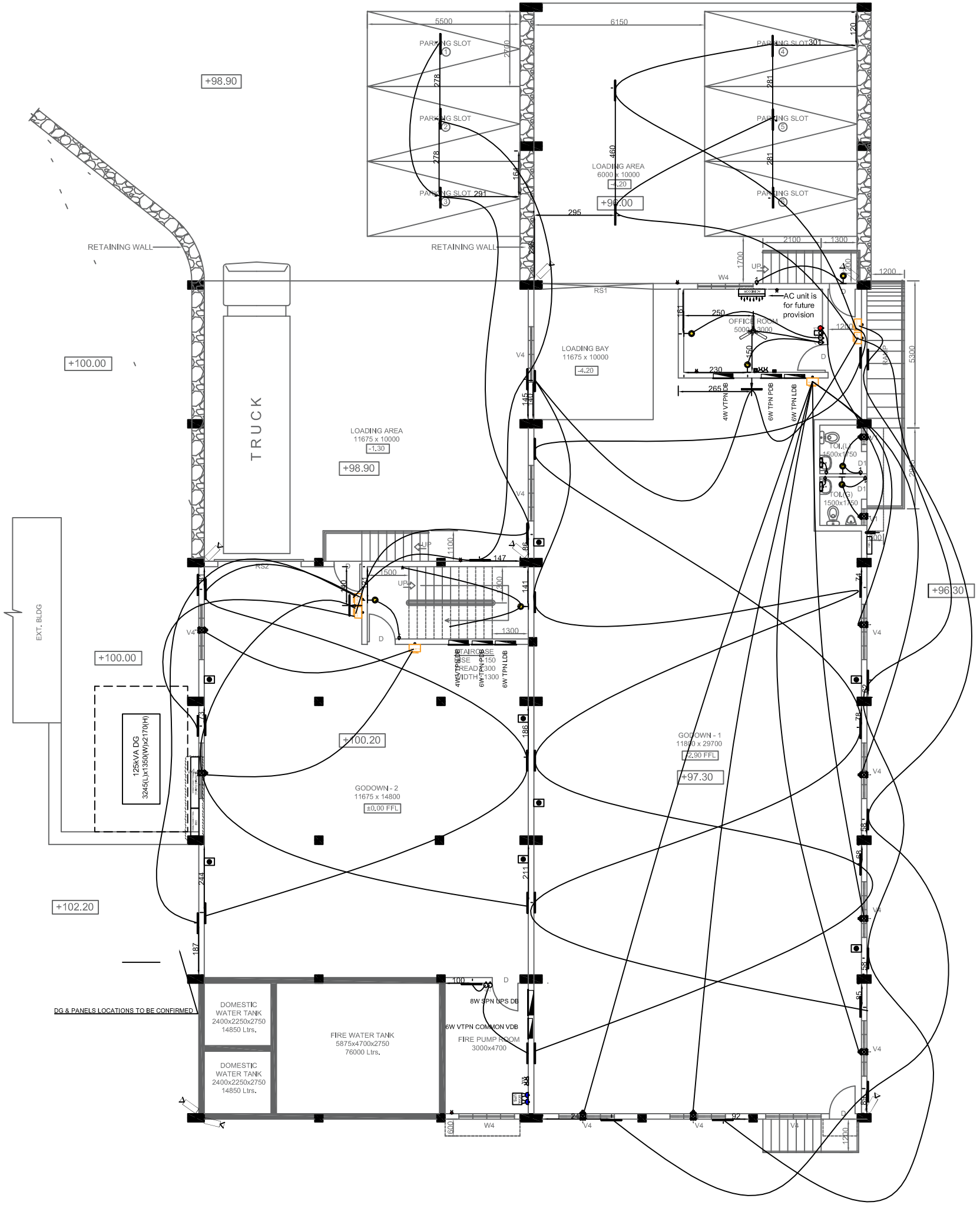
TITLE
LAYOUT PLAN OF GODOWN BUILDING

PROJECT
CONSTRUCTION OF GODOWN BUILDING
AT THALIPARAMBA

CLIENT
THE KERALA STATE CO-OPERATIVE
MARKETING FEDERATION LTD.
Head Office, Gandhi Nagar, Kochi - 682 020

STRUCTURAL CONSULTANT
Associated
STRUCTURAL CONSULTANTS
[illegible]

PROJECT CONSULTANT
feats
Feat Technical Services Pvt.Ltd.
Ground Floor, HB-47, Panampilly Nagar, Cochin 682 036
Tel: 0484- 4011868, 4010463 Email: feats@rediffmail.com



GROUND FLOOR PLAN
PlInth Area: 605.20 Sq.m
Loading/Parking Area: 240.00 Sq.m

LEGEND

	SYMBOL	DESCRIPTION
1		6A SWITCH - 1 WAY
2		WALL LAMP
3		6A SOCKET WITHOUT SWITCH
4		6A SOCKET WITH SWITCH
5		16A SOCKET WITH SWITCH
6		16A SOCKET WITH SWITCH(UPS)
7		20A DP SWITCH
8		6A SWITCH - 1 WAY(UPS)
9		6A SWITCH -2 WAY(UPS)
10		10A DP MCB
11		VDB @ 150 CM FROM FFL
12		PDB @ 150 CM FROM FFL
13		LDB @ 150 CM FROM FFL
14		UPS DB @ 150 CM FROM FFL
15		DATA POINT
16		MIRROR LAMP
17		TUBE LIGHT
18		20A AC SOCKET
19		AC INDOOR UNIT
20		AC OUTDOOR UNIT
21		EXHAUST FAN
22		FAN REGULATOR
23		CEILING FAN
24		UNINTERRUPTIBLE POWER SUPPLY
25		CAMERA
26 27		32 A INDUSTRIAL SOCKET FOR PRESSURE WASHER
28		WIFI ACCESS POINT
29		TELEPHONE

ALL DIMENSIONS ARE IN CM UNLESS OTHERWISE SPECIFIED

1.CONTROL LINES.
2.UPS CONTROL LINES.
3.CCTV CONDUIT 32mm.

NOTES:

1. Total lighting in the designed area is maintained as per the required
2. All concealed conduits through slab shall be of heavy duty PVC
3. The switch board shall be placed 230 mm from door
4. All light fittings are indicative of light points.Fittings shall be the selection of client.

PROJECT :

MARKET FED STORAGE SPACE AT THALIPARAMB

ARCHITECT :

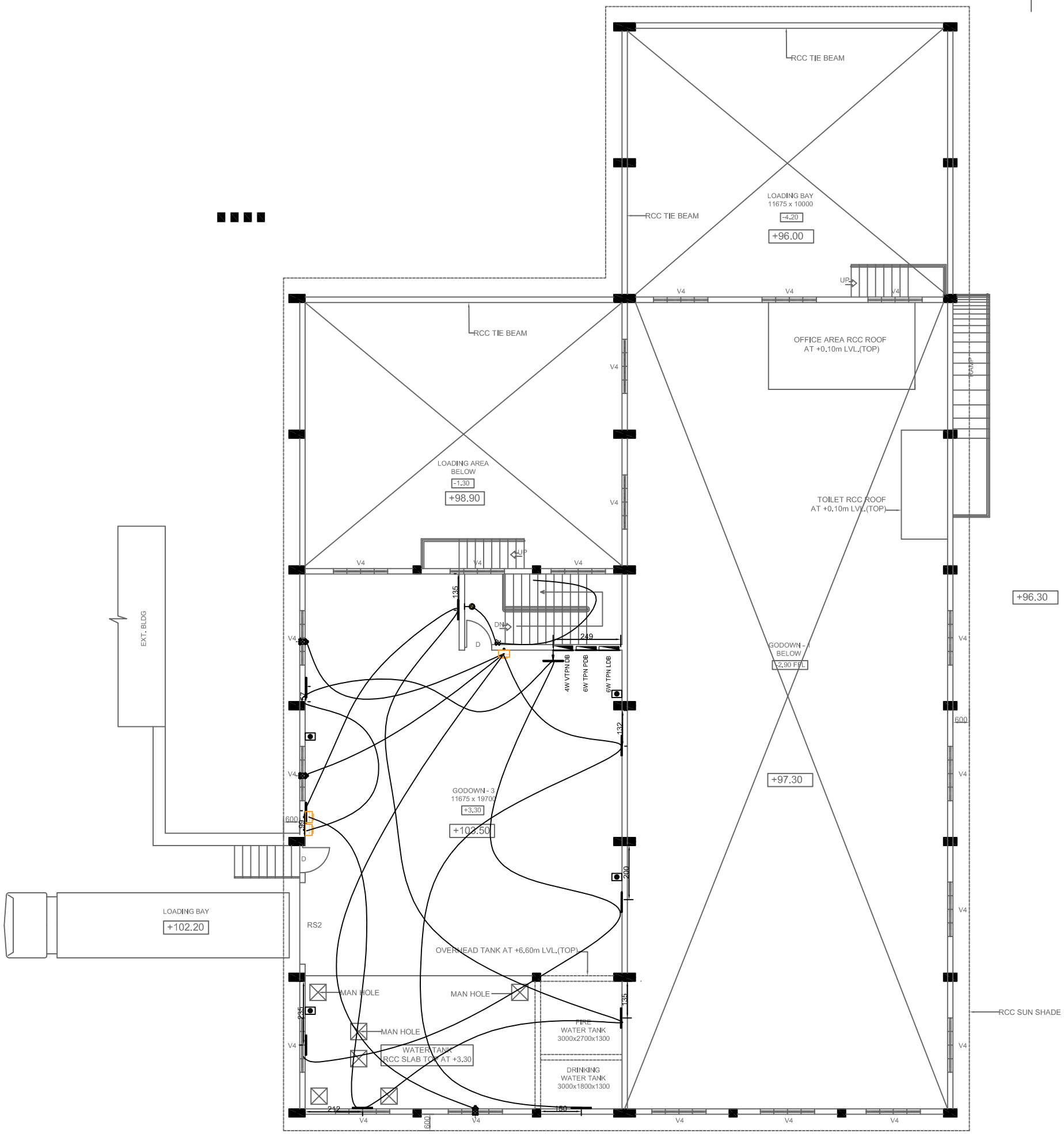
DRAWING TITLE :

ELECTRICAL LAYOUT OF GROUND FLOOR

DRAWN	SG	DATE	27.03.2024
CHECKED	AV	SCALE	
APPROVED	JE	DIMS	
TYPE	DRAWING NUMBER	SHEET	REV. NO.
ELECTRICAL	E-L-GF-01	01	00

CONSULTANT :

PROJECT CONSULTANT
feats
Feat Technical Services Pvt.Ltd.
First Floor, G-17, Panamplily Nagar, Cochin 682 036
Tel: 0484 - 4010463 Email: featscochin@gmail.com



FRIST FLOOR PLAN AT +3.30m LVL.(TOP)
Area: 242.70 Sq.m

LEGEND

	SYMBOL	DESCRIPTION
1		6A SWITCH - 1 WAY
2		WALL LAMP
3		6A SOCKET WITHOUT SWITCH
4		6A SOCKET WITH SWITCH
5		16A SOCKET WITH SWITCH
6		16A SOCKET WITH SWITCH(UPS)
7		20A DP SWITCH
8		6A SWITCH - 1 WAY(UPS)
9		6A SWITCH -2 WAY(UPS)
10		10A DP MCB
11		VDB @ 150 CM FROM FFL
12		PDB @ 150 CM FROM FFL
13		LDB @ 150 CM FROM FFL
14		UPS DB @ 150 CM FROM FFL
15		DATA POINT
16		MIRROR LAMP
17		TUBE LIGHT
18		20A AC SOCKET
19		AC INDOOR UNIT
20		AC OUTDOOR UNIT
21		EXHAUST FAN
22		FAN REGULATOR
23		CEILING FAN
24		UNINTERRUPTIBLE POWER SUPPLY
25		CAMERA
26 27		32 A INDUSTRIAL SOCKET FOR PRESSURE WASHER
28		WIFI ACCESS POINT
29		TELEPHONE

ALL DIMENSIONS ARE IN CM UNLESS OTHERWISE SPECIFIED

1.CONTROL LINES.
2.UPS CONTROL LINES.
3.CCTV CONDUIT 32mm.

NOTES:
1. Total lighting in the designed area is maintained as per the required
2. All concealed conduits through slab shall be of heavy duty PVC
3. The switch board shall be placed 230 mm from door
4. All light fittings are indicative of light points.Fittings shall be the selection of client.

PROJECT :
MARKET FED STORAGE SPACE AT THALIPARAMB

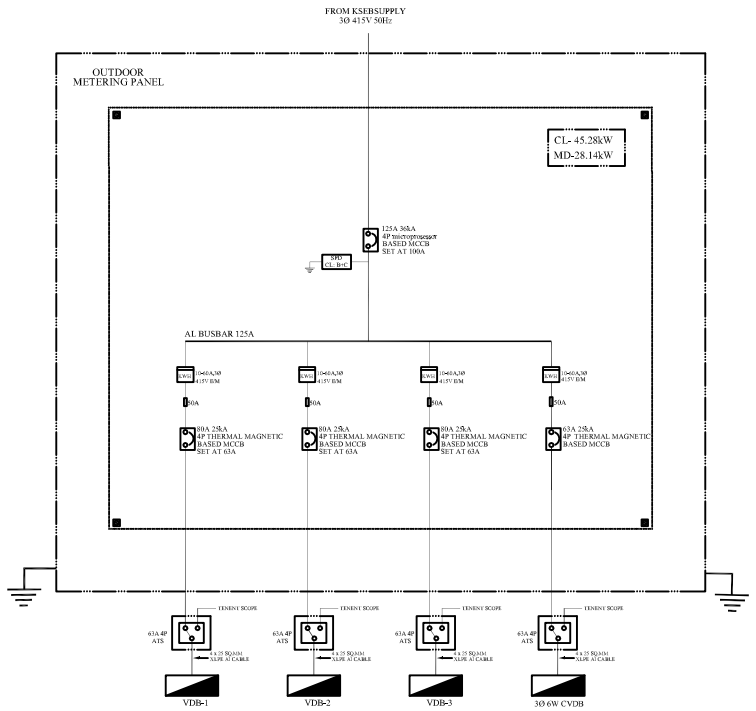
ARCHITECT :

DRAWING TITLE :
ELECTRICAL LAYOUT OF FIRST FLOOR

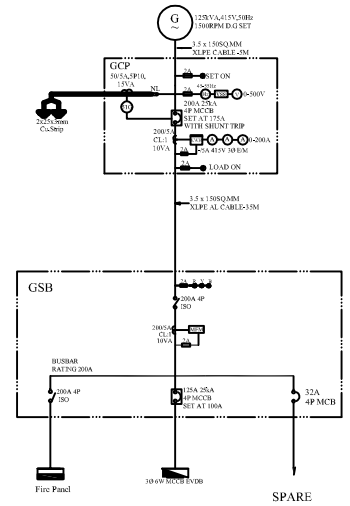
DRAWN	SG	DATE	27.03.2024
CHECKED	AV	SCALE	
APPROVED	JE	DIMS	
TYPE	DRAWING NUMBER	SHEET	REV. NO.
ELECTRICAL	E-L-FF-02	02	00

CONSULTANT :

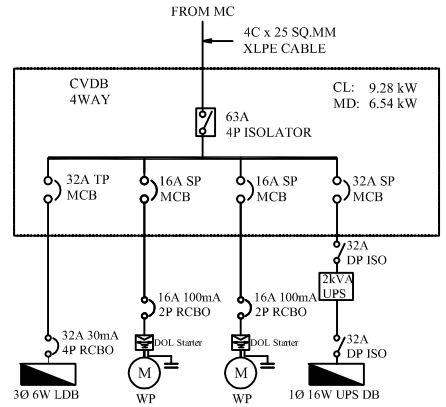
PROJECT CONSULTANT
feats
Feat Technical Services Pvt.Ltd.
First Floor, G-17, Panampilly Nagar, Cochin 682 036
Tel: 0484 - 4010463 Email: featscochin@gmail.com



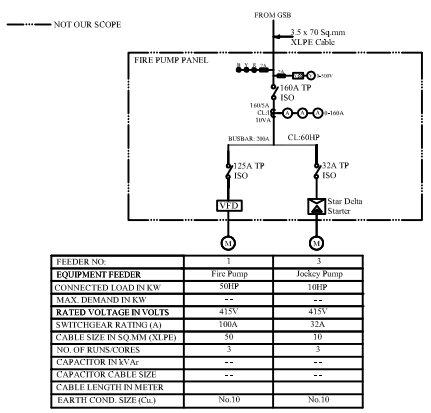
FEEDER NO.	1	2	3	4
EQUIPMENT DESCRIPTION	VDB-1	VDB-2	VDB-3	CVDB
CONNECTED LOAD	13.5kW	11kW	11.5kW	9.28kW
MAXIMUM DEMAND	8.1kW	6.6kW	6.9kW	6.54kW
RATED VOLTAGE	415V	415V	415V	415V
SWITCH RATING	63A	63A	63A	63A
SIZE OF CABLE (XLPE) IN SQMM	25	25	25	25
NO OF RUNS/CORE	4	4	4	4
LENGTH IN MTRS	-	-	-	-
SIZE OF EARTHING COND.CU.	No.10	No.10	No.10	No.10
LOCATION	GODOWN-2	GODOWN-3	GODOWN-1	FIRE PUMP ROOM



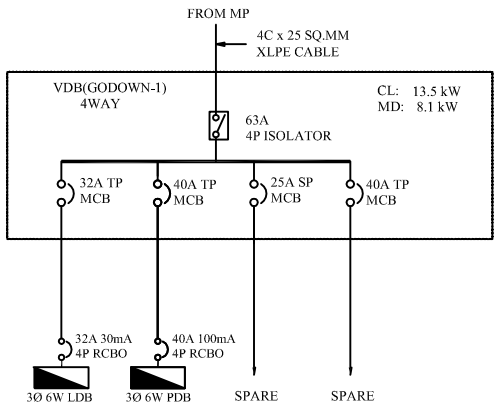
FEEDER NO.	1	2	3	4
EQUIPMENT DESCRIPTION	FIRE PANEL	CVDB	SPARE	
CONNECTED LOAD	60HP	45.28kW	-	
MAXIMUM DEMAND	--	28.14kW	-	
RATED VOLTAGE	415V	415V	-	
SWITCH RATING	200A	125A	-	
SIZE OF CABLE (XLPE) IN SQMM	70	50	-	
NO OF RUNS/CORE	3.5	3.5	-	
LENGTH IN MTRS.	**	-	-	
SIZE OF EARTHING COND.CU.	25x3Cu STRIP	25x2Cu STRIP	-	
LOCATION	FIRE PUMP ROOM	GODOWN-3		



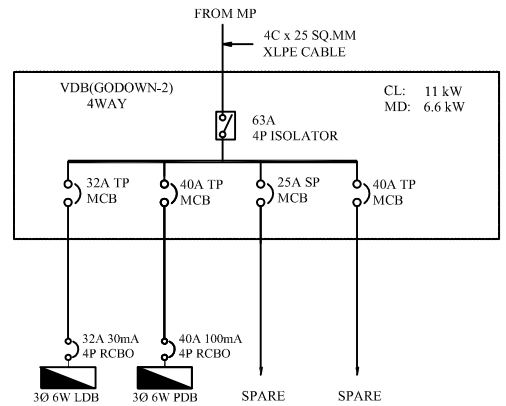
FEEDER NO.	1	2	3	4
DESCRIPTION	CommonDB	WaterPump-1	WaterPump-2	UPS DB
CONNECTED LOAD IN KW	4 kW	2HP	2HP	2.28 kW
MAX. DEMAND IN KW	2.4kW	1.5kW	1.5kW	1.14kW
RATED VOLTAGE IN VOLTS	415V	230V	230V	230V
SWITCH GEAR RATING (A)	32A	10A	10A	25A
CABLE SIZE IN SQ.MM (CU)	6	4	4	6 (Cu)
NO. OF RUNS/CORES	4	2	2	2
CABLE LENGTH IN Mtr.	- -	- -	- -	- -
EARTH COND.SIZE (Cu.)	No.10	No.10	No.10	No.10
LOCATION	FIRE PUMP ROOM			FIRE PUMP ROOM



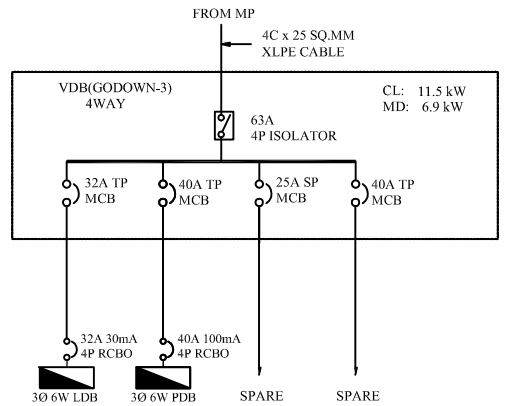
FEEDER NO	1	2
EQUIPMENT FEEDER	Fire Pump	Jockey Pump
CONNECTED LOAD IN KW	50HP	10HP
MAX. DEMAND IN KW	--	--
RATED VOLTAGE IN VOLTS	415V	415V
SWITCH/GEAR RATING (A)	100A	32A
CABLE SIZE IN SQ.MM (XLPE)	50	10
NO. OF RUNS/CORES	3	3
CAPACITOR IN kV/Ac	--	--
CAPACITOR CABLE SIZE	--	--
CABLE LENGTH IN METER		
EARTH COND. SIZE (Cu.)	No.10	No.10



FEEDER NO.	1	2	3	4
DESCRIPTION	LDB	PDB	SPARE	SPARE
CONNECTED LOAD IN KW	2.5 kW	11 kW	- -	- -
MAX. DEMAND IN KW	1.5 kW	6.6 kW	- -	- -
RATED VOLTAGE IN VOLTS	415V	415V	- -	- -
SWITCH GEAR RATING (A)	32A	32A	- -	- -
CABLE SIZE IN SQ.MM (CU)	6	6	- -	- -
NO. OF RUNS/CORES	4	4	- -	- -
CABLE LENGTH IN Mtr.	- -	- -	--	--
EARTH COND.SIZE (Cu.)	No.10	No.10	- -	- -
LOCATION	GODOWN-1	GODOWN-1	- -	- -



FEEDER NO.	1	2	3	4
DESCRIPTION	LDB	PDB	SPARE	SPARE
CONNECTED LOAD IN KW	1 kW	10 kW	- -	- -
MAX. DEMAND IN KW	0.6 kW	6 kW	- -	- -
RATED VOLTAGE IN VOLTS	415V	415V	- -	- -
SWITCH GEAR RATING (A)	32A	32A	- -	- -
CABLE SIZE IN SQ.MM (CU)	6	6	- -	- -
NO. OF RUNS/CORES	4	4	- -	- -
CABLE LENGTH IN Mtr.	- -	- -	--	--
EARTH COND.SIZE (Cu.)	No.10	No.10	- -	- -
LOCATION	GODOWN-1	GODOWN-1	- -	- -



FEEDER NO.	1	2	3	4
DESCRIPTION	LDB	PDB	SPARE	SPARE
CONNECTED LOAD IN KW	1.5 kW	10 kW	- -	- -
MAX. DEMAND IN KW	0.9 kW	6 kW	- -	- -
RATED VOLTAGE IN VOLTS	415V	415V	- -	- -
SWITCH GEAR RATING (A)	32A	32A	- -	- -
CABLE SIZE IN SQ.MM (CU)	6	6	- -	- -
NO. OF RUNS/CORES	4	4	- -	- -
CABLE LENGTH IN Mtr.	- -	- -	--	--
EARTH COND.SIZE (Cu.)	No.10	No.10	- -	- -
LOCATION	GODOWN-1	GODOWN-1	- -	- -

PROJECT :

MARKETFED GODOWN THALIPARAB

BUILDER :

DRAWING TITLE :

SCHEMATIC DIAGRAM

DRAWN	RL	DATE	01.03.2024
CHECKED	AV	SCALE	
APPROVED	JE	DIMS	
TYPE	DRAWING NUMBER	SHEET	REV. NO.
ELECTRICAL	E-L-SCH-01	01	0

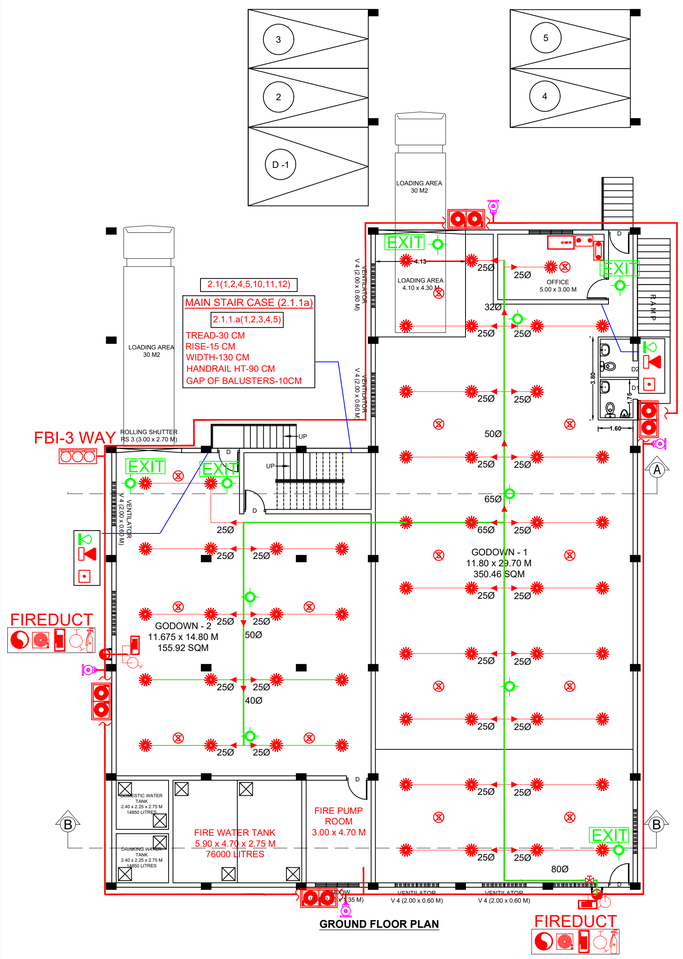
CONSULTANT :

PROJECT CONSULTANT

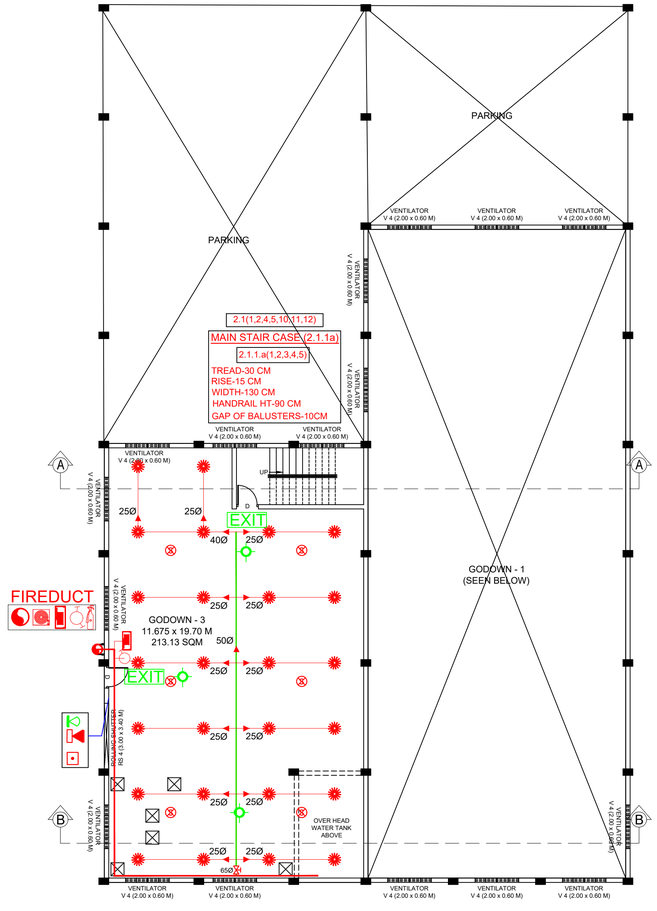
Feat Technical Services Pvt.Ltd.

Flrst Floor, G-17, Panampilly Nagar, Cochln 682 036

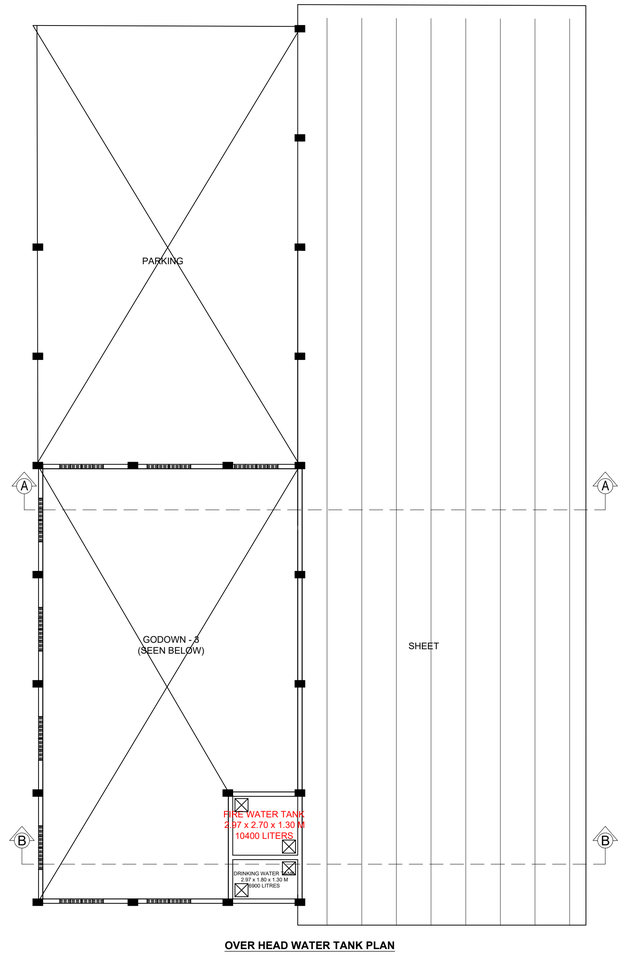
Tel: 0484 - 4010463 Emailt: featscochin@gmail.com



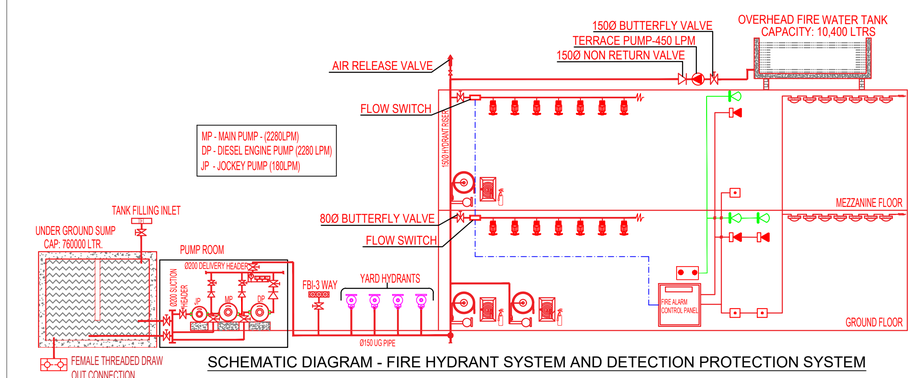
GROUND FLOOR PLAN



MEZZANINE FLOOR PLAN



OVER HEAD WATER TANK PLAN



SCHEMATIC DIAGRAM - FIRE HYDRANT SYSTEM AND DETECTION PROTECTION SYSTEM

PROJECT

PROPOSED STORAGE BUILDING AT THALIPARAMBA,KANNUR

LAND DETAILS

SURVEY NO	- 101/112
VILLAGE	- THALIPARAMBA
TALUK	- THALIPARAMBA
MUNICIPALITY	- THALIPARAMBA
DISTRICT	- KANNUR

APPLICANT SIGNATURE

MANAGING DIRECTOR,
KERALA STATE CO-OPERATIVE MARKETING FEDERATION,
THALIPARAMBA - 670 141

TITLES

FIRE FIGHTING EQUIPMENTS INSTALLATION PLAN OF GROUND, MEZZANINE,ROOF AND SCHEMATIC DIAGRAM

BUILDING HEIGHT	DRAWING NO
13.17 M{Average}	2523-PER-R2

AREA DETAILS

FLOOR	BUILTUP AREA	FLOOR AREA
GROUND	845.20 m²	605.20 m²
MEZZANINE	242.70 m²	242.70 m²
TOTAL	**1087.90** m²	**847.90** m²

DESIGN

DRAWN BY : FRJ
APPROVED BY : MG
DATE : 31-07-2023

FIRE CONSULTANTS

VESTA FIREFIGHTING PVT LTD
1ST FLOOR
SONI STEEL CORPARATION,
NADAKKAVU.P.O-682307
UDAYAMPEROOR
ERNAKULAM
PH:0484-2794101,9388043103

FOR VESTA FIREFIGHTING PVT LTD

LEGEND

- FIRE ALARM CONTROL PANEL
- UPS
- UPS CONTROL SWITCH
- MANUAL CALL POINT
- HOOTER
- EMERGENCY/EXIT LIGHT
- SMOKE DETECTOR
- HOSE REEL
- HOSE BOX
- HYDRANT VALVE
- WET RISER[150Ø]
- YARD HYDRANT
- FIRE BRIGADE INLET
- PENDENT SPRINKLER
- MODULAR FIRE EXTINGUISHER
- FIRE EXITINGUISHER

2.00 GENERAL CONDITIONS OF CONTRACT

2.01 Definitions

In the contract (as hereinafter defined) the following words and expressions shall have the meaning hereby assigned to them except where the contract otherwise requires.

The "OWNER/CLIENT" shall mean the Corporation / Board / Department / Agency / Person for whom the work is being arranged.

The ACCEPTING AUTHORITY shall mean the Accepting Officer/Firm with whom the Contractor executes the Agreement and this shall be mentioned in NIT.

The "CONTRACTOR" shall mean person or persons, firm or company whose tender has been accepted and includes the contractor's legal representatives, successors and permitted assigns.

The "CONSULTANTS" shall mean any competent agency duly appointed by OWNER/CLIENT to act as consultants for the purpose of the contract. The words "Consultants" "Consulting Engineers" appearing elsewhere in the tender shall also mean consultants.

"TENDER" shall mean the tender submitted by the contractor for acceptance before the ACCEPTING AUTHORITY.

The "WORK" shall mean and include all works to be executed in accordance with the contract or part thereof as the case may be and shall include all extras, additional, altered or substituted works required for the purpose of the contract.

The "CONTRACT DOCUMENT" shall mean the agreement between ACCEPTING AUTHORITY and the contractors for the execution of the work including therein all documents such as the Notice Inviting Tender, Tender Forms, General Conditions of Contract, Technical Specification, Schedule of Quantities, Special Conditions of Contract, Letter of Acceptance, Agreed variation if any, drawings, work orders, and / or any other / correspondences or negotiations, etc.

"SPECIFICATIONS" shall mean all directions, Descriptions of the item in the schedule of quantities various technical specifications, provisions and requirements attached to the contract which pertain to the method and manner of performing the work, and the materials to be furnished under the contract for the work as may be amplified or modified by ACCEPTING AUTHORITY/CONSULTANT, drawings for the performance of the contract in order to provide the unforeseen conditions or in the best interest of the work. It shall also include the latest revised version of the relevant B.I.S. specification and other relevant codes.

"SITE" shall mean the land allotted by the Owner/Client under in or through which the work is to be carried out.

"LETTER OF ACCEPTANCE/AWARD OF WORK" shall mean an intimation by letter, telegram, telex or fax to the tenderer that the tender has been accepted in accordance with the provisions contained therein.

"ENGINEER/ENGINEER-IN-CHARGE" shall mean the Engineering Personnel representing ACCEPTING AUTHORITY/CONSULTANT and entrusted with work of supervision of work at the site.

"CONTRACT VALUE /PRICE" shall mean the total amount quoted in the Price Bid and accepted by ACCEPTING AUTHORITY including tender below/excess.

The 'PROBABLE AMOUNT OF CONTRACT' (PAC) shall mean the Estimated amount/Tendered amount of the work.

The "PAYMENT AUTHORITY" shall mean the Officer/Firm who makes payments of the bills for the work done as mentioned in NIT.

2.02 SITE

Location and details of site are specified in NIT.

Entry into the project area will be restricted. If required passes and permits will have to be obtained from Owners for entry of all persons and vehicles into the project area. During working, the contractor shall provide barricades and working place shall be isolated from other places. Working place shall be visible from other areas.

2.03 SCOPE OF WORK

The scope of work is described in the NIT.

The scope of work further includes variation or modification of design, quantity or quality of work, addition, omissions or substitution of any work, under the written instruction of Engineer-in-Charge. Such instructions shall be complied forthwith.

The Contractor shall provide all necessary labour, materials, equipments and management and supervisory personnel to complete the works provided under this contract in time.

2.04 GENERAL OBLIGATIONS

2.04.01 INSPECTION OF SITE ETC. BEFORE SUBMISSION OF TENDER

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 ground, form and nature of the site, the quantities and nature of work and materials and its availability required for the completion of the works, the means of access to the site, the local labour conditions, the accommodation he may requires and in general shall obtain all necessary information as to the risks, contingencies and other circumstances which may influence or affect his tender. He must go through all the drawings, specifications and other tender documents. Any further clarifications in the drawings

and documents can be had from ACCEPTING AUTHORITY at the above mentioned address.

2.04.02 **SUFFICIENCY OF TENDER**

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 rates and prices stated in the priced schedule of quantities and the schedule of rates and prices, if any, with tender rates and prices shall cover all is obligations under the contract and all matters and things necessary for the proper completion and maintenance of the work.

2.04.03 **DISCREPANCY OR ERROR IN TENDER DOCUMENT**

Should the Contractor notice any discrepancy or error in the tender document, in the specification, conditions of contract or quantities or units shown against items or any other part of the tender document, he shall immediately bring to the notice of ACCEPTING AUTHORITY and obtain the clarification before submitting the tender. The tender shall be based on such clarifications received and shall be recorded as such in the covering letter to the tender, failing which ACCEPTING AUTHORITY shall have the right to ask the Contractor to execute the work according to the corrected statement made or quantities or units shown in the tender, without any compensation, when the same has come to the notice of the ACCEPTING AUTHORITY.

2.04.04 **RATES QUOTED FOR FINISHED WORK**

The rates quoted in the tender by the Contractor must be for the finished work as per the drawings and specifications.

2.04.05 **LOCATION OF WORK**

Unless specifically mentioned in the item, the work described there-in may be at any location or elevation.

2.04.06 **FIRM PERIOD**

The tender shall remain open for acceptance for a period of **90 days** from the date of opening of the tender. If any tenderer withdraws his tender before the said period or makes any modifications in terms and conditions of the tender, then Accepting Authority has the liberty to forfeit the said Earnest Money Deposit.

2.04.07 **COMMENCEMENT OF WORK**

The Contractor shall commence the work at site, within 15 days from the date of receipt of letter of award of work or handing over of the site whichever is later or as mentioned in the letter of award of work and shall proceed with the same with due expedition.

2.04.08 **PROGRAMME OF WORK**

As per the clause in special conditions of contract.

2.04.09 **CONTRACTOR'S EMPLOYEES**

The Contractors shall provide and employ sufficient qualified personnel at site the project management.

Only such technical assistants who are skilled and experienced in their respective fields and such as agents, foreman and leading hands who are competent to give proper supervision to the work they are required to supervise and,

Such skilled, semi-skilled and un-skilled labour as is necessary for the proper and timely execution and maintenance of works.

2.05 **ASSIGNMENT AND SUB-CONTRACTING**

2.05.1 **ASSIGNMENT**

The contractor shall not assign the contract or any part thereof or any benefit or interest therein or thereunder without the written permission of ACCEPTING AUTHORITY, nor shall transfers be made by Power of Attorney authorizing others to carry out the work or receive payment on behalf of the tenderer.

2.05.2 **SUB-CONTRACTING**

The Contractor shall not sublet any portion of the contract.

2.06 **REMOVAL OF WORKMEN**

ACCEPTING AUTHORITY shall be at liberty to object to and require the Contractor to remove forthwith from the works any person employed by the Contractor in or about the execution or maintenance of the works who in the opinion of ACCEPTING AUTHORITY misconduct himself or is incompetent or negligent in the proper performance of his duties or whose employment is otherwise considered by ACCEPTING AUTHORITY to be undesirable and such person shall be replaced by the Contractor without delay by a competent substitute approved by ACCEPTING AUTHORITY.

2.07 **COMMUNICATIONS TO BE IN WRITING**

All references, communications, correspondences made by ACCEPTING AUTHORITY/ Engineer-in-Charge or the Contractor concerning the works shall be in writing and no reference, communication, or complaint which is not in writing, shall be recognised.

2.08 DRAWING

2.08.01 ISSUE OF DRAWINGS

Drawings approved for construction will be issued to the Contractor progressively during the contract period and the Contractor shall arrange for the execution of the works and the procurement of materials accordingly. The Contractor shall give a notice well in advance in writing to ACCEPTING AUTHORITY/ Engineer-in-Charge or his representative of any further drawings or specifications of clarification that may be required for the execution of the works or otherwise under the contract.

2.08.02 COPIES OF DRAWINGS TO BE KEPT AT SITE

One copy of the drawings furnished to the Contractor shall be kept at the site and the same shall at all reasonable times be available for inspection and use by Engineer-in-Charge or any other person authorised by ACCEPTING AUTHORITY in writing.

2.08.03 ISSUE OF FURTHER DRAWINGS AND INSTRUCTIONS

ACCEPTING AUTHORITY/ENGINEER-IN-CHARGE shall have full power and authority to issue to the Contractor from time to time through his representative, during the progress of the works such further drawings and instructions as shall be necessary for the purpose of proper and adequate execution and maintenance of the works and the Contractor shall carry out and be bound by the same.

2.08.04 OWNERSHIP OF DRAWINGS

All drawings supplied to the Contractor are deemed to be the property of Owner. The Contractor should not divulge or use, expect for the purpose of this contract, any information contained in the drawings.

2.08.05 EXECUTION AS PER DRAWINGS

The Contractor must not vary or deviate from the drawings in any respect while executing the work or executing any extra work of any kind whatsoever unless authorised by Engineer-in-Charge.

2.08.06 PLANS AND DRAWINGS TO BE SUBMITTED BY CONTRACTOR

The Contractor shall submit the following information in triplicate to ACCEPTING AUTHORITY for approval within the time stipulated: each item below:-

a) A general tentative layout plan of site office, material, storage yard construction plant and equipments access/internal roads required for the execution of work within 15 days from the date of receipt of work order.

b) Layout and details of temporary works that the contractor wants to carry out to fulfill his obligation under the contract. Within 15 days ACCEPTING AUTHORITY/ Engineer-in-Charge will give their approval/comments sufficient to proceed with the work or objections/instructions to the Contractor

based on which the drawings shall be revised and submitted again for approval by the Contractor.

c) All these plans and drawings submitted by the Contractor and approved by ACCEPTING AUTHORITY/ Engineer-in-Charge shall become part of the contract.

2.08.07 **FABRICATION DRAWINGS**

Contractor shall prepare at his own cost all fabrication drawings of all structural steel works and bar bending schedule for R.C.C. works and submit them to Engineer-in-Charge for their approval at least before 15 days of commencing the fabrication. All the details like sizes, capacities, dimensions, arrangement of fabrication, etc. should be clearly indicated on these drawings.

2.09 **ROYALTIES AND PATENT RIGHTS**

All royalties or other sums payable in respect of the supply and use in carrying out the work as desired by or referred to in the schedule of quantities of any patented articles, process or inventions shall be deemed to have been included in the contract sum and the Contractor shall indemnify ACCEPTING AUTHORITY from and against all claims, proceedings, damages, costs and expenses which may be brought or made against ACCEPTING AUTHORITY or to which he may be put by reason of the Contractor infringing or being held to have infringed any patent rights in relation to any such articles, process and inventions.

2.10 **OCCUPATION AND USE OF LAND**

No land, building belonging to or in the possession of the Owner/Client/ Consultant shall be occupied by the Contractor. The Contractor shall not use, or allow to be used, the site for any purpose other than that for executing the works.

2.11 **CONTRACTOR'S STORE AND SITE OFFICE**

Any facility, proposed to be temporarily constructed by the Contractor for his office work, storage of materials, etc. shall conform to the standard sketch, or to the plan approved by ACCEPTING AUTHORITY. Permission for the construction of such facility shall be obtained in writing. Suitable area in the site of work shall be allowed to the contractor free of cost for constructing the temporary facility. However, the required structure shall be provided by him at his own expense and he shall be solely responsible for guarding his property with requisite insurance against theft, fire, etc. The contractor however will have to dismantle facility and clear the land of all debris, etc. at his own expense after completion of work.

2.12 **MATERIALS, TOOLS AND PLANT**

All materials, tools and plants required for the execution of the works other than those mentioned in the Tender shall be supplied by the Contractor. Permanent materials so supplied shall have the approval of Engineer-in-Charge before using on the works.

All the rejected materials shall be removed at once from the site of work at the Contractor's own cost.

2.13 TOLLAGES, ETC.

The Contractor shall pay all tollages and other royalties, rent and other payments or compensations, if any, for getting all materials required for the works.

2.14 SETTING OUT

The Contractor shall be responsible for the true and proper setting out of the works and for the correctness of the position, levels, dimensions and alignment of all parts of the works and for the provision of all necessary instruments, appliances and labour in connection therewith. If at any time during the progress of the works any error shall appear or arise in the position, level, dimensions or alignment of any part of the works, the Contractor on being required to do so by ACCEPTING AUTHORITY/ Engineer-in-Charge shall at his own cost rectify such error to the satisfaction of ACCEPTING AUTHORITY/ Engineer-in-Charge. The checking of any setting out or of any way relieve the Contractor from the responsibility of true and proper setting out of the works. The Contractor shall provide all necessary instruments, appliances and labour required by ACCEPTING AUTHORITY/ Engineer-in-Charge for checking if any, of the setting out. The Contractor shall carefully protect and observe all bench marks, site levels, pegs and other things used in setting out the works. The rates quoted for the work shall also include the cost of reference and level pillars and other dismantling, when no longer required.

2.15 DAMAGE TO PERSONS AND PROPERTY

The Contractor shall indemnify and keep indemnified Engineer-in-Charge / Client / Owner against all losses and claims for injuries or damages to any person or property whatsoever which may arise out of or in consequence of the construction and maintenance of works and against all claims, demands proceedings, damages, costs, charges, expenses, whatsoever in respect thereof in relation thereto.

2.16 CO-OPERATION WITH OTHER AGENCIES

The Contractor shall co-operate with the work of other agencies or Contractors that may be employed or engaged by ACCEPTING AUTHORITY/ CONSULTANT and as far as it relates to the Contractor's work. The sequence of work shall be so arranged that the work of other agencies are also in progress simultaneously.

2.17 BARRICADING AROUND EXCAVATED TRENCHES, ETC.

The Contractor shall at his own cost provide, around excavation, temporary barricading with bellies and bamboo with warning signals during day and night and shall maintain it so long as the trenches/pits are not filled up. Similar barricades shall also be provided in the area all dismantling work, erection of structure, sheeting work, etc. No extra claim shall be entertained for providing, maintaining and removing such barricades.

2.18 PROTECTION OF UNDERGROUND SERVICES

The contractor must take precautionary measures to protect the underground and other services lines viz. Cables, water and sewer lines, etc. and observe any specific instructions which may be given in this regard by Engineer-in-Charge.

2.19 DEWATERING TRENCHES AND PITS

The tendered rates shall always be deemed to have taken into account the cost of removal of silt and materials that may slip in the trenches and pits and dewatering the trenches or pits of water accumulated or collected through seepage or subsoil water or rain water. The contractor shall in no case be entitled to claim any extra amount for the above work. The contractor shall remain prepared with necessary pumps and equipment for dewatering the trenches or pits so as to avoid unnecessary delay and possible damage to the property, etc.

2.20 WORK IN OR AROUND OPERATING PLANT OR OFFICES ETC.

Where the work is being carried out in or around an operating plant where the plant must run uninterrupted, the contractor shall work only at specified place and times as mutually arranged between the Contractor and Engineer-in-Charge. Similar arrangement must be made while executing works inside the offices, buildings, etc. without causing disturbance to the office work. For this the work may be required to be done during off-hours and Sundays. No addition amount will be allowed beyond the rates quoted for doing work in the manner described above.

2.21 WORK IN SHIFTS AND ON OFF-DAYS

The Contractor shall work in one or more shifts as also on Sundays and off days to complete the work on time, if so required by ACCEPTING AUTHORITY for which ACCEPTING AUTHORITY shall not be liable to pay any extra. If instructed by Engineer-in-Charge, the Contractor should carry out the work in the night also.

2.22 SITE ORDER BOOK AND CEMENT REGISTER

A site order book must be maintained and always be available at site to record the instructions by Engineer-in-Charge. The Contractor must see that the instructions noted therein are properly carried out.

A register showing the stock, receipts, daily issue/consumption of cement and balance quantity available etc. should be maintained at site and made available on demand by the Engineer-in-Charge.

2.23 DELAY IN OBTAINING MATERIALS SUPPLIED BY ACCEPTING AUTHORITY

If ACCEPTING AUTHORITY has undertaken to supply any material specified in the special conditions at rates and conditions cited therein, the contractor shall keep himself in touch with day-to-day position regarding the supply of materials from ACCEPTING AUTHORITY and adjust the progress of the works in such a way that

labour may not remain idle nor there by any other claim due to or arising from delay in obtaining the materials.

2.24 RECORD OF MATERIALS SUPPLIED BY ACCEPTING AUTHORITY

The contractor shall maintain an account of different materials obtained from ACCEPTING AUTHORITY for executing the works under the contract. ACCEPTING AUTHORITY/ Engineer-in-Charge shall have the right to check the position of materials at all times.

2.25 SAFE STORAGE OF MATERIALS

The contractor shall be responsible for the safe storage of materials supplied by ACCEPTING AUTHORITY for executing of the works. Materials lost or damaged or unaccounted for or made unserviceable by the Contractor shall be charged at penal rates.

2.26 TRANSPORT OF MATERIALS

Unless otherwise specified, all the materials supplied by ACCEPTING AUTHORITY shall be transported by the Contractor from ACCEPTING AUTHORITY's store/yard, to the site of work at no extra cost.

2.27 SITE TO BE KEPT CLEAN

The surplus spoil and dismantled debris shall be removed to a place as directed by Engineer-in-Charge and stacked, levelled and dressed as directed. Rehandling charges will not be allowed.

2.28 CONFLICT IN MEANING BETWEEN SCHEDULE OF QUANTITIES AND SPECIFICATIONS

The schedule of quantities shall be read in conjunction with the specification, and in the event of conflict in meaning between the two, the meaning of the item in the schedule of quantities shall always have precedence over the technical specifications.

2.29 LABOUR

2.29.01 LABOUR RULES

In respect of all labour directly or indirectly employed on the works by the Contractor, the Contractor shall comply with the provisions of the contract labour (Regulation and Abolition) Act 1970, Minimum Wages Act 1948, Payment of Wages Act 1936, Employees Provident Funds and Miscellaneous Provision Act 1952, The Employees State Insurance Act, 1948 and any amendments thereof and all legislation and rules of the State and/or Central Government or other local authorities, framed from time to time, governing the protection of health, sanitary arrangements, wages, welfare and safety for labour employed on building and construction works and for bonus, retirement benefits, retrenchment/lay off, compensation and all other matter liabilities of ACCEPTING AUTHORITY to employees. The rules and the other

statutory obligations with regard to fair wages, welfare and safety measures, maintenance of register, etc. will be deemed to be part of the contract. The contractor shall produce documentary evidence for compliance of above Acts.

2.29.02 REPORTING ACCIDENT OF LABOUR

The Contractor shall be responsible for the safety of all employees and/or workers employed or engaged by him on and in connection with the works and shall forthwith report all cases or accidents to any of them, however caused and whenever occurring, to ACCEPTING AUTHORITY/ Engineer-in-Charge and shall make every arrangement to render all possible assistance and aid to the victims of the accident.

2.29.03 PROVISION OF WORKMEN'S COMPENSATION ACT

The Contractor shall at all times indemnify and keep indemnified ACCEPTING AUTHORITY against all claims for compensation under the provisions of the workmen's Compensation Act 1923 or any other law for the time being in force by or in respect of any workmen employed by the Contractor in carrying out the contract and against all cost and expenses or penalties incurred by ACCEPTING AUTHORITY in connection therewith. In any case by virtue of the provision of the said act, ACCEPTING AUTHORITY is obliged to pay compensation to a workman employed by the Contractor in executing the works, ACCEPTING AUTHORITY shall recover from the Contractor the amount of the compensation so paid and without prejudice to the rights of ACCEPTING AUTHORITY under the said Act. ACCEPTING AUTHORITY shall be at liberty to recover such amount or any part thereof by deducting it from the security deposit or from any amount due to the Contractor, whether under this contract or otherwise without prejudice to any other remedy that may be available to ACCEPTING AUTHORITY, in law. ACCEPTING AUTHORITY shall not be bound to contest any claim made against under the said Act, except on the written request of the Contractor and upon his giving to ACCEPTING AUTHORITY full security for all cost for which ACCEPTING AUTHORITY might become liable in consequence of contesting such claim.

2.29.04 ACCIDENT OR INJURY TO WORKMEN

ACCEPTING AUTHORITY shall not be liable for, in respect, or any damages or compensation payable as per regulations or in consequence of any accident or injury to any workmen or other person in the employment of the Contractor shall indemnify and keep indemnified ACCEPTING AUTHORITY against all such damages and compensation and against all claims, demands, proceedings costs, charges and expenses whatsoever in respect thereof or in relation thereto.

2.29.05 PRESERVATION OF PEACE

The Contractor shall take requisite precautions to prevent any riotous or unlawful behaviour by or amongst the workmen and/or others employed on the works by the contractor, for the preservation of peace and protection of the inhabitants and security of property in the neighbourhood of the works.

2.29.06 AGE LIMIT OF LABOUR

The age limit for employment of labour shall be in strict accordance with the prevailing labour legislation.

2.29.07 RETURN OF LABOUR EMPLOYED

The Contractor, if required by ACCEPTING AUTHORITY, shall submit return in detail in such form and at such interval as ACCEPTING AUTHORITY may prescribe showing number of different classes of labour employed on the work from time to time by the Contractor.

2.30 MATERIAL TESTS AND WORKMANSHIP

2.30.01 QUALITY OF MATERIALS, WORKMANSHIP AND TESTS

All materials and workmanship shall be of the respective kinds described in the contract and in accordance with ACCEPTING AUTHORITY or Engineer-in-Charge instructions and shall be subject, from time to time, to such tests as ACCEPTING AUTHORITY or Engineer-in-Charge may direct at the place or any of such places. The contractor shall provide required assistance, instruments, machines, labour and materials, as normally 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 works for approval as may be required by ACCEPTING AUTHORITY.

2.30.02 CONSTRUCTION OF PROTOTYPES OR SAMPLES OF WORK

The Contractor shall construct prototypes or samples of work as laid down in the contract or as instructed by Engineer-in-Charge. Such prototypes or samples or work, after approval by ACCEPTING AUTHORITY, shall serve as the standards to be achieved in the final construction.

2.30.03 COST OF SAMPLES/ PROTOTYPES

All Samples/Prototypes shall be supplied by the Contractor at his own cost.

2.30.04 COST OF TESTS

The cost of making any test as per specifications shall be born by the Contractor, and the Contractor should arrange for all facilities like meters, instruments as required for carrying out such tests.

2.30.05 INSPECTION OF OPERATION

ACCEPTING AUTHORITY/ Engineer-in-Charge shall at all times have access to the works and to the site and to all workshops and places where materials, manufactured articles or machinery are being obtained for the works and the Contractor shall arrange every facility for every assistance in obtaining the right to such access.

2.30.06 EXAMINATION OF WORK BEFORE COVERING UP

No work shall be covered up or put out of view without the approval of ACCEPTING AUTHORITY or Engineer-in-Charge and the Contractor shall arrange full opportunity to ACCEPTING AUTHORITY or Engineer-in-Charge to examine and measure any work which is about to be covered up or put out of view and to examine them before permanent work is placed thereon. The contractor shall give due notice to Engineer-in-Charge wherever any such work or foundations is or are ready or about to be ready for examination and Engineer-in-Charge shall without unreasonable delay, unless he considers it unnecessary and advise the Contractor accordingly, or attend for the purpose of examining and measuring such work.

2.30.07 UNCOVERING AND MAKING OPENINGS

The Contractor shall uncover any part of parts of the works or make opening in or through the same as ACCEPTING AUTHORITY may, from time to time, direct and shall reinstate and make good such part or parts to the satisfaction of ACCEPTING AUTHORITY. If any such part of parts have been covered up or put out of view and 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 Engineer-in-Charge but in any other case all such expenses shall be borne by the Contractor and shall be recoverable from him by Engineer-in-Charge and deducted by Engineer-in-Charge from any money due, which may become due to the Contractor, without prejudice to any other remedy that may be available to Engineer-in-Charge, by law.

2.30.08 REMOVAL OF IMPROPER WORK AND MATERIALS

Engineer-in-Charge shall during the progress of the works have power to order the following in writing from time to time for which no extra payment will be made to the Contractor.

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 Engineer-in-Charge are not in accordance with the contract.

b) The substitution of proper and suitable materials.

c) The removal and proper re-execution not withstanding a previous test thereof or interim payment thereof of a work which in respect of materials or workmanship is not in the opinion of Engineer-in-charge or his representative in accordance with contract.

2.30.09 SUSPENSION OF WORK

The Contractor shall, on the written order by ACCEPTING AUTHORITY suspend the progress of the works or any part thereof for such time or times and in such manner as ACCEPTING AUTHORITY may consider necessary and shall during such suspension, properly protect and secure the work, so far as is necessary in the opinion of ACCEPTING AUTHORITY.

2.31 TIME OF COMPLETION AND TAKING OVER

2.31.01 POSSESSION OF SITE

Save in so far the contract may prescribe the extent of portions of the site of which ACCEPTING AUTHORITY is to be given possession from time to time and the order in which such portions will be available to his and subject to any such portions will be available to him and subject to any requirement in the contract as to the order in which the work shall be executed, ACCEPTING AUTHORITY shall give to the Contractor possession of so much of the site as may be required to enable the Contractor to commence with such reasonable proposals of the Contractor as he will make in writing to ACCEPTING AUTHORITY and shall, from time to time as the work proceeds give the Contractor possession of such further portions of the site as may be required to enable the Contractor to proceed with the construction of the works in accordance with the said programme or proposal.

2.31.02 TIME OF COMPLETION

Time is deemed to be the essence of this contract and the whole of the works shall be completed within the time stipulated or within such extended time as has been allowed as mentioned in the contract.

2.31.03 EXTENSION OF TIME OF COMPLETION DUE TO EXTRA/ ADDITIONAL WORKS

Should the amount of extra or additional work of any kind or changes in scope of work or other special circumstances of any kind whatsoever which may occur, be such as fairly to justify the Contractor's request for extension of time for the completion of the works, the Engineer-In-Charge shall determine the amount of such extension and with the approval of the CLIENT/ENGINEER-IN-CHARGE/ACCEPTING AUTHORITY shall intimate the Contractor in writing provided that the ENGINEER-IN-CHARGE/ACCEPTING AUTHORITY is not bound to take into account any extra or additional work or other special circumstances unless the Contractor has within 28 days, after such work has been commenced or such circumstances have arisen, submit to the Engineer-In-Charge full and detailed particulars of any request for the extension of time to which he may consider to be justified. The Contractor is bound to complete the work at the same rates, terms and conditions during the extended time of contractor.

2.31.04 EXTENSION OF TIME OF COMPLETION DUE TO FORCE MAJEURE CONDITIONS

If in the opinion of the ENGINEER-IN-CHARGE/ACCEPTING AUTHORITY the progress of the work has at any time been delayed due to force majeure conditions like strikes, fire, inclement weather, un-avoidable causalities, acts of god or any cause whatsoever beyond the control of the Contractor, continuously for more than one month, then the time of completion of the work may be extended for such reasonable time as the Engineer-In-Charge may decide and this will be indicated in

writing. The Contractor shall complete the work at the accepted rates, terms and conditions. Even, if such extension of time is granted.

2.31.05 **FINES FOR EXTENSION OF TIME OF COMPLETION**.

The contractor is bound to complete the work within the stipulated period as per the agreement. When the contract period has to be extended wholly or partly due to default on part of the contractor, the Accepting Authority may sanction extension of time after imposing fine prescribed as follows:

Period	Rate of fine
First extension	1% of the PAC subject to a minimum of Rs.1000/- and maximum of Rs.50,000/-
Beyond First extension	2% of the PAC subject to a minimum of Rs.2000/- and maximum of Rs.1,00,000/-

2.31.06 **LIQUIDATED DAMAGES**

If the contractor fails to complete the work within the period of completion or within any extended time allowed the contractor shall pay or allow to the ACCEPTING AUTHORITY the sum equivalent to 1% of the PAC per month of delay calculated on each day basis and upto a maximum of 10% of PAC as liquidated and ascertained damages for the period of stipulated completion or such extended time as the case may be during which the work shall remain unfinished. Such damages may be deducted by the ACCEPTING AUTHORITY from any money due or that may become due the contractor.

2.31.07 **WORK TREATED AS COMPLETE**

The works shall not be treated as complete until:

i) The site is clear from all materials, temporary facilities, etc of the contractor. and ACCEPTING AUTHORITY is satisfied with the job done by the Contractor.

ii) The Contractor has submitted the reconciliation statement regarding the stores received from ACCEPTING AUTHORITY, and all the surplus and salvaged materials are returned to the stores.

iii) All equipment, tools, plant taken from ACCEPTING AUTHORITY have been returned by the Contractor.

iv) Any other material, taken on loan/transfer from other agency have been returned by the Contractor.

v) All power and water supply connections taken for the execution of the works have been disconnected by the Contractor.

vi) Rectification of any damage done by the Contractor to the work executed have been completed by the Contractor.

vii) The works shall not be considered as completed until ENGINEER-IN-CHARGE/ACCEPTING AUTHORITY has certified in writing that the works have been completed and the Defects Liability Period shall commence from the date of such certificate.

2.31.08 **TAKING OVER**

After completion of works or any substantial part of the works before the completion of the whole of the works, the Contractor shall notify ACCEPTING AUTHORITY in writing, who within 15 days of receipt of the said notice shall give such certificate with respect to any substantial part of the works which has been both completed to the satisfaction of ACCEPTING AUTHORITY and occupied or used by ACCEPTING AUTHORITY or refuse to issue the same stating the reasons thereof in writing. When any such certificate is given in respect of a part of the works, such part shall be considered as completed for the purpose of taking over and computation of the period of maintenance of such part, that is such period of the work as certified. The works in whole or part shall not however, be treated as completed for the purpose of other relevant clauses hereof unless and until the provision of this clause hereof are fully complied with.

2.31.09 **MAINTENANCE**

For a period of 12 MONTHS commencing immediately after taking over of the work by ACCEPTING AUTHORITY, the Contractors liability shall be to replace the defective parts, rectify/ reconstruct the defective work that may develop of his own construction or those of his sub-contractor approved by ACCEPTING AUTHORITY arising solely from faulty materials or workmanship.

If it is necessary for the Contractor to rectify/reconstruct any defective portions of the work under the contract, the provision of this condition shall apply to the portions of work so replaced or renewed until the expiration of three months from the date of such replacement or renewal or until the end of the above mentioned period of 12 months, whichever may be later. If any defects be not remedied within a reasonable time ACCEPTING AUTHORITY may proceed to do the work at Contractor's risk and expense, but without prejudice to any other rights which ACCEPTING AUTHORITY may have against the Contractor in respect of such defects.

The Contractor shall bear the cost of such repair/rectification carried out on his behalf at site. Immediately upon expiry of the maintenance period the ACCEPTING AUTHORITY shall issue a final certificate indicating that the Contractor has completed his obligation under the contract.

2.32 **TERMINATION AND BACK CHARGING OF CONTRACT**

2.32.01 **TERMINATION**

If the Contractor has abandoned the contract or has failed to proceed with the work due to negligence or the progress on any particular item, items is slow or has failed to execute the work in accordance with the terms and conditions of the contract, is

persistently or frequently neglecting to carry out his obligation under the contract, then it shall be lawful for ACCEPTING AUTHORITY to terminate the contract forthwith under written notice and to proceed with the balance work through any other agencies. During the course of execution of the job, in case the Contractor has done any substandard work, he shall be asked in writing to dismantle and redo the same at his own expenses. If the Contractor fails to comply with the above instructions immediately, then ACCEPTING AUTHORITY shall proceed with the above rectification work, through another agency or agencies. Similarly, if the Contractor goes slow on any particulars item or items of work, ACCEPTING AUTHORITY shall have the right to execute this item or items through another agency or agencies, including its own department.

2.32.02 BACK CHARGING THE CONTRACTOR

Extra cost and expenses incurred for completing the work of balance work or carrying out the rectification of any work as mentioned above through another agency or agencies including its own department, shall be debited to Contractor's account and shall be recovered from any money due or that may become due to the contractor without prejudice to any other remedy that may be available to ACCEPTING AUTHORITY in law. If there is any savings in cost due to re-arrangement or supplementing through other agencies the original contractor will not have any claim on this.

2.33 ALTERATIONS, ADDITIONS AND OMISSIONS

2.33.01 VARIATION

ACCEPTING AUTHORITY/OWNER shall be entitled to make any variation of the quality or quantity of the works or any part thereof that may in his opinion, is necessary and for that purpose, or if for any other reason it shall, in his opinion be desirable, he shall have power to order the Contractor to do and the Contractor shall do any of the following:

a) Increase or decrease the quantity of any work included in the contract.

b) Omit any portion of work.

c) Change the character or quality or kind of any such work.

d) Change the levels, lines, position and dimensions of any part of the works and

e) Execute additional work of any kind necessary for the completion of the works, and no such variation shall in any way vitiate or invalidate the contract by the value, if any, of all such variations shall be taken into account in ascertaining the amount of the contract price.

2.33.02 ORDER FOR VARIATIONS TO BE IN WRITING

No variation shall be made by the Contractor without an order in writing of Engineer-in-Charge, provided that no order in writing shall be required for increase or decrease

in the quantity of any item or work where such increase or decrease is the result of the actual quantities exceeding or being less than those stated in the schedule of quantities which are estimates. In such cases, the Contractor shall be paid only for the actual quantity of work done as certified by Engineer-in-Charge at the accepted schedule of quantities and no compensation shall be allowed. Provided also that if for any reason Engineer-in-Charge shall consider it desirable to give any such order verbally, the Contractor shall comply with such order but it must be followed by confirmation in writing of such verbal order given by Engineer-in-Charge, which shall be deemed to be an order writing within the meaning of this clause.

2.33.03 **EXTRA ITEMS**

.01 Any item of work that do not find a place in the schedule of quantities, in the original tender or in the accepted tender or contract as has been directed by Engineer-in-Charge to execute is deemed as an extra item of work. All such works that are necessary to be carried out under the direction of Engineer-in-Charge shall be carried out by the contractor. No such variation will violate the Contract.

.02 Extra items of work thus carried out by the contractor will be paid at the rates worked out by Engineer-in-Charge in the following manner.

.03 In the case of all extra items whether additional, altered or substituted, if accepted rates for identical items are provided for in the contract such rates shall be applicable.

.04 In the case of extra items whether altered or substituted, for which similar items exists in the contract, the rates shall be derived from the original item by appropriate adjustment of cost of affected components. The percentage excess or deduction of the contract rate for the original item with reference to the estimated rate shall be applied in deriving the rates for such items.

.05 In the case of extra items, whether altered or substituted, for which similar items do not exist in the contract, the rates shall be arrived at on the basis of provisions of CPWD DAR and prevailing market rates supported by three quotations by adding profit and overhead charge of 15%.

.06 In the case of extra items, whether additional altered or substituted, for which the rates cannot be derived from similar items in the contract, and only partly from similar items in the contract and only partly from the data from DAR, the rates shall be determined by Engineer-in-Charge on the basis of the prevailing market rates giving due consideration to the analysis of the rate furnished by the contractor with supporting document including contractor's profit.

.07 In the case of extra item whether additional, altered, substituted, for which the rates cannot be derived either from similar items of work in the contract or from the DAR, the contractor shall within 14 days of the receipt of order to carry out the said extra item of work, communicate to the Engineer the rate which he proposes to claim for the item, supported by analysis of the rate claimed and Engineer-in-charge shall within one month thereafter, determines, the rate on the basis of the market rate giving due consideration to the rate claimed by the Contractor.

2.33.04 **REBATE/EXTRA OVER ORIGINAL ITEM**

If there is a deviation in the specification of particular item of the tender, rebate/extra over the quoted rate shall be generally derived as follows:

For items not covered in the schedule, rebate/extra shall be derived based on observation/ analysis of labour and materials involved in such items.

2.33.05 **ITEMS OF AD-HOC NATURE**

The Contractor shall procure necessary materials and carry out miscellaneous work of ad-hoc nature specifically provided with necessary tools and tackles as may arise during execution of the contract. The actual quantum of work shall be certified and settled by Engineer-in-Charge and payment for the same shall be fixed on the basis of actual cost plus overheads, profits and establishments taken at 15% of the cost.

2.33.06 **CLAIMS**

The contractor shall send to Engineer-in-Charge an account, giving full and detailed particulars with proper analysis of all claims for any additional expenses to which the Contractor may consider himself entitled to authorise payment to be made for any such work not withstanding the Contractor's failure to comply with this condition if the Contractor has at the earliest practicable opportunity notified Engineer-in-charge in writing, that he intends to make a claim for such work.

2.34 **MEASUREMENTS**

2.34.01 **QUANTITIES**

The quantities set out in the schedule of quantities are the estimated quantities of the work. They are not to be taken as the actual and correct quantities of the works, to be executed by the Contractor in fulfillment of his obligations under the contract.

2.34.02 **WORKS TO BE MEASURED**

.01 Engineer-in-Charge shall, except as otherwise stated, ascertain and determine by measurement the value in terms of the contract. He shall when he requires any part or parts of the works to be measured, give notice to the Contractor's authorised agent or representative, who shall forthwith attend or send a qualified agent to assist Engineer-in-Charge or his representative in making such measurement, and shall furnish all particulars required by either of them. Should the Contractor not attend or neglect or omit to send such agents, then the measurement made by Engineer-in-charge and approved by him, shall be taken to be the correct measurement of the work. For the purpose of measuring such permanent work as is to be measured by record and drawings, Engineer-in-Charge shall prepare records and drawings month by month and the Contractor, as and when called upon to do so in writing, shall within fourteen days, attend to examine and agree such records and drawings with Engineer-in-Charge and shall sign the same when so agreed. If the Contractor does not so attend to examine and agree such records and drawings they shall be taken to be correct if, after examination of such records and drawings, the contractor does not agree to the

same or does not sign the same as agreed, they shall nevertheless be taken to be correct, unless the Contractor shall, within fourteen days of such examination, lodge with Engineering in Charge for decision by ACCEPTING AUTHORITY, notice in writing of the respects in which such records and drawings are claimed by him to be incorrect.

.02 The contractor shall raise bills once a month or for a minimum payment of 10% of contract amount.

.03 Payment towards all interim bills will be made by ACCEPTING AUTHORITY within 30 days of presentation by the contractor.

.04 Period of final measurement shall be three months from the time of completion of the project.

2.34.03 **METHOD OF MEASUREMENT**

The works shall be measured in accordance to relevant IS codes not withstanding any general or local custom, except where otherwise specifically described or prescribed in the contract.

2.35 **PROVISIONAL SUMS**

2.35.01 “Provisional sum" means a sum included in the contract and so designated in the schedule of quantities for execution of works or the supply of goods, materials or services or for contingencies, which sum may be used, in whole, or in part or not at all, at the direction or discretion of Engineer-in-Charge. The contract price shall include only such amounts in respect of the work, supply or services to which provisional sums relate as Engineer-in-Charge shall approve or determine.

2.35.02 The contractor shall when required by Engineer-in-Charge, produce all quotations, invoices, vouchers and accounts or receipts in connection with expenditure in respect of provisional sums.

2.36 **FURTHER INSTRUCTIONS**

In this tender specifications of the works are given in the following sections:

A. **TECHNICAL SPECIFICATIONS**
B. **SCHEDULE OF QUANTITIES with Unit Rate Specifications**

Technical specifications are the general instructions for carrying out the works.

Unit rate specifications are the descriptions of items for which unit rates are to be worked out by the tenderer by considering all tender information.

The Contractor has to work out his rate for each and every item and his quoted rates shall be entered in the specified columns against each and every item.

The rates against each item specification has to be entered by a single entry both in words and in figures.

Every contractor should furnish along with his tender income-tax clearance certificate and information regarding the income-tax circle or Ward of the District in which he is assessed by income-tax, the reference No. of assessment and the assessment year.

The rates should be quoted in decimal coinage system.

Certified copies of Registration Certificate, Partnership Deed and Power of Attorney or Articles of Agreement in case of Limited companies will have to be furnished for considering the acceptance of the tender.

Should the contractor notice any discrepancy or error in the statement made, or quantities or units shown against items, he shall immediately bring it to the notice of Engineer-in-Charge and obtain the clarification before submitting the tender. The tender shall be based on such clarifications received and shall be recorded as such in the covering letter to the contractor to execute the work according to the corrected statement made for quantities or units shown in the tender, without any compensation.

The tender of the Contractor not complying with the above instructions may be rejected.

The tenderer should put the signature on all pages of the tender documents.

2.37 MATERIALS OBTAINED FROM EXCAVATION

The contractor shall treat all materials obtained during dismantling of a structure, excavation of the site for a work, etc. as property of the OWNER and such materials shall be disposed off to the best advantage of the OWNER according to the instructions issued by the Engineer-in-Charge.

2.38 TREASURE TROVE, FOSSILS, ETC.

All fossils, coins, articles of value or antiquity and structures and other remains or things of geological or archaeological interest discovered on the Site shall be the absolute property of the OWNER and the Contractor shall take reasonable precautions to prevent his workmen or any other person from removing or damaging any such article or thing. The Contractor shall immediately upon discovery thereof and before removal, acquaint the Engineer-in-Charge with such discovery and carry out the Engineer-in-Charge's directions as to the disposal of the same at the expense of the OWNER.

2.39 JURISDICTION

Any legal dispute arising out of or in any way connected with this contract shall be deemed to have arisen at site and shall be settled in a court of competent jurisdiction located in Ernakulam, Kerala.

2.40 If the rate quoted for individual item/items is unbalanced or unworkable the successful bidder shall provide additional performance guarantee in the form of Cash or Bank Guarantee to ensure the successful completion of the individual item/items. The Accepting Authority may decide the amount of such performance guarantee based on the difference between quoted rate and estimated rate.

The Managing Director
Kerala State Co-Operative Marketing
Federation (MARKETFED)

I/We have carefully read the above said instructions and shall comply with the same.

Signature of the tenderer.

Place:
Date :

3.0 SPECIAL CONDITIONS OF CONTRACT

3.01 MOBILISATION ADVANCE

The successful Tenderer after having been offered the contract and executed the agreement with the Clients can avail a mobilisation advance not exceeding 10% (Ten percentage) of the contract value against a duly executed Bank guarantee for a sum equal to 120% (One hundred and twenty percentage) of the advance sought which may be submitted in six different bank guarantees of equal amount (20% of advance) so that the same can be released on pro-rata basis. The validity of the Bank guarantee should be for 13 months from the date on which mobilisation advance is made and shall be kept valid for the whole of the contract period and extended contract periods till the whole amount of advance is recovered. The advance will be recovered from the progressive part bills of the contractor on a prorata basis. However the whole of the balance amount will be recovered from the pre-final bill.

3.02 SECURED ADVANCE

No secured advance will be paid to the Contractor

3.03 BANK GUARANTEE

3.03.01 Additional bank guarantee as performance guarantee from a scheduled bank has to be remitted by the Contractor who quote very low rates as below:

i. If the quoted amount is 50% below PAC, appropriate additional performance guarantee or any amount as decided by the Accepting Authority shall be submitted by the Contractor before executing the agreement and the same will be released after the satisfactory competition of work.

ii. If the quoted amount is between 25% and 50% below PAC, the Contractor will remit performance guarantee equal to the difference between PAC and the quoted amount before executing the agreement and the same will be released after the satisfactory completion of the work.

iii. Performance guarantee for specialized items of work like antitermite treatment, glass work etc. shall be retained by the Accepting Authority/Client at the rate of 10% of the value of such items, for a period of 5 years. No interest shall be paid for the security so retained.

3.04 WATER

Water required for the construction will have to be provided by the Contractors at their own cost. It will be the responsibility of the Contractor to make arrangements for drawing and bringing it to the various construction points. Non availability of water from the

owner's property will not be ground for any delay in work or any claim for any compensation whatsoever.

3.05 ELECTRICITY

Electricity required for the construction and general lighting of the site will have to be provided by the Contractors at their own cost. Non availability of power from KSEB will not be a ground for any delay in work or any claims for any compensation whatsoever.

Temporary wiring/cabling shall not be routed across floors, around doors. It shall be properly routed as directed by the Engineer-in-Charge. Temporary wiring shall be protected from sharp edges, heat and sunlight to avoid breakdown of the insulation.

3.06 DRAINAGE ARRANGEMENTS

The contractor shall control the grading in the vicinity of the buildings and trenches, so that surface water is prevented from running into excavated areas. The contractor shall also be responsible to see that no area around his works becomes flooded during the rainy season because of his piled up material, etc. and subsequently floor another buildings. At the discretion of the Engineer-in-charge the contractor shall take steps to prevent flooding. It shall be the contractor's responsibility to keep areas around his work dry. The cost of repairing flood damage shall be the sole responsibility of the contractor.

3.07 APPROACH ROAD

The contractor will be required to construct suitable approach roads leading to the construction site from the main road Engineer-in-Charge and shall maintain it at his own cost.

3.08 FABRICATION WORKS

The contractor shall furnish to the Engineer-in-Charge 3 copies of detailed fabrication / erection drawing showing clearly all the joint details, two weeks before the commencement of actual fabrication / erection works. The Engineer-in-charge will have the right to suggest such modification to these details as found necessary by them, which shall be duly incorporated in the works by the Contractor. For the purpose of this clause, the two weeks period shall be deemed to begin from the date of the said drawings are received in the Engineer-in-charge office.

3.09. EXCISE DUTY, GST AND OTHER TAXES & DUTIES

Unit rate shall be inclusive of all applicable taxes and duties including GST and any other additional taxes.

Royalty charges & taxes if any on account of supply of materials for all works shall be paid by the Contractor at his own cost. No extra claim in this regard shall be admissible.

3.10. **TURNOVER TAXES / WORKS CONTRACT TAXES:**

Deductions will be made from the bills towards Tax as per the GST Act as per the existing provisions.

a) Cess for the construction of works under building and other Construction Workers Welfare Cess Act-1996. The Contractor shall remit the building and other Construction Workers Welfare Cess at 1% on the total cost of construction including the cost of materials and shall produce the certificate of remittance of Cess to ACCEPTING AUTHORITY. In case the Contractor fails to remit the Cess the applicable Cess will be recovered from the final bill of the contractor.

b. All plumbing and sanitary works shall be executed by a qualified and licensed plumber. The Contractor shall satisfy the Engineer-in-charge as to the competence and qualification of the workmen employed for plumbing and sanitary works.

c. All shuttering used in the work shall be either steel shuttering or of plywood with smooth surfaces so as to give a smooth finish to the concrete.

d. All fixtures & fittings (plumbing fixtures, sanitary materials, doors & window fixtures etc.) have to be got approved by the Engineer-in-charge in writing before fixing the same. However samples of all these fixtures & fittings have to be got approved well in advance of bulk procurement action.

3.11. **PROCUREMENT OF MATERIALS**

Contractor shall make his own arrangements for the procurement of all materials required for the work including cement, steel and bitumen. No assistance will be provided by ACCEPTING AUTHORITY for arrangement for quarries for sand, metal or earth.

3.11.1 **CEMENT**

The cement to be used shall be ordinary portland cement conforming to IS: 8112-1989 for 43/53 Grade OPC/PPC unless otherwise mentioned. The cement should be procured from reputed manufacturers and as approved by the Engineer-in-Charge. Whenever possible, all the cement shall be obtained from one constant source throughout the contract. Cement of different types shall not be mixed one with the other. Different brands of cements or same brand of cement from different sources shall be not used without prior approval of the Engineer-in-Charge.

The cement shall be delivered at site in original sealed bags which shall be labelled with the weight, date of manufacture, brand and type. Cement received in torn or hand-stitched bags shall not be used. For volumetric batching of, concrete, cement should be mixed only by box measurement. All cement should be fresh when delivered and shall be stored in an approved

manner in stores built by the Contractor at his own cost. Set cement shall not be allowed to be used for any work.

With each and every delivery of cement, the Contractor shall provide a certificate that the cement conforms to the relevant Indian standards. Seven days test, to determine the strength of cement, of each batch shall be done immediately upon arrival of the said material and the cement shall be used only after the test result is approved by the Engineer-in-Charge. The cost of the above tests shall be borne by the Contractor.

3.11.2 QUALITY CONTROL ON CEMENT CONSUMPTION

After the completion or at the stage of the determination of the contract, the theoretical quantity of cement shall be computed on the basis of statement showing quantity of cement to be used in different items of work as provided in Data Book. In case any item is executed for which standard co-efficient for the consumption of cement is not available in the above mentioned statement or cannot be derived from the statement, the same shall be calculated on the basis of formula to be laid down by the Engineer-in-Charge.

Over this theoretical quantity of cement required a variation upto (-) 2% may be allowed for less consumption of cement at the discretion of the Engineer-in-Charge provided Engineer-in-Charge is otherwise satisfied with the quality of the works executed. Such variation if more than (-) 2% will attract action of levy of compensation at the rate of twice the prevailing market rate of cement of the quantities consumed less over permissible (-) 2% variation provided Engineer-in-Charge decides to accept the work depending upon its quality etc.

3.11.3 CONSUMPTION OF CEMENT

Quantity of cement will be decided based on the DESIGN MIX. For concreting under water, 10% extra quantity will be allowed.

The contractor should submit design for the same before starting the work and after getting the trial mix approved by the Engineer, follow the same for execution of work.

Only the approved design mix shall be used for the concrete. The following minimum quantity of cement should be used of various grades of concrete:

M20	:	320 Kgs/Cum	With 43/53 grade OPC/PPC
M25	:	330 Kgs/Cum	
M30	:	340 Kgs/Cum	
M35	:	350 Kgs/Cum	
M40	:	360 Kgs/Cum	

Note: While doing mix design, design mix should be prepared with atleast 3 brands of cement from approved list to overcome situations of non-availability of a particular brand of cement.

3.11.4 **CONCRETE PLANT**

Modern dependable batch type mixing plants capable of producing concrete at the desired output to meet the scheduled requirements shall be provided at locations and in the manner approved by the Engineer.

3.11.5 **STEEL**

Steel reinforcing bars shall be round bars of grade I quality conforming to IS: 432 or High Yield Strength Deformed Round Bars conforming to IS:1786 and have to be purchased from approved manufacturer approved by ACCEPTING AUTHORITY. The Contractor shall place direct order on the manufacturing company without involving dealer or distributor.

With each and every delivery of consignment of steel the contractor shall provide the certificate that the steel conforms to the relevant Indian Standard. Any test required to be carried out on steel at all stages of construction shall deemed to be included in Contractor's scope of work. Type of test, frequency of test, acceptance criteria etc. for steel will be as per specification.

Conversion of length of various sizes of MS bars and for Tor Steel bars into weight are as under:-

Size (Dia) mm	Weight : Kg/M	Size (Dia) mm	Weight : Kg/M
6	0.222	25	3.855
8	0.395	28	4.836
10	0.617	32	6.316
12	0.888	36	7.994
16	1.579	40	9.869
18	1.999	45	12.490
20	2.467	50	15.424
22	2.985		

The actual quantity of steel shall be taken for measurement purpose as the quantity fixed as per approved design/drawings or as authorised by ACCEPTING AUTHORITY including authorised lap length/chairs etc. as per the standard sectional weights given in the above table or the actual weight whichever is less. Actual sectional weight of the steel if weighs less than 2% of the standard weights shown above shall be rejected. Nothing will be paid extra for wastage and rolling margin.

In the case of structural steel sections the theoretical weight shall be calculated from the steel tables or actual weight whichever is less.

The average sectional weight for each diameter shall be arrived at from samples from each lot of steel received at site. The actual steel consumed shall be worked out by this procedure. The discretion of the Engineer-in-Charge shall be final for the procedure to be followed for

determining the average sectional weight of each lot. Quantity of each diameter of steel received at site at work each day will constitute one single lot for this purpose.

3.11.6 SITE OFFICE

A site office of size 4mx3m to be provided by the Contractor for the use of Owner. The Office should have required furniture toilet facility, water and power.

The following minimum furniture / equipments shall be provided.

a. Executive tables	-	1 No
b. Chairs	-	3 Nos
c. Steel Almirah	-	1 No
d. Ceiling/Wall/Pedestal fan	-	1 No
e. Fluorescent light fixtures	-	2 Nos
f. Power socket for laptop	-	1 No

The Contractor has to dismantle and remove the temporary office after the completion of the Project.

3.11.7 SUPERVISORY STAFF

The Contractor shall appoint required number of experienced and qualified technical and supervisory staff at the site for supervising the work and shall see that all of them are always at the work spot during the working hours, personally checking all items of work. He shall take such orders as may be given to him by the Engineer-in-charge from time to time and shall be responsible to carry them out properly. In case Contractor fails to provide sufficient person as per terms given below, Owner/Client reserves the right to deduct a reasonable amount from the Contractor's bill, subject to a maximum of Rs.25,000/- for every month of absence.

3.11.8 PROGRAMME OF WORKS AND PROGRESS REPORTS

a) The entire work is scheduled to be completed as stipulated in NIT. The Contractor shall programme the different items of work in accordance with the detailed time schedule approved by the Engineer-in-charge.

b) CONTRACTOR TO SUBMIT PROGRAMME
After the acceptance of his Tender, the Contractor shall, within fifteen days, submit to the Engineer-in-Charge for his approval, a detailed programme taking into account the total time period stipulated in the contract showing the order, the procedure and method in which he proposes to carry out the works.

He shall furnish the particulars in writing of his arrangements of manpower, plant and machinery, shuttering and all other resources owned and dedicated to this work. Cash flow during the execution of project for procurement of materials and for

carrying out of the works including temporary works which the Contractor intends to construct shall also be furnished.

In support of this programme, the Contractor shall submit a work schedule in the form of a CPM/PERT Chart. The Engineer-in-Charge shall if necessary modify the programme submitted by the Contractor and approval shall be given by the Engineer-in-Charge indicating the major milestones. The programme approved by the Engineer-in-Charge shall be final and binding on the Contractor. The approval by the Engineer-in-Charge of such programme, or furnishing of such particulars shall not relieve the Contractor of any of his duties or responsibilities under the contract.

During the progress of work, the Contractor shall be required to furnish the resource mobilisation plan as required by Engineer-in-Charge to keep up the target date of completion.

This CPM/PERT programme will be required to be updated every three months or more frequently as directed by the Engineer-in-Charge, based on the actual progress, resource mobilisation and other field conditions actually prevailing.

c) PROGRESS REPORTS AND SCHEDULES
The Contractor shall submit to the Engineer-in-Charge by the third day of every fortnight, six (6) copies of a report in a duly approved format showing the progress made in construction of the works mobilisation of resources etc. during the previous fortnight.

d) The Contractor shall also submit by the end of every month his anticipated progress schedule for all items of work for the following month in six (6) copies in an approved proforma to the Engineer-in-Charge.

e) The Contractor shall also submit Photographs of completed works along with Monthly Progress Report (both soft copy & hard copy of approved size)

3.12 DOCUMENTATION

The Contractor shall prepare and submit the detailed documentation of all the structures by means of Photography (hard copy and soft copy), Video by a professional photographer covering various views of the project up to the satisfaction of the Consultant/Client and all as built drawings along with the final bill.

3.13 WORKS TO BE DONE BY CONTRACTOR- ELECTRICAL WORKS

Unless and otherwise mentioned in the tender document, the following works shall be done by the contractor, and therefore their cost shall be deemed to be included in their tendered cost:

a) Foundation and brackets and components wherever required, including foundation bolts, etc. wherever specified.

b) Excavation and refilling of trenches in soil wherever the pipes/cables are to be laid directly in ground, including necessary base treatment and supports for pipes, bricks, etc, as specified.

c) Sealing of all opening provided for pipes and cables, from fire safety point of view, after laying of the same.

d) Painting of all exposed metal surfaces of equipment and components.

e) Fixing of danger notice boards wherever required.

f) Making good all damages caused to the structure, walls, floors, slabs, etc., during installation and restoring the same to their original finish.

g) Consumables, fuels, cement, etc. required for the work, testing, trial runs and commissioning.

h) Testing and commissioning of the completed installation.

i) For any item of work, not covered in particular specification, the same shall be done as per latest relevant BIS codes of practice.

j) For any item of work not covered in particular specification, the same shall be done as per sound engineering practice as directed/approved by Engineer-in-Charge.

3.14 GENERAL REQUIREMENTS AND ARRANGEMENT OF MATERIALS

3.14.1 All sundry fittings, assemblies, accessories, hardware items, foundation bolts, termination lugs for electrical connections as required, and all other sundry items which are useful and necessary for proper assembly and efficient working of the various components of the work shall be deemed to have been included in the tender, whether such items are specifically mentioned in the tender document or not.

3.14.2 Busway/Cable Layout

Prior to the laying of the busbar trunking and cables, the contractor shall submit to the Engineer-in-charge detailed layout plan and get it approved. The layout plan shall contain particulars regarding size & routes of the busbar system/cables, number of supports, pipes carried and the tap-off points, inspection chambers provided along the route.

3.14.3 Centre of gravity

The centre of gravity of the assembled equipment shall be low and as near the vertical centre line as possible. If the centre of gravity is ex-centric relative to track, its location shall be shown on the outline drawing.

3.14.4 Quality of materials

All the materials and equipment supplied by the contractor for this work shall be new and should confirm to relevant BIS Specifications. They shall be of such design, size and material as to function satisfactorily under the rated conditions of operation and to withstand the environmental conditions at site. The copies of purchase vouchers & gate passes should be produced along with the materials. The type test certificates, routine test certificates and acceptance test certificates are also to be submitted.

3.14.5 Inspection of material and Equipment

The materials should be inspected/ tested prior to the despatch from the manufacturer by Client/Consultant. The inspection call should be given at least fifteen days in advance so as to depute the officials of Client/Consultant for the inspection.

Such inspection will be of the following categories:

1. Inspection of materials/equipment to be witnessed at the manufacturers' premises in accordance with relevant BIS/Agreement Inspection Procedure.
2. To receive materials at site with manufacturers' Test Certificate(s).
3. To receive materials after physical inspection at site.

Similarly, for fabricated equipment, 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.

3.14.6 Rating of components

All current carrying components in an installation shall be of appropriate rating of voltage, current and frequency as required at the respective sections of the electrical installation in which they are used, without their respective ratings being exceeded.

3.14.7 Fabrication of Panels in a CPRI approved workshop

Unless otherwise specified, switch boards/HT/LT panels etc. will be fabricated by a fabricating workshop preferably having a CPRI Certificate for short circuit withstand capability for manufacture/fabrication for the rating of Switchboards specified. The workshop also should have reasonable quality control, and testing facilities, besides, having a proper 7-tank process for treatment and painting of metal parts.

3.14.8 Storage of materials

The storage of materials brought to site is the full responsibility of the contractor. The contractor should construct necessary store rooms. The land required for stores will be provided by the Owner free of cost. The storeroom should be with double lock arrangement and key of one lock will be with Engineer-in-charge or his authorised representative and other one will be with the contractor.

3.14.9 Procurement of Materials

Contractor shall make his own arrangements for the procurement of all materials including cement and steel required for the work.

3.15 Samples

3.15.1 The Contractor shall be required to produce samples of all the materials sufficiently in advance to obtain approval of the Engineer-in-charge.

3.15.2 Approved samples shall be retained by the Engineer-in-charge until the completion of the work and all materials and workmanship incorporated in the work are to conform to the approved samples in all respects. Rejected materials shall be removed from the site immediately under the supervision of Engineer-in-charge.

3.15.3 If on handing over the site or at any time thereafter during the execution of work, the contractor considers that any drawing or information necessary for the execution of the work has not been provided, he shall inform the Engineer-in-charge in writing giving full details required. All materials or workmanship, which in the opinion of the Engineer-in-charge is defective or is unsuitable shall be removed immediately from the site within a reasonable time to be fixed by the Engineer-in-charge depending on the requirement in each case, failing which, the same shall be removed at the risk and cost of the Contractor. No claim whatever shall be entertained on this account.

3.15.4 Whenever B.I.S. codes are referred to in other particular specifications attached, the latest B.I.S. codes prevalent at the time of execution shall be followed.

3.16 Bye-laws

The Contractor shall comply with all bye-laws and regulations of local and statutory authorities having jurisdiction over the works and shall be responsible for obtaining prior approval, if any, and payment of all fees and other charges, giving and receiving of all necessary notices and keeping the Engineer-in-charge informed of the said compliance with the bye-laws payments made, notices issued and received.

The Contractor shall indemnify Owner against all claims in respect of royalties, patent rights, design trademarks of name or other protected rights in respect of any plant, machine, work or materials used for or in connection with work or temporary work and from and against all claims, demands proceeding, cost, charges and expenses whatsoever in respect of or in relation thereto. The Contractor shall defend all actions arising from such claims and shall himself and any every sort that may be legally incurred in respect thereof.

The Electrical work shall be carried out as per local Electrical Inspectorate / Central Electrical Authority, which even is concerned. standards/ specifications/ guidelines and the Contractor shall get the approval and safety certificate from the Inspectorate after the completion of work and before energisation.

3.17 Consumption of Materials

Proper record of daily consumption of materials shall be maintained at the site of work for each item as directed by the Engineer-in-charge. This is required to be done even if the contractor arranges these materials.

3.18 Co-ordination

The Contractor shall co-operate with other agencies working in the same project, compare plans, specifications and the time schedules and so arrange his work that there will be no interference. The Contractor shall forward to the Engineer-in-charge all correspondence and drawings exchanged. Failure to check plans for conditions will

render the Contractor responsible for bearing the cost of any subsequent change found necessary or damages done.

However, the Contractor shall afford necessary facilities to execute the work simultaneously with other agencies executing the works for the same project. The Owner shall entertain no claim on this account.

3.19 Safety

Only properly tested and marked material handling equipment shall be used.

All important connections/assembly of sound design related to pulley/guide etc., including the supporting arrangement and fixing details shall be checked periodically and necessary rectifying actions are to be taken in order to ensure safe handling of loads during different operations.

All plant and machinery of the contractor shall observe the safety regulations needed for working in a project where other contractors/ sub-contractors/ agencies might also be working on the project, so as not to interfere with the work of the other contractors or foul with their constructions shall be taken by the contractor and nothing extra is payable on this account.

The Contractor shall take all precautions to avoid all accidents by exhibiting necessary caution boards day and night, speed limit boards, red flags, red lights and providing barriers. He shall be responsible for all damages and accidents caused due to negligence on his part. No hindrances shall be caused to traffic during execution of work.

The rates quoted by the Contractor for all items except those where specific provisions indicated in the schedule of Requirements shall include all leads, lifts, and nothing extra shall be paid on this account.

The Contractor shall adjust his labour, staff, plant, machinery. etc., according to the requirement of work from time to time with particular regard to approved phases of work and no claim shall be entertained on account of idle labour, plant, machinery, etc., due to any reason whatsoever.

The Contractor shall clear the site thoroughly of all shuttering materials and rubbish etc., left out of his work and dress the site around the area to the satisfaction of Engineer-in-charge upon completion of the work and before release of payment of the last running bill. He will remove the labour huts on completion of the work. The payment of final bill will be subject to the compliance of this condition by the contractor.

3.20 Testing and Measuring Equipments

Equipment for measurement of work and testing the installation shall be procured by the Contractor for his use at his own cost. The same shall also be made available to the Engineer-in-charge without any charges for use of this work.

3.21 Tests

The Contractor shall produce samples of all the materials well in advance so that there is sufficient time for testing of the materials and clearance of the same before incorporation in the work.

All the materials to be used in and on every part of the work shall be subjected, from time to time, to such tests as the Engineer-in-charge may direct. Such tests shall be performed at the expense of the Contractor. The samples for tests shall be in all cases selected by the Engineer-in-charge and supplied by the Contractor as part of the contract. If at any time, any material so tested, fails to meet the acceptance criteria, the same shall be removed from the site of works and other materials substituted therefore, but in the absence of any specified test/acceptance criteria, the decision of the Engineer-in-charge shall be final and binding as to whether the said material or materials shall be used on the works, or removed forthwith and other suitable, approved material substituted.

The contractor shall produce on demand from the Engineer-in-charge, the necessary test certificates, Manufacturers' Authorization form certifying that the materials conform to the technical specifications. However, this clause will not apply to routine testing of materials at the site laboratory of the Contractor.

All tools, instruments, plants and labour/operating personnel for the test shall be provided by the Contractor at his own cost. For any tests as directed by the Engineer-in-charge, that has to be carried out at an outside laboratory, the same should be carried out by the Contractor without any extra cost.

3.22 Site for Plants/Equipment, Stacking of Materials and Labour

The Contractor shall stack materials at the site of work strictly as per instructions of Engineer-in-charge keeping in view the safety and smooth progress of the project.

Nothing extra shall be payable for any extra lead involved in stacking the materials at a reasonable distance away from the work place.

Site for labour camps will be made available to the Contractor, if found necessary, by the Owner and it should be vacated and area cleared by the Contractor on completion of work and before the release of final bill.

3.23 Site Maintenance during Construction

The Contractor and each Sub-Contractor shall from time to time clear and remove all rubbish and obstructions and driveways in the work area shall be kept clear and unobstructed at all times. Nothing extra shall be paid on this account.

3.24 Insurance

The Contractor shall arrange, secure and maintain insurance as may be necessary and for all such amounts to protect his risks as detailed herein. The form and the limit of such insurance as defined herein together with the underwritten thereof in such case shall be as acceptable to the Owner.

However, irrespective of such acceptance, the responsibility to maintain adequate insurance coverage on comprehensive all risks basis at all times during the period of contract shall be of the Contractor. The Contractor's failure in this regard shall not relieve him of any of his contractual responsibilities and obligations. Any loss or damage to the construction equipment or materials during handling, transporting, storage and erection, till such time as the work is certified by the Engineer-in-charge as having been completed in all respects & is taken over by the Owner: shall be to the account of the Contractor and his responsibility preferring all claims and make good for the damage or loss by way of repairs and/or replacement of the portion of the work damaged or lost. The completion of work shall not, in any, way relieve the Contractor of the above responsibilities during the period of the contract. The Contractor shall provide the Owner with a copy of all insurance policies and documents taken out by him in pursuance of this contract.

Such copies of documents shall be submitted to the Owner immediately after such insurance coverage. The Contractor shall also inform the Owner in writing at least twenty (20) days in advance regarding the expiry/cancellation and/or change in any of such documents and insurance revalidation/renewal, etc., well in time as may be necessary. The risks that are to be covered under the insurance shall include but not be limited to the loss or damage in transit, theft, pilferage, riot, civil commotion, weather conditions, accidents of all kinds, fire, etc. The scope of such insurance shall cover the entire value of the work from time to time. All costs on account of insurance liabilities covered under the contract will be on the Contractor's account and will be included in contract price. However, the Owner, may from time to time during the pendency of the contract, ask the Contractor in writing to limit the insurance coverage risks and in such a case the parties to the contract will agree for a mutual settlement for reduction in contract price to the extent of reduced premium account.

3.25 Insurance for Staff

The Contractor shall insure all his staff working at site against injury, loss of life etc., and the Owner will entertain no claims of compensation in this regard. The Contractor shall indemnify the Owner against all such claims as above, by his staff.

3.25 Compensation for Delay

If the Contractor fails to complete the work and clear the site for any particular phase on or before the stipulated completion time of that respective stage or extended period of completion, he shall, without prejudice to any other right or remedy of the Owner on account of such breach, pay as agreed a compensation of the amount calculated on the basis of General Conditions of Contract.

The Contractor shall maintain in perfect condition all works executed till the completion of the entire works allotted to him. When, phased handing-over is contemplated, the provisions mentioned above will apply to each phase.

3.27 Guarantee

At the close of work and before issue of final certificate of total completion by Engineer-in-charge, the contractor shall furnish a written guarantee indemnify the

Owner against defective materials and workmanship for a period of one year after completion. The Contractor shall hold himself fully responsible for reinstallation or replace free of cost to the Owner during the defect liability period as stipulated hereunder:

a) Any defective material supplied by the Contractor or defective workmanship of the Contractor.

b) Any material supplied by the Purchaser/owner, which is proved to be damaged or destroyed as a result of defective workmanship by the Contractor.

3.28 Payment Terms for the Supply and Installation

On progress of supply: Upto 75% of the supply value as assessed by the Engineer-in-Charge, for the materials supplied shall be paid as on account payment on the strength of certificate issued by the Engineer-in-charge.

On progress of erection: Upto 90% of the contract amount, less the initial payments till date, shall be paid on final completion of the entire supplies & installation work under contract, for which payments are claimed.

On taking over: 100% of the contract amount, less amount already paid and security deposits due, if any, shall be paid on completion of testing, trial run and satisfactory commissioning of the installation and issue of the final completion certificate, and on acceptance of the same by Owner, after obtaining the clearance from the Electrical Inspectorate.

All the payments are made, after deducting there from the amounts already paid, the security deposit, income tax and other amounts as may be deductable or recoverable in terms of the contract.

The amount admissible for interim bills shall be normally paid within a month from the date of receipt of the bill by the Engineer-in-charge after such verification as is considered necessarily.

Pending consideration of extension of date of completion, interim payments shall continue to be made as here in provided.

Any interim certificate given relating to work done or materials delivered, may be modified or corrected by any subsequent interim certificate or by the final certificate. No certificate of the Engineer-in-charge supporting an interim payment shall have itself be inclusive evidence that any work or materials to which it relates is/are in accordance with the contract.

3.29 Inspectorate Approval

3.29.1 All the equipment to be supplied and works to be executed shall conform to the State Electrical Inspectorate/Central Electrical Authority Standards including all protection and metering accessories. Nothing extra will be paid in this regard.

3.29.2 Contractor has to obtain necessary scheme approval, if any, from the statutory authorities concerned immediately after the award of work.

3.29.3 All testing/calibration etc., are to be carried out as per the requirements of statutory authorities concerned.

3.29.4 On completion of work, the contractor has to obtain necessary safety/ energization certificate from the statutory authorities concerned by submitting necessary completion certificate, drawings, equipment details, load details, test results etc., before energization.

3.29.5 All costs incurred in obtaining such approval/certificates are to be borne by the contractor. Statutory fees paid shall be reimbursed on presentation of documents.

3.29.6 If the current rating of any of the switchgears including circuit breakers mentioned in the Schedule of requirements is not available or is not in conformation to the Inspectorate standards then it shall be rated to the nearest higher rating available with the current rating/fuse rating as specified.

3.30 Structural Alterations to Building

No structural member in the building shall be damaged/ altered, without prior approval from the Engineer-in-charge.

Structural provisions like openings, if any, provided by Owner for the work, shall be used. Where these require modifications, such contingent works shall be carried out by the contractor, at his cost.

All cut out openings in floors provided by Owner shall be closed, after installation, in accordance with the schedule of work.

All cuttings made by the contractor in connection with the works shall be filled by him at his cost to the original finish.

3.31 Phasing of Works

The total period for completion of works under this contract is as given in the bid document. The work has to be carried out in phases as directed by the Engineer-in-charge from time to time so that the total project work can progress smoothly with least obstruction to the work of other Contractors/ agencies.

3.32 Completion Drawings and Certificate

For all work completion report as given in the pro-forma for test results shall be submitted to the Engineer-in-charge, after completion of work.

On completion of work, the Contractor shall submit “As fitted drawings” drawn to a suitable scale in tracing sheet indicating the following along with three copies and one set of computer floppy diskettes/CD ROMS of the same to the Engineer-in-charge before the submission of the final bill.

1. The Schematic diagram of HT, LT & control wiring showing all protective schemes, if applicable.
2. General layout of the site showing therein routes of cables and equipment position.
3. Schedule of lengths, types and sizes of cables.
4. Position of all cable joints type wise, supports, stays, struts, lightning arrestors, feeder pillars, structures, earthing and pipes or closed ducts.
5. Position of cable route markers and joint markers with respect to permanent land marks available at site.
6. Name of work, job number, accepted tender reference, actual date of completion, names of Division/Sub-Division, and name of the firm who executed the work with their signature(s).
7. Routine and type test certificates (3 sets)
8. Detailed Operation and Maintenance Manuals (3 sets)
9. Detailed erection, testing and commissioning manuals (3 sets).

3.33 Deviations from Owner's Specification

Deviations from the Owner's specification, if any, proposed by the bidder will be considered, provided they meet with the Owner's requirements and are necessary to improve utility, performance and efficiency. The deviations proposed by the bidder shall include the technical merits and the financial implications.

3.34 Conformity to IE Act, IE Rules and Standards

3.34.1 The work shall be carried out in the best workmanlike manner in conformity with this specification, the relevant specification/codes of practice of the Bureau of Indian Standards or IEC recommendations (Except where specified otherwise) and other relevant standards with latest amendments, approved drawings and the instructions issued by the Engineer-in-charge or his authorised representative, from time to time. Equipment meeting any other authoritative standard, which ensures an equal or better quality than the above standards, will also be acceptable.

3.34.2 In addition to the standards, all works shall also conform to the requirements of the followings:

a) All Electrical works shall be carried out in accordance with the provisions of Indian Electricity Act-1910, Indian Electricity Rules 1956 amended upto date (Date of call of tender unless specified otherwise)

b) The works shall also conform to relevant Bureau of Indian Standards' Codes of practice (COP) for the type of work involved.

c) Materials to be used in work shall be ISI marked wherever applicable.

d) In all electrical installation works, relevant Safety codes of practices shall be followed.

e) Fire Insurance Regulations/Tariff Advisory Committee.

f) Regulations laid down by the Chief Electrical Inspector of the State Electrical Inspectorate/State Electricity Board/ Central Electrical Authority or any other agencies concerned.

g) Regulations laid down by the Factory Inspector of the State.

h) Any other regulations laid down by the local authorities.

i) Installation & operating manuals of original manufacturers of equipment.

3.35 Data/Drawings/Documents

The bidder shall submit the following data/information/drawings/documents as indicated below:

i) List of deviations clause by clause and reasons.

ii) Descriptive literature of the various equipment offered with catalogues, if any.

ii) Guaranteed technical particulars of the equipment and performance particulars

iii) Approximate dimensions and weights and preliminary G.A drawings.

iv) List of optional features with extra price.

v) Make of various equipment and associated components/accessories.

vi) Where applicable, preliminary schematic of the equipment/ system offered in the tender.

Within 4 weeks of order, Contractor shall submit 4 sets of following documents for Client/Consultant's approval.

i) G.A Drawings with dimensions and weight, plan and sections and fixing/foundation details.

ii) **Where applicable, control scheme drawings with write-up and all terminal numbers for external hook up.**

Subsequently, 4 sets of the revised documents shall be submitted incorporating Owners / Consultants comments as **Final Drawings** for Owners's reference and records before the equipment is offered for inspection.

Liaison with all statutory authorities including KSEB for getting sanction/approval/safety certificate/ power connection including submission of necessary forms to KSEB/ Electrical inspectorate as required is included in the scope of this work. Necessary fee for the above will be reimbursed from District Industries Centre on production of actual bills.

INFORMATION ABOUT THE TENDERER
(To be filled by the tenderer)

1	Name of Bidder		
2	Registered office with address for communication	Full postal address	
		Telephone No	
		Mobile No.	
		Fax.No.	
		Email Id	
3	Status of the bidder (individual / Partnership/Private Company/Public Limited Company)		
4.	Details of local office	Address	
		Contact Peron	
		Tele.No.	
		Mobile No.	
		Fax No.	
		Email Id	
5	Particulars of experience as Prime Contractor as per eligibility criteria mentioned in NIT		
6	Annual trun over for the last three years	2020-21	
		2021-22	
		2022-23	
7	Permanent Account Number (PAN)		
8	GST Rate		(To be quoted as inclusive)
9	GST Regn No.		
10	PF Reg.No		
11	ESI Reg No.		

(Attested copies to prove the above shall be submitted along with the tender document)

Signature & Seal of tenderer:
Date:

Name of Tenderer:
Address:

4. PROFORMA OF PRELIMINARY AGREEMENT

(To be executed on stamp paper of value Rs.200/- and submitted along with tender).

Preliminary agreement entered into on this ..... day of ..... Between (name of Accepting Authority) (Hereinafter called ACCEPTING AUTHORITY on one part and Shri..... (name and address of the Contractor) (Hereinafter called the Contractor) on the other part for the execution of the agreement as well as the execution of the (NAME OF WORK) And where as the notice inviting tenders it is stated as follows. Before commencing the work of within a week of the date when the acceptance of tender has been intimated to him, the tenderer shall deposit a sum of Rs……..(as per NIT) which shall be treated as security for the proper fulfillment of the same and he shall execute an agreement for the work in the scheduled form of agreement. If he fails to do this or fail to maintain a specified rate of progress, the security deposit shall be forfeited to ACCEPTING AUTHORITY and fresh tenders shall be called for or the matter otherwise disposed. If as a result of such measures due to the default of the tender to pay the requisite deposit sign contracts to take possession of the work any loss to the ACCEPTING AUTHORITY results, the same will be recovered from him as arrears of revenue but should it be a saving to ACCEPTING AUTHORITY the original contractor shall have no claim whatever to the difference. Recoveries to this or any other account will be made from the sum that may be due to contractor on this or any other contracts or under the Revenue Recovery Act or otherwise as ACCEPTING AUTHORITY may decide.

Now therefore these present witness and it is mutually agreed as follows:

1. The terms and condition for the said contract having been stipulated in the said tender form to which the contractor has agreed, a copy of which is appended, and which forms part of this agreement, it is agreed that the terms and conditions stipulated there in shall bind the parties to this agreement, except to the extent to which they are abrogated or altered by express terms and conditions herein, agreed to and in which respect the express provisions herein shall supercede those of the said tender form.

2. The Contractor hereby agree and under take to perform and fulfill all the operation and obligations connected with the execution of the said contract work viz. – (NAME OF WORK)

3. If the Contractor does not come forward to execute the original agreement after the said work is awarded and letter of acceptance issued in his favour or commits breach of any of the conditions of the contract as stipulated in clause 1.06.4 of the Notice inviting Tenders as quoted above within the period stipulated, ACCEPTING AUTHORITY may rearrange the works otherwise or get it done otherwise at the risk and cost of the contractor and the loss so sustained by ACCEPTING AUTHORITY can be realising from the contractor under the Revenue Recovery Act as if arrears of land revenue as assessed, quantified and fixed by an adjudicating authority consisting of ACCEPTING AUTHORITY or any other officer or officers authorised by ACCEPTING AUTHORITY taking into consideration the prevailing rates and after giving due notice to the Contractor. The decision taken by such authorised officer or officers shall be final and conclusive and shall be binding on the contractor.

4. The contractor further agrees that any amount found due to ACCEPTING AUTHORITY under or by virtue of this agreement shall be recoverable from the Contractor from the Contractor from his EMD and his properties, movable and immovable as arrears of land revenue under the provision of the Revenue Recovery Act for the time being in force or in any other manner as ACCEPTING AUTHORITY may deem fir in this regard.

In witness where of Sri....., NAME OF ACCEPTING AUTHORITY and Sri.....……

Contractor, have set their hands on the day and year first above written,

Signed by Sri.....……. NAME OF ACCEPTING AUTHORITY

In the presence of witness

1. .....

2. .....

Signed and delivered by Sri....., Contractor in the presence of witness.

1.....

2.....

FORMAT OF CONTRACT AGREEMENT

THIS AGREEMENT MADE AT…….. ON THIS …….DAY OF …….. 20…
BY AND BETWEEN

Kerala State Co-Operative Marketing Federation (MARKETFED), Maveli Road, Gandhi Nagar, Kadavanthra, Kochi 682 020, represented by its Managing Director ----------, herein after referred to as "Owner", which expression unless repugnant to the context shall mean and include its successor in office, administrators and assigns of the one part

and

Mr/M/s…….., proprietor/partner……./a company registered under Companies Act 1956 having its principal place of business/registered office at …….. and represented by its Partner/Managing Director ……herein after referred to as "contractor" which expression unless repugnant to the context shall mean and include its successor in office, administrators and assigns.

Whereas, the "owner', has called for Tender No. dated…….for execution of …….(name of work) mentioned, enumerated or referred to in the tender documents including Letter Inviting Tender, General Tender Notice, General Conditions of Contract, Special Conditions of contract, Specifications, Drawings, Plans, Time Schedule of Completion of Jobs, Schedule of Rates, Agreed Variations, other documents.

Whereas the 'Contractor' has inspected the site and surroundings of the works specified in the tender documents and has satisfied himself by careful examination before submitting his tender as to the nature of surface, strata, soil, sub - soil and ground, the form and nature of site and local conditions, the quantities, nature and magnitude of the work, the availability of labour and materials necessary for the execution of work, the means of access to site, the supply of power and water there to and the accommodation he may require and has made local and independent enquiries and obtained complete information as to the matters and things referred to, or implied in the tender documents or having any connection therewith, and has considered the nature and extent of all probable and possible situations, delays, hindrances or interferences to or with the execution and completion of the work to be carried out under the contract, and has examined and considered all other matters, conditions and things and probable and possible contingencies, and generally all matters incidental thereto and ancillary thereof affecting the execution and completion of the work and which might have influenced him in making his tender.

Whereas the tender documents including the notice letter, inviting tender, General Conditions of Contract, Special Conditions of Contract, Schedule of Rates, General obligation, Specifications, Drawings, Plans, Time schedule of completion of jobs, Letter of Acceptance of tender and any statement of agreed variations with its enclosures copies of which are hereto annexed form part of this Contract though separately set out herein and are included in the expression " Contract" wherever herein used.

And Whereas the 'Owner' accepted the Tender of the 'Contractor' for the provision and the execution of the said work at the rates stated in the Schedule of Quantities of Work and finally approved the same (hereinafter called the " Schedule of Rates") for and on behalf of the 'Owner' upon the terms and subjects to the conditions of the Contract.

NOW THIS AGREEMENT WITNESSETH AND IT IS HEREBY AGREED AND DECLARED AS FOLLOWS:

1. In consideration of the payment to be made to the 'Contractor' for the work to be executed by him, the 'Contractor' hereby covenants with the 'Owner' that, the 'Contractor' shall and will duly provide, execute and complete the said works and shall do and perform all other acts and things in the Contract mentioned or described or which are to be implied there from or may be reasonably necessary for the completion of the said works and at the said times and in the manner and subject to the terms and conditions or stipulations mentioned in the Contract.

2. In consideration of the due provision, execution and completion of the said works, the 'Owner', do hereby agree with the 'Contractor' that the 'Owner', pay to the 'Contractor' the respective amounts for the work actually done by him and approved by the 'Owners' at the Schedule of Rates and such other sum payable to the 'Contractor' under provisions of Contract, such payment to be made at such time in such manner as provided for in this Contract. It is further understood that the Contract is neither a fixed lump sum contract nor a piece work contract, but is a contract to carry out the work in respect of the entire works to be paid for according to actual measured quantities at the rates contained in the schedule of rates and probable quantities or as provided in the said contract. It is also specifically understood that the Contractor shall not be eligible for or entitled to claim any amount except to the extent allowed or due under the terms of this contract.

3. The 'Owner' shall pay all amounts due to the 'Contractor' as per the terms of payment mentioned in the tender document.

4. In consideration of the provision, execution and completion of the said works the 'Contractor' does hereby agree to pay such sums as may be due to the 'Owner' for the services rendered by the 'Owner' to the 'Contractor', such as power supply, water supply and other asset for in the said Contract and such other sums as may become payable to the 'Owner' towards materials or towards loss, damage to the 'Owner's equipments, materials, construction plant and machinery, such payments to be made at such time and in such manner as is provided in the Contract.

5. The contractor shall be responsible for compliance of all statutory rules and regulations in relation to execution of the contract and in case, for any reason the owner is made to comply any such obligations or pay any dues on account thereof, the contractor shall reimburse such expenses or payments to the owner immediately on receipt of notice from such authorities.

6. The 'Contractor' shall be allowed to enter upon the site for execution of the works only as a licensee simplicitier and shall not have any claim, right, title or interest in the site or the structures erected there on and the 'Owner' shall be entitled to terminate such license at any time without assigning any reason and it is agreed that the 'Contractor' shall have no right, title or interest in the site made available by the 'Owner' for execution of the works or in the building, structures or works executed on the said site by the 'Contractor' or in the goods,

articles, materials, etc. brought on the said site (unless the same specifically belongs to the 'Contractor') and the 'Contractor' shall not have or deemed to have any lien whatsoever or charge for unpaid bills and will not be entitled to assume or retain possession or control of the site or structures and the 'Owner' shall have absolute and unfettered right to take full possession of site and to remove the 'Contractor', their servants, agents and materials belonging to the 'Contractor' and lying on the site.

7. The materials including sand, gravel, stone loose earth, rock, etc. dug up or excavated from the said site shall, unless otherwise expressly agreed under this 'Contract', exclusively belong to the 'Owner' and the 'Contractor' shall have no right to claim over the same and such excavation and materials should be disposed off on account of the 'Owner' according to the instruction in writing issued from time to time by the 'Owner'.

8. 'Owner' reserve to themselves the right of altering the drawings and nature of the work by adding or omitting any items of work from the Contract or having portions of the same carried out without prejudice to this contract.

9. Time shall be considered as the essence of this Agreement and the Contractor do hereby agree to commence the work within Fifteen days from the date of receipt of letter of acceptance/award of work and immediately after handing over of site whichever is later as provided for in the said conditions and to complete the entire works within the specified period subject nevertheless to the provisions for extension of time.

10. The Contractor shall be responsible for compliance of the laws of the Land includes those relating to labour and workmen, taxation, environment protection and pollution etc. and the 'Owner' will deduct taxes at sources, statutory deductions as applicable and other claims for damages and recoveries from the from the payments made to the Contractor under the Contract.

11. The Contractor shall indemnify and keep indemnified the 'Owner' against all losses and claims for injuries or damages to any person or property whatsoever which may arise out of or in consequence of the construction or maintenance of the works and against all claims, demands, proceedings, damages, cost, charges, expenses whatsoever in respect thereof in relation thereto.

12. The contractor shall follow Kerala PWD Manual or other rules and guidelines issued by Government of Kerala for executing public works of Government of Kerala, Government of Kerala undertakings, Boards and organizations and Central PWD Manuel and Rules and guidelines in regard to execution of woks of government of India, government of India undertakings, Boards and organizations belonging to Government of India.

13. Contractor agrees that time is the essence of the contract and that a detailed time schedule for the completion of various items of work shall be submitted by the Contractor within the time frame prescribed. The approved time schedule shall be strictly adhered to.

14. In case of failure by the contractor to adhere to the time schedule for completion of various items of work, fine for delay shall be levied as per Kerala PWD Manual or Rules / orders of Government or CPWD and government of India Rules as the case may be, in addition to the levy of liquidated damages prescribed therein.

15. In case of breach of any of the terms of contract by the contractor 'Owner' shall have the right to recover the losses and damage from them.

16. The contractor shall take all necessary measures to ensure quality of work in accordance with relevant quality control manuals published by National Institutes (IRC, National Building Code, IS or other prescribed specification

17. In case of failure to meet the specification, the contractor shall remove such and replace materials or work as per relevant IS Code. The Guarantee period of civil works will be as per Conditions of Contract.

18. The defect liability period of the contractor shall be 1 year after completion of the entire project or the identified phases of the project against the quality of materials and workmanship used in the contract. Five Percent(5%) of the executed value of work will be kept as performance guarantee which will be released only after successful completion of defect liability period.

19. The Agreement with the Contractor is on principal to principal basis where the contractor should retain all control over its personnel engaged by him for the above mentioned work and the 'Owner' has only secondary control regarding the compliance of statutory obligations like PF, ESI and other lows applicable in India.

20. Any matter connected with this contract agreement shall fall within the jurisdiction of courts in Ernakulam.

21. The several parts of this contract have been read by us and fully understood by us.

IN WITNESS WHEREOF THE PARTIES HAVE EXECUTED THESE PRESENTS ON THE DAY AND THE YEAR FIRST ABOVE WRITTEN

Signed and Delivered for and on behalf of OWNER		Signed and Delivered for and on behalf of CONTRACTORS.	
signature		signature	
Name		Name	
Designation		Designation	
Witness 1		Witness 2	
Name		Name	
s/o		s/o	
Address		Address	

FORM OF PERFORMANCE GUARANTEE/BANK GUARANTEE BOND
(On Non-Judicial Stamp Paper)

To
Managing Director,
……..(ACCEPTING AUTHORITY)

In consideration of the…….....(hereinafter called The ACCEPTING AUTHORITY) having offered to accept the terms and conditions of the proposed agreement between …….. and …….. (hereinafter called "the said contractor(s)" for the work……..(hereinafter called "the said agreement") having agreed to production of an irrevocable bank guarantee for Rs…….. (Rupees……. Only) as a security/guarantee from the contractor(s) for compliance of his obligations in accordance with the terms and conditions in the said contact.

1. We……(indicate the name of Bank)(hereinafter referred to as the "Bank") hereby undertake to pay to the Accepting Authority an amount not exceeding Rs…….(Rupees…… only) on demand by the Accepting Authority.

2. We…….(indicate the name of Bank) do hereby undertake to pay the amounts due and payable under this Guarantee without any demur, merely on a demand from the Accepting Authority stating that the amount claimed is required to meet the recoveries due or likely to be due from the said contractor(s). Any such demand made on the Bank shall be conclusive as regards the amount due and payable by the Bank under this guarantee. However, our liability under this guarantee shall be restricted to an amount not exceeding Rs…… (Rupees…… only).

3. We, the said Bank, further undertake to pay the Accepting Authority any money so demanded notwithstanding any dispute or disputes raised by the contractor9s) in any suit or proceeding pending before any Court or Tribunal relating thereto, our liability under this present being absolute and unequivocal.

The payment so made by us under this bond shall be a valid discharge of our liability for payment thereunder and the contractor(s) shall have not claim against us for making such payment.

4. We the said bank further agree that the Guarantee herein contained shall remain in full force and effect during the period that would be taken for the performance of the said agreement, and it shall continue to be enforceable till all the dues of the Accepting Authority under or by virtue of the said agreement have been fully paid, and its claims satisfied or discharged, or till the Engineer-in-charge, on behalf of the Government, certifies that the terms and conditions of the said agreement have been fully and properly carried out by the said contractor(s), and accordingly discharges this guarantee.

5. We the said bank further agree with the Accepting Authority that the Accepting Authority shall have the fullest liberty without or consent, and without effecting in any manner our obligations hereunder, to vary any of the terms and conditions of the said agreement or to

extend time of performance by the said contractor(s) from time to time or to postpone for any time or from time to time any of the powers exercisable by the Accepting Authority against the said contractor(s), and to forbear or enforce any of the terms and conditions relating to the said agreement, and we shall not be relieved from our liability by reason of any such variation or extension being granted to the said contractor(s) or for any forbearance, act of omission on the part of the Accepting Authority any indulgence by the Accepting Authority to the said contractor(s) or by any such matter or thing whatsoever which under the law relating to sureties would, but for this provision, have effect of so relieving us.

6. The guarantee will not be discharged due to the change in the constitution of the Bank or the contractor(s).

7. We the said bank lastly undertake not to revoke this guarantee except with the previous consent of the Accepting Authority in writing.

8. The guarantee shall be valid up to ……..unless extended on demand by the Accepting Authority. Notwithstanding anything mentioned above, our liability against this gurantee is restricted to Rs…….. (Rupees……. Only), and unless a claim in writing is lodged with us within six months of the date of expiry or extended date of expiry of this guarantee all our liabilities under this Guarantee shall stand discharged.

Dated the……. Day of……For……;.

In presence of:

WITNESS

1. For and on behalf of (The Bank)

Signature .....

Name & Designation .....

.....

2. .....

Authorisation No. .....

Name & Place .....

Bank's Seal .....

The above Guarantee is accepted by ----------

For and on behalf of ----------

Signature _____

Name _____

Designation _____

Dated _____

Note:

* **For Proprietary Concerns**

Shri _____ son of _____ resident of _____ carrying on business under the name and style of _____ at _____ (hereinafter called "the said Contractor" which expression shall unless the context requires otherwise include his heirs, executors, administrators and legal representatives).

* **For Partnership Concerns**

1. Shri_____son of_____ resident of _____.
2. Shri_____son of_____ resident of _____ carrying on business in co-partnership under the name and style of _____ at _____ (hereinafter collectively called "the said Contractor" which expression shall unless the context requires otherwise include each of them and their respective heirs, executors, administrators and legal representatives).

* **For Companies**

M/s. _____ a company registered under the Companies Act, 1956 and having its registered office in the State of _____ (Hereinafter called "the said Contractor" which expression shall unless the context requires otherwise include its administrators, successors and assignees).

FORM OF BANK GUARANTEE IN LIEU OF SECURITY DEPOSIT IN INDIVIDUAL CONTRACT

(On Non-Judicial Stamp Paper)

To
Managing Director,
……..(ACCEPTING AUTHORITY)

In consideration of the ……(ACCEPTING AUTHORITY) having its head office at ……. (which expression shall unless repugnant to the subject or context includes its administrators, successors and assignees) having agreed under the terms and conditions of Contract Agreement No._____ dated_____ made between _____ and …….(ACCEPTING AUTHORITY) connection with the work of _____ (hereinafter called the said contract), to accept a Deed of Guarantee as herein provided for Rs. _____ (Rupees _____ only) from a Nationalised/Scheduled Bank in lieu of the security deposit to be made by the Contractor or in lieu of the deduction to be made from the Contractor's bills, for the due fulfillment by the said Contractor of the term and conditions contained in the said Contract, We the _____ Bank (hereinafter referred to as "the said Bank" and having our registered office at _____ do hereby undertake and agree to indemnify and keen indemnified ……..(ACCEPTING AUTHORITY) from time to time to the extent of Rs. _____ (Rupees _____ only) against any loss or damage, cost, charges and expenses caused to or suffered by or that may be caused to or suffered by ……(ACCEPTING AUTHORITY) by reason of any breach or breaches by the said Contractor of any of the terms and conditions contained in the said contract and to unconditionally pay the amount claimed by …….(ACCEPTING AUTHORITY) on demand and without demur to the extent aforesaid.

2. We, the _____ Bank, further agree that ……..(ACCEPTING AUTHORITY) shall be the sole judge of and as to whether the said contractor has committed any breach or breachs of any of the terms and conditions of the said contract and the extent of loss, damage, costs, charges and expenses caused to or suffered by or that may be caused to or suffered by ….(ACCEPTING AUTHORITY) on account thereof and the decision of ……..(ACCEPTING AUTHORITY) that the said Contractor has committed such breach or breaches and as to the amount or amounts of loss, damage, costs, charges and expenses caused to or suffered to or suffered by or that may be caused to or suffered by …..(ACCEPTING AUTHORITY) from time to time shall be final and binding on us.

3. We, the said Bank, further agree that the Guarantee herein contained shall remain in full force and effect during the period that would be taken for the performance of the said Contract and till at the dues of ……(ACCEPTING AUTHORITY) under, the said Contract or by virtue of any of the terms and conditions governing the said Contract have been fully paid and its claimed satisfied or discharge and till the Accepting Authority of the contract certifies that the terms and conditions of the said Contract have been fully and properly carried out by the said Contractor and accordingly discharges this Guaranty subject, however, that ……(ACCEPTING AUTHORITY) shall have no claim under this Guarantee after 90 (Ninety) days from the date of expiry of the defects Liability period as provided in the said Contract. ie. _____ (date) or from the date of cancellation of the said Contract, as the case may be unless a notice of the claim under this Guaranty has been served on the Bank before the expiry of the said period in which case the same shall be

enforceable against the Bank notwithstanding the fact that the same is enforced after the expiry of the said period.

4. ….....(ACCEPTING AUTHORITY) shall have the fullest liberty without affecting in any way the liability of the Bank under this Guarantee or Indemnity from time to time to vary any of the terms and conditions of the said contract or to extended time of performance by the said Contractor or to postpone for any time and from time to time any of the powers exercisable by it against the said Contractor and either to enforcing or forbear from enforcing any of terms and conditions governing the said Contract or securities available to ….....(ACCEPTING AUTHORITY) and the said Bank shall not be released from its liability under these presents by any exercise by ….(ACCEPTING AUTHORITY) if any liberty with reference to the matters aforesaid or by reason of time being given to the said Contractor or any other forbearance, act or omission on the part of ….(ACCEPTING AUTHORITY) or any indulgence by ….(ACCEPTING AUTHORITY) to the said Contractor or any other ….....(ACCEPTING AUTHORITY) matter or thing whatsoever which under the law relating so sureties would but for this provision have the effect of so releasing the Bank from its such liability.

5. It shall not be necessary for ….....(ACCEPTING AUTHORITY) to proceed against the Contractor before proceeding against the Bank and the Guarantee herein contained shall be enforceable against the Bank, not withstanding any security which ….....(ACCEPTING AUTHORITY) may have obtained or obtain from the Contractor at the time when proceedings are taken against the Bank hereunder be outstanding or unrealised.

6. We, the said bank, lastly undertake not to revoke this Guarantee during its currency except with the previous consent of ….(ACCEPTING AUTHORITY) in writing and agree that any change in the Constitution of the said Contractor or the said Bank shall not discharge our liability hereunder.

Dated this ..... Day of .....,

In presence of:

WITNESS

1. For and on behalf of (The Bank)

Signature .....

Name & Designation .....
.
.....

2. .....

Authorisation No. .....

Name & Place .....

Bank's Seal .....

The above Guarantee is accepted by ……(ACCEPTING AUTHORITY)

For and on behalf of ……..(ACCEPTING AUTHORITY)

Signature _____
Name _____
Designation _____
Dated _____

Note:

* **For Proprietary Concerns**

Shri _____ son of _____ resident of _____ carrying on business under the name and style of _____ at _____ (hereinafter called "the said Contractor" which expression shall unless the context requires otherwise include his heirs, executors, administrators and legal representatives).

* **For Partnership Concerns**

1. Shri_____son of_____ resident of _____.
2. Shri_____son of_____ resident of _____ carrying on business in co-partnership under the name and style of _____ at _____ (hereinafter collectively called "the said Contractor" which expression shall unless the context requires otherwise include each of them and their respective heirs, executors, administrators and legal representatives).

* **For Companies**

M/s. _____ a company registered under the Companies Act, 1956 and having its registered office in the State of _____ (Hereinafter called "the said Contractor" which expression shall unless the context requires otherwise include its administrators, successors and assignees).

TECHNICAL SPECIFICATIONS –CIVIL WORKS

1. The following technical specification, code of practice etc. referred herein is form a part of the Item Specification and work shall be executed accordingly. Items which are not covered under Technical Specification shall be carried out as per relevant IS Specification or as per manufactures specification or as directed by Engineer-in-charge.

2. In case of discrepancy between technical specification and item specification provided along with Bill of Quantities, the Item Specification shall prevail.

3. All the measurements shall be as per latest edition of B.I.S.

JUNGLE CLEARANCE

Jungle clearance shall comprise uprooting of rank vegetation, grass, brushwood, shrubs, stumps, trees and saplings of girth upto 30 cm measured at a height of one metre above the ground level. Where only clearance of grass is involved it shall be measured and paid for separately**.**

Uprooting of Vegetations

The roots of trees and saplings shall be removed to a depth of 60 cm below ground level or 30 cm below formation level or 15 cm below sub-grade level, whichever is lower. All holes or hollows formed due to removal of roots shall be filled up with earth rammed and levelled. Trees, shrubs, poles, fences, signs, monuments, pipe lines, cable etc., within or adjacent to the area which are not required to be disturbed during jungle clearance shall be properly protected by the contractor at his own cost and nothing extra shall be payable.

Stacking and Disposal

All useful materials obtained from clearing and grubbing operation shall be stacked in the manner as directed by the Engineer-in-Charge. Trunks and branches of trees shall be cleared of limbs and tops and stacked neatly at places indicated by the Engineer-in-Charge. The materials shall be the property of the Government. All unserviceable materials which in the opinion of the Engineer-in-Charge cannot be used or auctioned shall be removed up to a distance of 50 m outside the periphery of the area under clearance. It shall be ensured by the contractor that unserviceable materials are disposed off in such a manner that there is no likelihood of getting mixed up with the materials meant for construction.

Clearance of Grass

Clearing and grubbing operation involving only the clearance of grass shall be measured and paid for separately and shall include removal of rubbish upto a distance of 50 m outside the periphery of the area under clearance**.**

Measurements

The length and breadth shall be measured correct to the nearest cm and area worked out in square metres correct to two places of decimal.

Rates

The rate includes cost of all the operation described above.

FELLING TREES

Felling

While clearing jungle, growth trees above 30 cm girth (measured at a height of one metre above ground level) to be cut, shall be approved by the Engineer-in-Charge and then marked at site. Felling trees shall include taking out roots upto 60 cm below ground level or 30 cm below formation level or 15 cm below sub-grade level, whichever is lower.

All excavation below general ground level arising out of the removal of trees, stumps etc. shall be filled with suitable material in 20 cm layers and compacted thoroughly so that the surfaces at these points conform to the surrounding area. The trunks and branches of trees shall be cleared of limbs and tops and cut into suitable pieces as directed by the Engineer-in-Charge.

Stacking and Disposal

Wood, branches, twigs of trees and other useful material shall be the property of the Government. The serviceable materials shall be stacked in the manner as directed by the Engineer-in-Charge upto a lead of 50m.

All unserviceable material, which in the opinion of Engineer-in-Charge cannot be used or auctioned shall be removed from the area and disposed off as per the directions of the Engineer-in-Charge. Care shall be taken to see that unsuitable waste materials are disposed off in such a manner that there is no likelihood of these getting mixed up with the materials meant for construction.

Measurements

Cutting of trees above 30 cm in girth (measured at a height of one metre above level) shall be measured in numbers according to the sizes given below:

(a) Beyond 30 cm girth, upto and including 60cm girth.
(b) Beyond 60 cm girth, upto and including 120 cm girth.
(c) Beyond 120 cm girth, upto and including 240 cm girth.
(d) Above 240 cm girth.

Rate

The rate includes the cost involved in all the operations described above. The contract unit rate for cutting trees above 30 cm in girth shall include removal of stumps as well.

EARTH WORK

Applicable Codes

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

a) IS - 4081 Safety code for blasting and related drilling operation.
b) IS - 1200 Method of measurement of building works.
c) IS - 3764 Safety code for excavation work.
d) IS - 3385 Code of practice for measurement of Civil Engineering works.
e) IS - 2720 Part II Determination of moisture content.

Part VIII	Determination of moisture content dry density relation using light compaction.
Part XXVIII	Determination of dry density of soils, in-place by the sand replacement method.
Part XXIX	Determination of dry density of soils, in-place, by the core cutter method.

General

Contractor shall carry out the survey of the site before excavation and set properly all lines and establish levels for various works such as earthwork in excavation for levelling, basement, foundations, plinth filling, roads, drains, cable trenches, pipelines, etc. It is necessary to establish permanent bench mark at such point which will not be affected by subsequent work. Such survey shall be carried out by taking accurate cross sections of the area perpendicular to establish reference/grid lines at 5 m intervals or nearer as determined by Engineer-in-charge based on ground profile.

The area to be excavated/ filled shall be cleared of fences, trees, plants, logs, slumps, bush, vegetations, rubbish slush, etc., and other objectionable matter. If any roots or stumps of trees are found during excavation, they shall also be removed. The material so removed shall be burnt or disposed off as directed by Engineer. Where earthfill is intended, the area shall be stripped of all loose/soft patches, top soil containing deleterious matter/materials before fill commences.

In firm soil if the excavation is deeper than 2 m and in loose, soft or slushy soil, the width of the step shall be suitably increased or the sides sloped or shoring and strutting may be done as per the Engineer's instructions without any extra cost.
For excavation in trenches for pipes nothing extra shall be payable for the lift irrespective of the depth unless specifically mentioned otherwise in the Schedule of Quantities.

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

The excavated stacked earth shall be refilled in the trenches and sides of foundation in 200 mm layers and the balance surplus shall be first filled in layers in plinth and the remaining surplus shall be disposed off by uniform spreading within the site/outside the site as directed by the Engineer.

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

Lead

Lead for disposal of excavated material inside the site and at convenient places in the surrounding areas have been specified in the respective items of work and no other extra lead is intended.

Classification

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

All kinds of soils

These shall include all kinds containing kankar, sand, silt, moorum and/or shingle, gravel, clay, loam peat, ash, shale, etc., which can generally be excavted by spade, pick-axe and shovel and which is not classified under ordinary rock, and hard rock defined below. This shall also include excavation in macadam and tarred roads and pavements. This shall also include rock boulders up to 200 dm^3. Rubble masonry to be dismantled below ground level will also be measured under this item.

Ordinary Rock

These shall include generally any rock which can be excavated by splitting with crowbars or picks and does not require blasting, wedging or similar means for excavation such as lime stone, sand stone, hard laterite, hard conglomerate and unreinforced cement concrete below ground level.

Hard Rock

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

Blasting in rocks

Unless otherwise stated herein, IS 4081, safety code for blasting and related drilling operations shall be followed. After removal of over burden, if any, excavation shall be continued in rock to such widths, lengths, depths and profiles as are shown on the drawings or such other lines and grades as may be specified by Engineer. As far as possible all blasting shall be completed prior to commencement of construction. At all stages of excavation, precautions, shall be taken to preserve the rock below and beyond the lines specified for the excavating, in the soundest possible condition. The quantity and strength of explosive used, shall be such as will neither damage nor crack the rock outside the limits of excavation. All precautions, as directed by Engineer shall be taken during the blasting operations and care shall be taken that no damage is caused to adjoining buildings or structure as a result of blasting operations. In case of damage to permanent or temporary structures, Contractor shall repair the same to the satisfaction of Engineer at his cost. As excavation approaches its final lines and levels, the depth of the charge holes and amount of explosives used shall be progressively and suitably reduced. Specific permission of Engineer will have to be taken by Contractor for blasting rock and he shall also obtain a valid blasting licence from the authorities concerned. If permission for blasting is refused by Engineer, the rock shall be removed by wedging, pick barring, heating and quenching or other approved means. All loose/loosened rock in the sides shall be removed by barring wedging, etc. The unit rates for excavation in hard rock shall include the cost of all these operations.

Contractor shall employ a competent and experienced supervisor and licensed blaster in charge for each set of operation, who shall be held personally responsible to ensure that all safety regulations are carried out.

Before any blasting is carried out, Contractor shall intimate Engineer-in-charge and obtain his approval in writing for resorting to such operations. He shall intimate the hours of firing charges, the nature of explosive to be used and the precautions taken for ensuring safety.

Filling in plinth with selected excavated earth

Plinth shall be filled in layers 15 - 30 cm, of thickness or as specified in items specification watered and compacted with hand rammers as directed by the Engineer-in-charge, so as to avoid any settlement at later stage. For the final layer the surface shall be flooded with water and water allowed to stand for 24 hours. The finished level of the filling shall be trimmed to the level specified.

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

Filling excavated earth in ground for land development

No earthfill shall commence until surface water discharges and streams have been properly intercepted or otherwise dealt with as directed by Engineer-in-charge.

Filling shall be carried out as indicated in the drawings and as directed by Engineer-in-charge. If no compaction is called for, the fill may be deposited to the full height in one operation and levelled. If the fill has to be compacted, it shall be placed in layers not exceeding 600 mm and levelled uniformly and compacted before the next layer is deposited.

Field compaction is called for, test shall be carried out at different stages of filling and also after the fill to the entire height has been completed. This shall hold good for embankments as well. The tests for field compaction shall be specified by the Engineer and the Contractor shall arrange to carry out such tests to the satisfaction of the Engineer-in-charge.

Contractor shall protect the earthfill from being washed away by rain or damaged in any other way. Should any slip occur, Contractor shall remove the affected material and make good the slip at his own cost.

The fill shall be carried out to such dimension and levels as indicated on the drawings after the stipulated compaction. The fill shall be considered as incomplete if the desired compaction has not been obtained.

Filling in plinth and ground with earth brought from outside

Filling shall be carried out with approved material. The material and source shall be subject to prior approval of Engineer-in-charge. The approved area, from where the fill material is to be dug, shall be cleared of all bushes, roots plants, rubbish, etc., top soil containing salts, sulphate and other foreign material shall be removed. The materials so removed shall be burnt or disposed off as directed by Engineer-in-charge. The Contractor shall make necessary access roads to those areas and maintain the same, if such access road does not exist, at his cost.

If any material is rejected by Engineer-in-charge, Contractor shall remove the same forthwith from the site at no extra cost to the owner. Surplus fill material shall be disposed of by uniform spreading within the site as instructed by the Engineer-in-charge. At places backfilling shall be carried out with local sand if directed by Engineer. The sand used shall be kept flooded with water for 24 hours to ensure maximum consolidation. Any temporary work required to contain sand under flooded condition shall be to Contractor's account. The surface of the consolidated sand shall be dressed to require level or slope. Construction of floors or other structures on sand fill shall not be started until Engineer has inspected and approved the fill.

DAMP PROOF COURSE

Cement Concrete Layer

This shall consist of cement concrete of specified proportions and thickness. The surface of brick or stone masonry work shall be levelled 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 honeycombing. Continuity shall be maintained while laying the cement concrete layer and laying 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.

Water Proofing Materials

Where so specified, water proofing material of approved quality shall be added to the concrete mixture in accordance with the manufacturer's specification stating the quantity of water proofing material in liters or kg per 50 kg or cement and will be paid for separately.

Measurements

The length and breadth shall be measured correct to a cm and its area shall be calculated in square metres correct to two places of decimal. The depth shall not be less than the specified thickness at any section.

Rate

The rate is inclusive of the cost of materials and labour involved in all the operations described above except for the applications of a coat of hot bitumen and addition of water proofing materials which shall be paid for separately, unless otherwise specified.

CONCRETE AND ALLIED WORKS

Applicable Codes

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

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

Materials

1) IS 269 : Specification for ordinary, rapid hardening and low heat portland cement
2) IS 455 : Specification for Portland blast furnace slag.
3) IS 1489 :Specification for Portland-pozalana cement
4) IS 4031 :Methods of physical tests for hydraulic cement
5) IS 650 :Specification for standard sand for testing of cement
6) IS 383 :Specification for coarse and fine aggregates from natural sources for concrete
7) IS 2386 (Parts I to VIII) : Methods of test for aggregates for concrete
8) IS 516 : Methods of test for strength of concrete
9) IS 1199 : Methods of sampling and analysis of concrete
10) IS 2396 (I) IS 5640: Flakiness Index of aggregates
11) IS 3025: Methods of sampling and test (physical and chemical water used in industry)
12) IS 432(Part I & II): Specification for mild steel and medium tensile steel bars and hard drawn steel wire for concrete reinforcement
13) IS 1139: Specification for hot rolled mild steel and medium tensile steel deformed bars for concrete reinforcement
14) IS 1566: Specification for plain hard drawn steel wire fabric for concrete reinforcement
15) IS 1785: Specification for plain hard drawn (Part I) steel wire for prestressed concrete
16) IS 1786 :Specification for cold twisted steel bars for concrete reinforcement
17) IS 2090 :Specification for high tensile steel bars used in prestressed concrete
18) IS 4990 :Specification for plywood for concrete shuttering work
19) IS 2645 :Specification for integral cement water-proofing compounds

Equipment

1) IS 1791 :Specification for batch type concrete mixers
2) IS 2438 :Specification for roller pan mixer
3) IS 2505 :Specification for concrete vibrators immersion type
4) IS 2506 :Specification for screed board concrete vibrators
5) IS 2514 :Specification for concrete vibrating tables
6) IS 3366 :Specification for pan vibrators
7) IS 4656 :Specification for form vibrators for concrete
8) IS 2722 :Specification for portable swing weigh-batchers for concrete (single and double bucket type)
9) IS 2750 : Specification for steel scaffoldings

Codes of Practice

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

Construction Safety

1) IS 3696 : Safety code for scaffolds and ladders

Measurement

1) IS 1200 :Method of measurement of building works
   IS 3385 :Code of practice for measurement of civil engineering works

General

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

Materials

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

Cement

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

a. The cement to be used shall be ordinary Portland/Portland Pozolana cement conforming to IS: 8112-1989 & IS:1489 part I respectively for 43 Grade OPC/PPC unless otherwise mentioned. The cement procured should be of reputed brands such as Malabar Cements, ACC, L&T, Shankar Cement, etc. and as approved by the Engineer-in-Charge. As far as possible, all the cement shall be obtained from a single source throughout the contract. Cement of different types shall not be mixed together. Different brands of cements or same brand of cement from different sources shall not be used without prior approval of the Engineer-in-Charge.

   The cement shall be delivered at site in original sealed bags which shall be labelled with the weight, date of manufacture, brand and type. Cement received in torn or hand-stitched bags shall not be used. For volumetric batching of, concrete, cement should be mixed only by box measurement. All cement should be fresh when delivered and shall be stored in an approved manner in stores built by the Contractor at his own cost. Set cement shall not be allowed to be used for any work.

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

c. Cement held in storage for a period of sixty (60) days or longer shall be tested. Should at any time Engineer have reasons to consider that any cement is defective, then irrespective of its origin, and/or manufacturers test certificate, such cement shall be tested immediately at contractor's cost at an approved laboratory and until the results of such tests are found satisfactory, it shall not be used in any work. Contractor shall not be entitled to any claim of any nature on this account.

d. Contractor will have to make his own arrangements for storage of adequate quantity of cement.

e. The site engineer shall be regularly notified when supplies of cement are made to the site store. Copies of invoices shall be made available to the site engineer and a common cement register shall be kept at his office showing the supply stock and issue on a daily basis.

If the cement is supplied by the Client

a) Contractor will have to make his own arrangements for the storage of cement. If supplies are arranged by owner, cement will be issued in quantities to cover work requirements of one month or more, as deemed fit by Engineer and it will be the responsibility of contractor to ensure adequate and proper storage. The storage arrangements shall be such that there is no dead storage. The storage arrangement shall be approved by Engineer.

Aggregates

Aggregate in general designates both fine and coarse inert materials used in the manufacture of concrete. Fine aggregate is aggregate all of which passes through 4.75

mm IS sieve. Coarse aggregate is aggregate most of which is retained on 4.75 mm sieve. Specification mentioned against various item of work may also be followed.

All fine and coarse aggregates proposed for use in the work shall be subject to Engineer's approval and after specific materials have been accepted the source of supply of such materials should not be changed without prior approval of Engineer.

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

Sampling and testing

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

Storage of Aggregates

All coarse and fine aggregates shall be stacked in stock separately in stock piles in the materials yard near the work site or if instructed in bins properly constructed to avoid inter mixing of different aggregates. Contamination with foreign materials and with earth during storage and while heaping the materials shall be avoided. The aggregate must be of specified quality not only at the time of receiving at site but more so at the time of loading into mixer.

Screening and Washing

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

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

Water

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

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

Brick aggregates

The brickbats shall be of new bricks well burnt, hard, durable and broken to sizes, well graded. It shall be free from dust, the size shall be of 37 mm and down. It shall be free from earth and other impurities.

Mix Design

Classification

In case of concrete works, mix design may be necessary as per IS:456 for certain items as directed by Engineer-in-charge. All concrete in the works shall be of design mix as defined in IS 456, unless it is a nominal mix concrete such as 1:3:6, 1:4:8, 1:5:10. Whether reinforced or otherwise, all design mix concrete works to be carried out under this specification shall be divided into the following classifications. (Also refer Clause 1.2.6.3 for testing of concrete).

MINIMUM COMPRESSIVE STRENGTH OF 15 CM CUBES AT 7 AND 28 DAYS AFTER MIXING, CONDUCTED IN ACCORDANCE WITH IS 516

Class	Specified Characteristic Compressive Strength of 15cm Cube at 28 Days in	Assumed Standard Deviation as per table no.8 of IS 456	Max. size of aggregate mm
M 40	40.0	5.0	40 or 20
M 35	35.0	5.0	40 or 20
M 30	30.0	5.0	40 or 20
M 25	25.0	4.0	40 or 20
M 20	20.0	4.0	40 or 20
M 15	15.0	3.5	40 or 20

It shall be very clearly understood that whenever the class of concrete such as M20 is specified it shall be the Contractor's responsibility to ensure that minimum crushing strength stipulated for the respective class of concrete is obtained at works. The maximum total quantity of aggregate by weight per 50 kg of cement shall not exceed 250 kg except when otherwise specifically permitted by Engineer.

To fix the grading of aggregates, water cement ratio, workability and the quantity of cement required to give preliminary and works cubes of the minimum strength specified, the proportions of the mix shall be determined by weight. Adjustment of aggregate

proportions due to moisture present in the aggregate shall be made. Mix proportioning shall be carried out according to Indian Standard Specifications.

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

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

Preliminary tests

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

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

Mixing shall be done by a mixer machine as per IS 516 in such a manner as to avoid loss of water. The cement and fine aggregate shall first be mixed dry until the mixture is uniform in colour. The coarse aggregate shall then be added, mixed and water added and mixed thoroughly for a period of not less than 3 minutes until the resulting concrete is uniform in appearance. Each mix of concrete shall be of such a quantity as to leave about 10% excess concrete after moulding the desired number of test specimens.

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

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

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

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

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

Testing of specimens

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

Proportioning, consistency, batching and mixing of concrete

Aggregate

The proportions which shall be decided by conducting preliminary test shall be by volume. These proportions of cement, fine and coarse aggregates shall be maintained during subsequent concrete mixing. The supply of properly graded aggregate of uniform quality shall be maintained over the period of work, the grading of aggregates shall be controlled by obtaining the coarse aggregate in different sizes and blending them in the right proportions. The different sizes shall be stocked in separate stock piles. The grading of coarse and fine aggregate shall be checked as frequently as possible as determined by Engineer, to ensure maintaining of grading in accordance with the samples used in preliminary mix design. The material shall be stock piled well in advance of use.

Cement

The cement shall be measured by weight.

Water

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

The water cement (W/C) ratio will be decided by Engineer-in-charge on weight basis and this shall be strictly followed at site.

Proportioning by Water/Cement ratio

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

Consistency and slump

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

Slumps for Various Types of Construction

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

Placing Conditions	Degree of Workability	Slump (mm)
[1]	[2]	[3]
Blinding concrete: Shallow sections; Pavements using pavers	Very low	
Mass concrete:	Low	25-75
Lightly reinforced sections in slabs, beams, walls, columns: Floors; Hand placed pavements; Canal lining; Strip footings		
Heavily reinforced sections in slabs, beams, walls, columns; Slipform work; Pumped concrete	Medium	50-100 75-100
Trench fill; *In-situ pilling*	High	100-150
Tremie concrete	Very high	

Sampling and testing concrete in the field

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

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

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

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

Admixtures

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

Air entraining agents

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

Water reducing admixtures

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

Retarding admixtures

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

Water proofing agent

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

Optional tests

Engineer-in-charge may order tests to be carried out on cement, sand, coarse aggregate and water in accordance with the relevant Indian Standards. Tests on cement shall include (i) fineness test (ii) test for normal consistency (iii) test for setting time (iv) test for soundness (v) test for tensile strength (vi) test for compressive strength (vii) test for heat of hydration by experiment and by calculations in accordance with IS 269. Tests on sand shall include (i) sieve test (ii) test for organic impurities (iii) decantation test for determining clay and silt content (iv) specific gravity test (v) test for unit weight and bulkage factor. Tests on coarsed aggregate shall include (i) test for sieve analysis (ii) specific gravity and unit weight of dry loose and rodded aggregate (iii) soundness and alkali aggregate reactivity (iv) pertrographic examination (v) deleterious materials and organic impurities (vi) test for aggregate crushing value. Any or all these tests would normally be ordered to be carried out only if Engineer feels the materials are not in accordance with the specifications or if the specified concrete strengths are not obtained and shall be performed by contractor at site or at an approved test laboratory.

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

Preparation prior to concrete placement

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

The various agencies shall be permitted ample time to install drainage and plumbing lines in floor and treech drains, conduits, hangers, anchors, inserts, sleeves, bolts, frames and other miscellaneous embedments to be cast in the concrete as indicated on the drawings or as is necessary for the proper execution of the work. Contractor shall cooperate fully with all such agencies and shall permit the use of scaffolding form work, etc., by other agencies at no extra cost.

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

Anchor bolts shall be positioned and kept in place with the help of properly manufactured templates. The use of all such templates, fixture, etc., shall be deemed to be included in the rates.

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

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

Approval by Engineer for all materials and work as required herein shall not relieve contractor from his obligation to produce finished concrete in accordance with the drawings and specifications.
No concrete shall be placed in wet weather or on water covered surface. Any concrete that has been washed by heavy rains, the work shall be entirely removed, if there is any sign of cement and having been washed from the concrete mixture. To guard against damage which may be caused by rains, the works shall be covered with tarpaulins immediately after the concrete has been placed and compacted. Any water accumulating on the surface of the newly placed concrete shall be removed by approved means and no further concrete shall be placed thereon until such water is removed. To avoid flow of water over/around freshly placed concrete, suitably drains and sumps shall be provided. Immediately before concrete placement begins, proposed surfaces except framework, which will come in contact with the concrete to be placed, shall be covered with a bonding mortar.

Transportation

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

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

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

Procedure for placing of concrete

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

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

Concrete, in all cases, be deposited as nearly as practicable directly in its final position, and shall not be rehandled or caused to flow in a manner which will cause segregation, loss of materials, displacement of reinforcement, shuttering or embedded inserts or impair its strength. For locations where direct placement is not possible, and in narrow forms, contractor shall provide suitable drop and elephant trunks to confine the movement of concrete. Special care shall be taken when concrete is dropped from a height especially if reinforcement is in the way, particularly in columns and thin walls. Except when otherwise approved by Engineer, concrete shall be placed in shovels or other approved implements and shall not be dropped from a height more than 1 M or handled in a manner which will cause segregation.

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

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

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

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

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

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

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

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

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

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

Compaction

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

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

The exact manner of application and the most suitable machines for the purpose must be carefully considered and operated by experienced men. Immersion vibrators shall be inserted vertically at points not more than 450 mm apart and withdrawn when air bubbles cease to come to the surface. Immersion vibrators shall be withdrawn very

slowly. In no case shall immersion vibrators be used to transport concrete inside the forms. Particular attention shall be paid to vibration at the top of a lift e.g. in a column or wall.

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

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

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

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

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

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

Placement interval

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

Special provision in placing

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

Placing concrete through reinforcement steel

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

Bleeding

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

Curing, protecting, repairing and finishing

Curing

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

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

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

Fresh concrete shall be kept continuously wet for a minimum period of 15 days from the date of placing of concrete following a lapse of 12 to 14 hours after laying of concrete. The curing of horizontal surfaces exposed to the drying winds shall however begin immediately the concrete has hardened. Water shall be applied uniformly to concrete surfaces within 1 hour after concrete has set. Water shall be applied to formed surfaces immediately upon removal of forms. Quantity of water applied shall be controlled so as to prevent erosion of freshly placed concrete.

Curing shall be assured by use of an ample water supply under pressure in pipes with all necessary appliance of hose, sprinklers and spraying devices. Continuous fine mist spraying or sprinkling shall be used, unless otherwise specified or approved by Engineer. Whenever, by the judgement of Engineer, it may be necessary to omit the continuous spray method, a covering of clean sand or other approved means such as wet gunny bags which will prevent loss of moisture from the concrete, may be used. No type of covering will be approved which would stain or damage the concrete during or after the curing period. Covering shall be kept continuously wet during the curing period.

For curing of concrete in pavements, side-walks floors, flat roofs or other level surfaces, the ponding method of curing is preferred. The method of containing the ponded water shall be approved by Engineer. Special attention shall be given to edges and corners of the slabs to ensure proper protection to these area. The ponded area shall be kept continuously filled with water during the curing period.

Surface coating type compounds shall be used only by special permission of Engineer, curing compounds shall be liquid type white pigmented. Other curing compounds shall be used on surfaces where future blending with concrete, water or acid proof membrane or painting is specified.

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

Protecting fresh concrete

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

Repair and replacement of unsatisfactory concrete

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

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

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

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

Small size holes having surface dimensions about equal to the depth of the hole, holes left after removal of form bottom, grout insert holes and slots cut for repair of cracks shall be repaired as follows. The hole to be patched shall be roughened and thoroughly soaked with clean water until absorption stops.

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

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

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

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

Finishing

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

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

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

Unless specified, surfaces which will be exposed when the structure is in service shall receive no special finish, except repairing of damage or defective concrete removal of

fins and abrupt irregularities, fillings of holes let by form ties and rods and clean up of loose or adhering debris.

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

Integral cement concrete finish

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

Exposed Concrete finish/Rendering

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

Form Work

The formwork shall consist of shores, bracings, sides of beams and columns, bottom of slabs, etc., including ties anchors, hangers inserts, etc., complete which shall be properly designed and planned for the work. False work shall be so constructed that necessary adjustment can be made to compensate for take up and settlements. Wedge may be used

at the top or bottom of timber shores but not at both ends to facilitate vertical adjustment or dismandling of the formwork.

Design of formwork

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

Type of formwork

Formwork may be of timber, plywood, metal, plastic or concrete. For special finishes the formwork may be lined with plywood, steel, sheets, oil, tempered hard board, etc. Sliding forms and slip forms may be used with the approval of Engineer.

Form work requirements

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

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

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

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

Formwork, during any stage of construction showing signs of distortion or distored to such a degree that the intended concrete work will not conform to the exact contours

indicated on the drawings, shall be repositioned and strengthened. Poured concrete affected by the faulty formwork, shall be removed completely and the formwork be corrected prior to placing of new concrete.
Excessive construction camber to compensate for shrinkage, settlement may impair the structural strength of members and shall not be permitted.

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

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

Formwork For Slope Surfaces

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

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

Formwork for Curved Surfaces

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

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

Formwork for Exposed Concrete Surfaces

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

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

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

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

Forms for exposed concrete surfaces shall be constructed with grade strips (the underside of which indicated top of pour) at horizontal construction joints, unless the use of groove strips is specified on the drawings. Such forms shall be removed and reset from lift to lift, they shall not be continuous from lift to lift. Sheeting of reset forms shall be tightened against the concrete so that the forms will not be spread and permit abrupting irregularities or loss of mortar. Supplementary form ties shall be used as necessary to hold the reset forms tight against the concrete.

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

Chamfer strips shall be placed in the corners of forms for exposed exterior corners so as to produce 20 mm bevelled edges except where otherwise shown in the drawings. Interior corners and edges at formed joints shall not be bevelled unless shown on the drgs. Mouldings for grooves, drip courses and bands shall be made in the form itself.
The wood planks, plywood and steel plates used in formwork for obtaining exposed surfaces shall not be used for more than 3 times in case of wood planks, 6 times for plywood and 10 times for steel plates respectively. However, no forms will be allowed for reuse, if in the opinion of the Engineer it is doubtful to produce desired texture of exposed concrete.
In order to obtain exposed concrete work of uniform colour it shall be necessary to ensure that the sand used for all exposed concrete work shall be of approved uniform colour. Moreover the cement used in the concrete for any complete element shall be from single consignment.

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

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

Bracings struts and props

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

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

Mould Oil

Care shall be taken to see that the faces of form work coming in contact with concrete are perfectly cleaned and two coats of mould oil or any other approved material applied before fixing reinforcement and placing concrete. Such coating shall be insoluble in water, non-staining and not injurious to the concrete. It shall not become flaky or be removed by rain or wash water. Reinforcement and/or other items to be cast in the concrete shall not be placed until coating of the forms is complete, adjoining concrete surface shall also be protected against contamination from the coating material.

Chamfers and fillets

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

Wall ties

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

Reuse of forms

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

Removal of forms

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

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

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

		Ordinary portland cement concrete	Rapid hardening portland cement
a)	Walls columns and vertical sides of beams	24 to 48 hrs as directed by the Engineer	24 hrs.
b)	Slabs proos left under	3 days	2 days
c)	Beam soffits prods left under	7 days	4 days
d)	Removal of props to slabs: i) Spanning upto 4.5m ii) Spanning over 4.5m.	 7 days 14 days	 4 days 8 days
e)	Removal of props to beams & arches i) Spanning upto 6m ii) Spanning over 6m	 14 days 21 days	 8 days 12 days

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

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

Tie rods, clamps, form bolts etc., which must be entirely removed from walls or similar structures shall be loosened not sooner than 24 hours nor later than 40 hrs. after the concrete has been deposited. Ties, except those required to hold forms in place, may be removed at the same time, Ties, withdrawn from walls and grade beams shall be pulled towards the inside face cutting ties back from the faces of walls and grade beams will not be permitted.

For liquid retaining structures no sleeves for through bolts shall be used nor shall through bolts be removed as indicated above. The bolts, in this case, shall be cut at 25mm depth from the surface and then the hole shall be made good by sand, cement mortar of the same proportions as the concrete just after striking the formwork.

Reinforcement Steel

General

Reinforcement bars, if supplies are arranged by contractor unless otherwise specified, shall be either plain round mild steel bars grade I as per IS 432 (Part I) or medium tensile steel bar as per IS 432 (Part I) or hot rolled mild steel and medium tensile steel deformed bars as per IS 1139 or cold twisted steel bars as per IS 1786, as shown and specified on the drawings. Wire mesh or fabric shall be in accordance with IS 1566. Substitution of reinforcement will not be permitted except upon written approval from Engineer.

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

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

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

Providing, fabricating and placing in position reinforcement steel

The quality of the steel shall be as mentioned in the materials section. The bars shall be fabricated as per the drawings and binding with 16 gauge GI binding wire etc. Laps and splices for reinforcement shall be as shown on the drawings. Splices in adjacent bars shall be approved by Engineer. The bars shall not be lapped unless the length required exceeds the maximum available lengths of bars at site.

Bending

Reinforcing bars supplied bent or in coils, shall be straightened before they are cut to size. Straightening of bars shall be done in cold and without damaging the bars. This is considered as a part of reinforcement binding fabricating work.

All bars shall be accurately bent according to the sizes and shapes shown on the detailed working drawings/bar bending schedules. They shall be bent gradually by machine or other approved means. Reinforcing bars shall not be straightened and rebent in a manner that will injure the material, bars containing cracks or splits shall be rejected. They shall be bent cold, except bars of over 32 mm in diameter which may be bent hot if specifically approved by Engineer. Bars bent hot shall not be heated beyond cherry red colour (not exceeding 845^{o}C) and after bending shall be allowed to cool slowly without

quenching. Bars incorrectly bent shall be used only if the means used for straightening and rebending shall not injure the material. No reinforcement shall be bent when in position in the work without approval whether or not it is partially embedded in hardened concrete. Bars having bends other than those required by design shall not be used.

Fixing

Reinforcement shall be accurately fixed by any approved means and maintained in the correct position shown in the drawings by the use of block, spacers and chairs as per IS 2502 to prevent displacement during placing and compaction of concrete. Bars intended to be in contact at crossing points shall be strongly bound together at all such points with two no. 16 gauge anhealed soft iron wire. The vertical distance required between successive layers of bar in beams or other members shall be maintained by providing of mild steel spacer bars at such intervals that the main bars do not perceptibly sag between adjacent spacer bars.

Cover

Unless indicated otherwise on the drawings, clear concrete cover for reinforcement (exclusive of plaster or other decorative finish) shall be as follows:

a) At each end of reinforcing bar, not less than 25 mm nor less than twice the diameter of the bar whichever is less.
b) For a longitudinal reinforcing bar in a column, not less than 40 mm, nor less than the diameter of the bar. In case of columns of minimum dimensions of 20 cm or under, with reinforcing bars of 12 mm and less in diameter, a cover of 25 mm may be used.
c) For longitudinal reinforcing bars in a beam 25 mm nor less than the diameter of the bar.
d) For tensile, compressive, shear, or other reinforcement in a slab or wall not less than 12 mm nor less than the diameter of such reinforcement.
e) For any other reinforcement not less than 12 mm nor less than the diameter of such reinforcement.
f) For footings and other principal structural members in which the concrete is deposited directly against the ground, cover to the bottom reinforcement shall be 75 mm. If concrete is poured on a layer of lean concrete the bottom cover may be reduced to 50 mm.
g) For concrete surfaces exposed to the weather or the ground after removal of forms, such as retaining walls, footing sides and top, etc., not less than 50 mm for bars larger than 16 mm dia and not less than 40 mm for bars 16 mm dia or smaller.
h) Increased cover thickness shall be provided, as indicated on the drawings, for surfaces exposed to the action of harmful chemicals (or exposed to earth contaminated by such chemical, acid, alkali, saline atmosphere, sulphurous smoke, etc.
i) For reinforced concrete members, totally or periodically immersed in sea water or subject to sea water spray, the cover of concrete shall be 50 mm more than those specified in (i) to (v) above.

j) For liquid retaining structures the minimum cover to all steel shall be 40 mm or the diameter of the main bars, whichever is greater. In the presence of sea water and soils and waters of a corrosive character the cover shall be increased by 10 mm.

k) Protection to reinforcement in case of concrete exposed to harmful surroundings may also be given by providing a dense impermeable concrete with approved protective coatings, as specified by the Engineer.

l) The correct cover shall be maintained by cement mortar cover blocks. Reinforcement for footings, beams and slabs on sub-grade shall be supported on precast concrete blocks as approved by engineer. The use of pebbles or stones shall not be permitted.

Inspection

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

MASONRY WORKS

Applicable codes and specifications

a) The following codes, standards and specifications are made a part of this specification. All standards, tentative specifications, codes of practices referred to herein shall be the latest edition including all applicable official amendments and revisions.

IS:1077 - Common burnt clay building bricks
IS:3102 - Classification of burnt clay bricks
IS:2180 - Burnt clay building bricks, heavy duty
IS:3495 - Method of sampling and testing clay building bricks
IS:2691 - Burnt clay facing bricks
IS:2221 - Code of practice for brick work
IS:2185 - Load bearing hollow concrete blocks
IS:5498 - Lime-cement-cinder hollow concrete blocks
IS:3115 - Lime-cement cinder soild blocks
IS:1597 - Code of practice for construction of stone masonry (Part I)

Brick

Bricks used in works shall be bricks of specified crushing strength as described in the Schedule of Quantities. They shall have the following general properties:

They shall be sound, hard, homogenous in texture, well burnt in kiln without being verified, table moulded, deep red, cherry or copper coloured, of regular shape and size and shall have sharp and square edges and parallelled faces. The bricks shall be free from pores, chips, flaws or humps of any kind. Bricks containing unground particles and which absorb water more than 1/5th of their weight when soaked in water for twenty four hours shall be rejected. Overburnt or under burnt bricks shall be liable to rejection. These bricks shall give a clear ringing sound when struck.

Samples of bricks shall be submitted before starting the brickwork to the Engineer for approval. Bricks supplied shall conform to these approved samples. Brick sample shall be got tested as per IS:3495 by Contractor at no extra cost. Bricks rejected by Engineer shall be removed from the site of works within 24 hours.

Mortar

Mix for cement mortar shall be as specified in the respective items of work. Gauge boxes for sand shall be of such dimensions that one complete bag of cement containing 50 kgs. of cement forms one unit. The sand shall be free from clay, shale, loam, alkali, and organic matter and of sound, hard, clean and durable practices. Sand shall be approved by the engineer. If so directed by the engineer sand shall be thoroughly washed till it is free of any contamination.

For preparing cement mortar the ingredients shall first be mixed thoroughly in dry condition. Water shall then be added and mixing continued to give a uniform mix of required consistency. Cement mortar shall preferably be machine mixed, through mixing in a thorough manner may be allowed. The mortar so mixed shall be used within 30 minutes of mixing. Mortar left unused in the specified period shall be rejected.

The Contractor shall arrange for test on mortar samples if so directed by the engineer retempering of mortar shall not be permitted.

Workmanship

All bricks shall be thoroughly soaked in clean water for at least one hour immediately before being laid. The cement mortar for brick masonry work shall be as specified in the respective item of work. Brick work 230 mm thick and over shall be laid in english bond unless otherwise specified. While laying bricks shall be pressed into the mortar and shoved into final position so as to embed the brick fully in mortar. Bricks shall be laid with frogs uppermost.

All brick work shall be plumb, square and true to dimensions. Vertical joints in alternate courses shall come directly one over the other and be in line. Horizontal courses shall be levelled. The thickness of brick courses shall be kept uniform. For walls of thickness greater than 230 mm both faces shall be kept in vertical planes. No broken bricks shall be used except as closers. Care shall be taken that the bricks forming the top corners and ends of the wall shall be properly radiated and keyed into position. Holes kept in masonry for scaffolding shall be closed before plastering. All interconnected brickwork shall be carried out at nearly one level (so that there is uniform distribution of pressure on the supporting structure) and no portion of the work shall be left more than one course lower than the adjacent work where this is not possible, the work shall be raked back accordingly to bond (and not saw toothed) at an angle not exceeding 45^{o}.

Bricks shall be so laid that all joints are well filled with mortar. The thickness of joints shall not be less than 6 mm and not more than 10 mm. The face joint shall be raked to a minimum depth of 12 mm by raking tools daily during the progress of work when the mortar is still green so as to provide a proper key for the plaster or pointing to be done.

Where plastering or pointing is not required to be done the joints shall be uniform in thickness and be struck flush and finished at the time of laying. The face of brickwork shall be cleaned daily and all mortar droppings removed. The surface of each course shall be thoroughly cleaned of all dirt before another course is laid on top. If the mortar in the lower course has begun to set the joints shall be raked out to depth of 12 mm before another course is laid.

All brick work shall be built tightly against columns, floor slabs or other structural member.

Where drawings indicate that structural steel columns are to be fireproofed with brick work the brick shall be built closely against all flanges and webs with all spaces between the steel and bricks works filled solid with mortar. Steel members partly embedded in brickwork and not indicated to be fireproofed with concrete shall be covered with not less than 12 mm thick mortar unless directed otherwise by engineer.

The work shall be cured for 15 days.

Miscellaneous inserts in masonry e.g. sleeves, wall ties, anchors, conduits, structural sheet, steel lintels, etc., shall be installed by the Contractor. Furnishing fixing of any of these inserts by the Contractor will be paid for separately under steel work. Openings, arches, etc., shall be provided as shown on the drawings, chasses, pockets, etc., shall be provided as shown on the drawings to receive rain water pipes, etc. Wall ties and flashings shall be built into the brickwork in accordance with the drawings and specifications.

CONCRETE BLOCK

Concrete block, hollow (open or closed cavity) or solid shall be referred to by its nominal dimensions. The term nominal means that the dimension includes the thickness of the mortar joint. Actual dimensions (length and depth only) shall be 10 mm short of the nominal dimensions.

The nominal dimensions of concrete block as specified in specification

MATERIALS

Cement

Cement complying with any of the following Indian Standards may be used:

The cement to be used shall be ordinary Portland/Portland Pozolana cement conforming to IS: 8112-1989 & IS:1489 part I respectively for 43 Grade OPC/PPC unless otherwise mentioned. The cement procured should be of reputed approved by the Engineer-in-Charge. As far as possible, all the cement shall be obtained from a single source throughout the contract. Cement of different types shall not be mixed together. Different brands of cements or same brand of cement from different sources shall not be used without prior approval of the Engineer-in-Charge.

Aggregates

The aggregates used in the manufacture of blocks at the mixer or the mixing platform shall be clean and free from deleterious matter and shall conform to the requirements of IS 383.

The grading of the combined aggregates shall conform as near as possible to the requirements indicated in IS 383.

Fly ash

Conforming to IS 3812 (Part 2) may be used for part replacement of fine aggregate upto a limit of 20 .percent (see *also* 6.1.1of IS 2185 (Part 1) :2005).

Water

The water used in the manufacture of concrete masonry units shall be free from matter harmful to concrete or reinforcement, or matter likely to cause efflorescence in the units and shall conform to the requirements of IS 456.

Additives or Admixtures

Additives or admixtures may be added either as additives to the cement during manufacture, or as admixtures to the concrete mix. Additives or admixtures used in the manufacture of concrete masonry units may be:

Where accelerating, water reducing, air-entraining and super plasticizer conforming to IS 9103, Waterproofing agents conforming to IS 2645, and Colouring pigments no Indian Standards apply; the additives or admixtures shall be shown by test or experience, to be not detrimental to the durability of the concrete.

MANUFACTURE

Mix

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

In machine-moulded blocks, the web markings on the units as they come from the machine give a good indication as to whether the proper consistency of concrete has been used. In addition to the grading of the aggregate and the quantity of the cement, the amount of water required for mix will depend to an extent on the type of machine on which blocks are produced. The amount of water required for mix should be electronically measured and controlled in the mixing drum.

Mixing

Batching of the ingredients should be done accurately and concrete mixing shall be done in a mixer to achieve homogeneous mix.

Mixing shall be continued until there is a uniform distribution of the materials, and the mass is uniform in colour and consistency.

Placing and Compaction

The block should be compacted by vibro-compaction and finished to proper size - without broken edges.

After ejection demoulding, the “blocks shall be handled carefully to avoid damage. The bIocks shall be protected until they are sufficiently hardened before starting curing.

Curing

The blocks hardened in accordance with the specification shall then be cured as per IS 456 or by mist curing .So as to deliver the specified strength of block.

The blocks hardened in accordance with the IS standards may alternatively be cured by steam.

Drying

After curing the blocks in accordance with IS standards they shall be dried for a period of 4 weeks before being used on the work.

Surface Texture and Finish

Concrete masonry units can be given a variety of surface textures ranging from a very fine close texture to a coarse open texture by the proper selection. grading, and proportioning of aggregates at the time

1S 2185 (Part 1): 2005 of manufacture. Textures may also be developed by treating the face of the units while still-green by wire brushing or combing, slightly eroding the surface by playing a fine spray of water upon it, and by splitting (split block). Colour maybe introduced by incorporating non-fading mineral pigments in the facing concrete, or by applying a coloured cement grout or paint to the face of the units soon atler they are removed from the moulds. Selected coloured aggregates may also be used in the facing and exposed by washing with water or dilute hydrochloric acid followed by thorough washing with water to ensure no traces of acid are left on the surface. 8.-2 Well made concrete masonry may not require plaster in case of.unimportant buildings in low rainfall areas; two or three coats of a cement paint being sufficient to render it resistant to rain water. If, however, it is intended to plaster concrete masonry, the block shall have a sufficiently rough surface to afford a good key to the plaster. Water proofing admixtures may be used for preparing the plaster.

Physical Requirements

General

All units shall be sound and free of cracks or other defects which interfere with the proper pIacing of the unit or impair the strength or performance of the construction. Minor chiping resulting from the customery methods of handling during delivery, shall not be deemed grounds for rejection.

Where units are to be used in exposed wall construction, the face or faces that are to be exposed shall be free of chips, cracks, or other imperfections, except that if not more than 5 percent of a consignment contains slight cracks or small chippings not larger than 25 mm, this shall not be deemed grounds for rejection.

Dimensions

The overall dimensions of the units shall be as per specification

Compressive Strength

The minimum compressive strength at 28 days being the average of eight units, and the minimum compressive strength at 28 days of individual units, when tested in the manner described in Annex D - IS2185 (Part I):2005 or shall be as specified in BOQ and as directed by the Engineer in Charge

Water Absorption

The water absorption, being the average of three units, when determined in the manner prescribed in Annex E- IS2185 (Part I):2005 shall not be more than 10 percent by mass.

Drying Shrinkage

The drying shrinkage of the units when unrestrained being the average of three units, shall be determined in the manner described in Annex F - IS2185 (Part I):2005 and shall not exceed 0.06 percent.

Moisture Movement

The moisture movement of the dried blocks on immersion in water, being the average of three units, when determined in the manner described in Annex G – IS 2185 (Part I):2005, shall not exceed 0.09 percent.

Tests

Tests as described in Annex B to Annex G of IS 2185 shall be conducted on samples of units selected according to the sampling procedure, to ensure conformity with the physical requirements.

Sampling

A sample of 20 blocks shall be taken from every lot/consignment of 5000 blocks or part thereof from the same grade, size and same batch of manufacture.

The required number of blocks shall be taken at regular intervals during the loading of the vehicle or the unloading of the vehicle depending on whether sample is to be taken before delivery or after delivery. When this is not practicable, the sample shall be taken from the stack in which case the required number of blocks shall be taken at random from across the top of the stacks, the sides accessible and from the interior of the stacks by opening trenches from the top.

The sample of blocks shall be marked for future identification of the consignment it represents. The blocks shall be kept under cover and protected from extreme conditions of temperature, relative humidity and wind until they are required for test. The tests shall be undertaken as soon as practicable after the sample has been taken.

Number of Tests

All the 20 blocks shall be checked for dimensions and inspected for visual

Out of the 20 blocks, 3 blocks shall be subjected to the test for block density, 8 blocks to the test for compressive strength, 3 blocks to the test for water absorption and 3 blocks to the test for drying shrinkage and later to the test for moisture movement The remaining 3 blocks shall be reserved for retest for drying shrinkage and moisture movement, if a need arises.

Manufacturer's Certificate

The manufacturer shall satisfy himself that the masonry units conform to the requirements of this standard and, if requested, shall supply a certificate to this effect to the purchaser or his representative.

Independent Tests

If the purchaser or his representative requires independent tests, the samples shall be taken before or immediately after delivery, at the option of the purchaser or his representative and the tests shall be carried out in accordance with this standard.

The manufacturer shall supply free of charge the units required for testing.

Cost of Testing

Unless otherwise specified in the enquiry or order, the cost of the tests shall be borne as follows:

By the manufacturer in the event of the results showing that the blocks do not conform to this specification, or By the purchaser in the event of the results showing that the blocks conform to this specification.

Marking

Concrete masonry units manufactured in accordance with this specification shall be marked permanently with the following information:

Identification of the manufacturer;

Grade of the unit and Year of manufacture, if required by the purchaser.

Rubble Masonry

Stones for this work shall be hard, durable rock, close or fine grained and uniform in colour free from veins, flaws and other defects and shall conform to IS:1597 (Part I). The stones shall be laid in mortar proportions specified for the particular item of work. Stones shall be got approved.

For all work below ground level the masonry shall be random rubble uncoursed with ordinary quarry dressed stones or hearting and faced with selected quarry dressed stones. For all work above ground level the masonry shall be random rubble faced with hammer dressed stones with squared quoins at joints and corners.

No stones shall tail into the wall, either with a point or to length less than $1\frac{1}{2}$ times its height. The thickness of the joints shall not exceed 12 mm.

Spauls and pinnings shall not be allowed to show on the face of the wall. Two bond stones each of minimum area of 500 sq.cm for every 1.0 sq.m. of each wall face shall be provided. These shall be through stones in walls 600 mm thick and under, in walls thicker than 600 mm the length of bond stones shall be 2/3 times the thickness of walls. The stones for hearting of the wall shall not be less than 150 mm in any direction. Chips and spauls shall be wedged in to avoid thick mortar beds and joints. The wall faces, corners and joints or openings shall be truly vertical the quoins shall be of selected stones, neatly dressed with chiesel to form the required angle and laid header and stretcher alternatively.

The exposed face of the work shall be carefully and neatly pointed with mortar in all joints on the other side the joints shall be neatly struck with trowel while the mortar is fresh.

The mortar for the work shall be as specified in the respective item of work. Curing of masonry shall continue for a minimum of ten days.

Glass

Sheet glass or plate glass shall be of Indian make as specified in the Schedule of Quantities/as directed. It shall be free from waves and bubbles and all defects. The thickness of the glass shall be as follows:

2 mm thick glass for panes upto 900 sq.cm. area
3 mm thick glass for panes from 900 - 5500 sq.cm. area
4 mm thick glass for panes 5500 - 8400 sq.c.m. area
5.5 mm thick glass or plate glass for panes above 8400 sq.cm.

It should be clearly understood that glass which does not have uniform refractive index or which is wavy, will be rejected. The glazing shall be fixed with teak wood beading and putty.

It shall conform to IS:1761. The putty shall be made up of one part of white lead, 3 parts of finely powdered chalk and adding boiled linseed oil to make a stiff elastic paste. No voids shall be left in the putty. Woodwork shall not be painted, oiled or otherwise treated before it has been approved by the engineer.

The window frame shall be provided with 2 nos. MS 230x30x3 mm flat split hold fasts on each side, respectively. These hold fasts shall be embedded in masonry or concrete work with concrete block of mix 1:2:4 and size 230x300x250 mm.
The type of windows shall be as specified. Each leaf of the shutter shall have one pair of hinges for a width of less than or equal to 2 feet, for width more than 2 feet extra nos. of hinges shall be provided as directed by the Engineer at no extra cost. The glazed windows shall be provided with glass of thickness as specified in the item description. Architraves shall be provided as per drawing.

FINISHING WORKS

Applicable Codes

1) IS:2394- Code of practice for application of lime plaster finish
2) IS:1477- Code of practice for painting of ferrous metals in buildings and allied finishes (Part I & II)
3) IS: 427 - Distemper, dry colour as required
4) IS:2395 - Code of practice for painting concrete, masonry and plaster surfaces
5) IS: 428 - Distemper, oil emulsion, colour as required

Plastering

The surface to be plastered shall be washed with fresh clean water free from all dirt, loose material grease, etc., and thoroughly wetted for 6 hours before plastering work is commenced. Concrete surfaces to be plastered will however be kept dry. The wall should not be too wet but only damp at the time of plastering. The damping shall be uniform to get uniform bond between the plaster and the wall. The junction between the brick work and RCC should be fixed with chicken wire mesh/PVC strip as directed before plaster.

The proportion of the mortar shall be as specified under the respective items of work. Cement shall be mixed thoroughly in dry condition and then just enough water added to obtain a workable consistency. The quality of water, sand and cement shall be as mentioned in the Specifications for Concrete & allied works. The mortar thus mixed shall be used immediately and in no case shall the mortar be allowed to stand for more than 30 minutes after mixing with water. The plaster shall be laid in a single coat. The mortar shall be splashed on the prepared surface with a trowel and finished smooth by trowelling. The plastered surface shall be rubbed with iron plate till the surface shows cement paste. The work shall be in line and level. Curing of plaster shall be started as soon as the applied plaster has hardened enough so as not to be damaged. Curing shall be done by continuously applying water in a fine spray and shall be carried out for at least 7 days.

The plaster shall be carried out on jambs, lintel and sill faces top and undersides, etc., as shown in the drawing or as directed by the engineer.

FLOORING

Applicable codes

1) IS: 1443- Code of practice for laying and finishing of cement concrete flooring tiles.
2) IS: 2114 -Code of practice for laying in situ terrazzo floor finish
3) IS: 777 - Glazed earthenware tiles

Ceramic tiles in flooring, skirting and dado

The ceramic tiles in flooring and dado shall be of first class quality as specified in the item specification and shall be approved by the Engineer. The tiles shall be of standard size without warp and with straight edges, true and even in shape and size and of uniform colour. The tiles surface shall be of fine grained texture, dense and homogeneous. The thickness of the tile shall be as per the item specification. The tiles shall be submerged in water till the bubbles cease.

They should be laid on a base of 12 mm thick mortar bed (cement or lime 1:3 sand) and cement (3 kg/sq.m) paste. They shall be laid truly vertical on walls and truly horizontal on floors or to slopes as directed. The joint shall be very thin, uniform and perfectly straight. The tiles in dado shall be finished in such a way that, only the tile thickness projects over the finished plaster or as specified otherwise. Where full tiles are not possible, the same should be cut or sawn to the required size and their edge rubbed to ensure straight and true joints. After the tiles are laid extra cement grout shall be removed. The joints shall be cleaned with wire brush and then the joint shall be floated with white or gray cement as approved by the Engineer. The tiles shall be cleaned after the work is complete.

Vitrified Tile Flooring

The vitrified tiles shall be of approved quality, size and uniform thickness and shall be hard, sound, dense and homogeneous in texture. It shall be uniform in shade free from stains, cracks and defects.

The Dimensional variations, surface quality, physical properties and chemical properties of tiles shall be as per internationally accepted relevant standards.

The edges are straight, with square edges and free from chippings. Tiles should be laid on a bed of cement mortar as specified in item specifications. Thickness of mortar bedding shall be specified in the item specifications and a neat cement shall be spread over the mortar bed. The tiles shall be placed one by one, keeping in check the level and line of the flooring. Tiles are wetted before placing. The tiles are then gently tapped with wooden mallet till it is firmly and properly bedded. There should be no voids left. The joint should be finished with tile joint filler of approved make and shade. The pattern of the flooring shall be as per the architectural drawings or as directed by Engineer-in-charge.

The base concrete or the RCC slab on which the tiles are to be laid shall be cleaned, batted and mopped. the minimum thickness of bed mortar shall not be less than 12mm. Any undulation in the base concrete or RCC slab shall be corrected by cement mortar without any extra cost and any additional leveling required beyond max. mortar thickness to be carried out with cement concrete.

The flooring shall be cured for a minimum period of 7 days. The surface of the flooring shall be laid to levels and slopes as directed by Engineer-in-charge.

The tiles which are fixed in the floor adjoining the wall shall enter not less than 12mm under the skirting or dado. The junction between the wall plaster and the floor shall be finished neatly and without waviness.
The free edges shall be cut as per the pattern and shall be polished to match with flooring.

Engineer-in-charge has liberty to ask for any tests with respect to physical and chemical properties, etc. and the contractor shall arrange the same without any extra cost.

Granite Stone Flooring

The granite has to be processed by water cut method and shall be machine polished using Auto polisher or line polisher to mirror finish to have a gloss meter reading of 90 above.

The stone shall be of approved quality, size and uniform thickness and shall be hard, sound, dense and homogenous in texture. It shall be uniform in shade free from stains, cracks, decay and weathering.

The edges are machine cut to fine, straight, with square edges and free from chippings. Stone should be laid on a bed of cement mortar as specified in item specifications. Thickness of mortar bedding shall be specified in the item specifications and a neat cement shall be spread over the motor bed and the slab/tiles shall be placed one by one, keeping in check the level and line of the flooring. Tiles are wetted before placing. The tiles are then gently tapped with wooden mallet till it is firmly and properly bedded. There should be no voids left. The joint should be paper joint. The pattern of the flooring shall be as per the architectural drawings or as directed by Engineer-in-charge.

The base concrete or the RCC slab on which the tiles are to be laid shall be cleaned, batted and mopped. The minimum thickness of bed mortar shall not be less than 12 mm. Any undulation in the base concrete or RCC slab shall be corrected by cement mortar without any extra cost and any additional leveling required beyond max. mortar thickness to be carried out with cement concrete.

The flooring shall be cured for a minimum period of 7 days. The surface of the flooring shall be laid to levels and slopes as directed by Engineer-in-charge.

Due care shall be taken to match the grains of tiles which shall be selected judiciously having uniform pattern.

The tiles which are fixed in the floor adjoining the wall shall enter not less than 12 mm under the skirting or dado. The junction between the wall plaster and the floor shall be finished neatly and without waviness.

The free edges shall be cut as per the pattern and shall be polished to match with flooring.

Before starting the work, the contractor shall generally get samples of granite tiles polished to the satisfactory level for approval of Engineer-in-charge and shall be kept in the custody of the Engineer-in-charge and the tiles/slabs supplied and used on the work shall confirm to the samples with regard to soundness, colour, shades, general texture and finishing/polishing.

Engineer-in-charge has liberty to ask for any tests with respect to physical properties, level of polishing, etc. and the contractor shall arrange the same without any extra cost.

Granite slabs in steps

It shall be of single piece and type/size shall be to match the sizes of the treads/risers. The edges shall be machine cut to the required shape.

Providing & Laying 52mm thick IPS flooring

The mix shall be 1 part cement, 2 parts coarse sand and 4 parts graded stone aggregate. The flooring shall be laid in panels of uniform sizes not exceeding 2 sq.m. They shall be laid in alternate panels on alternate days. The edges shall be protected properly. Glass/PVC/Aluminium strips shall be provided to separate the panels, as per the item

description in the Schedule of Quantities. The slope shall be maintained as directed by the Engineer.

The mix shall be prepared by volumes. Mixing shall be done in mixers. The concrete shall be placed in position and levelled up with the help of wooden straight edge and trowel and beaten up well till slurry comes on top and holes filled up with concrete.

If IPS has to be laid directly on RCC slab, the surface of the RCC slab shall be roughened up with brushes while the concrete is green. Before laying the floor, the laitance loose materials, cake of mortar dropping shall be removed and the surface of the slab hacked and a coat of cement slurry @ 2 kg. Of cement per sq.m. shall be applied so as to get ;a good bond between the slab and IPS. If IPS has to be provided on lean concrete no slurry is required.

The flooring shall be finished with 12mm thick (1:3) cement – sand mortar and cement slurry @ 2 kg. Of cement per Sq.m and water shall be applied on top with wooden float till the voids in the concrete are filled with mortar cream. The surface must be uniform and even in colour. Dry cement or cement sand mixer shall not be sprinkled to absorb excess moisture in the flooring, colour pigments shall be added to the flooring if instructed by the Engineer. Curing shall be done for seven days. The edges of the panels shall be protected from damage.

ACRYLIC POLYMER MODIFIED CEMENTITIOUS WATER PROOFING

Providing Acrylic polymer water proofing compound with the following specification:

1. Cleaning shall be carried out using coir brush, wire brush etc., and chip off all loose cement particles. Cut open the cracks and filling the same with approved non shrinking grout. Seal the all honey combed area with non shrinking grout. " V" Grooves shall be cut along with construction joints, chipping all honeycombed concrete and filling the same with approved mortar.(cement , sand 1:3 added with mortar @3.5kg/bag of cement. Nipples of 12 mm diameter shall be fixed along with construction joints, honeycombed area and other weak concrete junctions and grouted under pressure using neat cement slurry admixed with expansive grouting.

2. Acrylic polymer based waterproofing system shall be applied in 2 coats on the surface. One coat after other when the first coat is fully dry. 24 Kg powder with 4kg liquid and 4 liters of water will cover 150 Sqft for two coats.

3. Providing plastering 1:3 cement, sand including cost of applying one coat of polymer bonding slurry added with Acrylic polymer based waterproofing system 5ltr per bag of cement.

CEMENT CONCRETE FLOORING WITH METALLIC HARDENER TOPPING

Wherever floors are required to withstand heavy wear and tear, use of floor hardener shall be avoided as far as possible by using richer mixes of concrete, unless the use of a

metallic hardner is justified on the basis of cost. Where metallic hardener topping is used, it shall be 12 mm thick.

Metallic Hardening Compound

The compound shall be of approved quality consisting of uniformally graded iron particles, free from non-ferrous metal particles, oil, grease sand, soluble alkaline compounds. Where so directed by the Engineer-in-Charge.

Base Concrete

Flooring shall be laid on base concrete where so provided. The base concrete shall be provided with the slopes required for the flooring. Flooring in verandah, Courtyard, kitchens & baths shall have slope ranging from 1 : 48 to 1 : 60 depending upon location and as decided by the Engineer-in-Charge.

Floors in water closet portion shall have slope of 1:30 or as decided by the Engineer-in-Charge to drain off washing water. Further, necessary drop in flooring in bath, WC, kitchen near floor traps ranging from 6 mm to 10 mm will also be provided to avoid spread of water. Necessary margin to accommodate this drop shall be made in base concrete. Plinth masonry off set shall be depressed so as to allow the base concrete to rest on it.

The flooring shall be commenced preferably within 48 hours of the laying of base concrete. The surface of the base shall be roughened with steel wire brushes without disturbing the concrete. Immediately before laying the flooring, the base shall be wetted and a coat of cement slurry @ 2 kg of cement spread over an area of one sqm so as to get a good bond between the base and concrete floor.

If the cement concrete flooring is to be laid directly on the RCC slab, the top surface of RCC slab shall be cleaned and the laitance shall be removed and a coat of cement slurry @ 2 kg of cement spread over an area of one sqm so as to get a good bond between the base and concrete floor.

Under Layer

Cement concrete flooring of specified thickness and mix (mentioned in item for under layer) shall be laid as under layer. The top surface shall be roughened with brushes while the concrete is still green and the forms/strips shall be kept projecting up 12 mm over the concrete surface, to receive the metallic hardening compound topping.

Topping

This shall consist of 12 mm thick layer of mix 1:2 (1 cement : 2 stone aggregate 6 mm nominal size) by volume or as otherwise specified with which metallic hardening compound is mixed in the ratio of 1 : 4 (1 metallic concrete hardener : 4 cement) by weight. Metallic hardener shall be dry mixed thoroughly with cement on a clean dry pacca platform. This dry mixture shall be mixed with stone aggregate 6 mm nominal size

or as otherwise specified in the ratio of 1 : 2 (1 cement : 2 stone aggregate) and well turned over. Just enough water shall then be added to this dry mix as required for floor concrete.

The mixture so obtained shall be laid in 12 mm thickness, on cement concrete floor within 2 to 4 hours of its laying. The topping shall be laid true to provide a uniform and even surface. It shall be firmly pressed into the bottom concrete so as to have good bond with it. After the initial set has started, the surface shall be finished smooth and true to slope with steel floats.

The junction of floor with wall plaster, dado or skirting and finishing operations shall be dealt with as described .The men engaged on finishing operations shall be provided with raised wooden platform to sit on, so as to prevent damage to new work.

Curing

The curing shall be done for a minimum period of ten days. Curing shall not be commenced until the top layer has hardened. Covering with empty gunnies bag shall be avoided as the colour of the flooring is likely to be bleached due to the remanents of cement dust from the bags.

Precautions

Flooring in lavatories and bath room shall be laid only after fixing of water closet and squatting pans and floor traps. Traps shall be plugged while laying the floors and opened after the floors are cured and cleaned. Any damage done to W.C.'s squatting pans and floor traps during the execution of work shall be made good.

During cold weather, concreting shall not be done when the temperature falls below 4°C. The concrete placed shall be protected against frost by suitable covering. Concrete damaged by frost shall be removed and work redone. During hot weather, precautions shall be taken to see that the temperature of wet concrete does not exceed 38° C. No concreting shall be laid within half an hour of the closing time of the day, unless permitted by the Engineer-in-Charge. To facilitate rounding of junction of skirting, dado and floor, the skirting/dado shall be laid along with the border or adjacent panels of floor.

Measurement

Length and breadth shall be measured before laying skirting, dado or wall plaster. No deduction shall be made nor extra paid for voids not exceeding 0.20 sqm. Deductions for ends of dissimilar materials or other articles embedded shall not be made for areas not exceeding 0.10 sqm. The flooring done either with strips (in one operation) or without strips (in alternate panels) shall be treated as same and measured together.

Rate

The rate shall include the cost of all materials and labour involved in all the operations described above including application of cement slurry on RCC slab or on base concrete including roughening and cleaning the surface but excluding the cost of strips which shall be paid separately under relevant item. Nosing of steps where provided shall be paid for separately in running metre. Nothing extra shall be paid for laying the floor at different levels in the same room or courtyard and rounding off edges of sunk floors. In case the flooring is laid in alternate panels, nothing extra shall be paid towards the cost of shuttering used for this purpose.

CEMENT PLASTER IN RISERS OF STEPS, SKIRTING, DADO

Plaster at the bottom of wall not exceeding 30 cm in height above the floor shall be classified as skirting. It shall be flush with wall plaster or projecting out uniformly by 6 mm from the wall plaster, as specified. The work shall be preferably carried out simultaneously with the laying of floor. It's corners and junctions with floor shall be finished neatly as specified.

Thickness

The thickness of the plaster specified shall be measured exclusive of the thickness of key i.e. grooves or open joints in brick work. The average thickness shall not be less than the specified thickness. The average thickness should be regulated at the time of plastering by keeping suitable thickness of the gauges. Extra thickness required in rounding of corners at junctions of wall shall be ignored.

Preparation of Wall Surface

The joints shall be raked out to a depth of at least 15 mm in masonry walls. In case of concrete walls, the surfaces shall be roughened by hacking. The surface shall be cleaned thoroughly, washed with water and kept wet before skirting is commenced.

Application

Skirting with specified mortar and to specified thickness shall be laid immediately after the surface is prepared. It shall be laid along with the border or adjacent panels of floor. The joints in skirting shall be kept true and straight in continuation of the line of joints in borders or adjacent panels. The skirting shall be finished smooth with top truly horizontal and joints truly vertical except where otherwise indicated.

Finishing

The finishing of surface shall be done simultaneously with the borders or the adjacent panels of floor. The cement to be applied in the form of slurry for smooth finishing shall be at the rate of 2 kg of cement per litre of water applied over an area of 1 sqm. Where skirting is flush with plaster, a groove 10 mm wide and upto 5 mm deep shall be provided in plaster at the junction of skirting with plaster.

Curing

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

Measurement

Length and height shall be measured correct to a cm and its area shall be calculated in sqm correct to two places of decimals for a specified the thickness. Length shall be measured as the finished length of skirting. Height shall be measured from the finished level of floor correct to 5 mm.

Rate

Rate shall include the cost of all materials and labour involved in all the operations described above

STEEL WORK

Providing and fixing steel doors/windows/ventilators

The steel doors, windows, ventilators shall conform to IS:7452 and 1036. All steel doors, windows, ventilators, louvres, etc. shall be of sizes as specified and conform to the description in the respective items of work. Whether or not specifically mentioned, all fixtures and fittings necessary for the satisfactory operation of the doors and windows shall be provided. Doors, windows and ventilators shall be obtained from an approved manufacturer. Specific approval for such purchase shall be obtained before hand. Sample shall also be got approved before further manufacture starts, unless this is waived in writing by the ENGINEER. All steel door shall be of pressed steel (18 gauge) flush type with or without removable transome. All doors shall be provided with a three way bolting device and locking arrangement with duplicate keys and handles on both sides and operable from either side. The CONTRACTOR shall obtain windows with friction hinges in place of windows with pegstays if so directed by the ENGINEER. For centre hung and top hung ventilators suitable spring catch/pulley and chord arrangement shall be provided for facility of opening. Whenever fly mesh over windows have been called for, they shall be fixed on the window and suitable lever type or rototype arrangement shall be provided for opening or closing of the glazed panels from inside. Prior approval of Engineer shall be taken before order is placed with the manufacturer.

Where specified, steel door supplied shall be airtight. For this purpose, the CONTRACTOR shall provide necessary padding material such as rubber, felt or any other approved material.

The rate quoted shall be inclusive of glazing with 4mm thick glass free from all blemishes. The workmanship shall conform to IS:1081. The rate quoted shall also be inclusive of fixing doors, windows, ventilators, louvres, etc. in brick work, steel framing, etc. by making holes/drilling holes in steel work where required complete.
The rate shall also include cost of painting two coats of approved enamel paint over two coat of approved zinc chromate primer.

Providing and fixing inserts in concrete works

Inserts are required to be fixed/embedded as indicated in construction drawings and/or as directed by Engineer-in-charge in foundations, columns and other miscellaneous concrete works. These inserts comprise plates, angles, pipe sleeves, anchor bolt assemblies, etc.

The rate quoted by the Tenderer shall hold good for accurately fixing the inserts at the correct levels/alignment and shall include for the cost of any temporary or permanent supports/anchors such as bars including cutting, bending, welding, etc. as required.

Steel templates shall be used by Contractor to locate and very accurately position bolts, group of bolts, inserts, embedded parts, etc. at his cost. Such templates shall be previously approved by the Engineer. Templates shall invariably be supported such that the same is not disturbed due to vibration, movement of labourers, materials, shuttering work, reinforcement, etc. while concreting. The Contractor will have to suitably bend, cut or otherwise adjust the reinforcement in concrete at the locations of inserts as directed by the Engineer at no extra cost to OWNER. If the Engineer so directs, the inserts will have to be welded to reinforcement to keep them in place. Contractor shall be responsible for the accuracy of dimensions, levels, alignments and centre lines of the inserts in accordance with the drawings and for maintenance of the same until the erection of equipment/structure or final acceptance by Owner.

Contractor shall ensure proper protection of all bolts, inserts, etc. from weather and other damages by greasing or other approved means such as applying white lead putty and wrapping them with gunny bags or canvas or by other means as directed by Engineer to avoid damage due to movement of his labourers, material, equipment, etc. No extra claim from the Contractor on this account shall be entertained. Contractor shall be solely responsible for all the damages caused to bolts, inserts, etc. due to his negligence and in case damages do occur, they shall be rectified to the satisfaction of Engineer at the Contractor's cost.

Providing and fixing in position grill, railing, steel ladder, etc.

This work shall be carried out as per the detailed drawings. The MS sections shall be of approved quality. The welding shall be perfect and the junctions shall be ground properly. The frames shall be provided with hold fasts and the same shall be grouted with CC blocks in brick work. It shall be painted with two coats of zinc chromate primer and two coats of synthetic enamel paint of approved make and colour.

Providing & Fixing MS holding down bolts

The MS holding down bolts of specified dia, length and shape shall be provided as per the drawings in line & level. These shall be fixed to RCC work or brick work by grouting it with concrete. The bolt shall be provided with nuts and washers. The grease shall be applied to the threaded portion with the help of templates. If the bolts need some adjustment it shall be provided with a wooden piece 75x75 mm or 50 mm dia GI pipe around bolt shall be provided at the time of concreting and shall be removed after initial set.

ROLLING SHUTTERS

Rolling shutters shall conform to IS 6248. These shall include necessary locking arrangement and handles etc. These shall be suitable for fixing in the position as specified i.e. outside or inside on or below lintel or between jambs of the opening. The door shall be either push and pull type or operated with mechanical device supplied by the firm. Shutters upto 10 sq. metre shall be of push and pull type and shutters with an area of over 10 sq. metre shall generally be provided with reduction gear operated by mechanical device with chain or handle, if bearings are specified for each of operation, these shall be paid for separately.

Shutter :

The shutter be built up of inter locking lath section formed from cold rolled steel strips. The thickness of the sheets from which the lath sections have been rolled shall be not less than 0.90 mm for the shutters upto 3.5 m width and not less than 1.2mm for shutters above 3.5m width. Shutters above 9 metres width should be divided in 2 parts with provision of one middle fixed or movable guide channel or supported from the back side to resist wind pressure. The lath section shall be rolled so as to have interlocking curls at both edges and a deep corrugation at the centre with a bridge depth of not less than 12 mm to provide sufficient curtain of stiffness for resisting manual pressures and normal wind pressure. Each lath section shall be continuous single piece without any welded joint. When interlocked, the lath sections shall have a distance of 75 mm rolling centers. Each alternate lath section shall be fitted with malleable cast iron or mild steel clips securely riveted at either ends, thus locking in the lath section at both ends preventing lateral movement of the individual lath sections. The clips shall be so designed as to fit the contour of the lath sections.

Spring :

The spring shall be of coiled type. The spring shall be manufactured from high tensile spring steel wire or strips of adequate strength conforming to IS 4454- Part I .

Roller and Brackets :

The suspension shaft of the roller shall be made of steel pipe conforming to heavy duty as per IS 1161. For shutter upto 6 metre width and height not exceeding 5metre, steel pipes of 50 mm nominal bore shall be used. The shaft shall be supported on mild steel brackets of size 375 x 375 x 3.15 mm for shutters upto a clear height of 3.5 metre. The size of mild steel brackets shall be 500 x 500 x 10 mm for shutters of clear height above 3.5 m and upto 6.5 m. The suspension shaft clamped to the brackets shall be fitted with rotatable cast iron pulleys to which the shutter is attached. The pulleys and pipe shaft shall connected by means of pretensioned helical springs to counter balance the weight of the shutter and to keep the shutter in equilibrium in any partly open position.

When the width of the opening is greater than 3.5 mtr. The cast iron pulleys shall be interconnected with a cage formed out of mild steel flats of at least 32 x 6 mm and mild steel dummy rings made of similar flats to distribute the torque uniformly. Self aligning

two row ball bearing with special cast iron casings shall be provided at the extreme pulley and caging rings shall have a minimum spacing of 15mm and at least 4 number flats running throughout length of roller shall be provided.

In case of shutters of large opening with mechanical device for opening the shutter the roller shall be fitted with a purion wheel at one end which in contact with a worm fitted to the bracket plate, caging and pulley with two ball bearing shall be provided.

Guide Channels

The guide channels shall be of mild steel deep channel section and of rolled, pressed or built up (fabricated) construction. The thickness of the sheet used shall not be less than 3.15 mm. The depth of the guide should be such that there is sufficient clearance between the curtain ‘and the inner surface of the guide to avoid any rubbing or obstruction for free movement of the curtain. The curtain shall project into the guide at least 40 mm up to 3.5 m width and 60 mm for greater width and there shall be a clearance of 10 mm minimum between the guide wall and the end clips of the curtain to permit free movement of the curtain under normal wind pressure. **Where the shutter is installed in heavy windy zones special wind locking arrangements shall be provided to prevent the curtain coming out of the guide.**

The gap, on either side, between the edge of curtain and the inside edge of the guide channel shall be about 5 mm to allow for the free movement of the curtain and at the same time to prevent rattling of the curtain due to wind.

Size of the guide channel - The depth and width of the guide channel shall be as under:

a) ***Depth***	***Clear width of shutter Depth of guide channel, Min***
Up to 3.5 m	65 mm
3.5 m up to 8 m	75 mm
8 m and above	100 mm

b) Width of guide channel shall be 25 mm for lath sections with bridge depth of about 12 mm and 32 mm for lath sections with bridge depth of about 16 mm.

Each guide channel shall be provided with a minimum of three fixing cleats or supports for attachment to the walls or column-by means of bolts or screws. The spacing of cleats shall not exceed 0.75 m. Alternatively, the guide channels may also be provided with suitable dowels, hooks or pins for embedding in the walls.

The guide-channels shall be attached to the jambs, plumb and true, either in the overlapping fashion, projecting fashion or embedded in grooves, depending on the method of fixing.

Cover

Top cover shall be of mild steel sheets not less than 0.90 mm thick and stiffened with angle or flat stiffeners at top and bottom edges to retain shape.

Lock plates with sliding bolts, handles and anchoring rods shall be as per IS 6248.

Fixing

The arrangement for fixing in different situations in the opening shall be as per IS 6248.

Brackets shall be fixed on the lintel or under the lintel as specified with rawl. Plugs and screws bolts etc. The shaft along with the spring shall then be fixed on the brackets.

The lath portion (shutter) shall be laid on ground and the side guide channels shall be bound with ropes etc. The shutter shall then be placed in position and top fixed with pipe shaft with bolts and nuts. The side guide channels and cover frames shall then be fixed to the walls through the plate welded to the guides. These plates and bracket shall be fixed by means of steel screws bolts, and rawl plugs concealed in plaster to make their location invisible. Fixing shall be done accurately in a workmen like manner that the operation of the shutter is easy and smooth.

Measurements

Clear width and clear height of the opening for rolling shutter shall be measured correct to a mm. The clear distance between the two jambs of the opening shall be clear width and the clear distance between the sill and the soffit (bottom of lintel) of the opening shall be the clear height.

The area shall be calculated in square meters correct to two places of decimal.

Rate

The rate shall include the cost of materials and labour involved in all the operations described above including cost of top cover and spring except ball bearing and mechanical device of chain and crank operation, which shall be paid for separately.

Stainless Steel

All stainless steel works mentioned in this tender to be carried out using 304 grade SS. Alloy 304 (UNS S30400) stainless steel is a variation of the 18% chromium – 8% nickel austenitic alloy, the most familiar and most frequently used alloy in the stainless steel family. This stainless steel alloy may be considered for a wide variety of applications and exhibits good corrosion resistance, ease of fabrication, excellent formability, and high strength with low weight.

General Properties

Alloys 304 stainless steels are variations of the 18 percent chromium – 8 percent nickel austenitic alloy. These alloys may be considered for a wide variety of applications where one or more of the following properties are important:

- Resistance to corrosion
- Prevention of product contamination
- Resistance to oxidation
- Ease of fabrication
- Excellent formability
- Beauty of appearance
- Ease of cleaning
- High strength with low weight
- Good strength and toughness at cryogenic temperatures

Ready availability of a wide range of product forms

Chemical Composition as per ASTM A240 and ASME SA-240:

Physical Properties

Density**:**

0.285 lb/in3 (7.90 g/cm3)

Modulus of Elasticity in Tension**:**

29 x 106 psi (200 GPa)

Mechanical Properties

Minimum mechanical properties for annealed Alloys 304 austenitic stainless steel plate as required by ASTM specifications A240 and ASME specification SA-240 are shown below.

Welding

The austenitic stainless steels are considered to be the most weldable of the high-alloy steels and can be welded by all fusion and resistance welding processes. The Alloys 304 are typical of the austenitic stainless steels.

Two important considerations in producing weld joints in the austenitic stainless steels are: 1) preservation of corrosion resistance, and 2) avoidance of cracking.

A temperature gradient is produced in the material being welded which ranges from above the melting temperature in the molten pool to ambient temperature at some distance from the weld. The higher the carbon level of the material being welded, the greater the likelihood that the welding thermal cycle will result in the chromium carbide precipitation which is detrimental to corrosion resistance. To provide material at the best level of corrosion resistance, low carbon material (Alloy 304L) should be used for material put in service in the welded condition. Alternately, full annealing dissolves the chromium carbide and restores a high level of corrosion resistance to the standard carbon content materials.

Weld metal with a fully austenitic structure is more susceptible to cracking during the welding operation. For this reason, Alloys 304 and 304L are designed to resolidify with a small amount of ferrite to minimize cracking susceptibility.

Alloy 309 (23% Cr – 13.5% Ni) or nickel-base filler metals are used in joining the 18-8 austenitic alloys to carbon steel.

Heat Treatment

The austenitic stainless steels are heat treated to remove the effects of cold forming or to dissolve precipitated chromium carbides. The surest heat treatment to accomplish both requirements is the solution anneal which is conducted in the 1850°F to 2050°F range (1010°C to 1121°C). Cooling from the anneal temperature should be at sufficiently high rates through 1500-800°F (816°C - 427°C) to avoid reprecipitation of chromium carbides.

These materials cannot be hardened by heat treatment.

Cleaning

Despite their corrosion resistance, stainless steels need care in fabrication and use to maintain their surface appearance even under normal conditions of service.

In welding, inert gas processes are used. Scale or slag that forms from welding processes is removed with a stainless steel wire brush. Normal carbon steel wire brushes will leave carbon steel particles in the surface which will eventually produce surface rusting. For more severe applications, welded areas should be treated with a descaling solution such as a mixture of nitric and hydrofluoric acids, and these should be subsequently washed off.

Stainless steel finishes

Standard mill finishes can be applied to flat rolled stainless steel directly by the rollers and by mechanical abrasives. Steel is first rolled to size and thickness and then annealed to change the properties of the final material. Any oxidation that forms on the surface (scale) is removed by pickling, and the passivation layer is created on the surface. A final finish can then be applied to achieve the desired aesthetic appearance.

Coarse abrasive finish applied mechanically
Brushed finish
Satin finish
Matte finish
Reflective finish
Mirror finish
Bead blast finish
heat colored finish-wide range of electropolished & heat colored

STEEL WORK IN BUILT UP SECTION (WELDED)

The steel work in built up sections (welded) such as in trusses, form work etc. is specified in this clause.

Laying out

It shall be as specified

Fabrication

Straightening, shaping to form, cutting and assembling, shall be as per 10.3.2 as far as applicable, except that the words "riveted or bolted" shall be read as "welded" and holes shall only be used for the bolts used for temporary fastening as shown in drawings.

Welding : 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 efforts 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 dia 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.

Operation, Workmanship and process of Welding is described in Appendix B,

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 : The specification shall be as described except that 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.

Painting : Before the member of the steel structures are placed in position or taken out of the workshop these shall be painted as specified .

Measurements

The mode of measurements shall be the same as specified except that weight of welding material shall not be added in the weight of members for payment and nothing extra shall be paid for making and filling holes for temporary fastening of members during erection before welding.

Rate

The rate shall include the cost of all labour and materials involved in all the operations described above.

TUBULAR / HOLLOW SECTION TRUSSES

Structural Steel Tube

These shall be of:

1. Hot finished welded (HFW) type, or
2. Hot finished seamless (HFS) type, or
3. Electric resistance or induction butt welded (ERW), having carbon content less than 0.03percent, yield stress of 21.5 kg/mm2 (YST 210) type.

Conforming to the requirement of IS 1161. The steel tubes when analysed in accordance with the method specified in IS 228 shall show not more than 0.06 percent sulphur, and not more than 0.06 per cent phosphorous. Tubes shall be designated by their nominal bore. These shall be light, medium or heavy as specified depending upon the wall thickness. Hollow sections shall be as per IS 4923.Tubes shall be clean finished and

reasonably free from scale. They shall be free from cracks, surface flaws, laminations and other defects. The ends shall be cut clean and square with axis of tube, unless otherwise specified.

Minimum Thickness of Metals

Wall thickness of tubes used for construction exposed to weather shall be not less than 4 mm and for construction not exposed to weather it shall be not less than 3.2 mm where structures are not readily accessible for maintenance, the minimum thickness shall be 5 mm.

Fabrication

The component parts of the structure shall be assembled in such a manner that they are neither twisted nor otherwise damaged and be so prepared that the specified cambers, if any, are, maintained. The tubular steel work shall be painted with one coat of approved steel primer after fabrication. All fabrication and welding is to be done in an approved workshop. The joint details shall be generally as per S.P-38 of B.I.S publication.

Straightening : All material before being assembled shall be straightened, if necessary, unless required to be of curvilinear form and shall be free from twist.

Bolting : Washers shall be specially shaped where necessary, or other means, used to give the nuts and the heads of bolts a satisfactory bearing.

In all cases, where the full area of the bolts is to be developed, the threaded portion of the bolt shall not be within the thickness of the parts bolted together and washers of appropriate thickness shall be provided to allow the nuts to be completely tightened.

Welding : Where welding is adopted, it shall be as per IS 816.

Caps and Bases for Columns : The ends of all the tubes, for columns transmitting loads through the ends, should be true and square to the axis of the tubes and should be provided with a cap or base accurately fitted to the end of the tube and screwed, welded or shrunk on. The cap or base plate should be true and square to the axis of the column.

Sealing of Tubes : When the end of a tube is not automatically sealed by virtue of its connection be welding to another member the end shall be properly and completely sealed. Before sealing, the inside of the tubes should be dry and free from loose scale

Flattened Ends : In tubular construction the ends of tubes may be flattened or otherwise formed to provide for welded. Riveted or bolted connections provide that the methods adopted for such flattening do not injure the material. The change of sections shall be gradual.

Hoisting and Erection

Tubular trusses shall be hoisted and erected in position carefully, without damage to themselves, other structure, equipment and injury to workman. The method of hoisting and erection proposed to be adopted shall be got approved from the Engineer-in-charge. The contractor shall however be fully responsible, for the work being carried out in a safe and proper manner without unduly stressing the various members. Proper equipment such as derricks, lifting tackles, winches, ropes etc. shall be used.

Measurements

The work as fixed in place shall be measured in running metres correct to a centimeter on their weights calculated on the basis of standard tables correct to the nearest kilogram unless otherwise specified. Weight of cleats, brackets, packing pieces bolts nuts, washers distance pieces separators diapharam gussets (taking overall square dimensions) fish plates, etc. shall be added to the weight of respective items unless otherwise specified. No deduction shall be made for skew cuts.

Rate: The rate shall include the cost of labour and materials involved in all the operations described above including application of painting.

ALUMINIUM WORK

Sl. No. IS Code Subject

1. IS 733 : Wrought Aluminium and Aluminium Alloys, Bars, Rods and Sections (For General Engineering Purposes) -Specification
2. IS 737: Wrought Aluminium and Aluminium alloy sheet and strip for general engineering purposes -Specification
3. IS 1285: Wrought Aluminium and Aluminium Alloy, Extruded Round Tube and Hollow sections (For General Engineering Purposes) - Specification
4. IS 1868: Anodic coating on Aluminium and its Alloys-Specification
5. IS 1948: Specification for Aluminium Doors, Windows and Ventilators
6. IS 3908: Specification for Aluminium equal leg angles
7. IS 3909: Specification for Aluminium unequal leg angles
8. IS 3965: Dimensions for wrought Aluminium and Aluminium Alloys bars, rods and sections.
9. IS 5523: Method of testing anodic coating on aluminium and its alloys.
10. IS 6012: Measurement of coating thickness by Eddy Current Method
11. IS 6315: Floor springs (Hydraulically regulated) for heavy doors- Specifications
12. IS 6477: Dimensions of extruded hollow section and tolerances
13. IS 12823: Wood products- Pre-laminated particle board –Specifications.
14. IS 14900: Transparent Float glass- Specifications

Anodized Aluminium

Aluminium with an anodic coating, produced by an electrolytic oxidation process, in which the surface of the aluminium is covered with a coating, generally an oxide, to give protective and decorative properties.

Pre-laminated Particle Board

A particle board laminated on both surface by synthetic impregnated base papers under the influence of heat and pressure with finished foil under the pressure or pressure and heat depending on type of binder used.

ALUMINIUM

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.

Powder Coating

Material: The powder used for powder coating shall be Epoxy/polyester powder of make approved by the Engineer-in-Charge. The contractor shall give detailed programme for powder coating in advance, to facilitate the inspection by Engineer-in-Charge or his authorized representative.

Pre-treatment: Each aluminium alloy extrusion or performed section shall be thoroughly cleaned by alkaline or acidic solutions under the conditions specified by chemical conversion coating supplier and then rinsed. A chemical conversion coating shall be applied by treatment with a solution containing essentially chromate ions or chromate and phosphate ions as the active components as applicable. The amount of the conversion coating deposited depends on the type used by the conversion coating chemical supplier. The conversion coating shall be thoroughly rinsed either with the solution specified by the conversion coating chemical supplier or with de-mineralized water and then dried at the temperature for the time specified by the conversion coating chemical supplier. The contractor shall submit the detail specifications and application procedure for application of conversion coating for approval of Engineer-in-Charge. The metal surface after the conversion coating pretreatment and prior to the application of the coating shall be free from dust or powdery deposits

Process: The polyester powder shall be applied by electrostatic powder spray method. Before start of powder coating the contractor shall submit detail specification for application of polyester powder from manufacturer of the polyester powder for approval of Engineer-in-Charge. The powder coating shall be applied as per the specification approved by Engineer-in-Charge.

Thickness: The thickness of the finished polyester powder 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

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.

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 Powder Coated / 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 work including snap beading fixed in place shall be measured in square meter along the outer periphery of composite section correct to a millimeter.

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.

PANELING MATERIAL

Pre-laminated Particle Board

A particles board laminated on both surfaces by synthetic resin impregnated base papers under heat and pressure. Pre-laminated particle boards shall be of two grades, namely, Grade I and II corresponding to IS 3087 & 12823. Synthetic resin bonded flat pressed three layers, multilayer and graded particle board defined in IS 3087 having superfine surface shall be used for production of prelaminated particle board. For ECO Marks the particle board shall also conform to the requirements of ECO Mark specified in IS 3087

Float Glass

The glass shall be clear float glass and should be approved by the Engineer in Charge. It shall be clear, float transparent and free from cracks subject to allowable defects. The float glass shall conform to the IS 14900.

Thickness : The thickness of float glass shall depend on the size of panel. The tolerance in thickness shall be as under:

TABLE

Nominal Thickness (in mm) Tolerance (in mm)
4.0 ± 0.3
5.0 ± 0.3
6.0 ± 0.3
8.0 ± 0.6

EPDM- GASKETS

The EPDM Gaskets shall be of size and profile as shown in drawings and as called for, to render the glazing, doors, windows, ventilators etc. air and water tight. Samples of gaskets shall be submitted for approval and the EPDM gasket approved by Engineer-in-Charge shall only be used. The contractor shall submit documentary proof of using the above material in the work to the entire satisfaction of Engineer-in-Charge.

SEALANT

The sealants of approved grade and colour shall only be used. The silicone for perimeter joints (between Aluminium section and RCC/Stone masonry) shall be of make approved by the Engineer in Charge.

Method of Application

Surface Preparation : Clean all joints and glazing pockets by removing all foreign matter and contaminants such as grease, oil, dust, water, frost, surface dirt, old sealants or glazing compounds and protective coatings.

Masking

Areas adjacent to joints shall be masked to ensure neat sealant lines. Masking tape shall not be allowed to touch clean surfaces to which the silicone sealant is to adhere. Tooling shall be completed in one continuous stroke immediately after sealant application and before a skin forms and masking shall be removed immediately after tooling.

Application

Install backer rod of appropriate size and apply silicone sealant in a continuous operation using a positive pressure adequate to properly fill and seal the joint. The silicone sealant shall be tooled with light pressure to spread the sealant against backing material and the joint surfaces before a skin forms. A tool with convex profile shall be used to keep the sealant within the joint. Soap or water shall not be used as a tooling aid. Remove masking tape as soon as silicone joint is tooled.

Tolerance: A tolerance of + 3 mm shall be allowed in the width of silicone joints. The depth of the joints at throat shall not be less than 6 mm.

DOOR, WINDOW, VENTILATOR AND PARTITION FRAMES

Frame Work

First of all the shop drawings for each type of doors/windows/ventilators etc. shall be prepared by using suitable sections based on architectural drawings, adequate to meet the requirement/ specifications and by taking into consideration varying profiles of aluminium sections being extruded by approved manufacturers. The shop drawings shall show full size sections of glazed doors, windows, ventilators etc. The shop drawings shall also show the details of fittings and joints. Before start of the work, all the shop drawings shall be got approved from the Engineer-in-Charge. Actual measurement of openings left at site for different type of door/window etc. shall be taken. The fabrication of the individual door/windows/ventilators etc. shall be done as per the actual sizes of the opening left at site. The frames shall be truly rectangular and flat with regular shape corners fabricated to true right angles. The frames shall be fabricated out of section which have been cut to length, mitered and jointed mechanically using appropriate machines. Mitered joints shall be corner crimped or fixed with self tapping stainless steel screws using extruded aluminium cleats of required length and profile. All aluminium work shall provide for replacing damaged/broken glass panes without having to remove or damage any member of exterior finishing material.

Fixing of Frames

The holes in concrete/masonry/wood/any other members for fixing anchor bolts/ fasteners/ screws shall be drilled with an appropriate electric drill. Windows/ doors/ ventilators etc. shall be placed in correct final position in the opening and fixed to Sal wood backing using stainless steel screws of star headed, counter sunk and matching size groove. of required size at spacing not more than 250 mm c/c or dash fastener. All joints shall be sealed with approved silicone sealants.

In the case of composite windows and doors, the different units are to be assembled first. The assembled composite units shall be checked for line, level and plumb before final fixing is done. Engineer-in-Charge in his sole discretion may allow the units to be assembled in their final location if the situation so warrants. Snap beadings and EPDM gasket shall be fixed as per the detail shown in the shop drawings.

Where aluminium comes into contact with stone masonry, brick work, concrete, plaster or dissimilar metal, it shall be coated with an approved insulation lacquer, paint or plastic tape to ensure that electrochemical corrosion is avoided. Insulation material shall be trimmed off to a clean flush line on completion.

The contractor shall be responsible for the doors, windows etc. being set straight, plumb, level and for their satisfactory operation after fixing is complete.

Measurements

All the aluminium works including snap beadings fixed in place shall be measured in square meter along the outer periphery of composite section correct to a millimeter.

Rate

The rate shall include the cost of all the materials, labour 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.

Tolerances

The sizes for doors, windows and ventilators frames shall not vary by more than ±1.5 mm.

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.

Side-hung Shutters

For fixing aluminium alloy hinges, slots shall be cut in the fixed frame and the hinges inserted inside and may be riveted to the frame. The hinges shall normally be of the projecting type 67 mm wide. The aluminium alloy for cast hinges shall conform to IS Designation A-5-M of IS 617. Specification for Aluminium and Aluminium Alloy Ingots and Castings for General Engineering Purpose and for extruded section of hinges to IS Designation HE10-WP or HE30-WP of IS 733. The pins for hinges shall be of stainless steel of non-magnetic type or aluminium alloy HR30. Irrespective of hinges being anodized or not, the aluminium alloy pins shall be anodized to a minimum film thickness of 0.025 mm shall be sealed with oil, wax or lanolin. Non- projecting types of hinges may also be used where ever required. Frictions hinges may be provided for side-hung shutter windows, in which case peg stay may not be required. The handle for side-hung shutters shall be of cast aluminium conforming to IS Designation A-5-M of IS 617 and mounted on a handle plate welded or riveted to the opening frame in such a way that it could be fixed before the shutter is glazed. The handle should have anodized finish with minimum anodic film thickness of 0.015 mm. The handle shall have a two points nose which shall engage with an aluminium striking plate on the fixed frame in a slightly open position as well as in a fast position . The height of the handles in each type of side-hung shutters shall be fixed in approximate position . The peg stay shall be either of cast aluminium conforming to IS 617 or folded from IS Designation NS4 aluminium alloy sheet conforming to IS:737 specification for wrought aluminium and aluminium alloys, Sheet and strip. It shall be 300 mm long, The stay shall have holes for keeping the shutter open in three different positions. The peg and locking bracket shall be riveted or welded to the fixed frame. Alternatively, and if specifically required by the purchaser, side-hung shutters may be fitted with an internal removable fly screen of 0.375 mm wire and equivalent to IS Sieve 100 in a 0.900 mm aluminium alloy sheet conforming to IS Designation NS3-1/2H of IS 737 applied to the outer frame of the shutter by case or

extruded aluminium alloy turn-buckle at the jambs and by aluminium or plated bronze shoes at the sill to allow of the screen being readily removed, and with a rotor operator at the sill to permit the operation of the shutter through an angle of 90º .On fly-screened shutters the peg stay is omitted and the normal handle shall be replaced by a locking handle to hold the shutter in the fast position.

Top-Hung Ventilators

The aluminium hinges for top-hung ventilators shall be either cast or fabricated out of extruded sections and shall be riveted to the fixed rail after cutting a slot in it. The aluminium alloy for cast hinges shall conform to IS Designation A-5-M of IS 617 and the extruded section of hinge to IS Designation HE10-WP or HE30_WP of IS 733. The pegs stay shall be 300 mm long as in side-hung shutter. The locking bracket shall be fixed to the fixed frame.

Cement Plaster

The cement plaster shall be 12 mm, 15 mm or 20 mm thick as specified in the item.

Scaffolding

For all exposed brick work or tile work double scaffolding independent of the work having two sets of vertical supports shall be provided. The supports shall be sound and strong, tied together with horizontal pieces over which scaffolding planks shall be fixed. For all other work in buildings, single scaffolding shall be permitted. In such cases the inner end of the horizontal scaffolding pole shall rest in a hole provided only in the header course for the purpose. Only one header for each pole shall be left out. Such holes for scaffolding shall, however, not be allowed in pillars/columns less than one metre in width or immediately near the skew backs of arches. The holes left in masonry works for scaffolding purposes shall be filled and made good before plastering.

Note : In case of special type of brick work, scaffolding shall be got approved from Engineer-in-charge in advance.

Preparation of Surface

The joints shall be raked out properly. Dust and loose mortar shall be brushed out. Efflorescence if any shall be removed by brushing and scrapping. The surface shall then be thoroughly washed with water, cleaned and kept wet before plastering is commenced. In case of concrete surface if a chemical retarder has been applied to the form work, the surface shall be roughened by wire brushing and all the resulting dust and loose particles cleaned off and care shall be taken that none of the retarders is left on the surface.

Mortar

The mortar of the specified mix using the type of sand described in the item shall be used. It shall be as specified. For external work and under coat work, the fine aggregate

shall conform to grading IV. For finishing coat work the fine aggregate conforming to grading zone V shall be used.

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, arrises, angles and junctions shall be truly vertical or horizontal as the case may be and shall be carefully finished. Rounding or chamfering corners, arrises, 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 arrises. It shall not be closed on the body of the features such as plasters, bands and cornices, nor at the corners of arrises. 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.

Thickness

Where the thickness required as per description of the item is 20 mm the average thickness of the plaster shall not be less than 20 mm whether the wall treated is of brick or stone. In the case of brick work, the minimum thickness over any portion of the surface shall be not less than 15 mm while in case of stone work the minimum thickness over the bushings shall be not less than 12 mm.

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.

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.

Precaution

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.

(i) When ceiling plaster is done, it shall be finished to chamfered edge at an angle at its junction with a suitable tool when plaster is being done. Similarly when the wall plaster is being done, it shall be kept separate from the ceiling plaster by a thin straight groove not deeper than 6 mm drawn with any suitable method with the wall while the plaster is green.

(ii) To prevent surface cracks appearing between junctions of column/beam and walls, 150 mm wide chicken wire mesh should be fixed with U nails 150 mm centre to centre before plastering the junction. The plastering of walls and beam/column in one vertical plane should be carried out in one go. For providing and fixing chicken wire mesh with U nails payment shall be made separately.

Measurements

Length and breadth shall be measured correct to a cm and its area shall be calculated in square metres correct to two places of decimal.

Thickness of the plaster shall be exclusive of the thickness of the key i.e. grooves, or open joints in brick work.

The measurement of wall plaster shall be taken between the walls or partitions (the dimensions before the plaster shall be taken) for the length and from the top of the floor or skirting to the ceiling for the height. Depth of coves or cornices if any shall be deducted.

The following shall be measured separately from wall plaster.

(a) Plaster bands 30 cm wide and under

(b) Cornice beadings and architraves or architraves moulded wholly in plaster.

(c) Circular work not exceeding 6 m in radius.

Plaster over masonry pilasters will be measured and paid for as plaster only.

A coefficient of 1.63 shall be adopted for the measurement of one side plastering on honey comb work having 6 x 10 cm. opening.

Moulded cornices and coves.

(a) Length shall be measured at the centre of the girth.

(b) Moulded cornices and coves shall be given in square metres the area being arrived at by multiplying length by the girth.

(c) Flat or weathered top to cornices when exceeding 15 cm in width shall not be included in the girth but measured with the general plaster work.

(d) Cornices which are curved in their length shall be measured separately.

Exterior plastering at a height greater than 10 m from average ground level shall be measured separately in each storey height. Patch plastering (in repairs) shall be measured as plastering new work, where the patch exceed 2.5 sqm. Extra payment being made for preparing old wall, such as dismantling old plaster, raking out the joints and cleaning the surface. Where the patch does not exceed 2.5 sqm in area it shall be measured under the appropriate item under sub head 'Repairs to Buildings.'

Deductions in measurements, for opening etc. will be regulated as follows:

(a) No deduction will be made for openings or ends of joists, beams, posts, girders, steps etc. upto 0.5 sqm in area and no additions shall be made either, for the jambs, soffits and sills of such openings. The above procedure will apply to both faces of wall.

(b) Deduction for opening exceeding 0.5 sqm but not exceeding 3 sqm each shall be made for reveals, jambs, soffits sills, sills, etc. of these openings.

(i) When both faces of walls are plastered with same plaster, deductions shall be made for one face only.

(ii) When two faces of walls are plastered with different types of plaster or if one face is plastered and other is pointed or one face is plastered and other is unplastered, deduction shall be made from the plaster or pointing on the side of the frame for

the doors, windows etc. on which width of reveals is less than that on the other side but no deduction shall be made on the other side.

Where width of reveals on both faces of wall are equal, deduction of 50% of area of opening on each face shall be made from area of plaster and/or pointing as the case may be.

(iii) For opening having door frame equal to or projecting beyond thickness of wall, full deduction for opening shall be made from each plastered face of wall.

(c) For opening exceeding 3 sqm in area, deduction will be made in the measurements for the full opening of the wall treatment on both faces, while at the same time, jambs, sills and soffits will be measured for payment. In measuring jambs, sills and soffits, deduction shall not be made for the area in contact with the frame of doors, windows etc.

Rate

The rate shall include the cost of all labour and materials involved in all the operations described

Cement Plaster with a Floating Coat of Neat Cement

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. The rest of the specifications described and shall apply.

6mm Cement Plaster on Cement Concrete and Reinforced Cement

Concrete Work

Scaffolding

Stage scaffolding shall be provided for the work. This shall be independent of the walls.

Preparation of Surface

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.

Mortars

Mortar of the specified mix using the types of sand described in the item shall be used. It shall be as specified.

Application

To ensure even thickness and a true surface, gauges of plaster 15 x 15 cm. shall be first applied at not more than 1.5 m intervals in both directions to serve as guides for the plastering. Surface of these gauged areas shall be truly in the plane of the finished plaster surface. The plaster shall be then applied in a uniform surface to a thickness slightly more than the specified thickness and shall then be brought to true and even surface by working a wooden straight edge reaching across the gauges. Finally the surface shall be finished true with a trowel or with wooden float to give a smooth or sandy granular texture as required. Excess troweling or over working of the floats shall be avoided. The plastering and finishing shall be completed within half an hour of adding water to the dry mortar. Plastering of ceiling shall not be commenced until the slab above has been finished and centering has been removed. In the case of ceiling of roof slabs, plaster shall not be commenced until the terrace work has been completed. These precautions are necessary in order that the ceiling plaster is not disturbed by the vibrations set up in the above operations.

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.

Thickness

The average thickness of plaster shall not be less than 6 mm. The minimum thickness over any portion of the surface shall not be less than 5 mm.

Curing

The specifications shall be as detailed

Precautions

The specifications shall be as detailed

Measurements

Length and breadth shall be measured correct a cm. and its area shall be calculated in sqm. corrected to two places of decimal. Dimensions before plastering shall be taken.

Thickness of plaster shall be exclusive of the thickness of the key i.e. depth or rock marks and hacking.

Plastering on ceiling at height greater than 5 m above the corresponding floor level shall be so described and shall be measured separately stating the height in stages of 1 m or part thereof.

Plastering on the sides and soffits of the projected beams of ceiling at a height greater than 5 m above the corresponding floor level shall be measured and added to the quantity measured. Plastering on spherical and groined ceiling and circular work not exceeding 6 m in radius, shall be measured and paid for separately.

Flowing soffits (*viz.* portion under spiral stair case etc.) shall be measured and paid for separately.

Ribs and mouldings on ceiling shall be measured as for cornices, deductions being made from the plastering on ceiling in case the width of the moulding exceed 15 cm.

Deduction shall not be made for openings or for ends of columns, or columns caps of 0.5 sqm each in area and under. No additions will be made either for the plastering of the sides of such openings. For openings etc. of areas exceeding 0.5 sqm deduction will be made for the full opening but the sides of such openings shall be measured for payment.

Rate

The rate shall include the cost of all labour and materials involved in all the operations described above.

Cement Water Proofing Compound

It shall be used for cement mortar for plastering or concrete work.

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.

It shall be measured by weight.

The rate shall include the cost of all labour and materials involved in all the operations described above

Pointing on Brick work, Tile work and Stone work

Scaffolding

For all exposed brick work, tile work or stone work independent double scaffolding having two sets of vertical supports shall be provided. The supports shall be sound and strong tied together with horizontal pieces over which scaffolding planks shall be fixed. For all other work in building, single scaffolding shall be permitted. In such cases, the inner end of the horizontal scaffolding pole shall rest in a hole provided only in the header course for the purpose. Only one header for each pole shall be left out. Such holes for scaffolding shall, however, not be allowed in pillars/columns less than one metre in width, or immediately near the skew backs of arches. The holes left in masonry works for scaffolding purposes shall be filled and made good before plastering.

Note: In case of special type of work, scaffolding shall be got approved from Engineer-in-Charge in advance.

Preparation of surface

The joints shall be raked out properly. Dust and loose mortar shall be brushed out. Efflorescence if any shall be removed by brushing and scraping. The surface shall then be thoroughly washed with water, cleaned and kept wet before pointing is commenced. In case of concrete surface if a chemical retarder has been applied to the form work, the surface shall be roughened by wire brushing and all the resulting dust and loose particles cleaned off and care shall be taken that none of the retarders is left on the surface. The joints shall be raked to such a depth that the minimum depth of the new mortar measured from either the sunk surface of the finished pointing or from the edge of the brick shall not be less than 12 mm.

Mortar

Mortar of specified mix shall be used.

Application and Finishing

The mortar shall be pressed into the raked out joints, with a pointing trowel, either flush, sunk or raised, according to the type of pointing required. The mortar shall not spread over the corner, edges or surface of the masonry. The pointing shall then be finished with the proper tool, in the manner described below:

Flush Pointing: The mortar shall be pressed into the joints and shall be finished off flush and level with the edges of the bricks, tiles or stones so as to give a smooth appearance. The edges shall be neatly trimmed with a trowel and straight edge.

Ruled Pointing : The joints shall be initially formed as for flush pointing and then while the mortar is still green, a groove of shape and size as shown in drawings or as instructed, shall be formed by running a forming tool, straight along the centre line of the joints. This operation shall be continued till a smooth and hard surface is obtained.

The vertical joints shall also be finished in a similar way. The vertical lines shall make true right angles at their junctions with the horizontal lines and shall not project beyond the same.

Cut or Weather Struck Pointing: The mortar shall first be pressed into the joints. The top of the horizontal joints shall then be neatly pressed back about 3 mm or as directed, with the pointing tool so that the joints are sloping from top to bottom. The vertical joints shall be ruled pointed. The junctions of vertical joints with the horizontal joints shall be at true right angles.

Finishing

Raised and Cut Pointing : Raised and cut pointing shall project from the wall facing with its edges cut parallel so as to have a uniformly raised band about 6 mm raised and width 10 mm more as directed.

The superfluous mortar shall then be cut off from the edges of the lines and the surface of the masonry shall also be cleaned off all mortar. The finish shall be such that the pointing is to the exact size and shape required and the edges are straight, neat and clean.

Curing

The pointing shall be kept wet for seven days. During this period it shall be suitably protected from all damages. The pointing lines shall be truly horizontal and vertical except where the joints are slanting as in rubble random masonry. Lines of joints from different directions should meet neatly at the junctions instead of crossing beyond.

Measurements

Length and breadth shall be measured correct to a cm and its area shall be calculated in square metres upto two places of decimal.

The various types of pointing for example, struck, keyed, flush, tuck, etc. shall each be measured separately.

Pointing on different types of walls, floors, roofs etc. shall each be measured separately. The type and material of the surface to be pointed shall be described.

Pointing in a single detached joint as for flashing shall be given in running metres.

For jambs, soffits, sills etc. for opening not exceeding 0.5 sqm each in area, ends of joists, beams, posts, girders, steps etc. not exceeding 0.5 sqm each in area and opening not exceeding 3 sqm each deductions and additions shall be made in the following way, in case of pointing on external face only.

(a) No deduction shall be made for ends of joists, beams, posts etc. and openings not exceeding 0.5 sqm each, and no addition shall be made for reveals, jambs, soffits, sills, etc. of these openings.

(b) Deductions for openings exceeding 0.5 sqm but not exceeding 3 sqm each shall be made as follows and no additions shall be made for reveals, jambs, soffits, sills, etc. for these openings.

(c) When both the faces of the wall are pointed with the same pointing deduction shall be made for one face only.

(d) When two faces of wall are pointed with different pointings or if one face is plastered and other is pointed or plastered, deduction shall be made from the plaster or pointing on the side of frames for doors, windows, etc. on which the width of the reveal is less than that on the other side, but no deduction shall be made from the other side.

(e) Where width of reveals on both faces of wall are equal, deduction of 50% of area of opening on each face shall be made from area of pointing or laster as the case may be.

(f) For opening having door frame equal to or projecting beyond thickness of wall, full deduction for opening shall be made from each pointed face of wall.

In case of openings of area above 3 sqm each, deduction shall be made for the openings, but jambs, soffits and sills shall be measured.

The following shall be measured separately.

(a) Raking out joints for old work only shall be measured and given in square metres.

(b) Raking out joints of old work built in mud mortar, lime mortar and cement mortar shall each be measured separately.

(c) Raking out joints of different types of old walls, floors etc. shall each be measured separately.

(d) Raking single detached joints as for flashing old work shall be given in running metres.

Rate

The rate shall include the cost of all materials and labour involved in all the operations described above.

CEMENT PRIMER COAT

Cement primer coat is used as a base coat on wall finish of cement, lime or lime cement plaster or on non-asbestos cement surfaces before oil emulsion distemper Paints are applied on them. The cement primer is composed of a medium and pigment which are resistant to the alkalies present in the cement, lime or lime cement in wall finish and provides a barrier for the protection of subsequent coats of oil emulsion distemper

Paints. Primer coat shall be preferably applied by brushing and not by spraying. Hurried priming shall be avoided particularly on absorbent surfaces. New plaster patches in old work should also be treated with cement primer before applying oil emulsion Paints etc.

Preparation of the Surface

The surface shall be thoroughly cleaned of dust, old white or colour wash by washing and scrubbing. The surface shall then be allowed to dry for at least 48 hours. It shall then be sand papered to give a smooth and even surface. Any uneveness shall be made good by applying putty, made of plaster of paris mixed with water on the entire surface including filling up the undulations and then sand papering the same after it is dry.

Application

The cement primer shall be applied with a brush on the clean dry 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. It shall be allowed to dry for at least 48 hours, before oil emulsion Paint is applied.

CEMENT PAINT

Material

The cement Paint shall be (conforming to IS 5410) of approved brand and manufacture. The cement Paint shall be brought to the site of work by the contractor in its original containers is 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 the work has been completed and permission obtained from the Engineer-in-Charge.

Preparation of Surface

For New Work, the surface shall be thoroughly cleaned of all mortar dropping, dirt dust, algae, grease and other foreign matter by brushing and washing. Pitting in plaster shall be made good and a coat of water proof cement Paint shall be applied over patches after wetting them thoroughly.

Preparation of Mix

Cement Paint shall be mixed in such quantities as can be used up within an hour of its mixing as otherwise the mixture will set and thicken, affecting flow and finish. Cement Paint shall be mixed with water in two stages. The first stage shall comprise of 2 parts of cement Paint and one part of water stirred thoroughly and allowed to stand for 5 minutes. Care shall be taken to add the cement Paint gradually to the water and not *vice versa*. The second stage shall comprise of adding further one part of water to the mix and stirring thoroughly to obtain a liquid of workable and uniform consistency. In all

cases the manufacturer's instructions shall be followed meticulously. The lids of cement Paint drums shall be kept tightly closed when not in use, as by exposure to atmosphere the cement Paint rapidly becomes air set due to its hygroscopic qualities. In case of cement Paint brought in gunny bags, once the bag is opened, the contents should be consumed in full on the day of its opening. If the same is not likely to be consumed in full, the balance quantity should be transferred and preserved in an airtight container to avoid its exposure to atmosphere.

Application

The solution shall be applied on the clean and wetted surface with brushes or spraying machine. The solution shall be kept well stirred during the period of application. It shall be applied on the surface which is on the shady side of the building so that the direct heat of the sun on the surface is avoided. The method of application of cement Paint shall be as per manufacturer's specification. The completed surface shall be watered after the day's work.

The second coat shall be applied after the first coat has been set for at least 24 hours. Before application of the second or subsequent coats, the surface of the previous coat shall not be wetted.

For new work, the surface shall be treated with three or more coats of water proof cement Paint as found necessary to get a uniform shade.

For old work, the treatment shall be with one or more coats as found necessary to get a uniform shade.

Precaution

Water proof cement Paint shall not be applied on surfaces already treated with white wash, colour wash, distemper dry or oil bound, varnishes, Paints etc. It shall not be applied on gypsums, wood and metal surfaces. If water proofing cement is required to be applied on existing surface, previously treated with white wash, colour wash etc., the surface shall be thoroughly cleaned by scrapping off all the white wash, colour wash etc. completely. Thereafter, a coat of cement primer shall be applied followed by two or more coat of water proof cement.

Exterior Painting on Wall

Material

The paint shall be (Texured exterior paint/Acrylic smooth exterior paint/premium acrylic smooth exterior paint) of approved brand and manufacture. 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 fornight'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 water proofing cement paint

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.

SANITARY AND WATER SUPPLY

Applicable Codes:

1.	IS:77-1984	Flushing Cisterns for water closets and urinals
2.	IS:775/1970	Cast iron brackets and supports for wash basins and sinks
3.	IS:1300/1994	Phenolic moulding materials
4.	IS:1795/1982	Pillar taps for water supply purposes
5.	IS:2326/1987	Automatic flushing cisterns for urinals
6.	IS:2548/1983	Plastic seats and covers for water closets (Part-I & II)
7.	IS:2556/1994	Specification for vitreous sanitary appliances
8.	IS:2963/1979	Copper alloy waste fittings for wash basins and sinks
9.	IS:3076/1985	Low density polyethylene pipes for potable water supplies
10.	IS:3489/1985	Specification for enameled steel bath tubs
11.	IS:4984/1987	High density polyethylene pipes for potable water supplies, sewage and industrial effluents
12.	IS:4985/1988	Specification for unplasticised PVC pipes for potable

		water supplies
13.	IS:6411/1985	Specification for gel-coated-glass fibre reinforced polyester resin bath tub
14.	IS:7231/1984	Plastic flushing cisterns
15.	IS:13983/1994	Stainless steel sinks for domestic purposes
16.	IS:13592	Code of practise for PVC pipes for sanitary applications
17.	IS:14735	PVC pipe fittings
18.	IS:5382	Rubber rings

Scope of Work

Scope of work shall cover the following

1. Supplying, laying, jointing and testing PVC SWR pipe (type B), with specials such as tees, bend, door bend, coupling, Y with door, unions, rubber ring, etc. cutting, earth work excavation, back filling, making good the walls, testing the line, etc.
2. Supplying and fixing gully traps with gully chamber, ventilation cowl, floor trap, etc.
3. Commissioning the Sanitary Piping System
4. Maintaining the commissioned line for a defect liability period of 60 months.

Drawings

Checked and approved drawings showing location of sanitary and water supply fixtures will be furnished to the Contractor and all drawing so furnished shall form a part of this specification. The Contractor shall refer these drawings for all information contained thereon which pertains to and required for this work.

All connected works will be measured and paid under respective items of work unless specifically mentioned otherwise.

Providing & Laying concealed PVC rain water line

The strength of the pipe shall be 4kg/sqcm. It shall be of approved make. It shall be provided with all necessary specials. It shall be jointed with adhesive as per the manufacturer's specifications.

Specification for laying and jointing sanitary pipes

Jointing

1. Make sure the spigot end and inside of socket is clean and the sealing ring is placed evenly in the socket
2. During cutting of pipes, make sure that they are cut square. Chamfer the end cut to angle of 15^{o} with a medium file.
3. A correct depth of entry of the spigot into the socket is required to allow thermal movement. To achieve this, push spigot fully into the socket (remove sealing ring

at this time) and make a mark on the spigot. Withdraw the spigot by 10mm and mark the spigot with a bold line. This bold mark indicates the correct depth of entry to allow the necessary expansion gap.

4. Apply rubber lubricant evenly on the chamfered spigot and the sealing ring. Then insert the spigot into socket and pull out the pipe to allow 10mm expansion gap.

Precautions

1. Avoid over tightening of door caps. Proper placement of rubber ring should be confirmed before tightening
2. Avoid misalignment of vertical Pipe stacks and incorrect spacing of Pipe clips.
3. Cutting of pipes should be straight, as diagonal cutting leads to leakages.
4. All entry to main stacks should be protected with water seal trap, wherever there is mixing of Soil & Waste lines.
5. Keep a gap of 10mm between all Pipes and Fittings to accommodate thermal expansion and contraction of pipes for longer life of the system.
6. Horizontal lines within bathrooms should be cement encased and tested before compacting of sunken floor to avoid any accidental damages.

Installation in walls/concrete

The wall/concrete slots should allow for a stress-free installation.

Testing Non-pressure Installation above ground.

The PVC drainage system can be put to use immediately after installation, as no waiting time required for joints to be set and dried. The water level shall then be raised to a height of not less than three meters above the highest point of the section being tested as directed by the Engineer-in-charge. Every joint shall be carefully examined for leaks

Providing & Laying PVC line for Sanitary application.

The strength of the pipe shall be to withstand 4kg/cm^2 pressure rating. It shall be of approved make. It shall be provided with all necessary specials. It shall be jointed with manufacturer's specifications.

PVC PIPNG

A. Transportation and Stacking

Because of the lightweight, there may be a tendency for the PVC pipes to be thrown much more than their metal counterparts. This should be discouraged and reasonable care should be taken in handling and storage to prevent damage to the pipes. On no account should pipes be dragged along the ground. Pipes should be given adequate support at all times. These pipes should not be stacked in large piles, specially under warm temperature conditions, as the bottom pipes may be distorted thus giving rise to difficulty in pipe alignment and jointing. For temporary storage in the field, where racks are not provided, care should be taken

that the ground is level, and free from loose stones. Pipes stored thus should not exceed three layers and should be so stacked as to prevent movement. It is also recommended not to store one pipe inside another. It is advisable to follow the practices mentioned as per IS 7634 - Part I.

Laying and Jointing procedure

B. Trench Preparation

The trench bed must be free from any rock projections. The trench bottom where it is rocky and uneven a layer of sand or alluvial earth equal to 1/3 dia of pipe or 100mm whichever is less should be provided under the pipes.

The trench bottom should be carefully examined for the presence of hard objects such as flints, rock, projections or tree roots. In uniform, relatively soft fine grained soils found to be free of such objects and where the trench bottom can readily be brought to an even finish providing a uniform support for the pipes over their lengths, the pipes may normally be laid directly on the trench bottom. In other cases, the trench should be cut correspondingly deeper and the pipes laid on a prepared under-bedding, which may be drawn from the excavated material if suitable.

C. Laying and Jointing

As a rule, trenching should not be carried out too far ahead of pipe laying. The trench should be as narrow as practicable. This may be kept from 0.30m over the outside diameter of pipe and depth may be kept at 1.0 to 1.2m depending upon traffic conditions. Pipe lengths are placed end to end along the trench. The glued spigot an socket jointing technique as mentioned later is adopted. The jointed lengths are then lowered in the trench and when sufficient length has been laid, the trench is filled.

If trucks, lorries, or other heavy traffic will pass across the pipeline, concrete tiles 600 x 600mm of suitable thickness and reinforcement should be laid about 2m above the pipe to distribute the load. If the pipeline crosses a river, the pipe should be buried at least 2m below bed level to protect the pipe.

For bending, the clened pipe is filled with sand and compacted by trapping with wooden stick and pipe ends plugged. The pipe section is heated with flame and the portion bent as required. The bend is then cooled with water, the plug removed, the sand poured out and the pipe (bend) cooled again. Heating in hot air over hot oil bath, hot gas or other heating devices with solvent cement. Threaded joints are also feasible but are not recommended. Jointing of PVC pipes can be made in following ways:

i) Solvent cement
ii) Rubber ring joint
iii) Flanged joint

iv) Threaded joint

For further details on laying & jointing of PVC pipes, reference can be made to IS 4985-1998, IS 7634 - Part 1-3.

Socket and spigot joint is usually preferred for all PVC pipes upto 150mm in dia. The socket length should at least be one and half times the outer dia for sizes upto 100mm dia and equal to the outer dia for larger sizes.

For pipe installation, solvent gluing is preferable to welding. The glued spigot socket connection has greater strength than can ever be achieved by welding. The surfaces to be glued are thoroghly scoured with dry cloth and preferably chamfered to 30o. If the pipes have become heavily contaminated by grease or oil, methylene cement is applied with a brush evenly to the outside surface of the spigot on one pipe and to the inside of the socket on the other. The spigot is then inserted immediately in the socket upto the shoulder and thereafter a quarter (90o) turn is given to evenly distribute the cement over the treated surface. The excess cement which is pushed out of the socket must be removed at once with a clean cloth. Jointing must be carried out in minimum possible time, time of making complete joint not being more than one minute. Joints should not be disturbed for at least 5 minutes. Half strength is attained in 30 minutes and full in 24 hours. Gluing should be avoided in rainy or foggy weather, as the colour of glue will turn cloudy and milky as a result of water contamination.

D. Pre-fabricated Connections

In laying, long lengths of pipe, prefabricated double socketed connections are frequently used to join successive pipe lengths of either the same or one size different. The socket in this case must be formed over a steel mandrel. A short length of pipe is flared at both ends and used as the socket connection. The mandrel used is sized such that the internal dia of the flared socket matches the outer dia of the spigot to be connected. By proper sizing of the two ends of a connector, it is possible to achieve reduction (or expansion) of pipe size across the connector.

E. Standard Threaded Connections

Normally PVC pipes should not be threaded. For the connections of PVC pipes to metal pipes, a piece of a special thick wall PVC connecting tube threaded at one end is used. The other end is connected to the normal PVC pipe by means of a glued spigot and socket joint. Before installation, the condition of the threads should be carefully examined for cracks and impurities.

Glue can be used for making joints leak proof. Yarn and other materials generally used with metal pipe and fittings should not be used. Generally, it is advisable to use PVC as the spigot portion of the joint.

F. Pressure Testing

The method which is commonly in use is filling the pipe with water, taking care to evacuate any entrapped air and slowly raising the system to appropriate test pressure. The field test pressure to be imposed should be not less than the maximum of the following:

a. 1 1/2 times the maximum sustained operating pressure
b. 1 1/2 times the maximum pipeline static pressure
c. Sum of the maximum sustained operating pressure and the maximum surge pressure.
d. Sum of the maximum pipeline static pressure and maximum surge pressure, subject to a maximum equal to the work test pressure for any pipe fitting incorporated.

After the specified test time has elapsed, usually one hour, a measured quantity of water is pumped into the line to bring it to the original test pressure, if there has been loss of pressure during the test. The pipe shall be judged to have passed the test satisfactorily if the quantity of water required to restore the test pressure of 30m for 24 hours does not exceed 1.5 litres per 10mm of nominal bore for a length of 1 Km.

Testing

Water test and air test shall be conducted as stipulated in IS:5329.

Providing & constructing manholes

Manholes of different types and sizes as specified shall be constructed in the sewer line at such places and to such levels and dimensions as shown in the drawings or as directed by the engineer. The size indicate the inside dimensions of the manhole.

Excavation and back filling shall be as per respective specifications.

Manhole shall be built on a bed of brickbat cement concrete 1:4:8 (1 cement : 4 sand : 8 brickbats of 40mm nominal size). The thickness of the bed concrete shall be 150mm unless otherwise specified.

Brick work shall be in cement mortar 1:6 (1 cement : 6 sand). The external joints of the brick masonry shall be finished smooth. The joints of the pipes with the masonry shall be made perfectly leak-proof with cement concrete 1:2:4.

The brick walls of the manholes shall be plastered inside with 12mm thick cement plaster 1:4 (1 cement : 4 sand) finished smooth with a floating coat of neat cement.

Channels and benching shall be in cement concrete 1:2:4 (1 cement : 2 sand : 4 graded stone aggregate).

All manholes deeper than 1.0m shall be provided with CI foot rest. These shall be embedded 20 cm deep with 20x20x10 cm blocks of cement concrete 1:2:4 (1 cement : 2 sand : 4 graded stone aggregate). The block with CI foot rest placed in its centre shall be cast-in-situ along with the masonry and the surface finished with 12mm thick cement plaster 1:4 (1 cement : 4 sand) finished smooth. Foot rests shall be fixed 30cm apart vertically and staggered the wall. The top foot rest shall be 45 cm below the manhole cover. Foot rests shall be painted with coal tar, the portion embedded in cement concrete block painted with thick cement slurry before fixing.

The depth of channels and benching shall be as indicated in the table given below.

Size of drain (mm)	Top of channel at the centre above bed concrete (cm)	Depth of benching at side walls above bed concrete (cm)
100	15	20
150	20	30
200	25	35
250	30	40
300	35	45
350	40	50
400	45	55
450	50	60

CI manhole covers and frames shall conform to IS:1726. The covers and frames shall be cleanly cast and they shall be free from air and sand holes and from cold struts. They shall be neatly dressed and carefully trimmed. All casting shall be free from voids whether due to shrinkage, gas inclusion or other causes. Cover shall have a raised chequerred design on the top surfaces to provide an adequate non slip grip. The cover shall be capable of easy opening and closing. It shall be fitted in the frame in workmanship like manner. The cover shall be gas tight and water tight. Covers and frames shall be coated with a black bituminous paint. It shall not flow when exposed to a temperature of 63 Deg. Cent. and shall not be brittle as to chip off at temperature of 0 Deg.Cent.

Manhole cover and frame shall conform to medium duty 500 mm internal diameter and shall weigh not less than 75kg unless otherwise mentioned in the item description. (Weight of cover 58kg and weight of frame 58kg).

Manholes shall be measured in numbers. The depth of the manhole shall be reckoned from top level of CI cover to the invert levels of channel. The depth shall be measured correct to centimeters.

Sewers of unequal sectional area shall not be jointed at the same invert level in a manhole. The invert of the smaller sewer at its junction with main shall be, at a height at least 2/3 the diameter of the main, above the invert of the main. The branch sewer should deliver sewage in the manhole in the direction of main flow and the junction must be made with care so that flow in the main is not impeded. No drains from house fittings eg. GT, soil pipe etc. exceeding a length of 6m shall be connected unless it is inevitable.

The frame of the manhole cover shall be firmly embedded to correct alignment and levels in plain cement concrete 100mm thick 1:2:4 (1 cement :2 sand :4 graded stone aggregate) on top of the brick masonry. After completion of the work manhole covers shall be smeared by means of thick grease.

Providing & Constructing Soak pit

The earth excavation shall be carrying out to the exact dimensions as shown in the drawing. The soak pit shall be constructed of honey-comb dry brick work of 250 mm thick in cement mortar 1:6, RCC 1:2:4 precast or cast-in-situ slabs 150 mm thick for top cover with reinforcement, CI manhole cover 500 mm dia of 80 kg weight, 150 mm dia SW tee, outlet vent, 75 mm dia CI pipe 2 m high fixed on masonry pedestal with cowl and bituministic painting, refilling, watering, consolidating etc., all complete.

Providing & Constructing Drop connection

In cases where branch sewer enters the manholes of main pipe sewer at a higher level than the main sewer, a drop connection should be provided. Pipes and specials conforming to IS:1729 shall be of the same size as the branch pipe sewer.

For 150 mm and 250 mm main line if the difference in level between the water line (peak flow level and the invert level) of branch line is less than 60 cm a drop connection may be provided within the manhole by giving a suitable ramp. If the difference in level is more than 60 cm the drop should be provided externally.

The excavation shall be done for the drop connection at the place where the branch line meets the manhole. The excavation shall be carried up to the bed concrete of the manhole and to the full width of the branch line excavation and backfilling shall be done as per respective specifications.

At the end of branch sewer line SCI tee shall be fixed to the line which shall be extended through the wall of manhole by a horizontal piece of SCI pipe to form an inspection of cleaning eye. The open end shall be provided with chain and lid. The SCI drop pipe shall be connected to the tee at the top and to the SCI bend at the bottom. The bend shall be extended through the wall of the manhole by a piece of pipe which shall discharge into the channel. Necessary channel shall be made with cement concrete of grade M-150 and finished smooth to connect the main channel. The joint between CI pipe and fittings shall be lead caulked. The joint between SCI tee and SW branch line shall be made with cement mortar 1:1 (1 cement : 1 fine sand) as for emased alround with minimum 15 cm thick concrete 1:5:10 (1 cement : 5 coarse sand : 10 graded stone aggregate 40 mm nominal size) and cured. For encasing the concrete around the drop connection the necessary centering and shuttering shall be provided the holes made in the walls of the manhole shall be made good with brick work in cement mortar 1:5 (1 cement : 5 coarse sand) and plastered with cement mortar 1:3 (1 cement : 3 fine sand) on the inside of the manhole wall. The excavated earth shall be back filled in the trench in level with the original ground level.

TESTING AND ACCEPTANCE

Inspection before Installation

All pipes, fittings are fixtures shall be inspected before delivery at the site to see whether they confirm to accept standards. The pipes shall again be inspected before laying by sounding to disclose cracks. All defective items shall be clearly marked and removed from the site.

Testing and Commissioning

The manholes raised above the subsoil water, water level expected in the monsoon shall similarly be tested for water tightness as for the pipelines.

Testing and Commissioning of all completed work shall be done in accordance with the provisions of the I.S. codes mentioned in the beginning of these specifications

VALVES

General

1. Whenever practicable and except as otherwise shown on the drawings, valve stems shall be installed in a direction suitable for easy operation.

2. Where not otherwise specified on drawings, control valves shall be located and installed so as to provide the following clearance.

Below Valves - 300 mm minimum

Above valve - Sufficient to remove bonnet with wedge.

3. A minimum of 50 mm clearance shall be kept between the surface of insulation and the adjacent surface either insulated or uninsulated. Exceptions shall have the approval of the Engineer-in-Charge.

Cleaning of Valves

Valves will be cleaned before installation. All possible precautions shall be taken to prevent contamination and valves shall be inspected immediately prior to installation. If a valve is found to be contaminated in anyway, it shall be cleaned as follows.

1. Remove all foreign particles by wiping with a clean lintless cloth.
2. Wipe interior of valve with a clean lintless cloth moistened with clean trichloroethylene.

If contamination is excessive:

Suspend the valve in a degreasing tank with hand wheel uppermost. Direct a stream of liquid trichloroethylene into the rim of the valve, through both ends and against all inside surfaces. Flush thoroughly to remove all foreign matter.

Detailed Specification of Valves, Pumps & Motors and Starters

The Contractor should submit four copies of detailed datasheet for all the below mentioned items including electro-mechanical items and get the approval of CIAL before they are ordered. These datasheet should contain specification, quantity proposed to be supplied, details of each component of the item including MOC, time required for delivery, method of testing, reference to IS, copy of IS Certification for the item received by the manufactures, detailed dimensional drawings and literature. The data sheet should contain the signature of the manufacturer and the contractors failing which they will not be considered.

So also once the data sheets are approved by CIAL formal supply orders shall be placed over the manufacturer and the unpriced copy of the supply order shall be submitted to CIAL for reference.

Sluice Valves

As per IS 14846

Pressure rating	:	PN 1
Type	:	Double flanged non rising stem type, SS shaft, CI lined gates, etc.
Operation	:	Provided with cap at top for underground installation and with hand wheel for above ground installation
Stem seals	:	Stuffing box and gland type
Marking	:	ISI marking

Reflux Valves

As per IS 5312/1984

Type	:	Quick action single door type with door sealing and double flanged
Rating	:	P.N. 1
Marking	:	ISI Marking

Air Valves

Type	:	Cast iron screw down type single chambered fitted with brass ferrule to the line with GM isolation valves, etc.
Rating	:	P.N. 1
Marking	:	ISI Marking

Pumps

The design, manufacture and performance of the pumps specified herein shall comply with the latest version of the following codes.

IS:9137	:	Code for Acceptance Test for Centrifugal, Mixed and Axial Pump

The pumps shall be capable of developing the required total head at rated capacity (the design head and discharge should have a margin of 2.5% to allow for deterioration in performance in due course of time) for continuous operation. The pump shall have a stable head curve, i.e. the total head capacity shall be continuously rising towards the shut off. The shut off head shall be at least 10% over the maximum system resistance.

The pumps shall preferably be designed to have the best efficiency at the specified duty point.

The power characteristics shall be non-overloading and preferably flat for flow higher than the best efficiency flow (BEP)

The pump shall be capable of reverse rotation upto 125% rated full speed of the drive motor. The first critical speed shall be away from the operating speed and in no case less than 130% of the rated speed.

5% margin over maximum shaft input power required within the range of operation.

The Contractor shall submit the following drawings for approval.

Performance curve

Technical particulars

Torque-speed curve of pump superimposed on motor corresponding to 80%, 90%, 100% voltage

Test reports and instruction manual

Combined characteristics of two pumps which are working in parallel should be prepared by the manufacturer.

MOTORS

This section deals with supply, installation, testing and commissioning of all types of motors used for pumps, air handling units, compressors, etc. The motor installation, wiring control shall be carried out strictly in accordance with the specifications as detailed as below:

Specifications of Motors

a) The motor shall be of the following design and shall run at all loads without any appreciable noise or hum.
   i) Totally enclosed fan cooled squirrel cage.
   ii) Screen protected drip proof wound squirrel cage motor.
   iii) Enclosure and type of motor shall depend upon duty and usage unless otherwise specified.

b) The winding of motors shall be class 'B' insulation and suitable for local conditions. The insulation of motors shall confirm to IS:325/1978.

c) All motors shall comply with IS:325, IEC-34.1 or BS-2313, IS:2131, IEC-72.1 for foot mounted motors.

d) The motors shall be selected on the basis of ambient temperatures and allowable maximum temperature rise.

e) Motors above 1HP shall be three phase unless otherwise specified.

f) All motors shall be rated for continuous duty as per IS:325. Motor shall be suitable for operation on 415 volts +/- 10% volts, 50 +/- 5% Hz AC supply (or 230 volts 50 Hz 1 phase AC supply.)

g) Motors shall be provided with cable box to receive aluminum conductors XLPE insulated PVC sheathed and armoured cables without additional cost.

h) All motors shall be provided with combination of 'ball and roller bearing'. Suitable grease nipples for re-greasing the bearing shall be provided.

i) All motors shall be suitable for operation under the following conditions of voltage and frequency variation.

   1) Voltage variation +/- 10%

   2) Frequency variation +/- 5%

j) Motors above 25 HP shall be provided with running over current protection. Motors above 100 HP shall be provided with full thermal protection and thermistor detector in the stator winding.

k) The starting current and the type of starter to be used shall be as follows (unless otherwise specified)

l) All the motors should be of high efficient, with efficiency greater than or equal to 85%.

Type of motor	**Starting current**	**Starting method**
a) Sq. cage motor up to 5 HP	600% of full load current	D.O.L.
b) Sq. cage motor above 5 HP		
Up to 40 HP	300% of full load current	Star/Delta
c) Above 40 HP	300% of full load current	Preferably Soft starter

The power needed to be input to the pump is the power to be output by the drive, i.e. at the pump-shaft. Since, most drives are coupled direct to the pump, the power at the pump-shaft denotes the brake power of the drive. All drives are rated only as per their brake power capacity, often quoted in Brake Kilowatts (BKW).

To provide margins over the BKW required at the operating point, so that the overloading would not happen at HWL, the following margins are recommended.

MARGINS TO DECIDE DRIVE RATING

BKW required at the operating point	Multiplying factor to decide drive rating
Upto 1.5	1.5
1.5 to 3.7	1.4
3.7 to 7.5	1.3
7.5 to 15	1.2

15 to 75	1.15
Above 75	1.1

Motor Starters

a) All starter shall conform to IS: 8544-1977 and IEC 947 (-4-1). The starter shall be enclosed in sheet metal enclosure, which would be dust/ vermin proof, etc. All shall be continuous rating and of automatic type only.

b) All starters should have suitable range of voltage and frequency.

c) All starters shall have integral stop/start push button of international code.

d) Contactor shall have number of poles as required for appropriate duty. Contacts could be made of solid silver or silver faced and shall be suitable for at least 40 contacts per hour.

e) In event of power failure, the starter should automatically disconnect.

f) All starters shall be provided with thermal over load relay and single phasing preventer.

g) All starters shall have adjustable timers.

h) Terminal blocks with integral insulating barrier shall be provided for each starter.

i) Extra contact for interlocking purpose shall be provided in the starter.

j) Starter contactors should have sufficient number of auxiliary contacts.

Installation of Motors

a) The motor and drive machine shall be fixed on slide rails to facilitate belt and other adjustments.

b) Vibration isolation arrangement shall be provided.

c) The installation of motor shall be carried out as per IS:5124.

d) The motor with driving equipment shall be mounted on foundation and connected to each other with flexible coupling with guard.

e) All motor shall be wired as per specifications. Earthing of motor frame shall be done with Copper strips or Copper wires as per specification.

f) All motors shall be tested at manufacturer's works as per I.S. standard and test certificates shall be furnished.

g) All motors after installation shall be tested at site for vibrations, heating and electrical insulation resistance.

ANTI TERMITE TREATMENT

The chemicals used for anti termite treatment shall be Chloropyrifos E.C. with a concentration of 1% (by weight) (5 lts. to be mixed with 100 lts. of water).

Method of Treatment

The treatment shall be as per IS specifications vide IS : 6313 part II 1981.

Treatment for Masonry Foundations and Basements

The bottom surface and the side (upto a height of about 300mm) of the excavations made for masonry foundations and basements shall be treated with the chemical at the rate of 5 litres per square metre surface area.

After the masonry foundations and the retaining wall of the basements come up, the backfill in immediate contact with the foundation structure shall be treated at the rate of 7.5 litres per square metre of vertical surface of the sub-structure for each side. If water is used for ramming the earth fill, the chemical treatment shall be carried out after the ramming operation is done by rodding the earth at 150 mm centres close to the wall surface and working the rod backward and forward parallel to the wall surface and spraying the chemical emulsion at the above dosage. After the treatment, the soil should be tampted in place. The earth is usually returned in layers and the treatment shall be carried out in similar stages. The chemical emulsion shall be directed towards the masonry surfaces so that the earth in contact with these surfaces is wall treated with the chemical.

Treatment for RCC Foundations and Basements

The treatment described in the above paras applies essentially to masonry foundations where there are voids in the joints through which termites are able to seek entry into the buildings. Hence the foundations require to be completely enveloped by a chemical barrier. In the case of RCC foundations, the concrete is dense being a (cement : fine aggregates : coarse aggregates, by volume) mix or richer, the termite are unable to penetrate it. It is, therefore, unnecessary to start the treatment from the bottom of excavations. The treatment shall start at a depth of 500mm below the ground level except when such ground level is raised or lowered by filling or cutting after the foundations have been cast. In such case the depth of 500mm shall be determined from the new soil level resulting from the filling or cutting mentioned above, and soil in immediate contact with the vertical surfaces of RCC foundations shall be treated at the rate of 7.5 litres per square metre.

Treatment of Top Surface of Plinth Filling

The top surface of the consolidated earth within plinth walls shall be treated with chemical emulsion at the rate of 5 litres per square meter of the surface before the sand bed or sub-grade is laid. If the filled earth has been well rammed and the surface does not allow the emulsion to see through, holes up to 50 to 75 mm deep at 150mm centres both ways may be made with 12mm diameter mild steel rod on the surface to facilitate saturation of the soil with the chemical emulsion.

Treatment at Junction of the Wall and the Floor

Special care shall be taken to establish continuity of the vertical chemical barrier on inner wall surface from ground level up to the level of the filled earth surface. To achieve this, a small channel 30x30mm shall be made at all the junctions of wall and columns with the floor (before laying the sub-grade) and rod holes made in the channel

upto the ground level 150mm apart and the iron rod moved backward and forward to break up the earth and chemical emulsion poured along the channel at the rate of 7.5 litres per square metre of the vertical wall or column surface so as to soak the soil right to the bottom. The soil should be tamped back into place after this operation.

Treatment of Soil along External Perimeter of Building

After the building is complete, the earth along the external perimeter of the building should be rodded at intervals of 150mm and to a depth of 300mm. The rods should be moved backward and forward parallel to the wall to break up the earth and chemical emulsion poured along the wall at the rate of 7.5 litres per square metres of vertical surfaces. After the treatment, the earth should be tampted back into place. Should the earth outside the building be graded on completion of building, this treatment should be carried out on completion of such grading.

In the event of filling being more than 300mm, the external perimeter treatment shall extend to the full depth of filling up to the ground level so as to ensure continuity of the chemical barrier.

SPECIFICATIONS FOR FITTINGS AND FIXTURES

SCOPE OF WORK:

The work covered under these specifications consist of supplying different types of fittings and fixtures required for doors, windows, ventilators etc. The supply shall be in accordance with the specification, drawings / approved samples. Samples of various fittings and fixtures proposed to be incorporated in the work shall be submitted by the contractor for approval of the Engineer-in-charge before order for bulk supply is placed.

General:

All fittings and fixtures shall conform to relevant IS code and made of brass, anodised aluminium, iron oxidised (M.S.) or as specified. These shall be well made reasonably smooth and free from sharp edges, corners, flaws and other defects. Screw holes shall be counter sunk to suit the heads of the specified screws. All hinges pins shall be of steel for brass hinges and aluminium alloy NR-6 or steel pins for aluminium hinges with nylon washers or as specified. Al riveted heads pertaining to hinge pins shall be well formed. Screws supplied for fittings shall be of the same metal and finish as the fittings. However brass cadmium plated/chromium plated screws shall be supplied with aluminium fittings. Samples of each fixture/ fitting shall be furnished by the contractor for approval of the Engineer-in-Charge. Order for procurement of fittings and fixtures in bulk shall be placed only after approval by the Engineer-in-Charge.

The fittings and fixtures to be incorporated in the work shall be strictly according to the approved sample. Fittings shall be fixed in proper position as shown in the drawing and as directed by the Engineer-in-Charge. These shall be truly vertical or horizontal as the case may be. Screws shall be driven home with a screwdriver and not hammered in. Recess shall be cut to the exact size and depth for the counter sinking of hinges. The

fittings and fixtures shall be fixed in a workman like manner and any damages done either to fittings and fixtures or to the shutter frames etc. should be rectified by the contractor at his own cost.

Fittings shall be of Mild steel, Stainless steel, aluminium, brass or as specified. The fittings shall be well made, smooth, and free from sharp edges and corners, flaws and other defects.

Mild steel fittings shall be bright satin finish black stone enameled or copper oxidized (black finish), nickel chromium plated or as specified.

Brass fittings shall be finished bright satin finish or nickel chromium plated or copper oxidized or as specified.

Aluminium fittings shall be anodised to natural matt finish or dyed anodic coating less than grade AC 10 of IS: 1868

Stainless steel fittings shall be non-magnetic, rust & moisture proof, strong & sturdy. Pin of hinges shall also be of stainless steel.

Butt Hinges:

Brass and aluminium hinges shall be manufactured from the extruded sections and shall be free from cracks and other defects. M.S. butt hinges shall be cranked and manufactured from M.S. sheets. Al butt hinges shall conform to latest I.S. specifications butt hinges shall generally condorm to releval I.S viz IS 1341 (M.S.) IS : 205 (Cast brass & aluminium, IS : 362 (Parliament hinges); IS : 453 sprig hinges, IS : 3818 (Piano hinges) etc. The size of butt hinges shall be taken as the length of the hinge. Width of the hinge shall be measured from the centre line of hinge pin to end of flange.

Parliamentary Hinges:

These shall be manufactured from extruded section for brass and aluminium and from M.S. sheets for iron oxidised and shal be free from cracks and other defects. The size of the parliamentary hinges shall be taken as the width between open flanges, while the depth shall be as specified.

Piano Hinges:

These shall be generally conformed to I.S. 3818 and shall be made of either brass oxidized, aluminium anodized, iron oxidized (M.S.) or as specified. Piano hinges shall be fixed in the entire length of the cupboard shutters in a single piece. No joints shall be allowed.

Tower Bolts:

These shall generally conform to IS 204 (Part II & I). They shall be well made and shall be free from defects.

The tower bolts shall be of the following types:

i) MS semi barrel tower bolt with ms sheet pressed barrel and G.I. bolt or with ms barrel and ms Sheet bolt.
ii) Oxidised brass barrel tower bolt with brass sheet barrel and rolled or drawn brass bolt.
iii) Anodised aluminium tower bolt with barrel and bolt of extruded sections of aluminium alloy.

In case of M.S. tower bolt plates and straps after assembly shall be firmly riveted or spot welded properly.

The knobs of brass tower bolts shall be cast and the bolt fixed into the knob firmly as per I.S. specifications. The tower bolt shall be finished to correct shape and pattern so as to have a smooth action. Wherever specified, aluminium barrel tower bolts shall be manufactured from extruded sections of barrel & bolts.

Knobs shall be properly screwed to the bolt and riveted at the back. The size of the tower bolt shall be taken as the length of barrel without top socket.

Door Latch:

This shall be of MS, cast brass or as specified shall have smooth sliding action. MS Latch shall be copper oxidised (black finish) or as specified. Brass Latch shall be finished bright, CP or oxidised or as specified.

Aldrops:

These shall be oxidized brass or anodized aluminium, iron oxidized or as specified and shall be capable of smooth sliding action and shall be as per relevant I.S. Brass sliding door bolt (aldrop) shall be made from rolled brass generally confirming to IS : 2681. M.S. sliding door bolt shall generally conform to I.S.281.

The hasp shall be of cast brass and screwed to the bolt in a workman like manner. Alternatively the hasp and the bolt may be in one piece. Bolts shall be finished to shape and threaded with worth standard and provided with round brass washers and nuts of square or hexagonal shape. Al components shall be smooth and polished. The leading dimensions of aldrop shall be as the length of the bolt and specified diameter.

Door Handles- Bow/Plate Handles:

These should generally conform to IS : 208. Unless otherwise specified door handles shall be of 100 mm size & windows handles of 75 mm size. These shall be of cast brass of specified size, shape and pattern as approved by the Engineer- in-charge. All edges and corners shall be finished smooth and correct to shape and dimensions.

Brass handles shall be finished bright, chromium plated or oxidized as specified. Anodized aluminium or iron oxidized (m.s.) handles shall be of specified size, shape and

pattern. The size of the handle is taken as the inside grip of the handle. In case of iron oxidized handles, the same shall be manufactured from m.s. sheet pressed into oval section as per I.S.

Mortise Lock & Latch:

This should generally conform to I.S. 2209. Handles shall conform to IS 4992.

Mortise lock with latches and a pair of level handles shall be 6 levers, with zinc alloy pressure die cast/brass or as specified body of approved quality, and shall be right or left handed as specified. The pair of handles shall be either brass chromium plated or anodized aluminium of approved shape and pattern or as specified. It shall be of the best Indian make of approved quality. The size of the lock shall be determined by its length. The lock for single leaf door shall have plain face and that for double leaf door a rebated face. Level handles with springs shall be mounted on plates and shall be of approved quality, anodized aluminium or as specified.

Hydraulic Door Closer:

This shall be generally conform to IS : 3564. Hydraulic door closer shall be of approved quality and make. The operation of the Hydraulic door closer shall be very smooth.

This should be of H.D.-66 for external/main doors and elegant - 63 for all internal doors.

The overall height should not be more than 170 mm. for H.D.-66 and 160 mm. for elegant - 63, base shall be 110 x 60 mm. for H.D.-66 and 100 x 55 mm. for elegant - 63 weighing not less than 4.5 kg. for H.D.-66 and 4 Kg. for elegant - 63. Speed of the Hydraulic door closer shall be adjustable and latch closing also shall be adjustable type. Suspension and lubrication of door closer shall be in perfect line and level.

The contractor shall provide for al the incidentals required for fixing these fixtures and fittings such as cadmium plated screws etc. Fittings and fixtures shall be fixed securely in a workman like manner al as directed by the Engineer-in- charge. Any of the fixtures damaged during the fixing shall be removed and new one fixed in their place and the surface of joinery made good where affected, at his own expense. Mortise plates shall be used over holes where the bolts enter in the wood work. Metal sockets shall be provided to all bolts where the shoot enter brick, stone, concrete etc. The incidental Fixtures like mortise plates, metal sockets, screws etc. shall not be paid for separately.

Mortice Night Latch:

This is a mortice lock having a single spring bolt withdrawn from the outside by using the key and from inside by turning the knob and with an arrangement whereby the lock can be prevented from being opened by its key from outside while the night latch is used from inside the room.

This should generally conform to IS: 3847. It shall be cast or sheet brass, cast or sheet aluminium alloy or mild steel as specified and of approved make. These shall be bright

finished or copper oxidized (black) finish as specified. Normal size of the latch shall be denoted by the length of the face over the body in millimeters.

Floor Door Stopper:

The floor door stopper shall conform to IS: 1823. This shall be made of cast brass of overall size as specified and shall have rubber cushion. The shape and pattern of stopper shall be approved by the Engineer-in-Charge. It shall be of brass finished bright, chromium plated or oxidized or as specified. The size of door stopper shall be determined by the length of its plate. The body of the door stopper shall be cast in one piece. All parts of the door stopper shall be of good workmanship and finish and free from surface and casting defects. Aluminium stopper shall have anodic coating of not less than grade AC-10 of IS 1868.

Mode of measurement:

All the fittings with all the necessary accessories shall be measured in numbers and the rate shall include the cost of all materials including taxes, excise duty, if any, loading, unloading, transporting, cost of screws, bolts and other accessories complete, if the same are not to be paid for separately as per schedule of quantities.

DRY STONE PITCHING

Stones

These shall be clean, hard stones, free from decay and weathering. They shall be in block and hammer dressed on all sides. The size of the pitching stones shall be approximately 22.5 cm in depth and not less than 15 cm. in any other direction.

Supplying and Stacking of Hard Stone (For Stone Pitching)

Hard stone hammer dressed having no side less than 15 cm. with minimum depth of 20 cm

Preparation of surface

The sides and bottom of earth work to be pitched, shall be brought to the required slope and gradient and shall be compacted to a firm and even surface.

Pitching

Pitching shall be of 22.5 depth unless specified otherwise. Profiles shall be put up by means of pegs and strings or by placing stones, at intervals of not more than 15 cm. Stones shall then be laid closely in position in between the profile and firmly embedded with joints staggered and with exposed faces true to line, gradient and in uniform slope throughout. Cross bands of approximately 22.5 cm. width through bond stones equal to the full depth of pitching shall be provided at an interval of approximately 3 metres centre to centre both longitudinally and transversely. The interestices between adjacent

stones shall be filled in with stones of proper size, well driven in with crow bars to ensure tight packing and complete filling of all interstices. Such filling shall be carried on simultaneously with the placing in position of the large stones and shall in no case be permitted to fall behind. Final wedging shall be done with the largest sized chip practicable, each chip being well driven home with a hammer so that no chip is possible of being picked up or removed by hand.

Measurements

The measurements shall be taken in sqm. The area of pitching for drains shall be calculated by multiplying the perimeter (bed width plus side slopes) by the length of the pitching. The length, width and side slope shall be measured correct to a cm.

Rate

The rate shall include the cost of the materials and labour involved in all the operations described above, except pitching stone, if specified, shall be paid for separately

POLYESTER COLOUR COATED GALVALUME PROFILE ROOFING SHEET

Supplying and fixing on purlins polyester coated galvalume profiled sheets 445 mm wide pan and 50 mm depth rib made out of 0.50mm TCT, cold rolled steel of 300 Mpa (min.) yield strength conforming to ASTM A 368 or AS 1595 with hot dip metallic coating of minimum 150gm/sq.m zinc-aluminium alloy coating mass(55% Aluminium, 43% Zinc and 1.5% Silicon) total of both sides as per ASTM A 792 or AS 1397.The colour shall have a total coating thickness of 35 microns of polyester paint system as per AS/NZS-2728:1997 (Category 3) of approved colour, comprising of 20 microns exterior coat on top surface and 5 microns primer coat on both surfaces. Roofing sheets shall be factory cut and supplied in required lengths (of upto 12 m) to suit site conditions & design drawings. Roofing sheets shall be crest fixed to purlins with hot dip galvanized self drilling fastners with integral EPDM washers (one fastener on each crest). Also, fasteners to be provided on side laps. Minimum sheet overlap at end laps shall be 150mm. Penetrations and end laps in sheet shall be sealed by using proper sealant. Profiled HDPE fillers shall be provided wherever required to close voids between cappings and troughs of the sheet to provide a weather tight exterior. Rate shall include cost and conveyance of all materials, lead, lift, scaffolding, labour charges, etc. complete at all level and as directed by Engineer-in-charge.

Rate shall include cost and conveyance of all materials, lead, lift, scaffolding, labour charges, etc. complete at all level and as directed by Engineer-in-charge.

SCOPE

The scope of work is to provide profile roofing sheet on areas shown on the drawings. The work shall include the design, engineering, manufacture, supply, and installation of the roofing system on the roof of buildings as described in the schedule and shown on the drawings, including all fixings, flashings, finishing, gutters, down-spouts etc.

INSTALLATION

General

The contractor shall supply and install the roofing, gutters, down-spouts, as specified and as approved by the Engineer-in-charge with uniform and consistent product quality. All panels shall be factory formed and all materials shall be delivered to site with manufacturer's name or trade mark, grade of coating, length, thickness and item identification with respect to shop drawings legibly marked on top of each item or shown on a label fixed to each bundle. The material may also be marked with a standard mark where applicable.

Accessories

Cappings, Flashings and Trims:

All exposed flashing edges must have a 10mm hem and a 45° drip. All closure flashings shall be hemmed.

Material

In substrate, and finish as external sheeting.

Fixing

Cappings etc. shall be screwed to external sheeting at crests with hex head self drilling stitching fasteners at max. 500mm centers along the length of the capping/flashing. All fasteners must be installed at 90° to the material being fastened. If this is not done, the screw must be withdrawn and the hole closed with an oversize screw and EPDM washer. All longitudinal joints in cappings and flashings shall be overlapped a minimum of 50mm and sealed with a continuous run of sealant. Backing plates shall be provided in 16G steel wherever required at end conditions for proper support of cappings and closures.

Fixing Accessories

External fasteners

Fasteners for roof sheeting clips and self drilling stitching fasteners for cappings / flashings shall be mechanically galvanised carbon steel self drilling self tapping fasteners.

Sealants

All laps in flashing and capping shall be sealed with a non-hardening neutral cure silicon sealant.

Wind Loading

Permissible span versus load data table should be furnished with the offer. Load testing as per IS-801, BS and AS shall have to be arranged by the sheeting manufacturer to demonstrate compliance with load/span data conforming to spans and loads (as per IS-875 part 3) at manufacturer's plant.

External roof sheeting shall be capable of withstanding wind uplift and point loads as per IS codes for purlin support spacing as shown on the drawings.

Drawings and Literature

After award of work the agency shall be required to do the detailed design and engineering of the roof system. He shall prepare detailed shop drawings, bill of materials, and submit the same for approval of the Engineer-in-charge before commencement of work. He shall also prepare and furnish technical manuals and erection guides for the project.

Testing and Acceptance Criteria

Materials

Prior to delivery, manufacturers test certificates shall be supplied for all materials certifying grade and conformity with applicable standards. At owner's discretion on number and frequency, random samples drawn from material at site will be got tested at an independent test house/laboratory approved by the owner. The materials shall be tested for and demonstrate to meet performance criteria and requirements listed elsewhere.

Load testing

Profiles shall be load tested to justify load/span data furnished by manufacturer in accordance with IS-801/AS/BS standards. Profiles must exhibit deflection less than L/150 under live load and point load (as per IS 875) and less than L/100 under wind load.

Measurement

The length and breadth shall be measured correct to a cm. for providing & fixing Polyester coated Galvalume steel Roofing System and the area calculated in sqm correct to two places of decimal (Payment for flashing, gutter & down take pipe & ridge will be measured separately).

Rates

The rate for Providing & fixing Polyester coated Galvalume steel Roofing System shall include cost of all material and labour involved in all the operations described above i.e. basic, excise and custom duty if any, freight, taxes or any other tax complete.

Providing and fixing ridge/ valley capping in required width (minimum 500mm) with plain galvalume colour coated sheet made out of 0.5mm TCT, minimum 300 MPa cold rolled steel with hot dip metallic coating of Aluminium Zinc alloy (Galvalume) 150 gms/sqm, total of both sides, AZ 150 as per ASTM A 792 or AS1397, with polyester colour coating including cost and conveyance of all materials, scaffolding, lead, lift, labour charges, etc. complete at all levels as directed by Engineer-in-charge

Technical details same as Item No.1 above but for ridge/ valley capping etc. all complete and in straight lengths.

Measurement

The length shall be measured correct to a cm. for providing & fixing Polyester coated Galvalume steel Roofing System for ridge/ valley capping and the length shall be measured in running meter correct to two places of decimal

LIST OF APPROVED MAKES

1.	Cement	Malabar, Ultra Tech, Ramco, ACC, Dalmia, Ambuja, JSW, etc. or any other approved brand
2.	Steel (TMT)	Tata, Vizag, SAIL, TISCO, IISCO, RINL, Jindal Steel and Power Ltd, JSW Steel Ltd or equivalent as approved
3.	Structural Steel	Tata, Vizag, SAIL, Jindal Steel & Power Ltd, or equivalent as approved
4.	Welding rode	ESAB, Advani, Best Arc, Solar or equivalent as approved
5.	Vitrified tile	Simpolo, Nitco, Kajaria, RAK Ceramics India, or equivalent as approved
6.	Ceramic Tiles	Johnson, Kajaria, Bell, Regency, Nitco, RAK, or equivalent as approved
7.	Cement Concrete floor tiles	Eurocon Tiles, Ultra or equivalent as approved
8.	Tile Adhesive /Epoxy Grout	Ardex Endura (India) Pvt. Ltd, MYK Laticrete, Kerakoll India Pvt. Ltd, Eurobuild Construction Chemicals & Coating, BASF, Pidilite or equivalent as approved
9.	Self leveling compound/ Bonding primer	Ardex Endura (India) Pvt. Ltd, MYK Laticrete, Pidilite Industries Limited, Kerakoll India Pvt. Ltd, Fosroc Chemical India, Sika India, BASF, Eurobuild Construction Chemicals & Coating or equivalent as approved
10.	Concrete Paver blocks	Hycon, Amcon, Sirex, Stabil Blocks or equivalent as approved
11.	Metallic Hardener	BASF, Fosroc, Sika, Kironite, Eurobuild Construction Chemicals & Coating or equivalent as approved.
12.	Integrated water proofing	India water proofing, Sika, Pidilite, BASF, Fosroc, Euro Build or equivalent
13.	Water proofing compound	Roffe, Fosroc, Sika, Pidilite, BASF, Eurobuild Construction Chemicals & Coating or equivalent as approved
14.	Paint & Primer, Distemper	ICI (Akzonobel), Berger, Asian or equivalent as approved
15.	Wall Putty	Birla White, NCL, Altek, Berger, ICI or equivalent as approved

16.	Primer	Altek, Berger, Asian, ICI, Jotun or equivalent as approved
17.	Synthetic Enamel Paints & Primer	ICI (Akzonobel), Asian Paints, Berger, Jotun or equivalent as approved
18.	Premium Exterior Paint	ICI (Akzonobel), Asian Paints, Berger, Jotun or equivalent as approved
19.	PVC Water stopper	Fosroc, Sika, Euro Build, BASF or equivalent as approved.
20.	Door hardwares	Dorma, Ozone Overseas Pvt. Ltd., Dorset Kaba Security Systems Pvt. Ltd., ASSA ABLOY India Pvt. Ltd., Hafele, Godrej, Everite Agencies, Dyna, Door king, Hettich India Pvt. Ltd or equivalent as approved
21.	Mortice locks, locks, latch	Godrej, Dorset, Dorma, Hafele or equivalent as approved
22.	Auto Closer Hinges	Blum, Hafele, Ozone Overseas Pvt. Ltd or equivalent as approved
23.	Rolling Shutter	Popular, Gandhi Automation Pvt. Ltd, Falcon, Jacob Engineering or equivalent as approved
24.	Ball bearings	SKF, FAG, KOYO or equivalent as approved
25.	Steel doors /windows	Shakthi hormann, Indigatech, Ozone Overseas Pvt. Ltd, NCL Alltek & Seccolor Ltd, Kutty Flush Doors & Furniture Co. Pvt. Ltd ,or equivalent as approved
26.	Galvalume Roofing sheet	Tata Blue Scope, Interarch, LLOYD Insulations or equivalent as approved
27.	Plain float glass /lacquered glass & Mirror	Saint Gobain, Asahi, Pilkington ,Modiguard or equivalent as approved
28.	Pre Laminated Ply	Greenlam, Merino Industries Ltd, Kitply, or equivalent as approved
29.	Particle board	Jacksons (Exterior grade) or equivalent as approved
30.	Silicon Sealant	Dow corning, GE Silicon, Euro Build or equivalent as approved
31.	Epoxy chemical for anchoring grout	HILTI India Pvt. Ltd, Fisher, Euro Build, Pidilite or equivalent as approved
32.	Chemical /Mechanical Anchor Fasteners	HILTI, Fisher, MKT (Germany), Black and Decker India Ltd. or equivalent as approved.
33.	Plasticisers, Non shrink grout	Fosroc, BASF, Fairmate, Eurobuild Construction Chemicals & Coating or equivalent as approved

34.	Admixtures	FOSROC, Polygon, STP, BASF, CERACHEM, Don Chemicals, Sika, Eurobuild Construction Chemicals & Coating or equivalent as approved
35.	High tensile Bolts /Screws	Hilti, Fischer, Unbrako ,TVS, Euro Build or equivalent as approved
36.	EPDM Gaskets	Osaka Rubber Private Limited, AMEE Rubber Industries Pvt. Ltd or equivalent as approved
37.	Aluminum Structural Members	Hindalco Industries Ltd, Jindal Aluminium Ltd, Indalco Alloys or equivalent as approved.
38.	Aluminium louvers:	Hunterdouglas, Euro Build or equivalent as approved
39.	Stainless steel	Salem Steel, Hindalco, Jindal or equivalent as approved
40.	Expansion Joint Filler	Sil Fex of Supreme Industries Ltd. or equivalent as approved
41.	Floor hardeners	Fosroc, Roffe, Fairmate, STP Ltd, Apurva India Ltd, Eurobuild Construction Chemicals & Coating, Pidilite or equivalent as approved
42.	Expansion Anchors	HILTI, Fischer, MKT (Germany) or equivalent as approved
43.	Bolts /Screws (SS 316)	HILTI, Fischer, MKT (Germany), S.S. Fasteners Pvt Ltd or equivalent as approved
44.	Glass Hardwares	Dorma , Ozone, Hafele, Kinlong or equivalent as approved
45.	Sanitary Fixtures	Hindware, Cera, Parryware or equivalent as approved
46.	Plumbing Fittings	Jaquar, Nova, Essco, Gem or equivalent as approved
47.	FRP Manhole cover	HP Strongdrain or equivalent as approved
48.	MS/GI Pipe & specials	Tata, Zenith, Jindal or equivalent as approved
49.	UPVC ASTM, PVC, CPVC Pipe specials	Astral, Supreme, Finolex or equivalent as approved
50.	Valve	Zoloto, Leader or equivalent
51.	Polyethylene Storage Tank	Syntex, Hycount or equivalent as approved
52.	Weather proof coating	Fosroc, BASF, Sika, Euro build, Pidilite or equivalent as approved
53.	CP Grating for Floor Trap	Chilly, Sanjay Chilly or equivalent
54.	Pipe Supporting System	Hi Tech, Astral or equivalent

TECHNICAL SPECIFICATIONS- ELECTRICAL WORKS

Details of Tender

The tender specifications consists of 20 sub heads as shown below:

1. General
2. Double Pole Structures and Allied Equipments
3. Insulators
4. Cross Arms
5. Conductors.
6. Stays and Staying Arrangements.
7. Guarding wires
8. Transformer
9. Diesel Generating set and ancillaries
10. LT Panel Boards
11. Sandwich bus duct
12. Cabling
13. Wiring System
14. Light Fixtures and Fans
15. MCB and MCB distribution Boards.
16. Earthing
17. Lightning protection
18. Installation
19. Measurement
20. Approved makes of Equipment and Materials

1 General

The bidder should note that the specifications furnished in the tender is of general nature only and it is the responsibility of the bidder to design, supply, install and commission the equipment and services required for the satisfactory performance of the installation. All the items of equipment required for the safe and satisfactory operation of the installation shall be supplied and installed by the bidder.

The intent of this specification is to define the requirements for the design, manufacture, shop testing, supply, installation, testing and commissioning of the electrical system like DP structures, Insulators, Overhead line conductors, unitised substation, DG set, LT panel boards, street lighting, Power & control cables,earthing etc. Requirement shall be as specified in schedule of requirements / approved drawing of the Accepting Authority or as per the battery limits fixed by the Client/Consultant. The bidder shall furnish complete details of the equipment with all necessary drawings.

2 Double Pole Structure And Allied Equipments:-

When a HT overhead line deviated by more than 10^0,double pole, triple pole or four pole structure may be erected at the point of deviation depending upon the angle of deviation.Normall a double [pole strcucture

should suffice for an angle of deviation upto about 30^0. A triple structure upto an angle of deviation up to 60^0 and 4 pole structure beyond that angle of deviation.Multipole structures may be used for dead ends, mouning transformers, AB switches etc.

Multipole structures sahll comprise of the same type of poles s sused for the overheadlines unless other wise specified.

All poles shall be numbered as directed by the engineer-in –charge.

Double pole structure shall be fabricated from hot dip galvanized structural steel. The mild steel shall be conforming to IS-2062-1992 grade 'A' modified up to date or its equivalent international standard for steel materials, documents for which shall be made available during the inspection.

The material used in the construction of steel shall be suitable for use under following weather conditions.

1. Temperature variation : 0 Deg C to 50 Deg C
2. Relative humidity : 20% to 100%
3. Altitude : 0 to 1000 Mtrs

Minimum size of the RSJ pole shall be 175x85mm and channels shall be 75x50mm.
A set of double channel iron cross-arms of the same length duly clamped to the poles through bolts and nuts shall be provided for each structure. The two channel iron lengths of the double channel iron cross arm shall be stepped to each other by flat iron strips to prevent bulging of the cross arms during stringing of the lines. These flat iron strips shall be bolted to the two channel iron lengths adjacent to each strain/disc insulator fittings supported by the cross arm.

Cross Bracings

Minimum clearence between suppliers and consumers DP structurs shall be 3mtr.If it is 5mtr or less they should be braced together at the top and middle A set of cross bracings shall be fabricated and fixing of 65mm x 65mm x 6mm angle iron.

Jumpers

Jumpers shall be neat and as far as possible symmetrical to the run of conductors. These shall be so made as to prevent occurance of fault due to wind or birds.

Jumpers used shall normally be of the same material as the line conductor and they shall be of adequate current carrying capacity. If the material of the jumper wire is different from that of the line conductor, suitable bimetallic clamps should be used. If copper to aluminium bimetallic

clamps is to be used, it should be ensured that the aluminium conductor is situated above the copper conductor so that no copper contaminated water comes in contact with aluminium.

Minimum size of the 11kV jumper shall be number '0' SWG copper.Maximum length of unsupported 11kV jumper shall be 2.44 mtr for solid conductors and 1.5 m for stranded conductors

Earth Wire

The size of the continuous earth wire shall not be less than 4mm (8SWG) GI.

Lightning Arresters

Lightning arresters shall be provided between AB switch and Drop Out fuse

The lightning arrester system shall conform to Rule 92 of the Indian Electricity Rules.

Clearances

1 The spacing of conductors depends on their disposition and is determined by the line voltage, sag, span, swing amplitude and type of structure.

2 The minimum clearance of the lowest conductor above ground level across a street, along a street and elsewhere for different voltage systems shall be in accordance with Rule 77 of the Indian Electricity Rules.

3 The minimum clearance of overhead lines and service lines for different voltage systems from buildings shall be in accordance with Rule 79 and 80 of the Indian Electricity Rules.

4 The minimum clearance between guard wire and LV/MV line shall be 10cm and between guard wire and 11KV line shall be 30cm.

5 The minimum clearance between ground and 11kVbushings of the transformer shall be 2.6mtr.

6 AB switch operating handle shall be fixed at 1mtr to 1.25 mtr from ground level.

7 Phase to phase and Phase to earth clearance at AB switch shall be 915mm and 610mm respectively.

8 Minimum clearences between 11kV up and down jumpers shall be 75cm.

9 Fencing with height of 1.8 mtr shall be provided keeping a minimum clearence of 1.5 mtr from the transformer body

10 Maximum length of unsupported 11kVjumper shall be 2.44 mtr for solid conductors and 1.5 m for stranded conductors

11 KV 400 Amp 3 Pole AB Switch

This specification covers manufacturing testing and supply of 11kV 200 AMPS 50 HZ Air Break switches for out door installation in horizontal configuration. The switches are suitable for opeartion under off load conditions and are intended for use on Distribution Sub – stations and tapping sectionalizing points of 11 KV lines.

Description of the Matierals

The 11 KV A.B switch sets shall confirm to the following parameters:

a.	Number of poles	:	3
b.	Nominal system voltage	:	11KV
c.	Highest system voltage	:	12 KV
d.	Rated frequency	:	50 Hz
e.	System earthing	:	effectively earthed
f.	Rated nominal current	:	400 amps
g.	Altitude of installation	:	Not exceeding 1000M

Standards

The AB Switch Set shall conform to the following standards:

a. IS-9920 (Part-I to V)
b. IS-2544/1973 (for porcelain post insulators)
c. IS-2633, (for galvanization of ferrous parts) or its latest amendments if any.

Insulator make

11KV post insulators complete with post and cap duly cemented to be used in the AB switch set confirming to IS-2544/1973.

Climatic Condition

The A.B switch set shalll be suitable for operation under the following climatic conditions.

a.	Maximum ambient air temperature	$45^{o}C$
b.	Maximum daily average air temperature	$35^{O}C$
c.	Maximum yearly average ambient air temperature	$30^{o}C$
d.	Maximum temperature attainably bya body	
e.	Exposed to the sun	$50^{o}C$

f.	Minimum ambient air temperature	$0^{O}C$
g.	Maximum relative humidity	100%
h.	Minimum number of rainy days per annum	70
i.	Average number of rainy days per annum	120
j.	Average annual rain fall	150 cm
k.	Number of months of tropical monsoon conditions	4
l.	Maximum wind pressure	260 kg/mm^2
m.	Degree of exposure to atmospheric pollution	normally
n.	Atmosphere	polluted

Technical Details

The 11 KV A.B Switch Set shall be the gang operated rotating single air break type having 3 post insulators per phase. The operating mechanism shall be suitable for manual operation from the ground level and shall be so designed that all the three phases shall open or close simultaneously. The switches shall be robust in construction, easy in operation and shall be protected against over travel or staining that might adversely affect any of its parts. Phase coupling rod, operation rod with intermediate guide braided with flexible electrolytic copper, tail piece of required current carrying capacity and operation mechanism with `ON' & `OFF' positions shall be provided. The operation rod shall be medium gauge of minimum 32 mm diameter nominal bore G.I pipe. The phase coupling rod for gang operation shall be medium gauge 25 mm minimum dia nominal bore G.I. pipe. The operating down rod shall be coupled to the spindle (minimum dia – 32 mm) for gang operation through another suitable bearing by two numbers 10 mm dia stainless steel bolts with double nuts. All the bearings shall be provided with grease nipple. All metal (ferrous) parts shall be galvanized anf polished. The pipe shall be galvanized in accordance with IS-4736/1968. The post insulators should be fixed with the base channel using galvanized nuts and bolts.

Tests & Test Certificate

Type Test: Certificate for the following type tests conducted on a prototype set of A.B.Switch in a NABL approved test house/CPRI shall have to be submitted.

Dielectric Test (impulse and one minute power frequency withstand voltage test).

- ✓ Temperature rise test (for contacts and terminals)
- ✓ Short Time current and peak withstand current test
- ✓ Mainly active load breaking capacity test
- ✓ Transformer off-load breaking capacity test
- ✓ Line charging breaking test

- ✓ Cable charging breaking test
- ✓ Operation and mechanical endurance test
- ✓ Mechanical strength test for post insulator, as per IS-2444/1937 shall be furnished.
- ✓ Test for galvanization of metal (ferrous) parts.

Earthing

In the case of RCC/PCC poles, all insulator pins, cross arms, stays, and other metallic fittings shall be bonded to the continuous earth wire.

The continuous earth wire shall be connected to earth.Where a continuous earth wire cannot be provided, every pole should be earthed and all the metal parts are to be bonded, with the concurrence of the Engineer-in-charge.

The lead from the earth electrode shall be suitably protected by a 15mm dia GI pipe upto a height of 3m from the ground level and shall be bonded to the continuous earth wire.

The protection pipe and the earth lead shall be suitably clamped to the support.

Galvanising

General

The nuts, bolts, washers and other fixing accessories used shall be galvanised. Poles, cross arms and structural steel supports shall also be galvanised if so specified in schedule of items of work. Structural steel items, which are not galvanised, shall be applied with two coats of paint over suitable primer. The requirements on painting is specified elsewhere.

Bolts and nuts shall be galvanised as per IS: 1367 Part 13-1983.

Galvanising shall be done after fabrication works is completed. The galvanise surface shall consisit of continuous and thick coating of zinc firmly adhering to the surface of steel. The finished surface shall be clean and smooth and shall be free from defects like discoloured patches, bare spots, unevenness of coating, which loosely attaches to the steel, globules. Spikily deposits, blistered surface, flaking or peeling off, etc. The presence of any of these defects, noticed on visual inspection shall render the material liable for rejection. Before galvanising, the steel shall be thoroughly cleaned of all paints, grease, dust, scale, acid or alkali, galvanising, the steel shall be thorougly cleaned of all paints, grease, dust, scale, acid or alkali or such other foreign matters as are likely to interfere with the galvanising process or with the quality and durability of the zinc coating. The picling of members shall be carried out satisfactorily. The extend of galvanising will be checked on typical sample members. Galvanising kettle shall contain only the approved spelter and no addition

of other metal shall be made. The kettle shall be reasonably free from dross and the steel shall be dipped in such a manner that it will nto come in contact with the dross which may have collected at the bottom of the kettle. On removal from the kettle, the galvanised material may have excess spelter removed from tis surface by 'bumping'. The process known as 'wiping' or scraping shall not be used. The temderature of kettle shall be controlled by means of accurate pyrometers within close limits.

Tests

All galvanised articles withstand test as per IS: 2633-1968 or any other equivalent standard.

The contractor shall submit zinc spelter manufacturers certificate on chemcial analysis of spelter before galvanising is started.

No spelter shall be used without prior approval of manufactuuer's certificate by the purchaser.

The contractor in the works shall perform routine samle tests on galvanised steel complying with the relevant specification adopted.

The purchaser reserves the right to pickup samples at random and have them independently tested for galvanising in any standard Laboratory. If the test is unsatisfacotry, the whole of the members galvanised in that shift will be rejected.

3. Insulators

Insulators for overhead lines are fixed to the crossarms and provide insulation to power conductors from the ground. Power conductors are either tied or clamped to the insulators. Insulators are made of glazed porcelain or toughend glass. The dielectric strength of porcelain is around 15-17kV and that of tough glass 35kV for a thickness of one-tenth of an inch. The porcelain should be sound, free from defects, thoroughly vitrified and smoothly glazed. The glaze should be unaffected by sudden changes in temperature and by atmospheric pollution (ozone, acids, alkali, dust and water vapours, etc.). The isulation should be designed to avoid excessive concentration of electrical stresses in any section or across leakage surfaces. Tough glass insulators are used for voltages above 33kV.

Insulators of voltages upto 1000 volts are manufactured as per ISI 445-1965 and above 3300 volts are manufacutred as per IS731-1963. The principle types of insulators are.

1. Pin insulators
2. Shackle insulators
3. Disc insulators
4. Strain insulators
5. Post insulators
6. Post top insulators

Pin insulators

These are used wherever overhead power wires are run in a straight line formation. The insulators have special wire grooves such that the power conductors can be tied to the insulation by copper or aluminium binding wire. In order to fix insulators to crossarms, special metal pins are fabricatied from good commercial grade melleable iron or open hearth or electric furnace steel with hot dip galvanizing coating. The castings should be free from blow holes, cracks or other defects. Different sizes of pin insulators with suitable metal pins are available for different voltage grades, ie, for 230V, or 400V or 600V, 11000V or 22000V.

i) Pin insulator fittings

The insulator fittings shall comply with IS:731

(a) The pins shall be of single piece MS without joints, obtained by the process of forging.

(b) The pins, nuts and washers, shall be galvanized.

(c) The threads of nuts and tapped holes shall be cut before galvanizing and shall be well oiled or greased.

Shackle insulators

Shackle insulators are used in medium voltages upto 660V overhead power distribution lines for dead ending or tee off. These are also used for supporting bare wires laid in vertical formation on poles. These are clamped to the crossarms by two metal straps of proper size with bolts nuts and washers or one metal “U” clamp with bots, nuts and washers.

Disc Insulators

Disc insulators are used on high voltage, suspension lines of 11kV or above, Disc insulators are provided with ball and socket or tongue and clevis melleable fittings. The hardware should be drop froged from high carbon steel and hot-dip galvanised. The disc insulators with these metal parts canbe assembled to from string-assemblies- to suit any voltage. Single 11kV voltage grade disc insulators are used for 11kV dead end lines or 11kV tee-off lines. The disc insulator is provided with suspension clamp to support the conductors.

Strain insulators

Procelain strain insulators are used for insulating stay wires, guard wires, etc., where it is not proposed to earth them.

Post insulators

These are used for supporting busbars in switchgear and in the manufacture of HV switchgear.

Post top insulators

These are used in the manufacture of 11kV airbreak switches and 11kV horn gap switches.

4 Cross arms

Generally, for overhead line power distribution crossarms are used. Insulators are fixed to the crossarms and bare conductor line are strung and tied to the insulators.

Standard clearnaces for high tension corssarms

Voltage line (kV)	Vertical Clearance between top and bottom conductors (m)	Length of "V" cross-arm (m)
11	0.75	0.9
22	0.90	1.0

The cross arms for overhead lines shall be made of hot dip galvanised angle iron of size not less than 50mmx50mmx6mm thick for LV lines and hot dip galvanised 65mmx65mmx6mm thick for 11kV line. However, if higher size members are shown in the attached drawings, the size indicated in the drawing shall be final.

The length of cross arms shall be suitable for accommodating the required number of insulators with the required spacing of conductors.

The minimum clearance for LV lines in horizontal configuration shall be as follows:

Minimum clearance between live wires		
On either side of a support	-	45cm
Minimum clearance between live wires		
On the same side of the support	-	30cm
Minimum clearance between the centres of Insulator		
Pin hole and end of cross arm	-	5 cm

In the case of HV lines the conductors shall be erected in such a way that they form an equilateral pattern of side minimum 1m.

Where guard wire cradle is specified to be fixed directly to the cross arms (without additional brackets) the length of cross arm supporting the cradle shall be such that the required minimum clearances shall not be affected.

The cross arm shall have holes for fixing on to the poles and for taking insulator pins, wire guards etc. as required. A minimum clearance of 50mm for LV/MV lines and 100mm for HV lines shall be left from the center of insulator pin hole to the end of the cross arm.

The cross arms shall be complete with pole clamps made of steel flat size not less than 50mm x6mm with necessary bolts, nuts and washers (galvanised). The mounting of the cross arm shall be rigid with no chance of sidewise movement. Brackets made of steel angles may be welded to the main members of the pole for mounting to cross arms. The size of such brackets shall be same as that of the cross arm. Double bolting shall be used as wherever required. Where cradle guards are provided it shall be supported to the cross arms with bolts , nuts and washers.

5. Conductors

Types of conductors

The conductors shall be aluminium conductors galvanised steel reinforced, conformig to IS:398 (Part-2)-1976.3

Choice of conductors

The conductors shall be in accordance with relevant Indian Standards.

All conductors shall have a breaking strength of not less than 350kg.

Lengths and variation in length

Unless otherwise specified, the conducotr shall be supplied in the manufactureres usual producation lengths with the permitted vatiations of + 5%.

Tests and Test Crtificates

Tests as per IS shall be conducted and test certificate shall be furnished.

6 Stays and Staying Arrangement

Overhead line supports at angles and terminal points shoul be well stayed with stay wire, rod, etyc. The angle between pole and wire should be about 45^0 and in no case should be less than 30^0. if the site conditions are such that angle of more than 30^0 between the pole and the stay wire cannot be obtained, special stays such as foto stay, flying stay or strutas may be used.

Stay Sets

i) Locations and Number

the stays shall be provided on the side of the pole opposite to the likely direction of pull from the line i.e, opposite to where the shackle/disc insulators are provided. In the case of deviations from straight runs, the stays shall be provided opposite to the side of deviation and preferably on the bisection of the angle fo devition. The number of stay sets to be provided shall be decided depending on the likely pull to be expereinced on the pole dictaged by th length of span, number and size of conductors etc.

ii) Construction

a. A stay set shall consist of stay rod, anchor plate, bow tightener or turnbuckel, thimbles, stay wire, strian insulators and stay clamp.
b. All components fo the stay set assembly shall be of steel and galvanised.
c. The stay rod shall be not less than 1.80m long and 19mm dia. The stay rod shall be with stay clamp incase turnbuckle is used instead of bow tightener. The tesile stength of these rods shall not be less than 42kgf/sq.mm
d. The anchor plate shall be not less than 450mm x450mmx7mm thick.
e. The stay wirshall be 7/4mm dia. and generally conform to grade 2 of IS: 2141-197
f. The strain insulator shall conform to IS: 5300-1969

ii) Settng stays

The inclination of stay relative to the ground is to be roughly determined before making the hole for excavation.

This enables the position of stay hole to be fixed so that when the stay is set, the stay rod will have the correct inclination and will comeout of the ground at correct distance fromt eh pole. The stay rod should be secruely fixed to te gorund by means of a suitable anchor.

iv) Struts

Struts may be used if specified in schedule of items of work.

7 Guarding Wires

Guarding is provided for the safely of life, installations and of communicaiton circuits. It is necessary to provide gurading for 11kV lines at road crossings, canal crossigns, railway corssings, overhead LT or telephone lines. For LT lines, the guarding is provided throughout. When guard wires are provided, if a phase conductor snaps and falls on the guard wire, it becomes earthed before falling to the ground. The main fuses will bow or circuit breakers will trip, thus protecting plant and machinery.

Types of guarding.

There are two types of guarding

i) Cradle guard: In 11kV line,s when the conductors are in horizontal or delta fromation, cardle guard is provided.

ii) Box or cage guard: Cage guard is provided on LT lines with vertical formation.

Propterties of steel galvanised wires

Steel galvanised wires used in guard wires and earthign, have the following propoerteis:

Resistivitiy at 20^0 C	: 13.5 Ohm cm^3
Constant mass temperature coefficent of resistnace at 20^0 C	: 0.004
Coefficient of linear expansion per ^{0} C	: 11.5x 10^{-6}
Density at 20^0 C	: 7.78 gm/ cm^3
Ultimate tensile stress	: 1.36 kg/ cm^2
Final modulus of elasticity	: 0.2 tons/ cm^2

Anti-climbing devices

Necessary arrangement for preventing unauthorised persons from ascending any of the support carrying HV lines without the ladder or special appliances shall be made. Unless otherwise specified, barbed wire conforming to IS:278-1987 having 4 point barbs, spaced 75mm+ 12mm apart tied firmly commencing from a height of 1.5m and upto a height of 2.5m or as directed by the Engineer-in-Charge.

8 11kV/0.433kV 3 PHASE TRANSFORMER

8.1 APPLICABLE CODES AND STANDARDS

The latest revisions of the following Codes and Standards listed shall be applicable for the equipment/material covered in this.

- **IS-2026-PART 1-4**: Power Transformers
- **IS-335-1993:** New Insulating Oils.
- **IS-10028-PART 1-3:** Code of practice for selection, installation and maintenance of transformers.
- **IS 6792 – 1992:** Method of determination of electric strength of insulating oil.

- **IS6262 – 1971:** Method of test for PF and dielectric constant of electrical insulating liquids.

8.2 DESIGN AND CONSTRUCTION REQUIREMENTS

8.2.1 General:

Transformers shall be suitable for indoor usage, three phase, having two separate mineral oil immersed copper windings in mild steel tanks. It should be suitable for base mounting with HV and LV bushings inside cable boxes.

8.2.3 Ratings:

All ratings of transformers shall be designed for single output voltage of 415/240V.

Transformer rated kVA shall be calculated on the following assumptions:

- Constant flux regulation
- Continuous steady load
- Design temperature of 40ºC
- 55ºC average winding temperature rise and 50ºC top oil temperature rise limits above ambient
- Maximum winding hot spot temperature of 98ºC

Guaranteed Values:

No-load and Load losses mentioned in the specification shall be treated as guaranteed values. Any increase in these values at the time of testing shall not be accepted.

Emergency Loading:

After thermal equilibrium has been reached at 75% of rated load, the transformer shall be capable of sustaining the overload conditions listed in the following table without the transformer winding hot spot temperature exceeding 140ºC:

Load Percent of rating (%)	Minimum duration in minutes at ambient temperatures of	
	30 ºC	40ºC
133	240	155
150	98	65

The supplier shall submit calculations that these requirements are met.

Cooling:

Cooling shall be by natural circulation of oil internal to the transformer and external air i.e. ONAN.

Transformer Oil:

Transformer shall be supplied initially filled of Class 1 uninhibited transformer mineral oil complying with IS-335-1993: New Insulating Oils.

Tap Changer:

Transformer shall be fitted with an Off-load tap changer having the following taps on HV side:

+5% TO -10% in steps of 2.5%

Vector group

The transformer shall be connected delta-star in accordance with vector group reference Dyn11.

Impedance Voltage:

The impedance voltage at normal tap shall be not less than 4%.

Temperature Rise:

At the rated power the transformer shall comply with the following Maximum temperature rises:

Top oil : 50°C Max.

Winding : 55°C Max.

Hot Spot : 98°C Max.

Avg. temp. due to short circuit: 250°C Max.

Noise Level:

The noise level emitted by a transformer, at full load, shall not exceed 48 dB. Measurements shall be in accordance with IEC Standard 60551.

Short Circuit Level:

The short circuit current that transformer should withstand for two seconds is 17 times full load current.

Degree of protection

Transformer and its cable boxes shall be designed to have adequate protection level suitable for indoor usage.

Tanks

Tank fabrication:

- Transformer tanks shall be made of mild steel of minimum thickness 3mm. The transformer shall be leak proof. The criterion of leakage shall be discoloration by oil of white wash applied externally to the suspected part at an oil temperature 90ºC or other method approved by consultant.
- Al l pipes, radiators, fins, that are welded to the tank shall be externally welded.
- The tank shall withstand an internal pressure of 0.3kg/mm² without permanent deformation.
- Top cover shall be bolted type and fitted with neoprene cork seals suitable for temperatures as specified in this specification. The cover shall be in such a design and construction as to prevent the ingress of moisture and accumulation of rainwater.

Tank corrosion protection and finish:

- The transformer tank and its accessories shall be adequately protected against corrosion.
- The outer surface of the transformer tank shall be thoroughly cleaned and painted with one coat of zinc chromate based primary paint and two coats of durable oil and weather resisting paint. Finish color shall be light gray. All bolts and fixing shall be suitably protected against corrosion.

HV bushings:

Bushings shall generally comply with the requirements of IEC Standard 60137. The HV bushings shall be labeled U, V, W by using indelible black color paint. Phase identification by adhesive stickers is not acceptable.

LV bushings/terminals:

The low voltage leads of all transformers shall be brought out of the transformer tank on the opposite side of the HV bushings inside a cable box. The bushings shall be suitable for trunked bus bars.

Supplementary Fittings

Temperature Indicator:

A removable dial type thermometer shall be fitted in a thermometer pocket on the transformer for oil temperature reading with a range 0-120ºC. The indicator shall be visible from ground level. Winding temperature indicator with alarm and trip shall be provided for the transformer.

Oil Level Indicator:

An oil level indicator shall be MOG type fitted to the same side of the transformer as the tap change control handle. The indicator shall be visible from ground level.

Lifting Lugs:

Lift lugs shall be permanently attached and arranged on the tank to provide a distributed balanced lift in a vertical direction for the completely assembled transformer and shall be designed to provide a safety factor of 3 (assuming that the transformer is filled with oil). The safety factor is the ratio of the ultimate stress of the material used to the working stress. The working stress is the maximum combined stress developed in the lifting provision by the static load of the completely assembled transformer including oil.

Tank Earthing:

Two stainless steel M10 studs with nut and washer shall be provided diagonally opposite on the tank for pole mounted transformer, for pad mounted it shall be at the HV side of the transformer to facilitate tank earthing. If the base assembly is detachable then the earthing facilities shall be located on the tank wall. Suitable precautions shall also be taken to avoid corrosion attack on earthing facility.

Oil Drain Facility

Facility for oil draining and filling shall be provided. The drainpipe size shall be one inch with opening valve and sealing plug, provided at a position to drain oil fully. The filling facility size shall be minimum 25mm size with sealing plug.

Over pressure device

Auto resetting type pressure relief valve shall be provided with trip contacts.

Rollers:

Bi-directional rollers having 12.5cm minimum diameter shall be fitted to facilitate site installation. Rollers should have a locking facility to secure the transformer in its position.

Oil conservator:

Oil conservator with oil filling hole, cover and drain valve shall be provided. The conservator shall be provided with de hydrating silica gel breather with transparent body. Magnetic oil level gauge shall be provided on the conservator tank to indicate oil level inside the conservator tank.

Name Plate:

Each transformer shall be fitted with a rating plate of stainless steel material, fitted in a visible position, showing the information listed below. Etching, engraving or stamping shall legibly mark entries on the plate.

Manufacturer's name	-
Manufacturer's serial number	-
Year of manufacture	-
Specification	- IS 2026
Number of phases	- 3
Rated power	-630 kVA
Rated frequency	– 50 Hz
Rated voltages(HV/LV)	– 11kV /433V
Connections symbol (Vector Group)	- Dyn11
Type of cooling	- Air cooled

Winding connection

a) HT	:	Delta
b) LT	:	Star

Terminal arrangement

a) HT	:	Suitable for connecting HT cable
b) LT	:	Cable box for LT
Neutral terminals	:	Two, one brought out for earthing
Body earthing terminals	:	Two

8.3 TESTING

Routine Tests:

Routine tests shall be carried out on the transformer, and shall be free of charge. The manufacturer shall carry out the tests in accordance with IS 2026 and a test certificate should be provided along with transformer. The results of the tests shall be recorded on a routine test certificate, and two copies of this shall be sent to Consultant immediately after the tests.

The following routine tests shall be carried out:

- Measurement of winding resistance.
- Voltage ratio measurement and check of polarity or vector group symbol at all tap positions. Bushing positions must have permanent markings at this stage of production.
- Measurement of impedance voltage.
- Measurement of load loss.
- Measurement of no-load loss and no-load current.
- Induced over voltage withstand test.
- Separate source voltage withstands tests on HV and LV windings.
- Oil leakage test.

Type Tests:

The following Type tests shall be carried out on a transformer of similar capacity as per relevant IS at an independent testing laboratory and be witnessed by representative acceptable to Consultant.

- Test of temperature rise
- Impulse voltage withstand tests

8.4 INSPECTION:

The Consultant/Client may wish to witness tests or to visit factory during manufacture of any or all items covered in this specification. Accordingly the supplier shall give advance notice to the Consultant/Client of the manufacturing and test schedule.

PARTICULAR SPECIFICATION OF TRANSFORMER

Scope of Manufacturing and Supply

Technical Specification:

Type of Transformer	:	Industrial Distribution
Type of Cooling	:	Air cooled
Rated Voltage in KVA	:	**--- kVA**
High Voltage Rating	:	11 kV
Low Voltage Rating	:	433V
Winding Material	:	TPC Copper with 99.9% Purity.
Vector Group	:	Dyn 11
Type of Installation	:	Indoor
Insulation Class	:	Class A
Lamination	:	Laser scribed core
Rated Frequency/Phase	:	50Hz / 3 Phase
Connection of HV / LV	:	Delta / Star
Tapings	:	+5 % to -10% in the step of 2.5%
Temperature Rise /winding	:	50˚ C /55˚ C above ambient Oil
Ref . Stand.	:	IS 2026

No load loss, Load loss , Impedance shall be as per IS.

Terminals

HV Terminal	:	Cable Box
LV Terminal	:	Cable Box
Tap Circuit	:	OFF Circuit Tap Change

INSTALLATION , TESTING AND COMMISSIONING

Transformer shall be installed in accordance with specified code of practice and as directed by Engineer-in -Charge

All routine and other tests prescribed in IS 2026 shall be carried out for the transformer at site.

In addition all checks and tests as per the Manufacturer's drawings/manuals, relevant code of installation shall be carried out by the Contractor as part of the installation work.

Before erection of transformer, the level of rails on foundation shall be checked and minor corrections if necessary shall be carried out.

After completely assembling, installation, the transformer shall be cleaned and touch up paint supplied by the manufacturer applied wherever necessary. Enclosure bolts shall be checked for proper tightness.

The Contractor shall provide wedges/clamps to rigidly station the transformer on rails. The cables/conduits between all the accessories mounted on the transformer and the transformer marshalling kiosk should be laid and terminate by the Contractor.

9 Diesel Generating Sets & Ancillaries

Scope

The scope of these specifications covers the supply, installation, testing and commissioning of 1 number of 160 kVA prime rated, 415 volts, 3ph, 4 wire diesel alternator set as specified and given in Bill of Quantity and sigle line diagram. The synchronous speed of the set shall not be more than 1500 RPM.

Set shall be with acoustic enclosure and shall have a common bed plate mounted and complete in all respect including the ancillary equipment such as batteries, auxiliary lube oil pumps, filters, exhaust piping stack with proper supports as per pollution control board norms, oil storage tank etc. including piping required for interconnection between the set and the diesel tank which are mounted separately. The set shall be mounted in a sound proof enclosure.

Rating of the diesel alternator shall be based on the operation of the set when equipped with all necessary operating accessories. The complete set shall be capable of producing specified output continuously at the climatic conditions mentioned below.

Climatic condition

Ambient temperature $40^{o}C$

Altitude 8 M above mean sea level

Design of the equipment should take these conditions into account. The equipment shall be given tropical and anticorrosion treatment.

Diesel Engine

a) Construction

Engine shall be of robust construction suitable for continuous operation. Bearing housings shall be sealed against ingress of dirt and loss of lubrication. The diesel engine shall be four stroke, multi-cylinder type but not less than four cylinders.

The engine should have over load capacity of 10% for 1 hour in any 12 continuous hours operation. The engine rating shall be higher than alternator.

b) Material

The selection of suitable material shall be the responsibility of the contractor in accordance with accepted practices. Full details of the material of construction for major components shall be included in the offer.

c) Dynamic characteristics

An analysis be made of engine, couplings and driver/driven unit to ensure that complete installation starts, operates and stops free of vibrations and oscillations as per normal industrial standards. The Contractor shall provide calculations, etc. as evidence to support that such as analysis has been made.

d) Filters

The following filters shall be used:

i) Air - Paper type air filters for direct mounting on the engine air manifold or as specified by the engine manufacturer.

ii) Fuel - Duplex fuel oil filters or as specified by the engine manufacturer.

iii) Lubricating oil - Simplex lube oil filters or as specified by the engine manufacturer.

e) Flywheel

Flywheels shall be designed and manufactured to meet cyclic variation levels.

f) Priming pump

Contractor should provide pump for priming the engine bearings and for emptying sump.

g) Governor

Governor should be Electronic type. Governor should maintain the speed within 1/8 cycles minimum, of 50 cycles from no load to full load generator output. The frequency at any constant load, including no-load, shall remain within a steady state band width of rated frequency. The governor shall not permit frequency modulation to exceed one cycle per second.

h) Fuel System

Fuel system shall have gravity feed to engine driven fuel pump and a replaceable element fuel filter conveniently located for servicing.

Contractor shall provide fuel oil tank of specified capacity with supports, guage and connecting piping upto fuel oil pump suction header. The fuel tank should be of floor mounted type fabricated out of 3mm thick MS sheet steel painted and with standard accessories like fuel level indicator, fuel inlet and outlet air vent, drain plug inlet arrangement for direct filling and set of braided fuel hoses.

i) Lubricating oil

All lubricating points of the engine shall be connected to pressure oil system. The system shall be so designed that when the engine starts after prolonged shutdown, lubrication failure does not occur. Oil drippings from lubricating points shall have connections to the oil sump and get recirculated. Full flow strainer shall be fitted with level gauges for visual observation. Contractor shall provide motor driven lube oil pump if required to keep the bearings primed. Its power consumption to be indicated. The frequency and duration of the pump operation to be specified.

j) Starting System

Engine shall be started by 24V D.C. starting motor engaging on the toothed ring of the flywheel.

k) Ladders and Platforms

Necessary platforms and railings shall be provided by the contractor around the engine if required.

l) Installation and Silencer

The foundation drawing of the D.G. Set shall be provided by the Contractor, and it is the responsibility of the contractor to provide the Accepting Authority with all drawings, design calculations, etc. well in advance as per the manufacturer's specifications and meeting statutary standards and requirements. Contractor shall provide skid mounting with common base plate and all mounting structure, shims, etc., for the diesel alternator set. Contractor has to mount the engine with alternator on the base plate and align and assemble the set. Suitable anti-vibration mountings as approved for the complete set shall be provided. Coupling (both halves) with guards shall be provided. Contractor shall provide CPCB/Electrical Inspectorate approved Thermal insulated exhaust piping with Aluminium cladding for each set and there should be hood on top of the exhaust pipe and the work should be as per electrical inspectorate rules and pollution Control specification. The stack and stack fundation shall be provide as pollution Control specification.

Exhaust stack height:

In order to dispose exhaust above building height, minimum exhaust stack height

should be as follows:-

(a) For DG set up to 1000KVA :-
$H = h + 0.2\times$ sqrt (KVA)
Where H = height of exhaust stack
h = height of building

m) Insulation of the exhaust pipe shall be carried out as follows

i) Surface shall be thoroughly cleaned with wire brush and rendered free from all foreign matter and grease.

ii) 75 mm thick insulation fixed tightly to the surfaces butting all joints and tightened with lacing wire. (Type of insulation to be got approved by the Engineer-in-charge).

iii) Insulation to be wrapped with aluminium sheet 26 guage and joints overlapped and sealed with adhesive tape and in addition fixed with cadmium coated steel screws.

iv) Instrumentation & Controls

Instrumentation shall be housed in the control panel of the DG set.

Following instruments shall be provided :

i) Cooling water/ coolant temp. indicator (deg.C)
ii) Lubricating oil temperature indicator (deg.C)
iii) Lubricating oil pressure guage (psig).
iv) Tachometer
v) Engine run hour and RPM meter
vi) Engine over speed indicator (alarm & light)
vii) Cooling water/ coolant temperature high (alarm & light)
viii Low lube oil pressure (alarm & light)
ix) Engine start – stop control switch with keys
x) Battery voltage indicator

Multifunction Electronic/ digital meters indicating the above parameters shall also be acceptable.

v) Controls

Following protective devices and equipment shall be provided for the engine protection

vi) Electronic overspeed governor and shutdown device, visual and audible alarms and associated devices shall be provided to stop the engine in the event of any of these faults

a) Low lubricating oil pressure.
b) Excessive cooling water/ coolant temperature.
c) Overspeed.

Alternator

a) Standards

Alternator shall be in accordance with the relevant Bureau of Indian Standards prevailing on date (IS 4722) with upto date ammendements.

b) Type

The machine will be of rotating field stationery armature type, brushless, self-excited, and self regulated air cooled with IP classification 21. The excitation supply shall be obtained from a shaft mounted exciter, an A.C. generator, supplying the field winding through shaft mounted rectifier from the alternator terminals.

c) Technical data for the Alternator shall be as indicated below:-

- Prime Rated KVA (at site conditions)- 160 kVA
- Power factor - 0.8 (LAG)
- Duty - Prime duty
- Rated rpm - 1500
- Voltage - 415 KV
- Number of poles - 4
- Rated Frequency - 50 Hz
- Over speed - 20 % for 2 minutes
- Over load duration - 1 hr in every 12 hours
- Over load capacity - 10%
- Insulation class - F/H
- Enclosure - IP 54
- No. Of bearings - 2
- Excitation - Brush less.
- Type of AVR - Static
- Connection - Star
- Termination box - IP 55

d) Performance

The voltage regulation from no load to rated full load shall be within a band +1 to -1% of rated voltage. Steady state voltage modulation shall not exceed one cycle per second. For any addition of load upto and including 90% of rated load, the voltage dip shall not exceed 10% of rated voltage.

The voltage shall recover to and remain in the steady band in not more than 1.5 seconds. The frequency regulation from no load to rated load shall be in accordance with that defined by the engine governor performance. For any addition of load upto 90% of rated load, the frequency shall recover to the steady state frequency band within 5 seconds. (the prime mover shall have an overload capacity of 110% for one hour in 12 hours operation).

e) Enclosure

Alternator stator enclosure shall preferably be totally enclosed fan cooled (IP 21). However, if this is not feasible, a screen protected drip proof (SPDP) enclosure may be accepted, provided special treatment is given to winding, such as double impregnation of windings. The stator frame shall be either of cast iron or of fabricated steel construction.

f) Terminal Boxes

The main terminal box for alternator output terminals shall be suited for termination and connection of aluminium conductor armoured cable. A control terminal box shall be provided on the base frame. All wirings from electrical/ instrumentation equipment or devices on the engine alternator shall be brought upto this terminal box from where external wiring to other equipment shall be carried out. The terminal box should be suitable for termination of sufficent run 3.5C 400 Sq.mm 1.1kV grade XLPE, cables.

g) Earth Terminals

Two number 12 mm dia earth terminals to be provided on opposite sides of the alternator, complete with all hardware, including plain and spring washer for secure, vibration-proof connections; all hardware to be galvanised or plated and passivated.

h) Voltage Regulations

Contractor shall submit in his quotation the momentary voltage dips and period required for voltage to recover its normal value corresponding to loading performance of the set.

i) Winding

The alternator winding shall be of Copper and render them non-hygroscopic and resistant to acidic/alkaline vapours. Class ‘F or H’ insulation shall be used for stator and rotor winding.

j) Space Heaters

Anti-condensation space heaters shall be provided to maintain winding temperature 5 Deg. above ambient temperature. The heaters shall be suitable for operation on 240 V, 1 Phase, 50 Hz., A.C. Supply, Heater terminals shall be brought out to a separate

terminal box. A caution name plate 'Caution Live Terminals - Isolate Supply Elsewhere Before Disconnecting' shall be affixed on the terminal box. The space heaters shall be of metal encased and low surface temperature type.

k) Base Frame

Engine and Alternator shall be coupled and mounted on a sturdy, fabricated, welded construction; chanel iron base frame with coupling guard and antivibration pads.

Generator Control Panel (GCP)

An GCP with manual switch (for automatic and manual operation) suitable for AMF and synchronized operation with suitably rated switch gear, starters, ACB's(for local protection/isolation of output of alternator), MPCBs, thermal over load relays, contactors, timers, control wiring etc.as required shall be supplied by the tenderer for power connection to DG set accessories like fuel pump, priming pump, space heaters etc. Suitable timers for periodic starting and stopping of pre-lube oil pump shall be incorporated in the controls of the same (timer adjustable from 1 minute to 10 minutes at an interval of 6 hours during the idle period of the DG set). The GCP shall be fabricated as per Kerala State Electrical Inspectorate Standards. The tenderer shall obtain approval for GCP drawings from Engineer-in-Charge prior to GCP fabrication. The installation of GCP is under the scope of this contract . The GCP shall be fuse less type using only MCCBs and MPCBs only. All protection relays as per Kerala State Electrical inspectorate shall be provided in the panel.

The Generator Communications Module

The Genset Communications Module (GCM) shall be provide an interface for a Generator to the Network. The GCM shall be provided with local or remote monitoring and control of the Generator. The GCM shall include start, stop, and emergency stop or reset a fault of the Generator.

GCM shall be capable to provide following real time data.

- Voltage (3-phase)
- Engine speed
- Current (3-phase)
- Engine temperature (L & R)
- Genset status
- Percent load
- Oil pressure
- Power factor
- Oil temperature
- Frequency
- Battery voltage

- Fault status
- Energy
- GCM shall be capable to provide following Annunciation.
- Paralleling
- Emergency stop
- Low battery voltage
- Low AC voltage
- Pre-high engine temp
- Under frequency
- Overcurrent
- Short circuit
- Overspeed
- Reverse power
- Fail to start
- Overspeed
- Loss of field
- Low coolant level
- Fail to synchronize
- Overload

AMF Operation

Operation of DG sets shall be monitored and controlled by an AMF relay panel. In case of mains failure, this relay shall control auto changeover from mains to DG Sets supply and interlocking of ACBs

Tools & Tackles

A set of tools and tackles required for maintenance shall be supplied with DG set free of cost as part of equipment. This shall include box spanner, double end spanners & feeler gauge. A set of commissioning and operating instructions shall also be provided with DG set.

Inspection & Testing

The DG set shall be subjected to all Routine Tests including operation test for demonstrating full load and over load performance as per relevant IEC/ State Electrical Inspectorate standards.

Lead Acid 24 V D.C. Battery

a) General

The battery cells and charging equipment will be housed in separate units. The battery shall be of Lead acid type in accordance with IS 1652 ‘Specifications for Stationary cells and batteries lead acid type’.

b) Construction

Batteries shall be of lead acid, sealed maintanance free type, indoor, The battery shall be sealed and complete with intercell connectors, acid level indicating floats, filter vent plugs, etc. The Batteries should be mounted on suitable metal stand having undergone anticorrossive coating.

c) Capacity

The battery Ampere hour rating shall suit the required duty. The discharge rate shall take into account the maximum load imposed during starting of engine, together with steady load as indicating lamps, relays, etc. Battery capacity shall be suitable for meeting the needs of starting system (as three attempt starting), as well as the requirements of control panel, indications and auxiliaries such as priming pump as applicable etc. The scope shall cover all cabling, terminals, including initial charging etc. The system shall be capable of starting the DG set within 20-30 sec., even in winter condition with an ambient temperature down to 00C.

Battery Charger

a) General

The battery charging equipment (transformer rectifier unit) are provided to charge the 24 V battery required for Diesel Engine starting. **A separate (additional) battery charger suitable for charging the battery using external 230V AC supply is also supplied along with each DG set.**

b) Operation

i) The battery will normally be in parallel with a constant voltage float (trickle) charger of adequate capacity to meet the continuous loads and to keep battery in fully charged capacity under all the conditions of system variations.

ii) A saparate boost charge shall be provided for initial charging and re-charging the batteries when they are in ‘run-down’ condition. a selector switch for selecting ‘float charge’, ‘boost-charge’ shall also be provided on panel.

iii) Protection against over charging of batteries should be provided in the Battery charger

c) Accessories

The following instruments shall be mounted on the charging panel :

i) Voltmeter with protective HRC fuses
ii) Ammeter

Contactors, Relays, Auxiliary Relays, Timers etc

Control Panel shall be equipped with contactors, relays, auxiliary relays and timers etc.

Manual operation of the Generating Set

The Control Panel, though catering to the auto-start and other functions described above, shall facilitate, whenever necessary, manual start, stop and test run of the generating set.

Contractor has to mount the engine with alternator on the base plate and align and assemble the set. Suitable anti-vibration mountings as approved for the complete set shall be provided. Coupling (both halves) with guards shall be provided. Contractor shall provide as CPCB/Electrical Inspectorate approved Thermal Insulated exhaust piping for DG sets. The acoustic should be designed to reduce the noise level to around 70 dB measured 1m from DG set Acoustic enclosure. There should be hood on top of the exhaust pipe and the work should be as per pollution Control board and other statutory authorities specification.

All accessories like cooling system, fuel line, exhaust line, ACBs, Interconnecting piping, supports, control wiring cable etc. should be done by the contractor as per standards.

All checks and tests as per the Manufacturer's drawings/manuals, relevant code of installation shall be carried out by the Contractor as part of the installation work.

9 LT Panel Boards

General:

The switch boards are to be factory built or to fabricated by a firm preferably having CPRI test certificate for short circuit rating and IP classification.

Statutory Requirement:

Switch Distribution Boards are to be manufactured/ assembled as per the latest BIS Specifications,IP 42 classification for indoor and IP 54 for out door, Indian Electricity Rules, including special requirements of State Electrical Inspectorate and the detailed specifications mentioned. The panel board shall be floor mounted, free standing type suitable for indoor installation in dust and vermin proof construction.

Housing Details:

The panel board shall be fabricated out of 14 SWG CRCA sheet steel and shall consist of free standing front and back openable panels arranged to form a continuous line-up of uniform height. Cold rolled sheets shall be used for doors and front covers. Front doors shall be concealed hinged type and bus bars and cable alleys covers shall be bolted type. The switch board shall be totally enclosed, dust, weather and vermin proof Gaskets of durable material shall be provided for doors and other openings. Suitable hooks shall be provided for lifting the boards. These hooks when removed shall not leave any opening in the board. All hardware shall be corrosion resistant. All joints and connections shall be made by galvanised zinc passivated or cadmium plated high tensile strength steel bolts, nuts and washers secured against loosening.

The switch board shall be in cubicle design (each feeder components are housed in individual cubicle) and fully compartmentalised. Suitable cable and busbar alleys as well as separate metering and relaying compartments shall be provided. All components of the switch board shall be approachable from front. The maximum and minimum operating handle/push button height of any feeder shall not be more than 1800mm or less than 400 mm with reference to panel bottom. Supporting arrangement for dressing of power and control cables in cable alleys also shall be provided.

Painting:

All metal sheets shall undergo 7 tank metal treatment, thorough derusting-rinsing-degreasing-rinsing- phosphating-rinsing and then passivation. All metal surfaces shall be thoroughly cleaned and degreased to remove all scales, rust, grease and dirt. Fabricated structures shall be pickled and treated to remove any trace of acid. The under-surface shall be prepared by applying a coat of phosphate paint and a coat of yellow zinc chromate primer. The undersurface shall be made free from all imperfections before undertaking the final coat.

After preparation of the under surface, the panel shall be spray painted with final two coats of approved enamel paint. Contractor shall obtain details of approved paint from the Engineer-in-charge before final painting.

The finished panels shall be dried in dust free atmosphere. Panel finish shall be free from imperfections like pin holes, orange peels, run-off paint, etc.

All unpainted steel parts shall be cadmium plated or suitably treated to prevent rust, corrosion, etc.

Name Plates:

Name plates for all incoming and outgoing feeders shall be provided on doors for each compartment. Name plates shall be fixed by screws only and not by adhesives. Special danger plates shall be provided as per requirement.

Inside the panels, stickers should be provided for all components giving identification no. as per detailed wiring diagram.

Busbar sizing connection and supports:

The busbars shall be made from high conductivity electrolytic grade aluminium alloy conforming to IS 5082. The busbars and supports shall be capable of withstanding the rated and short circuit current as per the single line diagram/ feeder details. Minimum size of main power bus bars shall be 200 Amps. rating. Maximum current density permissible for aluminium bus bars shall be 0.8 Amps/Sq.mm. An earthing busbar of minimum 150 sq.mm section copper shall be provided outside panel at bottom throughout the length of the panel.

The busbars shall be provided with heat shrinkable PVC insulating sleeve. Supports for busbars shall be made of suitable size cast resin ribbed insulators and these should be adequate in number so as to avoid any sag in the busbars. (Hylam supports may not be used)

Minimum clearance between phase to phase shall be 32mm and that between phase to neutral/ earth shall be 26 mm.

Power Connection:

a) For power interconnections within the panel board

Rigid Aluminium conductor, with PVC insulation, of adequate cross section i.e., current carrying capacity not less than the outgoing fuse rating shall be used. Cable lugs/ sockets of suitable size and type shall be used for all interconnections.

For incoming and outgoing feeders of the switch boards, aluminium conductor cable will be used and hence the panel has to be designed for receiving these and wherever required cable boxes shall be provided in panel by removable gland plates and shall be provided on top/bottom of panel, for cable entries.

To prevent accidental contacts, all interconnecting cables/ busbars and all terminals also shall be shrouded.

Standard colour code of red, yellow and blue for phases and black for Neutral to be followed for all busbars/conductors.

b) Auxiliary wiring and Terminals

Wiring for all controls, protection, metering, signaling, etc. inside the switchboard shall be done with 650 volts grey colour PVC insulated copper conductors. Minimum size of these conductors shall be 2.5 sq.mm. Control wiring to components fixed on doors shall be flexible type.

The complete panel would be sub-divided into different sections and each section shall have its own control circuit with fuse and indication.

All control wiring should be provided with necessary cable sockets/ lugs at both ends. Conductors shall be terminated using compression type lugs. Each termination shall be identified at both the ends by PVC ferrules.

The identification termination numbers should match with those on the drawings.

Component of switch boards

The panel shall be provided with MCCBs, SDFUs, Isolators, meters and instruments etc. of size, capacity as specified in schedule of requirements.

Moulded case Circuit Breakers

General

Moulded case circuit breakers (MCCBs) shall be incorporated wherever required and shall be of current limiting type and preferably double break. MCCBs shall confirm to IS 13947-1/IEC 947-1 for general rules and IS 13947-2/IEC 947-2 for circuit breakers in all respects. MCCB shall be suitable for single phase 240V or three phase 415 V, 50Hz, AC and shall have a rated insulation voltage of 750 V AC. All the breakers shall have tropicalisation as a standard feature. MCCBs rated from 250A and above shall be of plug in type.

Construction:

The MCCB case & cover shall be made of high strength heat resistant and flame retardant thermosetting insulating material.

The operating handle shall be quick make, quick break trip free type. The operating handle shall have suitable 'ON','OFF','TRIPPED' indicators.

In order to ensure suitability for isolation complying with IS13947-2/IEC947-2, the operating mechanism shall be designed such that the toggle or handle can only be in 'OFF' position.
Three phase MCCBs shall have a common operating handle for simultaneous operation and tripping of all the three phases.

Rating & Breaking Capacity:

The rating of the circuit breaker shall be as per the drawings and schedule of quantities.

The MCCB shall have minimum Service Breaking Capacity (Ics) equal to Ultimate Breaking capacity (Icu).

The Service S/c Breaking Capacity (Ics) in kA for different ratings at 415V AC, 50Hz, 0.2 p.f shall preferably be as follows:

25kA for ratings upto 100A
35KA for ratings above 100A and upto 250A
50KA for ratings above 250A and upto 630A.

Protection:

Unless specified all breakers upto 125A shall have thermal-magnetic trip unit with adjustable overload protection from 80% to 100% of rated current (Ir) and adjustable short circuit protection from 3 to 6 times of Nominal Current (In).

The MCCBs ratings above 125A shall be microprocessor based fitted with electronic trip unit. The overload setting adjustable from 40% to 100% of the nominal current(In). The short circuit protection should be adjustable from 1.5 to 8 times the rated current(Ir) with tripping time fixed. The Instantaneous Short Circuit protection to be fixed,without any time delay at 12 times the nominal current(In).

The Earth fault protection , if specified in schedule, shall have adjustable sensitivity with adjustable time delay settings.

The MCCBs shall be possible to fully co-ordinate the over-load & short-circuit tripping of the circuit breakers with the upstream and downstream circuit breakers to provide Total Discrimination.

There should be no line load restriction for MCCBs

Accessories:

MCCBs shall be provided with the following accessories,

Shunt trip, if specified in the BOQ
Extended terminals.
Rotary operating handle

Interlocking:

MCCBs shall be provided with the following interlocking devices for interlocking the door of the switchboard.

Handle interlock to prevent unnecessary manipulations of the breaker.
Door interlock to prevent door being opened when breaker is in ON or OFF position
Door-interlock defeat to open the door even if the breaker is in ON position.
Front operated rotary handle should have OFF-position pad-locking facility.
Testing:
Test certificate
Original Test certificate of the MCCB as per IS13947-2/IEC947-2 shall be provided.

Measuring instruments

These shall be of square pattern having approximate dimensions 144mmx144mm, flush mounting type in the case of main LT panel and 96x96 mm in sub switch boards. Necessary auxiliary instruments like CTs, etc. are also included in the scope of supply.

All AC meters shall be of moving iron type having class 1.0 accuracy.

Voltmeter shall be suitable for direct line connection. Voltmeters shall be connected through fuses only.

All voltmeters and ammeters shall be provided with selector switches.

Ammeters shall be CT operated.

Current Transformers (CTs)

CTs shall be cast resin insulated type. Primary and secondary terminals shall be marked indelibly. CTs shall preferably be mounted on stationery parts. CT rating and ratios shall be as per feeder ratings. These shall be capable of withstanding momentary short circuit and symmetrical short circuit current for 1 second. Neutral side of CTs shall be earthed. Protection CTs shall have low reactance, accuracy class “PS” and an accuracy limit factor greater than “10”. Instrument CTs shall be of accuracy class “1.0” and accuracy limit factor less than “5.0”.

Indicating Lamps

Type	:	Panel mounting LED type (Immune to electromagnetic interference and over voltage.
Standards applicable	:	IEC 947-5-1
Diameter	:	22mm
Operating voltage	:	230V AC
Current consumption	:	15 mA
Colour of lamps	:	as per standards

Connection

Connections to the busbars shall be made by drilling holes. However, no holes shall be left in the busbars. The bolts & nuts used for connections to busbars shall be of Aluminium alloy of tinned forged brass. For tapping of connections from busbars suitable size PVC insulated copper conductor (minimum size 4.0 Sq.mm) shall be used with suitable size and type of crimped lugs/cable sockets. For connection of feeder above 63 Amps only busbar links with PVC tapes/heat shrinkable PVC shall be used. Suitable size cable boxes shall be provided for incoming/outgoing cables. For all outgoing cables, cable alleys of suitable sizes in sides and tops, as required for proper cable connections/laying inside the panel, shall be provided. Switch board shall be suitable for Aluminium conductor PVC insulated incoming and outgoing cables. Removable gland plates shall be provided for cable entries.

Earthing

Two independent earthing points shall be provided outside the panel near bottom and these shall be inter-connected with Cu earthing busbars of size 25 x 6 mm. All earthing points inside the distribution board shall be interconnected to these earthing points with suitable size copper conductor.

Name plates

Switch board/distribution board shall be provided with danger plate and name plates for all incoming and outgoing feeders. These name plates shall be of PVC (black colour base & white letters engraved) screwed to panel. PVC identification ferrule numbers shall be used for all internal wiring.

Approvals

The drawing showing general arrangements and detailed wiring diagram for the Panels shall be submitted to the Engineer-in-charge for approval, prior to manufacture and the same shall be got inspected, prior to despatch to project site. The complete switch board and its component shall conform to Indian Electricity Rules & Relevant BIS. Prior approval is required from Electrical Inspector and shall be obtained by contractor and changes if desired by Electrical Inspector, shall be carried out by the contractor.

Bus Bar Chambers

Construction

Enclosure

i) Bus bar chamber shall be fabricated with MS angles for frame work and covered all rounds with sheet steel of thickness not less than 2 mm (14 gauge) in a box form. Front covers of the busbar chambers shall be detachable and cover(s) on the remaining sides may or may not be

detachable as may be specified. The covers shall be fitted with dust excluding gasket, secured with sufficient number of cadmium plated iron screws to ensure that the covers are dust tight. Suitable openings shall be provided for cable/conduit entries as required. Busbar chambers for busbar of more than 90 cm length shall have horizontal and vertical stiffeners welded to the main frame.

ii) Alternatively, the busbar chamber shall be made of sheet steel of thickness not less than 2 mm (14 gauge), with detachable covers and dust excluding gasket. The joints shall be continuous welded. The detachable cover(s) shall be secured to the box with sufficient number of cadmium plated iron screws. This type of busbar chamber shall be restricted for busbar upto 90 cm length.

iii) Bus bar chambers for busbars upto 90 cm length shall have detachable end covers so that the same can be extended.

iv) Two numbers of GI earth studs of appropriate size with double washers shall be provided on the body of the enclosure. The terminals shall be permanently marked 'E'.

v) The enclosure shall be painted with two coat of primer paint after cleaning the surfaces, and after derusting and degreasing. Two coats of finish paint shall thereafter be applied by spray painting process. This shall be done in the works before bringing the material to site.

Supports

Busbars shall be rigidly fixed to the supports, if not porcelain or of SMC/DMC solid block type base. Busbars shall be firmly held within the slots in sheet type supports, which in turn shall be rigidly fixed to the chamber.

Clearances

The minimum clearances to be maintained for enclosed indoor air insulated busbars for medium voltage applications shall be as follows:

Between	Min. clearances
Phase to earth	26 mm
Phase to phase	32 mm

Arrangement of busbars and main connections

Busbars and main connections, which are substantially in one plane, shall be arranged in the order given below:

i) AC. System

a) The order of phase connections shall be red, yellow and blue.

b) When the run of the conductors is horizontal, the red shall be on the top, or farthest away as viewed from the front.

c) When the run of the conductors is vertical, the red shall be on the left, or farthest away as viewed from the front.

d) When the system has a neutral connection in the same plane as the phase connections, the neutral shall occupy the bottom position if horizontal and extreme right if vertical, or nearest position when viewed from the front.

e) Unless the neutral connections can be readily distinguished from the phase connections, the order shall be red, yellow, blue and black.

Push Buttons

1	Type	: Manually operated spring return type.
2	Standard applicable	: IEC947-5-1
3	Electric Shock protection	: Class 2 (IEC 536)
4	degree of protection	: IP54 (IEC529)
5	Diameter	: 22mm
6	Type of mounting	: snap type
7	Color of actuator	: Start PB - Green Stop PB - Red Test/Reset PB - Black
8	Contact configuration	: 2NO+2NC

Data/Drawings/Documents

The bidder shall submit the following data /information /drawings /documents as indicated below:

i) List of deviations clause by clause and reasons.

ii) Descriptive literature of the various equipment offered with catalogues, if any.

iii) Guaranteed technical particulars of the equipment.

iv) Approximate dimensions and weights and preliminary G.A drawings

v) List of optional features with extra price.

vi) Make of various equipment and associated components/ accessories.

vii) Where applicable, preliminary schematic of the equipment/ system offered in the tender.

viii) Brief write-up on control scheme and features.

Within 4 weeks of order, Contractor shall submit 4 sets of following documents for purchaser/Consultant's approval.

i) Guaranteed technical and performance particulars.
ii) G.A Drawings with dimensions and weight, plan and sections and fixing/foundation details
iii) Where applicable, control scheme drawings with write-up and all terminal numbers for external hook up.

Subsequently, 4 sets of the revised documents shall be submitted incorporating Consultants comments as Final Drawings for Purchaser's reference and records before the equipment is offered for inspection.

At Final Execution Stage

The following shall be submitted after inspection but before dispatch of the equipment.

i) "As Built" drawings (one set of film reproducible)
ii) Routine and type test certificates (8 sets)
iii) Detailed Operation and Maintenance Manuals (4 sets)
iv) Detailed erection, testing and commissioning manuals (4 sets).

M C B Type Distribution Boards (MCB DBs)

All TPN MCBDBs are to be suitable for flush mounting with double door having acrylic front door and to be provided with inbuilt additional compartment for looping of loose wires/adapter boxes for entry of armoured cables and conform to IS: 8623.

i) Material

The DBs are to be fabricated out of SWG MS sheets suitable for all weather operation. The current carrying parts are to be made of electrolytic grade copper and are to be rated for the duty intended.

ii) Painting

The DBs are to be subjected to seven tank phosphating processes (Degreasing, pickling, surface activation, phosphating and passivation) and to be powder coated ensuring rust prevention and scratch resistant.

iii) Accessories

Following accessories are to be provided: -

a) Copper bus bars of rated current capacity per phase.

b) Special brass terminals to ensure perfect connections of incoming cable with the bus bars.

c) Brass neutral bars isolated and insulated from the enclosures with suitable cross sectional area.

d) Earth bars for firm earthing and for facilitating individual earthings for each outgoing terminal.

e) Sufficient number of blanking plates.

Miniature Circuit Breakers (MCBs)

All MCBs should conform to IS:8828(1996), BS: 3871, IEC:898(1995) and rated for 10kA category of short circuit duty and tested for breaking capacity upto 10 kA. B curve type MCBs should be used for resistive loads, C curve type for inductive loads and D curve type for UPS loads. MCBs shall be suitable for use in frequency range 40 Hz to 60 Hz and shall accommodate AC/DC supply according to requirements. It should have inverse time overload and short circuit tripping mechanism with trip free operation and toggle shall give positive contact indication. Arc chutes should be provided for effective quenching of arc during operations and fault conditions. Terminals should be provided with proper shrouding arrangement. Silver cadmium Oxide tipped contacts should be provided in MCBs. Pressure clamp terminals for users upto 4 sq.mm and bolted lugs for higher rating should be provided. Multipole MCBs should be provided with common operating handle and integral tripping. The MCBs shall be of IP 20 degree of protection. The power loss per pole shall be in accordance with IS:8828(1996) and shall be furnished by the manufacturer.

MCB casing shall be made of self extinguishing tropicalised material. It shall be suitable for mounting on 35 mm DIN rail/surface mounting. Line supply may be connected to either top or bottom terminals i.e there shall be no line load restriction. Degree of protection, when the MCB is flush mounted, shall be IP 40. MCB shall be supplied with clamping terminals fully open. Contact closing shall be independent of the speed of the operator. The MCB shall be capable of being used as incomer circuit breaker and shall be suitable for use as an isolator. In case of multiple MCBs in a single location (DB), it shall be possible to remove MCB without having to disturb other MCBs in the vicinity.

Miniature Circuit Breaker and Residual current Circuit Breaker (RCBO)

Miniature Circuit Breaker-and- Residual current Circuit Breakers based on residual current operation should provide complete protection against Earth leakage faults, overloads and short circuits. The breakers should conform to IS: 12640-1988, IEC 601008-1 and IS: 8828-1996 should be rated for 10 kA. The RCCB shall have threshold sensitivities (non-user adjustable) of 30mA, 100 mA & 300 mA with inbuilt time delay of 200 ms for discrimination with downstream RCCB. The short circuit withstand

capacity of the RCCB without the associated short circuit/overload protection shall not be less than 3 kA. It shall be operationally independent of line voltage. There should be clear identification of earth fault or overload and short circuit fault on the RCCB. The breaker should be maintenance free. The breaker should be capable of detecting earth leakage currents and disconnecting the faulty lines. The RCCBs should be capable of preventing the risk of unwanted tripping due to transient voltages (lightning, line disturbances on other equipment) and transient currents (from high capacitive circuits). The RCCB should be unaffected by the DC pulsated components, present if any in the circuit, and should not give nuisance tripping. A test devise should be incorporated to check the integrity of the system and tripping mechanism. Terminals should ensure easy termination of cables and should provide covers to shield incoming and outgoing terminals with IP 20 degree of protection. The breaker should be suitable for DIN rail mounting.

10 SANDWICH BUSDUCT

Scope:

Scope of this section covers manufacture, supply, installation, testing and commissioning of indoor type. 415 volts, four pole Bus Ducts of rating mentioned in the Bill of Quantity for connection between Transformers and MV panels and between MV panels.

Standard:

All materials, equipment and accessories used in the manufacture shall confirm to relevant Indian Standards some of which are listed below:

IS 376	-	Marking & arrangement for Busbars.
IS 2147	-	Degree of protection provided by enclosure for low voltage switchgears.
IS 3202	-	Code of practice for climate proofing of electrical equipments.
IS 159	-	Busbars

IS : 8623/1993 I &II -Low-Voltage Switchgear and Control gear Assemblies
IEC 61439-1&2 – Low-Voltage Switchgear

Construction:

The enclosure shall be made from Aluminum alloy and powder coated to withstand the salt spray test. Bus bars would be in 'Sandwitch' construction and the conductors shall be individually insulated. Length of section shall be limited to max 3 Mtrs. Bus bars of one section shall be connected to bus bars of adjacent section by uniblock joint system removable as separate sub-assembly, So that it can inserted or removed with out disturbing the adjacent sections.

All busbar trunking products and fittings(straight length, elbow, tees, flanged ends, cable tap box etc.) shall be in accordance with relevant IEC 61439-6 standard and

from the same manufacturer as the busbar trunking system. The degree of protection of the busbar trunking system should be IP54 in accordance to relevant standard. The electrical contractor shall be responsible for routing the busbar trunking to coordinate with the other trades. Final field measurements shall be made by the contractor prior to release to the busbar trunking for fabrication by the manufacturer. The whole busbar trunking system shall be capable of withstanding the short circuit of the electrical installation without damaging the electrical, mechanical and thermal stress under fault condition.

The voltage drop (input voltage minus output voltage) specified shall be based on the busway operating at full rated current and at stabilized operating temperature in 30 degree Centigrade ambient. The voltage drop should be less than the permissible limits as per relevant standards. Hanger spacing shall be noted on layout drawings and shall not exceed manufacturer's recommendations. The design of Bus duct should be as per relevant Standards considering all derating factors.

The ducts shall be designed for a continuous current rating as specified in the Bill of Quantities/Drawings. Cross section of neutral busbar shall be same as that of the phase-busbar. The short circuit rating shall 50 KA at 415 volts and the Contractor shall satisfy the Engineer-in-charge in this regard by calculations to prove this capability.

Suitable flanged arrangements to be provided at both ends to match with MV circuit breaker panels/Transformers terminal box.

All joints shall be bolted type with the bolt shall be two-headed design to indicate when proper torque has been applied.

The busduct shall be installed as per manufacturer's instructions.

Enclosure will be tested for protection degree IP – 54.

Necessary Vertical / Horizontal bends / Tees shall be provided as required by layout.

Bus bars trunking shall be rigidly fixed to the side walls or suspended from ceiling. by supports as per requirement detailed in the layout.

At the termination either on the transformer side or on generator end or on switchgear panel, busduct shall be provided with flange ends, adopter Box and copper flexible to connect Bus bars of bus duct to busbars of switchgear panel or transformer terminals or generator terminals.

Technical parameters for compliance:

- Bus trunking shall be designed to withstand short circuit current for one second.

- Bus bar system should be designed for an ambient temperature of 40 deg. C and temperature rise restricted to 55 Deg. C max on conductors above

ambient.

- Temperature rise of the enclosure 40 deg. C maximum. Temperature rise at terminals 70 Deg. C max.
- Maximum operating voltage = 690 Volts.
- Insulation voltage = 1000 Volts.
- Bus trunking shall be suitably chosen to give permissible voltage drop.

TESTING

Routine Tests shall be conducted on the Bus Duct as per relevant IS standard amended up to date. Client/Consultant shall have the right to inspect the progress of work, quality of materials used/ workmanship and to witness the Routine tests after completion of work at the premises of the manufacturer.

In case factory inspection is not witnessed by consultant/client ,type tests and routine tests as per IS/IEC standards/ as detailed below and the reports shall be submitted for the approval of Client/Consultant before despatch.

List of test to be carried out

Copies of the following type test certificates should be submitted.

1 Verification of Temperature Rise limits.

2 Verification of dielectric properties.

3 Verification of short circuit strength.

4 Verification of degree of protection.

Routine Tests

1 Verification of insulation Resistance.

2 Inspection of assembly, interlocks, locks etc.

3 Dielectric test.

11 Cables & Cabling:

Scope

The scope under this section covers the following:

a) Power cables HV & LV

b) Control cable

Armouring and Serving

All multicore cables liable for mechanical damage shall be armoured.

Standards

The following standards shall be applicable:

1.	IS : 1753	:	Specification for aluminium conductors for insulated cables.
2.	IS : 2982	:	Specification for copper conductors in insulated cables.
3.	IS : 5831	:	Specification for PVC insulated and sheath of electric cables.
4.	IS : 6474	:	Polythene insulation and sheath of electric cables.
5.	IS:3975	:	Specification for mild steel wires, strips and tapes for armouring of cables.
6.	IS : 694	:	PVC insulated cables.
7.	IS : 7098	:	Specification for XLPE insulated PVC sheathed cables.
8.	IS : 3961	:	Recommended current ratings of cables.

Power cables (HV) 11kV grade XLPE insulated cable

The conductors shall be screened by extruded compound and XLPE insulated. The cores shall be screened by extruded compound in combination with non- metallic tape. The inner sheath over laid up cores and outer sheath over the armour shall be extruded black PVC compound type ST-2. The inner and outer sheath should be separated by armouring. The construction, performance and testing of the cable shall comply with IS: 7098- part-2.

General details

1.	Cross sectional area of conductor	:	AS specified in the boq
	No. of cores	:	3
	Conductor	:	Aluminium

Insulation

The thickness of insulation shall be on the basis of insulation material, voltage and conductor size conforming to the relevant standard specification. The cores shall be colour coded to IS specifications.

Sheathing

The sheathing shall be PVC and shall be before and after the armouring, the thickness of the sheathing shall be based on the conductor size and overall diameter below the sheathing.

Armouring

Single core cables shall be with non-magnetic armouring. Multi core cables shall be with armouring. The armouring for cables upto 16 mm sq. shall be galvanised steel strips and below with wire strips.

Power cables (LV) 415 V, XLPE, 1.1. kV grade.

Power cables for use on 415 V system shall be of 1100 volt grade, aluminium conductor, XLPE insulated, PVC sheathed, armoured and overall PVC sheathed, strictly as per IS : 7098 (Part I & II) - 1976. Unarmoured cable to be used only if specifically mentioned in schedule of requirements.

Control Cables

Control cables for use on 415 V system shall be FRLS type 1100 volts grade, copper conductor, PVC insulated, PVC sheathed, armoured and overall PVC sheathed, strictly as per IS : 1554 (Part I) - 1976. Unarmoured cables to be used only if specifically mentioned in schedule of requirements.

The size of these cables shall be as specified in schedule of requirements or as per erection drawing. No cable of size less than 2.5 sq.mm. shall be used.

Cable Glands

Cable glands shall be of heavy duty, made of brass, Chrome plated. These shall have a screwed nipple with conduit electrical thread and checknut.

Cable Connectors

Cable connectors, lugs/sockets, shall be of copper/aluminium alloy, suitably tinned, solderless, crimping type. These shall be suitable for the cable being connected and type of function (such as power, control or connection to instruments, etc.)

Cable Indicators

These shall be self-sticking type and of 2 mm thick aluminum/copper strap for overall cable. PVC identification numbers, ferrule shall be used for each wire.

Cable Route Markers

These shall be galvanised Cast Iron plate with marking (LT/HT) diameter

150 mm with 600 mm long 35x35x6 mm MS. angle 60 cm long riveted/bolted with this plate.

12. WIRING SYSTEMS

Materials

A. Wires

Wires shall comply the following features:

- Flame Retardant Low Smoke (FRLS), suitable upto 660V grade wires for single phase circuits and 1100 V grade for 3 phase circuits as per IS 694/1990 amended upto date.

- Colour coded as below:

Phase - R	-	Red
Phase - Y	-	yellow
Phase - B	-	Blue
Neutral	-	Black
Earth	-	Green

B. Conduits

Two types of Conduit Wiring System shall be followed.

- Rigid Steel Conduit Wiring System

- Rigid PVC (heavy gauge) Conduit Wiring System

i. General requirements:

All rigid conduit pipes shall be ISI marked. The wall thickness shall be not less than 1.4 mm thickness for conduit up to 20 mm dia, 1.6mm thickness for conduit for 25 mm dia, 1.9mm thickness for conduit for 32 mm dia and not less than 2 mm for conduits above 32 mm dia.

b) The maximum number of PVC insulated cables conforming to IS:694-1990 that can be drawn in one conduit is given size wise in Table I, and the number of cables per conduit shall not be exceeded. Conduit sizes shall be selected accordingly in each run.

c) No conduit less than 20 mm in diameter shall be used.

Flexible conduits will only be permitted for interconnections between switchgear, DB's and conduit terminations in wall.

All flexible conduits used in the system should be Halogen free, flame retardant and self extinguishing polyamide conduits.

ii. Conduit Accessories

a) The conduit wiring system shall be complete in all respects, including their accessories.

b) All conduit accessories shall be of solvent cement plastering type, and should have undergone circumstances pin grip type of clamp grip type accessories shall be used.

c) Bends, couplers, etc. shall be solid type in recessed type of works and may be solid or inspection type as required.

d) 1) Saddles for surface conduit work on wall shall not be less than 0.55 mm (24 gauge) for conduits up to 25 mm dia. and not less than 0.9 mm (20 gauge) for larger diameter.

2) The minimum width and the thickness of grider clips used for fixing conduits to steel joists, and clamps shall be as per **Table II.**

iii. Outlets

a) The switch box or regulator box shall be made of metal on all sides, except on the front. In the case of cast boxes, the wall thickness shall be at least 2 mm and in case of welded mild steel sheet boxes, the wall thickness shall not less than 1.2 mm (18 gauge) for boxes upto a size of 20 cm x 30 cm, and above this size 1.6 mm (16 gauge) thick MS boxes shall be used. The metallic boxes shall be duly painted with anticorrosive paint before erection.

b) An earth terminal with stud and 2 metal washers shall be provided in each MS box for termination of protective conductors and for connection to socket outlet/metallic body of fan regulator etc.

c) Clear depth of the box shall not be less than 60 mm, and this shall be increased suitably to accommodate mounting of fan regulators in flush pattern.

d) The fan regulators can also be mounted on the switch box covers, if so stipulated in the tender specifications, or if so directed by the Engineer-in-charge.

f) Except where otherwise stated, 3 mm thick phenolic laminated sheets as per clause shall be fixed on the front with brass screws, or cadmium plated iron screws as approved by the Engineer-in-charge.

TABLE I

MAXIMUM NUMBER OF PVC INSULATED 650/1100 V GRADE ALUMINIUM/ COPPER CONDUCTOR CABLE CONFORMING TO IS: 694-1990 IN RIGID PVS/STEEL CONDUITS

Nominal cross sectional area of conductor in sq.mm	20 mm		25 mm		32 mm		38 mm		51 mm		64 mm	
	S	B	S	B	S	B	S	B	S	B	S	B
1.5	5	4	10	8	18	12	-	-	-	-	-	-
2.5	5	3	8	6	12	10	-	-	-	-	-	-
4	3	2	6	5	10	8	-	-	-	-	-	-
8	2	-	5	4	8	7	-	-	-	-	-	-
10	2	-	4	3	6	5	8	6	-	-	-	-
16	-	-	2	2	3	3	6	5	10	7	12	8
25	-	-	-	-	3	2	5	3	8	6	9	7
35	-	-	-	-	-	-	3	2	6	5	8	6
50	-	-	-	-	-	-	-	-	5	3	6	5
70	-	-	-	-	-	-	-	-	4	3	5	4

Note:

1) The above table shows the maximum size of conduits for a simultaneous drawing of cables.

2) The columns headed S apply to runs of conduits which have distance not exceeding 4.25 m between draw in boxes and which do not deflect from the straight by an angle of more than 15 degrees. The columns headed B applies to runs of conduit which deflect from straight by an angle of more than 15 degrees.

3) Conduit sizes are the nominal external diameters.

TABLE II
GIRDER CLIPS CLAMPS

Size of conduit	Width	Thickness
20 mm	19 mm	0.9 mm (20 SWG)
25 mm	19 mm	0.9 mm (20 SWG)
32 mm & above	25 mm	1.2 mm (18 SWG)

WIRING

A. POINT WIRING

i) Definition

A point (other than socket outlet point) shall include all works necessary in complete wiring to the following outlets from the controlling switch or MCB. The scope of wiring for a point shall, however, includes the wiring work necessary in tapping from another point in the same distribution circuit: -

(a) Ceiling rose or connector (in the case of points for ceiling /exhaust fan points, pre-wired light fittings and call bells).

(b) Ceiling rose (in the case of pendants except stiff pendants).

(c) Back plate (in the case of stiff pendants).

(d) Lamp holder (in the case of gooseneck type wall brackets, batten holders and fittings which are not pre-wired).

In the case of call bell points, the words "from the controlling switch or MCB" shall be read as "from the ceiling rose meant for connection to bell push".

ii) Scope

(a) Following shall be deemed to be included in point wiring.

1) Conduit, accessories for the conduit and wiring cables between the switch box and the point outlet.

2) Ceiling rose or Connectors shall be provided near the fitting as required.

3) For points coming in false ceiling, as far as possible, wiring shall be terminated in a junction box/connector very close to the points. The cost of additional length of wires used in this regard shall be treated as replacement of 3Rx1.5sqmm wire against the items specified in BOQ in fixing of fitting using chain/down rod.

4) For points coming in false ceiling, all conduits shall be adequately supported. For this purpose, MS supports shall be provided as specified in BOQ as a separate item.

5) Loop wiring in rigid/flexible conduit

6) All fixing accessories such as clips, nails, screws, Phil plug, raw plug etc. as required.

7) Metal switch boxes for control switches, regulators, sockets etc. recessed or surface type, and phenolic laminated sheet covers in case of piano type switches and outer & inner cover plates in case of modular type switches.

8) Outlet boxes, junction boxes, pull-through boxes etc. but excluding metal boxes if any, provided with switchboards for loose wires/conduit terminations.

9) All the civil works such as chipping, plastering, Making good all damages connected with the fixing of switch boxes, conduit laying etc are included in the scope.

10) Control switch as specified.

11) Connections to ceiling rose, connector, lamp holder, switch etc.

12) Interconnecting wiring between points on the same circuit, in the same switch box or from another.

13) Loop earthing in rigid/flexible conduit

14) Protective (loop earthing) conductor from one metallic switch box to another in the distribution circuits, and for socket outlets.(The length of protective conductor run along with the circuits/submains is excluded from the scope of points).

B. Following shall be deemed to be included in group control point wiring.

1) Conduit, accessories for the conduit and wiring cables between the Control location (DP/SP MCB/Isolator/ DP switch) to the first point and wiring cable between points forming the particular number of group (providing MCB or switch is not included in this scope).

2) Ceiling rose or Connectors shall be provided near the fitting as required.

3) For points coming in false ceiling, as far as possible, wiring shall be terminated in a junction box/connector very close to the points. The cost of additional length of wires used in this regard shall be treated as replacement of 3R x 1.5sqmm wire against the items specified in BOQ in fixing of fitting using chain/down rod.

4) For points coming in false ceiling, all conduits shall be adequately supported. When large number of points comes in false ceiling, conduits shall be run in adequate steel supports/tray. The size and cross section of the above mentioned supports shall be planned as per the site condition and

got approved by the engineer in charge before commencing the work. MS supports provided shall be as specified in BOQ and will be a separate item.

5) Loop wiring in rigid/flexible conduit

6) All fixing accessories such as clips, nails, screws, Phil plug, rawl plug etc. as required.

7) Junction boxes, pull-through boxes etc. but excluding metal boxes if any, provided with MCBDB for loose wires/conduit terminations.

8) Connections to ceiling rose, connector, MCB etc.

9) Loop earthing in rigid/flexible conduit

C. CIRCUITS AND SUBMAIN WIRING

i) Circuit wiring
Circuit wiring shall mean the wiring from the distribution board up to the tapping point for the nearest first point of that distribution circuit, viz. Upto the nearest first switch box.

ii) Sub main wiring
Sub main wiring shall mean the wiring from one main/ distribution switchboard to another.

D. WIRING IN CONDUIT

The wiring in conduit shall comply the following:

- Wire sizes

Copper conductor

Light point / Sub main wiring	1.5 sq.mm
Light Circuit Point	2.5 sq.mm
Power points	4.0 sq.mm

Machinery as per schedule of requirements

Jointing of wires is not permissible, however looping may be done from point (same circuit) or using a terminal strip in junction box where site condition warrants, prior permission from Engineer-in-Charge shall be obtained.

Metallic/non-metallic trunking may be used if number of conduits is many. The metallic trunking shall be earthed securely at DB end and throughout the length. Single trunking with metallic partition may be used for wiring different services.

E. WIRING ACCESSORIES

i) Control switches for points

(a) Control switch shall be placed only in the live conductor of the circuit. No single pole switch or fuse shall be inserted in the protective (earth) conductor, or earthed neutral conductor of the circuit.

(b) Combined switch cum socket shall not be permitted.

ii) Socket outlets

The 5A/6A socket outlet shall be 5 pin socket outlet with 5A/6A switch, where so specified in the tender documents.

The power point outlet shall be 15A/5A or 16A/6A 6 pin socket outlet with 15A/16A switch, where so specified in the tender documents.

iii) Switch box covers

Phenolic laminated sheet of 3 mm thick of approved shade shall be used for switch box covers in case of piano type switches. For Modular type switches/ sockets suitable outer and inner cover plates as specified shall be provided over the standard box as recommended by the manufacturers of modular type switch/ sockets and no separate sheet cover is required to be provided.

iv) Ceiling rose

(a) Ceiling rose shall be of 3-plate type.
A ceiling rose shall not be used on circuit the voltage of which normally exceeds 250V.

(b) Only one flexible cord shall be connected to a ceiling rose. Specially designed ceiling roses shall be used for multiple pendants.

(c) A ceiling rose shall not embody fuse terminal as an integral part of it.

(d) Where ever ceiling roses are not used the wires are to be terminated in good quality connectors of 6A capacity inside PVC junction boxes.

(e) All the junction boxes are to be covered with good quality round cover plate of approved colour.

v) Lamp holders

(a) The standard constructional feature of manufacturers (ISI approved) of lamp holders is acceptable.

(b) Where the lamp holders are part of light fixtures the holders shall be suitable for the type of lamps used.

F. MS Items

i) Scope

Supply, fabrication, painting and fixing of M.S items such as Flat / Tees / Angles / Channels etc. required for the cable bay/conduit tray and necessary civil works such as grouting, finishing etc.

Scope covers supply of all anchor fasteners, anchor bolts and all connected civil works such as cutting holes on wall, making good the same.

ii) Material

The steel sections used should be of good quality, manufactured by reputed companies. Steel sections of reputed manufacturers (like SAIL, Vaizah steel etc) shall be used. If smaller sections of these makes are not available, re-rolled steels of reputed make shall be used. In any case the make of steel should be got approved from Engineer-in-Charge before its supply.

13. LIGHT FIXTURES AND FANS

The type of fittings shall be as specified in BOQ of tender documents.

i) The contractors shall supply the specified model and make of the fittings. The standard constructional features of specified make and model as given in the tender document are acceptable. However, one sample of each of every fitting shall be produced for approval.

ii) Though a particular model number of a fitting is mentioned in the tender, Client reserve the right to reject the make if the quality of these fitting is found to be not up to the standard.

iii) Fittings using discharge lamps shall be complete with power factor correction capacitors, either internally or externally. An earth terminal with suitable marking shall be provided for each fitting for discharge lamps.

iv) The contractors shall supply the specified type of lamp mentioned in the BOQ. All the accessories of the light fittings should be fitted with nut bolt and not to be riveted.

v) Unless otherwise specified, Copper chokes of Fluorescent Tube light Fittings shall be of super low loss type (Not more than 6 watts) or as specified in BOQ.

vi) Ceiling fans including their suspension shall conform to relevant Indian Standards.

vii) Wall Fans, Air Circulators, Exhaust fans etc shall conform to relevant Indian Standards.

14. M C B Distribution Boards (MCB DBs) and accessories.

A) M C B Distribution Boards (MCB DBs)

All SPN & TPN DBs are to be weather proof, thermo plastic or MS powder coated suitable for flush mounting with double door and to be provided with inbuilt additional compartment for looping of loose wires/adapter boxes for entry of armoured cables with IP 42 category of protection and conform to IS: 8623.

i) Material

The DBs are to be fabricated out of CRCA sheets suitable for all weather operation. The current carrying parts are to be made of electrolytic grade copper and are to be rated for the duty intended. The DBs should have knock out holes at the bottom, and detachable plate with knock out holes at the top.

ii) Painting

The DBs are to be subjected to seven tank phosphatising processes (Degreasing, pickling, surface activation, phosphatising and passivation) and to be powder coated ensuring rust prevention and scratch resistant.

iii) Accessories

Following accessories are to be provided: -

(a) Copper bus bars of rated current capacity per phase.

(b) Special brass terminals to ensure perfect connections of incoming cable with the bus bars.

(c) Brass neutral bars three numbers, one for each phase, isolated andinsulated from the enclosures with suitable cross sectional area.

(d) Earth bars for firm earthing and for facilitating individual earthings for each outgoing terminal.

(e) Sufficient number of blanking plates.

(f) Provision for accommodating four pole MCB and RCCB as incomer.

B) Miniature Circuit Breakers (MCBs)

All MCBs should conform to IS:8828(1996), BS: 3871, IEC:898(1995) and rated for 10kA category of short circuit duty and tested for breaking capacity upto 10 kA. B curve type MCBs should be used for resistive loads, C curve type for inductive loads and D curve type for UPS loads. MCBs

shall be suitable for use in frequency range 40 Hz to 60 Hz and shall accommodate AC/DC supply according to requirements. It should have inverse time overload and short circuit tripping mechanism with trip free operation and toggle shall give positive contact indication. Arc chutes should be provided for effective quenching of arc during operations and fault conditions. Terminals should be provided with proper shrouding arrangement. Silver cadmium Oxide tipped contacts should be provided in MCBs. Pressure clamp terminals for users upto 4 sq.mm and bolted lugs for higher rating should be provided. Multipole MCBs should be provided with common operating handle and integral tripping. The MCBs shall be of IP 20 degree of protection. The power loss per pole shall be in accordance with IS:8828(1996) and shall be furnished by the manufacturer.

MCB casing shall be made of self extinguishing tropicalised material. It shall be suitable for mounting on 35 mm DIN rail/surface mounting. Line supply may be connected to either top or bottom terminals i.e there shall be no line load restriction. Degree of protection, when the MCB is flush mounted, shall be IP 40. MCB shall be supplied with clamping terminals fully open. Contact closing shall be independent of thespeed of theoperator. The MCB shall be capable of being used as incomer circuit breaker and shall be suitable for use as an isolator. In case of multiple MCBs ina single location (DB), it shall be possible to remove MCB without having to disturb other MCBs in the vicinity. All MCB's shall be capable of carring 35sq.mm. cable termination. Both the upper and lower terminals of MCB's shall be bi-connect type, ie., capable of connecting busbar and cable at both the end.

C) Residual Current Circuit Breaker (RCCB)

Residual Current Circuit Breakers based on residual current operation should provide complete protection against Earth leakage faults. The breakers should conform to IS: 12640-1988, IEC 601008-1 and IS: 8828-1996 should be rated for 6 kA or more. The RCCB shall have threshold sensitivities (non-user adjustable) of 30mA, 100 mA & 300 mA with inbuilt time delay of 200 ms for discrimination with downstream RCCB. The short circuit withstand capacity of the RCCB shall not be less than 6 kA. It shall be operationally independent of line voltage. The breaker should be maintenance free. The breaker should be capable of detecting earth leakage currents and disconnecting the faulty lines. The RCCBs should be capable of preventing the risk of unwanted tripping due to transient voltages (lightning, line disturbances on other equipment) and transient currents (from high capacitive circuits). The RCCB should be unaffected by the DC pulsated components, present if any in the circuit, and should not give nuisance tripping. A test devise should be incorporated to check the integrity of the system and tripping mechanism. Terminals should ensure easy termination of cables and should provide covers to shield incoming and outgoing terminals with IP 20 degree of protection. The breaker should be suitable for DIN rail mounting. All RCCB's shall be capable of carring 35sq.mm. cable termination. Both the upper and lower

terminals of RCCB's shall be bi-connect type, ie., capable of connecting busbar and cable at both the end.

16 Earthing

All metalic poles including reinforced cement concrete and prestressed cement concrete poles shall be permenently and efficiently earthed. For this purpose a continuous earth wire shall be provided and securely and fastened to each pole and and connected with earth ordinarily at 3 points in every kilometer, the spacing between the points being as nearly equidistant as possible. Alternatively each pole, and metallic fitting attached thereto shall be efficiently earthed.

All stay wires of low and medium voltage lines othern than those, which are connected with earth by means of continuous earth wire, shall have an insulator inserted at a height of not less than 3m from the ground.

The cross-sectional area of the earth conductor shall not be less than 16 mm^2, if of copper, and 25mm^2, if of galvanized iron or steel.

Types

The type of earth electrode shall be any of the following, as specified.

1. Pipe earth electrode; as per IS:3043 revised
2. Plate earth electrode; as per IS:3043

General

All cladding or steel work should be bonded to the earthing system, as should all structural steel work. A main earth bar should be provided, so disposed as to allow of the shortest subsidiary connections to all major equipment, such as DG set, Substations and electrical panel boards. When piles are used they should be bonded by welding and connected to earth bonding bars. All earth connections shall be visible for inspection.

i) Electrode materials and dimensions

   a) The materials and minimum sizes of earth electrodes shall be as per fault level calculation.

   b) GI pipe electrodes shall be cut tapered at the bottom, and provided with holes of 12 mm dia, drilled not less than 7.5 cm from each other upto 2 m of length from the bottom.

   c) Pipe electrode shall be buried in the ground vertically with its top not less than 20cm below the ground level. The installation shall be carried out as per IS:3043 and as directed by the engineer in charge.

d) Plate electrode shall be buried in ground with its face vertical, and its top not less than 2m below the ground level. The installation shall be carried out as per IS:3043 and as directed by the engineer in charge.

e) When more than one electrode is to be installed the distance between the pipe electrode shall be 5m and that between plates shall be 8m.

f) The strip or conductor electrode shall be buried in trench not less than 0.5m deep.

g) If the conditions necessitate the use of more than one strip or conductor electrode, they shall be laid as widely distributed as possible, in a single straight trench where feasible, or preferably in a number of trenches radiating from one point or as directed by the Engineer-in-charge.

h) All joints in copper conductor should be tinned properly.

Earthing Conductor

a) The earthing conductor (protective conductor from earth electrode upto 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.

b) Protective (Earth continuity/Loop earthing) Conductor)

c) The material and size of protective conductors shall be as specified by the Engineer-in-charge.

Location for Earth Electrodes

i) 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 Engineer-in-Charge.

Protective (Loop earthing/earth continuity) Conductor:

i) Earth terminal of every switchboard in the distribution system shall be bonded to the main earth bus.

ii) Two protective conductors shall be provided for a switchboard.

iii) A protective conductor shall securely connect the earth connector in every distribution board (DB) to the earth bus.

iv) All metallic switch boxes and regulator boxes in a circuit shall be connected to the earth connector in the DB by protective conductor.

v) Provision should be given for the testing of earth electrodes by connecting a group of rod driven electrodes to the main earth grid through a bolted link adjacent to the electrodes in a sunken concrete box. Simpler disconnecting arrangements are not acceptable.

Marking

i) Earth bars/terminals at all switch boards shall be marked permanently as E

ii) Main earth terminal shall be marked Safety Earth – Do Not Disconnect.

17. Lightning Protection

A) Scope

This chapter covers the detailed requirements of installation of lightning conductor system for protection of buildings against lightning. For details not covered in these specifications, reference may be made to IS:2309 - 1989.

B) Principal Components

The principal components of a lightning protective system are:
a) Air terminations
b) Down conductors
c) Joints and bonds
d) Testing joints
e) Earth terminations
f) Earth electrodes.

C) Materials

The materials of air terminations, down conductors, earth termination, etc. of the protective system shall be reliably resistant to corrosion, or be adequately protected against corrosion. The material shall be of the following, as specified.

All air terminations and down conductors shall be of copper.

The recommended shape and minimum sizes of conductors for use above and below ground shall be copper strip/GI strip 20 mm x 3 mm conforming to relevant I.S. specifications.

D) Layout

The system design and layout shall be done in accordance with IS/IEC 62305 -2010 and specified in the tender documents. The work shall be carried out accordingly satisfying at the same time, the requirements given below.

E) Air terminations

Air termination networks may consist of vertical or horizontal conductors, or combinations of both. For the purpose of lightning protection, the vertical and horizontal conductors are considered equivalent and the use of pointed air terminations, or vertical final is, therefore, not regarded as essential.

A vertical air termination, where provided, need not have more than one point, and shall at least 30 cm, above the object, salient point or network on which it is fixed.

For a flat roof, horizontal air termination along the outer perimeter of the roof shall be used. For a roof of larger area a network of parallel horizontal conductors shall be installed. No part of the roof should be more than 9 m from the nearest horizontal protective conductor.

Horizontal air terminations should be carried along the contours such as ridges, parapets and edges of flat roofs, and where necessary, over flat surfaces, in such a way as to join each air termination to the rest, and should themselves form a closed network.

All metallic projections including reinforcement, on or above the main surface of the roof which are connected to the general mass of the earth, should be bonded and form a part of the termination network.

If portions of a structure vary considerably in height, any necessary air terminations or air termination network for the lower portions should be bonded to the down conductors of the taller portions, in addition to their own conductors.

F) Down Conductors

i. The number and spacing of down conductors shall be a specified, or as directed by the Engineer-in-charge.

ii. Routing

a) A down conductor should follow the most direct path possible between the air terminal network and the earth termination network. Where more than one down conductor is used, the conductors should be arranged as evenly as practicable around the outside walls of the structures.

b) The walls of light wells may be used for fixing down conductors, but lift shafts should not be used for this purpose.
c) Metal pipes leading rainwater from the roof to the ground may be connected to the down conductors, but cannot replace them, such connections should have disconnecting joints.
d) In deciding on the routing of the down conductor, its accessibility for inspection, testing and maintenance should be taken into consideration.
e) Proper porcelain/ DMC supports should be used to support the lightning conductor at regular intervals.

iii. Provision when external route is not available:

Where the provision of external routes for down conductors is impracticable, for example, in buildings of cantilever construction from the first floor upwards, down conductors should not follow the outside contours of the building. To do so would create a hazard to persons standing under the over hang. In such cases, the down conductors may be housed in an air space provided by a nonmetallic and noncombustible internal duct and taken straight down to the ground.

a) Any suitable covered recess, not smaller than 76 mm x 13mm, or any suitable vertical services duct running the full height of the building may be used for this purpose, provided it does not contain an un-armoured or a non-metal sheathed cable.
b) In case where an unrestricted duct is used seals at each floor level may be required for fire protection. As far as possible, access to the interior of the duct should be available.
c) The lightning protective system should be so installed that it does not spoil the architectural or aesthetic beauty of the building.

NOTE: - The specifications indicated above are minimum requirement only. The contractor should supply, erect and commission the equipments/ system according to latest editions of IEC and EI/IS standards

19 INSTALLATION

The intent of this specification is to define the requirements for the installation, testing and commissioning of the electrical items mentioned in the schedule of requirements. The work shall, however at all times carried out strictly as per the instructions of the Engineer-in-Charge.

The Contractor shall furnish all tools, welding equipment, rigging materials, testing equipment, test connections and kits etc. Required for complete installation, testing and commissioning of the items included in the Contract.

The Contractor shall carry out touch-up painting on any equipment indicated by the Engineer-in-Charge, if the finish paint on the equipment is soiled or marred during installation handling.

The interconnecting control cables between LT panel boards ,230V auxillary power supply etc. should be done by the contractor as required.

The installation shall conform in all respects with Indian Standard Code of Practice.

DP Structure & Allied equipments

The Contractor shall carry out DP Structure & Allied equipments

installation as required by the approved drawings and as directed by Engineer-in -Charge. All equipment including clamps and connectors wherever necessary shall be supplied and installed by the Contractor as instructed by the Engineer-in-Charge.

The contractor shall undertake the design, fabrication and installation as per the Purchaser/Consultant's requirements.

Steel tubular / steel rail/ other steel poles shall be fixed in cement concrete 1:3:6 (1 cement: 3 coarse sand: 6 graded stone aggregate of 40mm nominal size) foundation with not less than 20cm thick layer of the cement concrete all round the support, the foundation being continued above ground level and tapered suitably into a collar. Watering of concreted foundation above ground level and curing shall be done by using moist gunny etc. before loading the pole.

Pin insulators and shackle / disc insulators shall be erected on cross arms.

Where so directed by the Engineer-in-Charge, pin insulators may be provided above in addition to disc/shackle insulators over the cross arm, so that the line conductors are properly routed with adequate clearances.Care shall be taken that insulators are not damaged during handling and erection. Damaged insulators shall not be used for any reason.

Cross arms shall be clamped to the support properly, taking into consideration the orientation of the lines.Double clamping shall be provided where required.

Testing and Commissioning

All checks and tests as per the Manufacturer's drawings/manuals, relevant code of installation shall be carried out by the Contractor as part of the installation work.

Before connecting the service to transformer, equipments etc. a pressure test of appropriate standard shall be carried out on the line as directed by the Engineer-in-charge.Before charging 11KV lines the insulation resistance testing shall be done with a 2500V megger .All earth sets associated with the work shall be tested. All test results including earth test results shall be recorded and submitted to the Engineer-in-charge

The distribution lines shall be charged only if the pressure/megger test and earth results are satisfactory.

The lines shall be commissioned in the presence of the Engineer-in-charge.

LT Panel Boards

Switchgears shall be installed in accordance with specified code of practice and the Consultants instructions. The panels shall be delivered in convenient shipping section by the contractors. The Contractor shall be responsible for final assembly and inter-connection of busbars/wiring. Foundation channel shall be grouted in the flooring by the Contractor. Switchgear panels shall be aligned and levelled on their base channels and bolted or tack welded to them as per the instructions of the Engineer-in-charge. The earth bus shall be made continuous throughout the length. Loosely supplied relays and instruments shall be mounted and connected on the switchgear. Wherever the instruments and relays are supplied separately, they shall be mounted only after the associated control panel have been erected and aligned.

After erection the switchboard shall be inspected for dust and vermin proofness. Any hole, which might allow dust or vermin etc. to enter the panel, shall be plugged suitably at no extra cost.

If the instrument transformers are supplied separately they shall be erected as per the direction of the Engineer-in-charge. The Contractor shall fix the cable glands after drilling the bottom top plates of all switch boards with suitable holes at no extra cost.

Range of overload relays/timers etc. shall be checked with requirement of purchaser actually to be connected at site and if the same is under-sized/over-sized, it shall be brought to the notice of Engineer-in-charge and shall arrange procurement of correct rated components. However, the Contractor shall not charge anything extra for cost/labour for such replacements.

Testing

The Contractor shall perform operating tests on all switchgear and panels to verify operation of switchgear/panels and correctness of the interconnections between various items of the equipment. This shall be done by applying normal ac or dc voltage to the circuits and operating the equipment for functional checking of all control circuits, eg. closing, tripping, control interlock, supervision and alarm circuits.

All connections in the switchgear shall be tested from point to point for possible grounds or short circuit.

All electrical equipment alarms shall be tested for proper operation by causing alarms to sound under simulated abnormal conditions.

The Contractor shall arrange testing and calibrations of relays. The testing equipment including primary and secondary injection sets (if required) etc. shall also have to be arranged by the Contractor. Payment for above work shall be deemed to have been included in the erection of switch boards/control panels.

Insulation resistance tests shall be carried out by following rating meggers:

a)	Control circuits upto 220 V	:	by 500 V megger
b)	Power circuits, busbars, connections Upto 11kV	:	by 1000V meggar

Before electrical panel is energised, the insulation resistance of each bus shall be measured from phase to ground. Measurement shall be repeated with circuit breakers in operating positions and contact open. Before switchgear is energised, the insulation resistance of all DC control circuits shall be measured from line to ground.

The following tests shall be performed on all circuit breakers during erection:

i) Contact alignment and wipe shall be checked an adjusted where necessary in accordance with the breakers manufacture's instructions.

ii) Each circuit breaker shall be closed manually and its insulation resistance measured from phase to phase and phase to ground before erection.

iii) All adjustable direct acting trip devices shall be set using values given by the Engineer-in-charge/manufacturer.

iv) The dielectric strength of insulating oil wherever applicable shall be checked

Before switchgear is energised the following tests shall be performed on each circuit breaker in its test position.

i) Close and trip the circuit breaker from its local & remote control switch, push button or operating handle. Switchgear control bus may be energised to permit test operation of circuit breaker with AC closing with prior permission of the Engineer-in-charge.

ii) Test operation of circuit breaker latch, check carriage limit switch if provided.

iii) Test proper operation of lockout device in the closing circuit, wherever provided by simulating conditions, which would cause a lockout to occur.

iv) Trip breaker either manually or by applying current or voltage to each of its associated protective relays.
Before switchgear is energised, the test covered above shall be repeated with each breaker in its normal operating position.

All electrical equipment alarms shall be tested for proper operation by causing alarms to sound under simulated abnormal conditions.

The Contractor shall arrange testing and calibrations of relays. The testing equipment including primary and secondary injection sets (if required) etc. shall also have to be arranged by the contractor. Payment for the above work shall be deemed to have been included in the erection of switch boards/control panels.

Performa for Panels

a) Circuit (breaker or Supplier module designation/bus no.)
b) Insulation resistance tests (contacts open, breaker racked in position).
   i) Between each phase of bus : Mega ohm
   ii) Between each phase and earth : Mega ohm
   iii) DC and AC control & auxiliary circuits : Mega ohm
   iv) Between each phase of CT/PT and CT & PT circuit if any : Mega ohm

c) CT checks:
   i) CT ratio
   ii) CT secondary resistance
   iii) CT polarity check

d) Check for contact alignment and wipe.
e) Check/test all releases/relays.
f) Check mechanical interlocks.
g) Check switchgear/control panel wiring.
h) Check electrical interlocks.
i) Checking of breaker/control circuits for
   i) Closing-local and remote (wherever applicable)
   ii) Tripping-local and remote (wherever applicable)
j) Opening time of breaker/contactor.
k) Closing time of breaker/contactor.

(This Performa shall be jointly signed by the Engineer-in-charge and the Contractor.)

Completion tests

After supply and installation of complete project or a particular building/area, the contractor shall carry out following tests before switching on the power to installation and the results shall be recorded and submitted to the engineer-in-charge. If results are not satisfactory/as per the standard, the contractor shall identify the defects/short coming and

shall rectify the same. Nothing extra shall be paid for carrying out these tests and contractor has to arrange all necessary instruments.

Insulation resistance to earth

This to be measured with all fuse links in place all switches on all lamps and appliance in position by applying a voltage not less than twice the working voltage (subject to a limit of 500V). Insulation resistance of the whole or any part of the installation to earth must not be less than 50 Megaohms divided by the number of outlets (points and switch positions) except that it need not exceed 1 Megaohm for the whole installation.

Insulation resistance between conductors

Test to be made between all the conductors connected to one pole or phase conductor of the supply and all the conductors connected to the middle wire or neutral or the other pole or phase conductors of the supply. For this test, all lamps shall be removed and all switches put on. The result of the test must be 50 Megaohms divided by the number of outlets (point and switch positions) but need not exceed one Megaohm for the whole installation.

Polarity of single pole switches

Test shall be made to verify that all non-linked single pole switches are on phase conductor (Live) and not on the neutral or earthed conductor.

Resistance of metal conduits/sheaths (Earth continuity test)

In case of cables encased in metal conduit or metallic sheathing, the total resistance of the conduit or sheathing from the earthing point to any other position in the completed installation shall not exceed 2 ohms.

Busbar chamber

Busbar chambers shall be installed on fixed type switch boards with GI bolts and nuts.

Connections

i) Connections to busbars shall be made either by clamping arrangement, or by bolts and nuts as required. Tapped holes with studs may be permitted only for copper busbars for tapping conductor size upto 16 sq.mm.

ii) All connections shall be made such that there is a clear metal to metal area contact at the tappings so that the current density of the busbars at the point of connection does not exceed permissible limits, avoiding local heating.

iii) For tap-off connections from busbars, PVC insulated wiring cables may be used for current capacity upto 100A. and for higher current capacities, solid conductors/strips suitably insulated with PVC sleeve/tape shall be used.

iv) The bolts and nuts used for connections to busbars shall be of aluminium alloy, tinned forged brass or galvanised iron. Suitable precaution shall be taken against heating due to bi-metallic contact, spring washers and plate washers, shall be used with the studs/nuts to ensure proper contact pressure.

Cabling

Cable network shall include power, control and lighting cables, which shall be laid in underground trenches, Hume pipes, open trenches, cable trays, GI pipes, or on building structure surfaces as detailed in the relevant drawings. Cable schedules or as per the Engineer-in-charge's instructions. Supply and installation of cable trays, GI pipes/conduits, cable glades sockets at both ends, isolators, junction boxes, remote push buttons stations, etc. shall be under the scope of the Contractor.

General requirements for handling of cables

a) Before laying cables, these shall be tested for physical damage, continuity absence of cross phasing, insulation resistance to earth and between conductors. Insulation resistance tests shall be carried out with 500/1000 volt Megger.

b) The cables shall be supplied at site, wound on wooden drum as far as possible. For smaller length and sizes, cables in properly coiled form can be accepted. The cables shall laid by mounting the drum of the cable on drum carriage. Where the carriage is not available, the drum shall be mounted on a properly supported axle, and the cable laid out from the top of the drum. In no case the cable will be rolled on, as it produces kinks which may damage the conductor.

c) Sharp bending and kinking of cables shall be avoided. The bending radius for PVC insulated and sheath armoured cable shall not be less than 10 D Where 'D' is overall diameter of the cable.

d) While drawing cables through GI pipes, conduits, RCC pipe, ensure that size of pipe is such that, after drawing cables, 40 % area is free. After drawing cable, the end of pipe shall be sealed with cotton/bituminous compound.

e) High voltage (11 kV and above), medium voltage (230 V and above) and other control cables shall be separated from each other by adequate spacing or running through independent pipes/trays.

f) Armoured cables shall never be concealed in walls/floors / roads without GI pipes, conduits RCC pipes.

g) Joints in the cable throughout its length of laying shall be avoided as far as possible and if unavoidable, prior approval of site engineer shall be taken. If allowed, proper straight through epoxy resin type joint shall be made, without any additional cost.

h) A minimum loop of 3 M shall be provided on both ends of the cable, or after every 50 M of unjointed length of cable and on both ends of straight through cable joint. This additional length shall be used for fresh termination in future. Cable for this loop shall be paid for supply and laying.

i) Cable shall be neatly arranged in the trenches/trays in such a manner so that criss-crossing is avoided and final take off to the motor/switchgear is facilitated. Arrangement of cables within the trenches/trays shall be the responsibility of the Contractor.

j) All cable routes shall be carefully measured and cable cut to the required lengths and undue wastage of cables to be avoided. The routes indicated in the drawings is indicative only and the same may be rechecked with the Engineer-in-charge before cutting of cables. While selecting cable routes, interference with structures, foundations, pipe line, future expansion of buildings, etc. should be avoided.

k) All temporary ends of cables must be protected against dirt and moisture to prevent damage to the insulation. For this purpose, ends of all PVC insulated cables shall be taped with an approved PVC or rubber insulating tape. Use of friction type or other fabric type tape is not permitted. Lead sheathed cables shall be plumbed with lead alloy.

l) Wherever cable rises from underground/concrete trenches to motors/switchgears/push buttons, these shall be taken in GI pipes of suitable size, for mechanical protection upto 300 mm distance of concerned cable gland or as instructed by the Engineer-in-charge.

m) Where cables pass through foundation/walls of other underground structures, the necessary ducts or openings will be provided in advance for the same. However, should it become necessary to cut holes in existing foundations or structures the electrical Contractor shall determine their location and obtain approval of the Engineer-in-charge before cutting is done.

Installation of Cables

Wherever cables are taken through masonry works and road crossings etc., they shall be protected by running through GI pipes and Hume pipes

respectively. Depth shall be 1200 mm from top of finished road surface and it shall extend for about 1070 mm on both sides of the roads.

Utmost care shall be taken to avoid scratches, kinks and cuts on the conductor while transporting the cables to site or during installation. Suitable inhibiting grease shall be liberally applied to bare conductors, wherever they exist.

The junction boxes, cable end boxes etc. wherever required to be provided shall have sufficient wiring spaces with regard to the sizes of cables indicated in the drawings. Wherever required, the items to be supplied for electrification shall be complete with requisite type of cable glands, cable boxes, termination etc. and other accessories which are necessary for the satisfactory installation/operation of the installations as per relevant statutory rules and regulations.

Installation of all cables should be as per E.I. Standards. Fuses should be graded properly and should be selected based on the rating of cables. The cables shall be laid in trenches/overhead racks wherever available. The cables from cable trenches to the switcher shall be buried (as per standard practices and or taken through GI pipes to 1.2 m above ground/racks floor level. The cables taken over racks/ walls/ columns/ trusses shall be properly clamped using aluminium clamps of 16 SWG 1/4 hard or 3/4 hard sheet, the width varying from 12.5 to 25 mm at intervals of 750 mm. 225 mm minimum horizontal interaxial spacing shall be maintained when more than one cable is laid in same trench. Suitable and permanent type of cable markers is to be provided indicating the route and position of joints of cable. Loops should be provided at either ends of the cable. Identification tags should be provided for each cable in the trench at a distance of 3 metres.

Supply and installation of danger notice boards, where required, and other provisions under the statutory rules and regulations shall be included in the scope of this work.

The Contractor has to provide materials and carry out the wiring work including earthing according to IS 3043 unless otherwise specified and get it approved before using for work, by the authorised engineer of the Purchaser.

The complete installation work shall be conforming to NEC-1985 and complying with the Indian Electricity Rules and to meet the approval of the State Electrical Inspector etc. Installation of all switch boards and distribution boards should be in conformity with Rule 51(1)(c) of I.E.R. 1958. MV installation should conform to I.S. 7732.

The cable terminations and earth terminations, wherever required, shall only be using compression type cable glands and suitable lugs.

All the materials to be supplied for this work shall be got approved by the concerned engineer at site.

The work will be considered complete only if the following tests are conducted, by the contractor at his own cost, satisfactorily in the presence of the site Engineer and are:

a) Insulation test

b) Earth resistance test and

c) Continuity test

Laying of Cables (underground system)

a) Cables shall be so laid in ground that these will not interfere with other underground structures. All water pipes, sewage lines or other structures, which become exposed by excavation, shall be properly supported and protection from injury until the filling has been rammed solidly in places under and around them. Any telephone or other cables coming in the way are to be properly shielded diverted as directed by the Purchaser.

b) Cables shall be laid at minimum depth of 750 mm in case of LT & 1200 mm in case of HT, from ground level. Excavation will be generally in ordinary alluvial soil. The width of the trench shall be sufficient for laying of required number of cables.

c) Sand bedding 75 mm thick shall be made below and above the cables. A layer of bricks (full size) shall be laid on the edge, above sand bedding on the sides of cables and a flat brick to cover cable completely. More than one cable can be laid in the same trench by providing a brick on edge between two cables. However the relating location of cables in trench shall be maintained till termination. The surface of the ground after back filling the earth shall be made good so as to conform in all respects to the surrounded ground and to the entire satisfaction to the Engineer-in-charge.

d) For all underground cables, route markers should be used.

   i) Separate cable route markers should be used for LT, HT and telephone cables.

   ii) Route markers should be grounded in ground with with 1:2:4 cement concrete pedestal size 230 x 230 x 300 mm.

   iii) Cable markers should be installed at an interval not exceeding 50 M along the straight routes of cables at a distance of 0.5 M away from centre of cable with the arrow marked on the cable markers plate indicating the location of cable. Cable markers

should also be used to identify change in direction of cable route and for location of every joint in underground cable.

e) RCC hume pipes for crossing road in cable laying shall be provided by Contractor. RCC hume pipe at the ends shall be sealed by bituminous compound after laying and testing of cable by electrical Contractor without any extra charge.

Laying of Cables under Floors

a) GI class A pipe shall be used for laying of outgoing cables from distribution boards to various equipment. Preferably one cable shall be drawn through one pipe. Size of pipe shall be such that after drawing of cable 40 % area is free. If length of pipe is more than 30 M, free area may be increased to 50 %.

b) Use of elbows is not allowed at all and number of bends shall be kept minimum. Instead of using bends with sockets, pipe bending machine shall be used for making long smooth bends at site.

c) Ends of pipe shall be sealed temporarily while laying with cotton/jute/rubber stopper etc. to avoid entry of building material.

d) Exact locations of equipment shall be ascertain prior to laying of pipe.

Laying of Cable in Masonry Trenches

a) Masonry/concrete trenches of laying of cable shall be provided by Contractor. However steel members such as MS angles/flats etc. shall be provided & grouted by electrical Contractor to support the cables. Cables shall be clamped to these supports with aluminium saddles/damps. More than one tier of cables can be provided in the same trench if the number of cables is more.

b) Entry of cables in trenches shall be sealed with bituminous MASTIC compound to stop entry of water in trenches.

Laying of Cables in Cable Racks

Cable Racks to be used for cables laid indoors except for single cables. The cable racks shall be of ladder type fabricated out of structural steel, MS, GI or aluminium perforated as indicated. The cable racks shall be of adequate strength to carry the weight of cables with out sagging. Structural bracket grounted in the build up trenches to support the cable such supports shall be at intervals of not less than 750 mm centres. All the structural steel work shall be finished with two coats of paint over primer.

a) Cables shall be fixed in cable trays in single tier formation and shall be clamped with aluminium flat clamps and galvanised bolts/unit.

b) Earthing flat/wire can also be laid in cable tray along with cables.

c) After laying of cables minimum 20 % area shall be spare.

Laying of Cables on Building Surface/Structure

a) Such type of cable laying shall be avoided as far as possible and will be allowed only for individual cables or small group of cables which run along structure.

b) Cables shall be rigidly supported on structural steel/masonry using individual cast/malleable iron galvanised saddles and these supports shall be approximately 400 to 500 mm for cables upto 25 mm overall diameter and maximum 1000 mm for cables larger than 25 mm. Unsightly sagging of cables shall be prevented. Only aluminium/GI clamps with GI bolts/nuts shall be used.

c) If drilling of steel structure must be resorted to, approval must be secured from the Engineer-in-charge and steel must be drilled where the minimum weakening of the structure will result.

Termination and Jointing of Cables

a) Use of Glands

All PVC cable upto 1.1 kV grade, armoured or unarmoured shall be terminated at the equipment/junction box/ isolators/push buttons/control accessories, etc. by means of suitable size compression type cable glands armour of cable shall be connected to earth point. The Contractor shall drill holes for fixing glands wherever necessary. Wherever threaded cable gland is to be screwed into threaded opening of different size, suitable galvanised threaded reducing bushing shall be used for approved type.

In case of termination of cables at the bottom of the panel over a cable trench having no access from the bottom, a close fit holes should be drilled in the bottom plate for all the cables in one line, then bottom plate should be split in two parts along the centre line of holes. After installation of bottom plate and cables with glands, it shall be sealed with cold sealing compound.

b) Use of Lugs/Sockets

All cable leads shall be terminated at the equipment terminals, by means of crimped type solder less connectors unless the terminals at the equipment ends are suitable for direct jointing without lugs/sockets.

The following is the recommended procedure for crimped joints and the same shall be followed:

i) Strip off the insulation of the cable end with every precaution, not to severe or damage any stand. All insulation to be removed from the stripped portion of the conductor and ends of the insulation should be clean and square.

ii) The cable should be kept clean as far as possible before assembling it with the terminal/socket. For preventing the ingress of moisture and possibility of re-oxidation after crimping of the aluminium conductors, the socket should be fitted with corrosion inhibiting compound. This compound should also be applied over the stripped portion of the conductor and the palm surface of socket.

iii) Correct size and type of socket/ferrule/lug should be selected depending on size of conductor and type of connection to be made.

iv) Make the crimped joint by suitable crimping tool.

v) If after crimping the conductor in socket/lug, same portion of the conductor remains without insulation the same should be covered sufficiently with PVC tape.

c) Dressing of Cable inside the Equipment

After fixing of cable glands, the individual cores of cable shall be dressed and taken along the cableways (if provided) or shall be fixed to the panels with polyethylene straps. Cable shall be dressed in such a manner that small loop of each core is available inside the panel.

For motors of 20 HP and above, terminal box if found not suitable for proper dressing of an aluminium cables, the Contractor shall modify the same without any additional cost.

Cables inside the equipment shall be measured and paid for.

d) Identification of Cables/Wires/Cores

Power cables shall be identified with red, yellow & blue PVC tapes for trip circuits identification, additional red ferrules shall be used only in the particular cores of control cable at the termination points in the switchgear/control panels and control switches.

In case of control cables all cores shall be identified at both ends by their wire numbers by means of PVC ferrules or self sticking cable markers, wire numbers shall be as per schematic/connection drawing. For power circuit also wire numbers shall be provided if required as per the drawings of switchgear manufacturer.

Testing of Cables

a) Before energising, the insulation resistance of every circuit shall be measured from phase to phase and from phase to ground. This requires 3 measurements if one side is grounded and 6 measurements for 3 phase circuits.

b) Where splices or terminations are required in circuits rated above 650 volts, measure insulation resistance of each length of cable before splicing and/or terminating. Report measurements after splices and/or terminations are complete.

c) DC High Voltage test shall be made after installation on the following:

i) All 1100 Volts grade cables in which straight through joints have been made.

ii) All cables above 1100 V grade.

For record purposes test data shall include the measured values of leakage current versus time.

The DC High Voltage test shall be performed as detailed below:

Cables shall be installed in final position with the entire straight through joints complete. Terminations shall be kept unfinished so that motors, switchgear, transformer etc. are not subjected to test voltage.

The test voltage and duration shall be as per relevant codes and practices of Indian Standards Institution.

Proforma for Testing Cables

Proforma - A

Date of Test

a) Drum No. from which cable taken

b) Cable from to

c) Length of run of this table metre

d) Insulation resistance test :

Voltage of Megger ..... Volts

i) between core-1 to earth..... Megaohm
ii) between core-2 to earth..... Megaohm
iii) between core-3 to earth..... Megaohm
iv) between core-1 to core-2..... Megaohm

v) between core-2 to core-3..... Megaohm
vi) between core-3 to core-1..... Megaohm

e) Highvoltage test Voltage Duration
i) between cores and earth
ii) between individual cores

Signature of Engineer-in-Charge

Signature of Contractor

Proforma - B

Cable Laying

(To be shown for each cable separately, voltage wise)

Date(s) of Test:.....
Voltage of Megger used:.....

Continuity of cores	IR value (mega ohm)		
	Before laying	Before back filling	
	Between value	Between	Value
1) From.....To.....PVC/XLPE.....x.....sq.mm LV/MV/HV cable.....m in length.			
	R-N		R-N
	Y-N		Y-N
	B-N		B-N
	R-Y		R-Y
	B-R		B-R
	Y-B		Y-B
	R-E		R-E
	Y-E		Y-E
	B-E		B-E

Signature of Engineer-in-Charge

Signature of Contractor

Proforma - C

Cable Jointing

(To be shown for each cable separately, voltage wise)

Date(s) of Test:.....

Voltage of Megger used:.....

			1	2	3
Number of Joint					
Location					
Type of cable(s)					
Type of joint (Indoor/Outdoor, straight through/termination, LV/MV/HV)					

Insulation resistance (Mega ohm) before jointing

Cable I -	(a) Between	R & Y			
		Y & B			
		B & R			
	(b) Between	R & N			
		Y & N			
		B & N			
	(c) Between	R & E			
		Y & E			
		B & E			
		N & E			
Cable II -	(a) Between	R & Y			
		Y & B			
		B & R			
	(b) Between	R & N			
		Y & N			
		B & N			
	(c) Between	R & E			
		Y & E			
		B & E			
		N & E			

Insulation resistance (Mega ohm) of Jointed cable

Cable I -	(a) Between	R & Y			
		Y & B			
		B & R			
	(b) Between	R & N			
		Y & N			
		B & N			
	(c) Between	R & E			
		Y & E			
		B & E			
		N & E			

Signature of Engineer-in-Charge

Signature of Contractor

Proforma - D

Testing Before Commissioning

(a) Cable Work Date(s) of Test:.....

(i) Details of high Voltage test conducted

System of supply.....
Test Voltage applied…….....kV…….....Minutes
Result of test-Satisfactory/Unsatisfactory.

Voltage of Megger used:-
Result of Megger testing:-

Between	R & Y
	Y & B
	B & R
Between	R & N
	Y & N
	B & N
Between	R & E
	Y & E
	B & E
	N & E

Earthing

Scope

The scope of this section shall cover the following:

a) Earthing station
b) Earthing conductors
c) Earthing of equipment and installation

Standards

The following standards shall be applicable:

IS : 3043 COP for earthing
IS : 5216 Safety procedures & practice in electrical work

Earth Station

The earth station shall be made by excavating the ground to a depth as required and the excess earth after back filling shall be removed from site. Ground with rocky strata, the depth of excavation shall be less. However

additional earthing stations or earth matting to be provided to achieve the system earthing less than one ohm.

Electrodes

Sufficient number of earth pits shall be provided and inter-connected so as to have the resistance of the earthing installations not more than 1 ohm. In case the soil resistivity is found to be very high, a high sensitive relay may be used to co-relate the relay setting with high earth resistance.

a) Various types of electrodes

i) Pipe electrode shall be buried in the ground vertically with its top at not less than 20 cm below the ground level. The installation shall be carried out as shown in the figure and as directed by the Engineer-in-charge.

ii) Plate electrode shall be buried in ground with its face vertical, and its top not less than 2 m below the ground level. The installation shall be carried out as directed by the Engineer-in-charge.

iii) a) The strip or conductor electrode shall be buried in trench not less than 0.5 m deep.

b) If conditions necessitate the use of more than one strip or conductor electrode, they shall be laid as widely distributed as possible, in a single straight trench where feasible, or preferably in a number of trenches radiating from one point or as directed by the Engineer-in-charge.

Earthing Conductor (Main earthing lead)

The earth conductors shall be fixed to the wall/columns etc at every 500 mm centres with 10 mm spacers. The total earthing system shall be mechanically and electrically connected to provide independent path to earth.

i) In the case of plate earth electrode, the earthing conductor shall be securely terminated on to the plate with two bolts, nuts, check nuts and washers.

ii) A double C-clamp arrangement shall be provided for terminating tape type earthing conductor with GI watering pipe coupled to the pipe earth electrode. Galvanised “C” shaped strips, bolts, washers, nuts and checknuts of adequate size shall be used for the purpose.

iii) The earthing conductor from the electrode upto the building shall be protected from mechanical injury by a medium class,

minimum 15 mm dia. GI pipe in the case of wire, and by 40 mm dia. medium class GI pipe in the case of strip. The protection pipe in ground shall be buried atleast 30 cm deep to be increased to 60 cm in case of road crossing and pavements). The portion within the building shall be recessed in walls and floors to adequate depth in due co-ordination with the building work.

iv) The earthing conductor shall be securely connected at the other end to the earth stud/earth bar provided on the switch board by bolt, nut and washer.

Earth bus and main earthing terminal

i) The Main Earth bus shall be laid as directed by the Engineer-in charge.

ii) Following conductors shall be terminated into the main earthing terminal/earth bus.

a) Earth connection from the Substation.

b) Earthing conductor from electrode.

c) Protective conductors;

d) Equi-potential bonding conductors.

Protective (Loop earthing/earth continuity) Conductor

i) Earth terminal of every switch board in the distribution system shall be bonded to the main earth bus.

ii) Two protective conductors shall be provided for a switchboard.

iii) A protective conductor shall securely connect the earth connector in every distribution board (DB) to the earth bus.

iv) All metallic switch boxes and regulator boxes in a circuit shall be connected to the earth connector in the DB by protective conductor.

v) The earth pin of socket outlets as well as metallic body of fan regulators shall be connected to the earth stud in switch boxes by protective conductor.

Marking

i) Earth bars/terminals at all switch boards shall be marked permanently, either as E or as

ii) Main earth terminal shall be marked “Safety Earth – Do Not Disconnect”.

Proforma for testing Earth Electrodes

i) Total number of earth electrodes.....
ii) Earth resistance of each earth electrode:

Sl.No.	Location	Value

Signature of
Engineer-in-Charge

Signature of
Contractor

19.MEASUREMENT

Quantities

The quantities set out in the Schedule of Requirements are the estimated quantities of the work, but they are not to be taken as the actual and exact quantities of the Work to be executed by the Contractor in fulfillment of his obligations under the Contract.

Works to be Measured

The Consultant/Client shall, except as otherwise stated, ascertain and determine by measurement the value in terms of the Contract of work done in accordance with the Contract. He shall, when he required any part or parts of the Work to be measured, give notice to the Contractor's authorised agent or representative, who shall forthwith attend or send a qualified agent to assist the Engineer in making such measurement, and shall furnish all particulars required by either of them. Should the Contractor not attend, or neglect or omit to send such agent, then the measurement made by the Engineer or agent approved by him shall be taken to be the correct measurement of the work. For the purpose of measuring such permanent work as is to be measured by records and drawings, the Consultant shall prepare records and drawing month by month of such work and the Contractor, as and when called upon to do so in writing, shall, within fourteen days, attend to examine and agree such records and drawings with the Consultant and shall sign the same when so agree such records and drawings, they shall be taken to be correct. If, after examination of such records and drawings the Contractor does not agree the same or does not sign the same as agreed, they shall nevertheless be taken to be correct, unless the Contractor shall, within fourteen days of such examination, lodge with the Consultant, for decision by the Consultant, notice in writing of the respects in which such records and drawing are claimed by him to be incorrect.

Mode of Measurement

The Works shall be measured net, as prescribed in the specification of work, notwithstanding any general or local custom, except where otherwise specifically described or prescribed in the Contract. Wherever not specifically mentioned in the Contract, the mode of measurement as prescribed in the relevant IS codes shall be applicable and binding to the Contract. Only the latest editions of all the codes of practices including all latest official amendments and revisions shall be applicable.

Battery Limit

Scope of work includes:

1. Supply and installation of,,LT panel boards, street light poles wiring, Supply and installation of Distribution board and accessories, light fixtures and fans

2. Stringing of HT/LT over head lines with all the necessary accessories, lighting Cable laying, termination at both ends, testing & commissioning, etc.

3. Earthing system includes supply, installation and testing of earth pits and relevant earth conductors as per specification.

4. Wherever buried cables are envisaged, scope of work includes digging of earth along the cable route, filling up of sand protective covering as per specification, laying of cable, covering the cables with sand bricks, back filling of earth etc., as per specification. Installation of Hume pipes including excavation, erection, back filling etc. Cable markers shall be supplied & installed as per specification.

5. Civil work includes grouting of equipment, Foundations for over head poles, panel boards, fixing of cable trays, pipes with all necessary supports.

6. In addition to the electrical erection the contractor shall provide the electrical danger boards, shock treatment charts, etc. on all the panel boards and other places where it is required.

7. The rates quoted for installation should include the charges for painting the poles and supports as directed by Engineer- In charge

20 APPROVED MAKES OF EQUIPMENT AND MATERIALS

Scope

The scope of this section covers the recommended makes of equipment, material components. The final choice of makes shall be indicated at the time of finalistation of order.

The makes of material offered by the contractor shall be indicated at the space provided for proper evaluation of the offer and shall be one of the recommend makes. In the absence of such indication, the decision rests with the Purchaser/consultant.

Makes recommended

The makes of material recommended are exhibited in respective section. The offers shall be strictly on the basis of the makes recommended.

Where specified make and model nos. are indicated in the schedule of requirements, the bidder should quote for the same items.

List of Approved Makes of Equipment and Materials

Sl.No.	Item	Make of Materials/Equipment
1.	Switches, Sockets & Accessories	Legrand /Schneider / GM / Panasonic
2.	LT Wires (FRLSH) /LT Cables (XLPE)	Polycab/RR KABEL/Gloster/Apar
3.	TV Coaxial Wires	Polycab/RR KABEL
4.	Optical Fiber Cable	Systimax/Commscope
5.	CAT6 Cable	Polycab/RR KABEL
6.	Telephone Wires	Polycab/RR KABEL
7.	PVC Pipes & Accessories	Balco/Toms
8.	Disribution Boards	Legrand/Schneider
9.	MCBS / RCCBS / RCBO / Isolators	Legrand/Schneider
10.	MCCB	L&T
11.	Industrial Socket Outlet	Cape / OBO
12.	Surge Protection Device (SPD)	Cape / OBO
13.	Maintenance Free Earthing	Cape / OBO
14.	External Lightning Protection	Cape / OBO
15.	Weather Proof Box	Cape / OBO
16.	Uninterruptible Power Supply	Delta/Legrand-Numeric/Hykon

17.	Light Fittings	Wipro/Crompton/Jaquar
18.	Exhaust Fan	Crompton/Havells
19.	CCTV	Hikvision/CP Plus/Dahua
20.	Measuring and Indicating Metres	HPL/ L&T/ MECO/ Rishabh/ Universal
21.	Current Transformer	Kappa/Intrans/PGR Power Tech
22.	MCCB/ACB	Siemens, Schnieder, L&T, ABB, Legrand
23.	Capacitor Banks	L&T, Saha, Sprague, ABB, shreem, Epcos, Schnieder
24.	Starters, Timer & Contactors	Siemens, L&T, Schneider, C&S. ABB, BCH.
25.	SDFU, Isolator, SFCOS	L&T, Siemens, Schnieder, ABB
26.	Push Buttons	Tecnic, Schneider, Siemens, BCH, C&S, L & T, ABB
27.	LT Panels	CPRI certified panel manufacturer with components of approved makes.
28.	Digital meters	L&T, ABB, Siemens, Schneider, Socomec, Secure
29.	APFC relay	ABB, Beluk, Epcos
30.	Indicating lamps (LED type)	Tecnic, Schneider, Siemens, BCH, C&S, L & T
31.	Fuses/Fuse carriers	Siemens, L & T, Schnieder, ABB.
32.	Relays	Siemens, L&T, ABB, GE, Schneider, Alstom, C&S
33.	Indicating meters(analog)	AE, MECO, L&T, HPL, Schneider, Secure, Socomec
34.	Instrument Transformer	AE, Intrans, Kappa, Intech, PGR Powertech
35.	Selector switches	L&T, C & S, Siemens, Schnieder, BCH, Teknic, Kaycee
36.	660/1100 volt grade stranded unsheathed wire with copper conductor	Finolex, RR Kabel, Lapp Kabel, Polycab, KEI
37.	Cable glands, lugs, End termination kits	Lapp Kabel, Gripwel, HMI, Denson, Multipressings, Yamuna Gasses, Dowels, Jainsons, Axis
38.	Battery Charger	Amara Raja, Waves Electronics, HBL
39.	TOD meter	L&T, Schnieder, Secure
40.	Exhaust Fans	Almonard, Crompton, polar, Khaitan, Baliga

* For these items sample shall be approved by the Engineer in Charge

TECHNICAL SPECIFICATIONS- FIRE FIGHTING WORKS

1. SCOPE WORK

The scope of the work covers design, supply of materials, installation, testing and commissioning of Fire Hydrant & Sprinkler System and Fire detection & Alarm system.

The hydrant system, detection systemlayout is attached in the tender document. All the equipment and installation shall conform to specifications contained in Indian Standards.

The installation of system shall conform to norms as per National Building Code.

The scope of work also includes obtaining final certificate of approvals/ NOC for the systems from State Fire Department and liaison works with the department.All incidental expenses in this regard shall be borne by the contractor.However the statutory fees paid to the authorities will be reimbursed on submission of the documentation evidence.

The bidder shall visit the site before submitting the tender and familiarize the work and nature of site condition.

2. Works to be done by the Contractor

In addition to supply, installation, testing and commissioning of all equipments and materials as per schedule of work, the following works shall be deemed to be included within the scope of work to be executed by the contractor, whether or not indicated in the schedule of work.

(i) All minor building work, such as cutting and making good the damages and filling up the hole in flooring with cement concrete, after laying the wet riser pipes.

(ii) Cabling and earthing including inter-connection etc. necessary to comply with the regulations as well as proper and trouble free operation of the equipment inclusive of all accessories.

(iii) Necessary equipments and consumables for testing and commissioning of the system.

(iv) Approval from Local Fire Authorities as may be required as per local bye-laws. The contractor shall be responsible to arrange an inspection visit of concerned fire officer before start of work and shall carry out any rectification / modification as may be suggested by the Fire Officer and obtain necessary fire clearance certificate. The contractor shall also obtain clearance from electrical inspectorate for energisation of electrical items included in his scope.

(v) The installation shall be carried out strictly in accordance with the approved drawing.

(vii) RCC foundation for all pumps sets, water monitors and water-foam monitors.

(viii) Vibration elimination arrangements (anti-vibration pads) for all pumps sets.

(ix) Necessary supports and clamps for pipes for the fire fighting, in the buildings, pump room.

(x) Supporting brackets/frame work for the fuel oil tank and the fuel tank of capacity as mentioned in the schedule of quantities.

(xi) Provision of necessary cement concrete intermediate supports, as required in approved manner in case of soils which are not strong enough to support the pipes, thereby likely to cause differential settlement.

(xii) Necessary anchor blocks of ample dimensions in cement concrete at all bends, tees,connections, foot of the wet riser, and other places as required to stand the pressure thrust in pipes.

(xiii) Preparation of shop drawings and getting the same approved by the client/Consultant before execution. Preparation of drawings to be submitted for approval from statutory authorities.

(xiv) Necessary masonry work/steel work for supporting hose cabinets for external (yard) hydrants.

(xv) All the required control piping, drain piping from the pumps to the drain point in the pump room, overflow piping from priming tank to the sump. The piping work shall include all necessary fittings, valves and accessories for effective functional requirements.

HYDRANT SYSTEM

1. STANDARDS

The manufacture, identification of material and testing of equipment covered in this specification shall comply with the latest editions as on date of opening of tenders of the appropriate standards of the following. Unless otherwise specified, Indian Standards are preferred. All the appliances and accessories shall carry IS or International certification and shall be of approved make.

IS: 325 Induction motors

IS 636-1988 Non percolating flexible fire fighting delivery hose (third revision)

IS 694-1990 PVC insulated cables for working voltages upto and including 1.100volts (third revision)

IS 778-1984 Copper alloy gate, globe and check valves for water works purposes (fourth revision) (Amendment 2)

IS 780-1984 Sluice valves for water works purposes (50 to 300 mm) size (sixthrevision) (amendment 3)

IS 900-1992 Code of practice for installation and maintenance of induction motors (second revision)

IS 901-1988 Specification for couplings, double male and double female, instantaneous pattern for firefighting (third revision)

IS 902-1992 Suction hose coupling for firefighting of purposes (third revision)

IS 903-1984 Specification of fire hose delivery couplings branch pipe, nozzlesand nozzle spanner (third revision) (Amendment 5)

IS 937-1981 Specification for washers for water fittings for firefighting purposes(revised) (with amendment No, 1)

IS 1239-1968 (Part-I) Specifications for mild steel tube, tubular and other steel pipe fittings.

IS 1239-1968 (Part-II Specifications for mild steel tube, tubular and other steel pipe fittings.

IS: 1255 Code of practice for installation and maintenance of power cables

IS 1520-1980 Horizontal centrifugal pumps for clear cold, fresh water (second revision)

IS 1536-1976 Specification for centrifugally Cast (Spun) Iron pressure pipes with flanges for water, gas and sewage.

IS 1538 (Part 1 to 23) Specification for Cast Iron fittings for pressure pipes for water, gas and sewage.

IS 1554-1988 Part II PVC insulated (heavy duty) electric cables (working voltage from 3.3 KV upto and including 11 KV (second revision)

IS 1648-1961 Code of practice for fire safety of buildings (General) Firefighting Equipment and its maintenance (with amendment No.1)

IS: 1652 Batteries

IS: 3043 Code of practice for earthing.

IS 3589-1981 Pressure and vacuum gauges (Second revision)

IS 4736-1986 Galvanizing G.I. Pipes

IS: 5216 Guide for safety procedures and practices in electrical work.

IS 5290-1983 Specification for landing valves (second revision) (with Amendments

IS 5312- 1984 Part I Swing check type reflux (non return) valves Part I-single door pattern (with amendments nos. 1 & 2)

IS 5312- 1986 Part II Swing check type reflux (non return) valves Part II-Multidoor pattern (with amendments nos. 1 & 2) No.6)

IS: 5578 Guide for marking of insulated conductors

IS: 5959 Specification for polyethylene insulated PVC sheathed heavy duty electric cables, voltage not exceeding 1100 V

IS: 5959 — do — voltage 3.3 kV to 11 kV

IS 7285 Seamless cylinders for storage of gas at high pressure.

IS 8442 Specification for stand post type water and foam monitor for fire fighting

IS: 13947 SDFUs

In case where the offer deviates from the specified standards, the tenderer shall indicate clearly in the offer the alternative standards proposed to be adopted and details thereof.

Unless otherwise mentioned, all applicable codes and standards shall be of the latest editions as published by the Indian Standards and all other such as may be published by them during the tenure of the contract, and shall govern in respect of workmanship, properties of materials, installation and methods of testing. In case where suitable Indian Standards are not available, generally accepted codes and practices as approved by consultant/client shall be adopted.Any changes or modifications directed by consultant/client shall also be incorporated by the contractor during execution of the work.

2. PUMPS AND ACCESSORIES

The pumping system consists of four pumps.

i). Electric Main Pump
ii). Diesel Stand By Pump
iii). Jockey Pump
iv). Terrace Pump

The fire pumps shall be of centrifugal, end suction type.The main, standby and jockey pumps shall be direct-couplednot belt-driven.Parts of pumps like impeller, shaft sleeve, wearing sleeves, shaft etc. shall be of cast iron. The body of the pumps shall be of cast iron and shall withstand 1.5 times working pressure, the protection class for the body shall confirm to IP55 Standards. Pumps shall be capable of furnishing not less than 150% of the rated capacity at a head not less than 65 % of the rated head. The shut-off rate shall not exceed 120% of the rated head in the case of horizontal pumps. Each pump shall be provided with a nameplate showing the delivery head, discharge capacity and the RPM. Pumps shall be securely mounted on a robust bedplate of horizontal type with ant vibration pads, and shall be free from vibration at all varying loads. Suitable concrete foundation shall be provided for all pumps, the drawings of which are to be submitted to the client/Consultant for approval before construction at site.

Theelectric driven pumps and diesel enginedriven pump shall be interconnected through pressure switches and panel board such that only electric driven pump shall operate first in the event of low system pressure and the latter operates automatically in case of failure of the former within a specified switchover time or fall in pressure.

The Jockey pump shall have automatic starting and stopping arrangements to maintain the system pressure. The terrace pump shall be manually operated in case of emergency. Sequence of operation of pumps is mentioned in the section ‘Inspection and Testing’.Two pumps should never run simultaneously at any condition.

3.Diesel Engine

a. 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 multi cylinder/vertical, 4-stroke cycle, water-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 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 the rated head. The engine shall be capable of continuous non-stop operation for 8 hours. 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 B.S. 649/IS 1601/IS 10002, all amended up to date.

b. Cooling System

The engine cooling system shall be radiator water cooled system. The radiator assembly shall be mounted on the common baseplate. The radiator fan shall be driven by the engine as its auxiliary with a multiple fan belt. When half the belts brake remaining belts must be capable of driving the fan. Cooling water shall be circulated by means of an auxiliary pump of suitable capacity driven by the engine in a closed circuit.

c. Fuel System

The fuel shall be gravity fed from the engine fuel tank to the engine driven pump. The engine fuel tank shall be mounted either over or adjacent to the engine itself suitably wall mounted on brackets. The fuel filter shall be suitably located to permit easy servicing.

The engine fuel tank shall be welded steel construction using MS sheets(3mm thick) with proper primer coating,painting as instructed by the Engineer-in-Charge and of capacity sufficient to make the engine to run on full load for at least 8 hours. The tank shall be complete with necessary supports, level indicator (protected against mechanical injury),inlet, outlet, over flow connections drain plug and piping to the engine fuel tank. The outlet should be so located as to avoid entry of any sediment into the fuel line of the engine. Necessary MS fuel &Bypass piping shall be provided from the Tank to the diesel engine

d. Lubricating Oil System

Forced feed Lubricating Oil system shall be employed for positive lubrication. Necessary Lubricating Oil filters shall be provided and located suitably for convenient servicing.

e. Starting System

The starting system shall comprise of necessary battery/batteries, starter motor of adequate capacity and axle type gear to match with the toothed ring fly wheel and starter panel equipped with solenoid stop for emergency stopping of the engine. Suitable metallic relay to protect starting motor from excessively long cranking runs shall be included within the scope of the work. The metallic relay protection shall be integrated with engine protection system.

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.

f. Exhaust System

The exhaust system shall be complete with silencer suitable for indoor installation, and silencer piping including bends and accessories needed. The exhaust pipe shall protrude outside the pump room.The total backpressure shall not exceed the engine manufacturer's recommendations. The exhaust piping shall be suitably supported and the pipe used shall be of medium class MS pipe. The exhaust pipe shall be extended up to 1 m. outside pump house duly insulated with 50 mm thick glass wool with 1.0 mm thick aluminium sheet cladding.

g. Engine Shut Down Mechanism

This shall be manually operated and shall return automatically to the starting position after use.

h. 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.

i. Engine Instrumentation

Engine instrumentation shall include the following:-

a. Lubricating Oil Pressure Gauge
b. Lubricating Oil temperature gauge
c. Water temperature gauge

d. Water pressure gauge
e. Tachometer
f. Hour meter
g. Starting key

The instrument panel shall be suitably mounted on the floor using suitable support/pedestal close to the engine.

j. Pipe Work

The piping for exhaust outlet as well as fuel piping between fuel tank and the engine shall be with Medium class M.S.

k. 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 in the report, which will be submitted to engineer-in-charge before installation.

l. Battery Charger

Necessary float and boost charger shall be incorporated in the control section of the power and control panel to keep the battery under trickle condition. Ammeter to indicate the state of charge of the batteries shall be provided.

m. Motor

The motors used for the fire pumps 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 confirming to protection clause IP 55 of IS 4691. The class of insulation shall be "F". The motor shall conform IS 325-1978 and rated for continuous duty.Earthingand cabling to motors from feeder panel is included in the contractors scope.

n. Motor Starter

The motor starter for pumps above 7.5 HP shall be of Star Delta type and for pumps below 7.5 HP shall be of Direct On Line type,without volt trip. Starter shall conform to IS 1822-1967.

4.HYDRANT SYSTEM AND PIPING

a MS Pipes

The MS pipes used shall be of standard IS 1239, medium duty type (Class B), electric resistance welded and shall be free from scale, cracks, surface flaws and other defects.

b) Exposed/Above ground (AG) pipes

Exposed/Above ground (AG) pipe lines and fittings shall be coated with one coat of suitable primer and two coats of suitable paint as per IS approved color code. The surfaces shall be properly cleaned before applying the primer. AG pipes shall be supported at regular intervals on masonry, RCC, truss, beams, roofs, trenches etc. The minimum spacing of supports shall be as shown below:-

Pipe dia. in mm
80, 100 and 125 : 3.5 m
150, 200 and 250 : 5.0 m

c) Under ground (UG) pipes

Underground pipes shall be laid such that the top of the pipe is not less than 1 m below the ground level. Pipes if laid through built-in trenches shall be supported by PCC blocks (1:2:4) of suitable size as decided by the engineer in charge at intervals of 3.5 m trenches. The bends and joints shall also be supported at both sides using PCC blocks. Pipes shall be laid through hume pipes of Class NP3 in road crossings. Mains shall not be laid under buildings. The underground pipes shall be applied with standard anti-corrosive treatment as described below.

d) Anti-corrosive treatment for UG pipes

For applying anti corrosive treatment, pipes are initially wire brushed to remove all foreign matters. It shall be with two coats of asphaltic primer and the primer shall be allowed to dry until the solvent evaporates and the surface becomes tacky. Then the pipes are wound with polymeric mix of approved make to a thickness of 4 mm. The mix shall be wound around the pipes and the overlap is maintained at 15 mm. The material shall conform to IS 10221.

e) Fittings

Fittings installed underground shall be of MS conforming to IS-1239 (Part-II). All fittings shall be able to withstand atleast a pressure of 150 % of the maximum working pressure. Welded fitting according to the laid down welding procedure are permitted. Welded parts shall be suitably coated after welding as per the requirement of the areas. Welded joints are not permitted for fittings of less than 50 mm dia.

f) Flanges

The flanges shall be of heavy duty type manufactured from material as per standards mentioned having flat face as per requirement and its dimensions shall also satisfy appropriate standards. All bolt holes in flanges shall be drilled. The drilling of each flange shall be in accordance with relevant Indian Standards. The gaskets used in all flange joints shall be of standard size and are to be approved, verified and checked before use. Fixing of gasket is to be as per standard procedures so as to ensure efficient and quality type joints. The flange faces shall be true and perpendicular to the axis of the pipes, and if due to other various reasons, such as, but not necessarily limited to the process and / or layout requirements, it is not feasible, the Contractor shall ensure that the joints shall be drawn up in order to provide even and adequate

uniform pressure on gaskets. All flanges shall be installed such that the bolt holes straddle the normal centerlines.

g) Welding procedure

The welding procedure shall only be carried out by fully trained and experienced welders and shall conform to IS-823. CONSULTANT/CLIENT reserves the right to set the correct welding procedure, if not satisfied. The welding electrode shall be of reputed make, and shall have suitable coating complying with relevant Indian Standards.

h) Air cushion tank

The air cushion tank shall be of 150 mm dia. and 1200 mm height fabricated out of 6 mm MS sheet steel and shall be complete with 20 mm dia. air release valve and associated piping work, etc. It shall be constructed with air outlet at the top. Drain valves of gun-metal shall be provided at the lowest points of the piping work to enable draining of water from the system. The drain valves assembly shall include nipple and PVC rubber hose.

i) Diesel tank

Diesel tank shall be fabricated out of MS steel sheet of thickness 4 mm with inlet, outlet, open/close valves, by-pass lines, clear level indicators, drain pipes, MS ¼" fuel lines to the diesel engine, etc. The same shall be installed at a suitable height in the pump house with necessary supports. The drawings of the tank shall be prepared and approved before fabrication and installation.

j) Butterfly Valve (BV)

The butterfly valve shall be wafer type to suit the flanges as per ANSI B 16.5 #150 standards. The body shall be of cast iron with Nitrile bonded seat, SG Iron disc. The valve shall be hand lever operated and having PN16/Class 125 rating.

k) Non Return Valve (NRV)

It shall be of dual plate type. Construction shall be of waferend/ flanged wafer type.The valve shall conform to APS 594/ API 6D/ ANSI 125. The body shall be of cast iron type and having PN16/Class 125 rating

l) Gun Metal Gate Valve

It shall be of IS 778 standards. Construction shall be of globe and lift type with screwed bonnet and inside female screwed construction. Pressure class shall be of PN 16. End connection shall be of screwed type.

m) Pressure gauges

It shall be of dial type with Bourden tube element of SS 316. The dial size shall be 150 mm dia. and scale division shall be in metric unit marked in black on white dial.

It shall be comprised with snubber, isolation coke, nipples, tail, connecting pipes, etc. The range of pressure gauge shall be 0 to 16 kg / sq.cm .

n) Pressure switches

It shall be of industrial type, single pole double throw electric pressure switching designed for starting or stopping equipment when the pressure of the system drops or exceeds the pre-set limits. All switches shall have ¼" BSP (F) inlet connection and screwed cable entry for fixing cable gland. It shall be comprised with snubber, isolation coke, nipples, tail, connecting pipes, etc.

o) Hydrant valves

The external/internal fire hydrantvalves shall be of oblique type single headed of 63 mm dia. conforming to IS-5290 suitable for connecting to 80 mm pipe. The hydrant shall be complete with hydrant valve, other fittings, etc. The hydrant couplings shall be flanged gun-metal with instantaneous female spring-lock of 63 mm dia. and valves shall be of screw down type. Orifice plates of suitable design shall be provided for hydrants wherever required.

The number of fire hydrants in a main of 80 mm dia. shall not feed more than one hydrant, that having a dia. of 100 mm shall not feed more than two hydrants,that having a dia. of 125 mm shall not feed more than three hydrants. The pressure at the most highest end hydrant in the hydrant mains shall be restricted to5 Kg per Sq. cm. All hydrant outlets shall be situated 1 m above ground level.

p) Hose pipes

The hose pipes for hydrants shall be 15m long, 63 mm dia. conforming to BIS Standards with gun metal 63mm size male coupling at one end and female coupling at other end conforming to IS:903. Synthetic fibre circular woven jacketed rubber linked firehose,38Kg/cm2 burst pressure,22Kg/Cm2 proof pressure and 14Kg/cm2 working pressure bearing IS:636-88 type-A mark. Hose is kept in hose boxes alongside hydrants; each box shall contain two lengths of hoses. All the hoses and branch pipes/nozzles shall be kept inside the boxes as per standard practices.

q) Hose reel

The hose reel shall consist of 30 m long 20 mm dia. high Pressure Thermoplastic hose(Textile Reinforced) mounted on heavy duty circular MS drum complete with gun-metal shut-off valve, nozzle, etc. The hose reel bracket shall be of MS fabricated or cast iron swing type suitable for 90 deg. smooth and free rotations in vertical plane conforming to IS-884. The hose reel shall be directly tapped from hydrant mains using 25mm Dia. MS "C" class pipe and gate valve.

r) RRL Hose

The RRL hose for hydrants shall be 15m long, 63 mm dia. Synthetic fibre circular woven jacketed rubber linked fire hose conforming to IS-8423 with gun metal 63mm size male coupling at one end and female coupling at other end conforming to IS: 903.

If hose is kept in hose boxes alongside hydrants, each box shall contain two lengths of hoses. All the hoses and branch pipes/nozzles shall be kept inside the boxes as per standard practices.

s) Hose boxes

The fire hose boxes shall be of size 750x250x600 mm, 16 SWG sheet steel with front side glass of 4 mm thick, lockable hinged door and painted with one coat of primer and two coats of synthetic enamel paint of approved colour.

t) Couplings

All couplings shall be of the instantaneous spring-lock type and the nozzles shall be of not more than 16 mm in dia. All couplings in the branch pipes and nozzles shall be of gun-metal and shall comply with IS-903. The hose shall be attached to the coupling.

u) Fire brigade outlets

The fire brigade collective breaching shall be with 150 mm flange outlet connection with gun-metal twin-siamese collecting head having 4 instantaneous outlets with built-in check valves. The fire brigade breaching shall be connected to the sump and the main header.

v). Foot valve

It shall conform to IS:4038 standard and shall be swing type, C.I. metallic and with grey CI / galvanised steel perforated screen with flanged connection, nut bolts, gasket, washers etc. to be connected only for negative suction. It shall be tested certified for hydrostatic test pressure, for Body: 6 kg/cm2 and Seat : 2 kg/ cm2 . The disc of the valve shall open at a minimum pressure of 0.035kg/cm2.

w). Priming tank

The priming tank shall be of HDPE type and shall be fitted with level indicator, Drain valve,Overflow arrangement etc.

SPRINKLER SYSTEM

1. Sprinklers Design Criteria.

The sprinkler system is designed for a Design Density of 5 lpm/Sq.m and Assumed Maximum Area of Operation (AMAO) is 360 Sq.m. The minimum sprinkler discharge pressure shall be 1 bar and 'K' factor shall be 80. Sprinkler shall not be reconditioned or repaired. Defective sprinklers shall be replaced with new ones. Sprinklers and multiple controls shall not be painted except for the identification purpose. Sprinklers shall be of standard response, standard coverage, upright type with size 15 mm dia. Sprinklers shall have temperature rating for 68 deg. C with Red colour code. It shall have ½" NPT and chrome finish.

2. Arrangement of sprinklers

Sprinklers shall be installed with the axis of the sprinkler perpendicular to the wall. The sprinklers shall be placed such that the minimum distance between 2 sprinklers is 3m - 4m. As far as possible, sprinklers shall be located away from the columns. Sprinklersshall not be connected directly to distribution and main pipes. Sprinklers shall not be provided in the following areas of the building:

Stairs, spaces below stair headings.

Toilets.

Rooms containing electric power distribution apparatus.

Control rooms.

Number of sprinklers that can be installed on range pipes is as given below:

25 mm dia. Range pipe: 2 nos. max.
32 mm dia. Range pipe: 3 nos. max.
40 mm dia. Range pipe: 4 nos. max.
50 mm dia. Range pipe: 9 nos. max.

Number of sprinklers that can be installed on distribution pipes is as given below:
32 mm dia. distribution pipe: 3 nos. max.
40 mm dia. distribution pipe: 6 nos. max.
50 mm dia. distribution pipe: 9 nos. max.
65 mm dia. distribution pipe: 18 nos. max.

3. Supports for sprinkler piping system

Sprinkler pipes shall be supported from the building structure,wall/truss/ purlin and shall not impair the performance of sprinklers under fire conditions. Pipe work shall not be used to support any other loads. Supports shall not be welded or fastened directly to the pipe work. The thickness of pipe supports shall not be less than 3 mm.The weight of pipes filled with water shall be considered for design of structural supports for pipes. Whereverpossible; pipes shall be supported from non-combustible building elements. Pipe works in corrosion areas shall be of either stainless steel or suitably protected against corrosion. Standard pipe hangers such as solid ring, swivel ring, clip, band hanger, bracket, ceiling flange, clamp, etc. shall be used for supports. The spacing between the pipe supports measured along the line of connected pipes shall not be more than the following:

Pipe (MM)	**Spacing (MTR)**	**Size of support**
Up to 25	2.0	6mm
32 to 65	2.4	8mm
75 to 125	2.7	10mm
150 & above	3.0	12mm

INSPECTION AND TESTING

1. General

All site fabricated work/ material shall be subject to inspection in cleaned condition, prior to erection. At no event, site fabricated work /material shall be installed in position without inspection and approval by CONSULTANT/CLIENT. The Contractor shall ensure that each stage of fabrication is carried out in compliance with the procedures specified in the NBC and IS standards as applicable and/or specified in this document.

The contractor shall conduct sample tests of all the materials supplied at reputed laboratories/agencies as directed by CONSULTANT/CLIENT at his own cost and test reports are to be submitted. Inspecting officials of CONSULTANT/CLIENT and Local Authorities shall have the right to access the premises of the work at any time with or without giving prior notice. All the formalities or procedures for conducting the inspections by the authorities as required by them shall be arranged by the contractor free of cost.

All testing shall be carried out in the presence of CONSULTANT/CLIENT / statutory authorities and test registers shall be maintained by the contractor. The contractor shall provide all material, tools, equipment, instruments, services and personnel required to perform the tests and remove debris/water resulting from cleaning and after testing free of cost.

The original test certificates of all tests conducted are to be forwarded to CONSULTANT/CLIENT. After conducting the tests, any defects found on materials, equipment, piping, etc. shall be got rectified/repaired by the Contractor without any extra cost.

2 Testing

Before energising electrically operated equipment, care shall be taken to meet the local electrical rules and regulations, earthing of the body, verifying availability of safe insulation resistance value, etc. Also confirm the motor enclosure to the level of protection required for the particular application.

a. Pumps

The pumps shall be tested according to the standard recommendations of the manufacturer. The following parameters are to be recorded and plotted and submitted to the CONSULTANT/CLIENT.

a. Discharge Q
b. Pressure P or Head H
c. Motor voltage and current.
d. Efficiency

The power consumption is to be computed and cross-checked with manufacturers data. Any abnormalities, if noted, shall be brought to the notice of the manufacturer and necessary corrective action be taken before commissioning and handing over, without any extra cost. Manufacturers test certificates shall also be submitted to CONSULTANT/CLIENT for verification.

b. Piping

All piping shall be tested by filling water, removing air locks, foreign materials, etc. and applying pressure at 1.5 times of the maximum working pressure and see that the pressure drop is within 0.5 Kg per Sq. cm over a period of 2 hours. The testing shall be carried in sections by blocking both ends or closing the valves provided. After completion of the installation and connecting to the mains of pumping system the installation shall once again tested and rectify breakage if any or replace the defective material, free of cost.

Holiday tests for wrapping and coating of MS pipes is essential as per IS-10221.

c. Diesel engine driven pump

All the tests for the diesel engine driven pump as recommended by the manufacturer shall be conducted in the presence of CONSULTANT/CLIENT and the test report shall be submitted for approval. Manufacturers test certificates shall also be submitted to CONSULTANT/CLIENT for verification.

d. Hydrant system

The entire hydrant system shall be tested in the presence of CONSULTANT/CLIENT to ascertain the functioning of each system, equipment, etc. as desired by CONSULTANT/CLIENT. The contractor shall hand over the system only if it is proved that the system performs as per the specifications.

3. Operation of pumps

i) Starting up of the pressurization (Jockey) Pump

The pressure switch shall be set at 5 kg /cm^2 at the lower limit and 5.5 kg/cm^2 at the upper limit. The system drain shall be opened to cause a drop in the pressure. The Jockey Pump shall start as soon as the pressure gauge needle falls down to 5 kg/cm^2. The Jockey Pump shall also automatically stop when the system has been pressurized again upto5.5 kg /cm^2.

ii) The main electric pump shall be set to start at 4 kg/cm^2. An external hydrant valve using a single length of hose and branch pipe shall be fully opened to cause a drop of pressure in the system. At first, the jockey pump shall start when the pressure drops to 5 kg/cm^2. Further, drop in the pressure upto 4 kg/cm^2 should be allowed to test automatic start-up of the main electrical fire pump. The Jockey Pump shall automatically stop at this stage. The external hydrant valve will be closed and the electrical pump shall continue to run and register rise in the pressure upto5.5 kg/cm^2. The electrical pump shall be stopped manually by pressing the stop button.

iii) After having the system got fully charged at 5.5 kg /cm^2 and the main electrical fire pump having stopped, the external hydrant valve using hose and branch pipe shall be opened again. After the sequence of automatic starting of the jockey pump at 5 kg/cm^2

and starting of the main electrical fire pump at 4 kg/cm^2 (the jockey pump will stop automatically at the starting of the main electrical fire pump), the power supply in the pump house shall be switched off. The standby pump shall automatically come into operation at a drop in pressure to 3 kg/cm^2. The standby pump will be allowed to run for 10 minutes. The external hydrant valve will be closed and standby pump will continue to run and register a rise in pressure upto5.5 kg/cm^2. The standby pump will be stopped manually by pressing the stop button.

iv) All these tests mentioned above shall be repeated after one hour interval. The result of all the tests shall be identical again. After the system has satisfactorily withstood the above tests, it can be taken over.

The main Electric pump and the second DG driven pump (Stand by)shall be interconnected through pressure switches and existing panel board such that only main pump operates first in the event of low system pressure and the latter operates automatically in case of failure of the former within a specified switchover time or fall in pressure.
The Jockey pump shall have automatic starting and stopping arrangements to maintain the system pressure. Jockey pump shall not be in operation while the main pump is in operation.

The contractor shall carry out necessary arrangements for the supply and installation of items like timer, sensors, control cabling, etc. in the panels to function the pumps as described above free of cost. The rate quoted shall include cost of above items.

4.Sprinklers

It shall be factory tested for operation characteristics and chemical tests. Necessary test results shall be submitted before supply. If required the above tests shall be conducted as per the requirement of the Engineer-in-Charge at the time of installation at no extra cost. Valve seizures, sensor malfunctions, broken seals, leakage and other valve issues has to be checked and the damaged item must be repaired/ replaced. During a fire sprinkler system test, physical checks are performed on all the parts of the fire sprinkler system. These checks include water flow tests, fire pump tests, alarm tests and trip tests. The inspection and testing has to be carried out in accordance with NFPA 25.

TECHNICAL DATA

HYDRANT SYSTEM

(To be submitted along with the tender)

1 Diesel engine driven pump

1.A	Pump details	
a)	Make	
b)	Type	
c)	Model	
d)	Overall dimensions	
e)	Weight (Kgs)	
f)	Material	
g)	Pump casing	
h)	Impeller	
i)	Shaft sleeve	
j)	Base plate	
k)	Operating speed (R.P.M.)	
l)	Head (Mtr)	
m)	Efficiency	
n)	Performance curves (whether enclosed with the tender) Yes/No	
1.B	Engine details	
a)	Make	
b)	Model	
c)	HP	
d)	RPM	
e)	SFC	
f)	Oil consumption	
g)	Weight	
h)	Overall dimension	
i)	Exhaust pipe dia	

2 Battery & Battery Charger

a)	Make of battery charger	
b)	Make of batteries	
c)	Model No. of batteries	
d)	Voltage	
e)	AH	
f)	No. of batteries	
g)	Model No. of battery charger	

3 Electric motor driven pump

3.A	Pump details	
a)	Make	
b)	Type	
c)	Model	
d)	Overall dimensions	
e)	Weight (Kgs)	
f)	Material	
g)	Pump casing	
h)	Impeller	
i)	Shaft sleeve	
j)	Base plate	
k)	Operating speed (R.P.M.)	
l)	Head (Mtr)	
m)	Efficiency	
n)	Performance curves (whether enclosed with the tender) Yes/No	
3.B	Motor details	
a)	Make	
b)	Model	

c)	HP	
d)	RPM	
e)	Weight	
f)	Overall dimension	

4 Jockey pump

4.A	Pump details	
a)	Make	
b)	Type	
c)	Model	
d)	Overall dimensions	
e)	Weight (Kgs)	
f)	Material	
g)	Pump casing	
h)	Impeller	
i)	Shaft sleeve	
j)	Base plate	
k)	Operating speed (R.P.M.)	
l)	Head (Mtr)	
m)	Efficiency	
	ce curves (whether enclosed with the tender) Yes/No	
4.B	Motor details	
	Make	
	Model	
	HP	
	RPM	
	Weight	
	Overall dimension	

LIST OF APPROVED MAKES

Diesel Engine	:Ashok Leyland / Kirloskar / Cummins
Motor	: Kirloskar/Siemens/ABB/Crompton Greaves
Battery	: Exide/Amco/Prestolite/ Standard Furkawa/Amaron
Pump	:Kirloskar/Mather & Platt/KSB/Xylem/CRI / Lubi
MS Pipe	: Tata/Jindal/SAIL/GST/Zenith
GI & MS fittings	: Tube weld/Tube products/Punjab steel/TNT
Valves	: Inter valve/Kartar/ Advance/ Leader/Kirloskar
Pressure gauge	: Fiebig / National /H.Guru
Pressure switch	: Indfoss/Switzer/Schneider / Danfoss
Hydrant valve	: Minimax / Safex / Newage/ Winco
Fire brigade point	: Minimax / Safex / Newage/ Winco
Branch pipe	: Minimax / Safex / Newage/ Essel
RRL hose	: Minimax / Safex / Newage / Winco
Hose Reel	: Minimax / Safex / Newage/ Monsher
Hose cabinet	: Minimax / Safex / Newage/ Monsher
Paint	: Asian/ICI/Nerolac/Berger
Wrap coat	: IWL/Pypkote
Sprinkler	: Tyco/ Reliable/ HD/ Newage/ Safex
Foot valve	: Kejiriwal/ Leade/ Kirloskar/ Kartar
Fire extinguisher	: Ceasefire/ Minimax / Supremex / Everex / Safepro

FIRE DETECTION AND ALARM SYSTEM

1. STANDARDS

The manufacture, identification of material and testing of equipment covered in this specification shall comply with the latest editions as on date of opening of tenders of the appropriate standards of the following. Unless otherwise specified, Indian Standards are preferred. All the appliances and accessories shall carry IS or International certification and shall be of approved make.

NFPA 72E	Standards on automatic fire detection.
IS: 2189	Code of practice for selection, installation and maintenance of automatic fire detection and alarm system.
IS: 1652	Batteries
IS: 694	PVC insulated cables (light duty) for working voltage upto 1100 volts.
IS: 1554	PVC insulated cables (heavy duty) for voltage upto 1100 volts.
IS: 5959	Specification for polyethylene insulated PVC sheathed heavy-duty electric cables, voltage not exceeding 1100 V
IS: 5578	Guide for marking of insulated conductors
IS: 3043	Code of practice for earthing.
IS: 5216	Guide for safety procedures and practices in electrical work.
IS: 15908	Code of Practice for Selection, Installation and Maintenance of Control and Indicating Equipments for Fire Detection and Alarm System

Automatic fire detection and alarm system consists of fire control panel, detectors, manual call points, hooters, isolators, response indicators, etc. The equipment and cables of the system shall be independent of any other system in the premises and shall not be shared with any other system. The fire detection and alarm system shall be installed as per EN/ NFPA / IS code.

2. DETECTORS AND ACCESSORIES

General

The fire detectors shall be of analogue addressable type to detect one or more characteristic of fire like smoke, heat or flame. It shall be sleek, suitable communication technique with noise immunity, built-in functional test switch, microprocessor based technology, mechanically integrated photoelectric and ionisation shared volume smoke chamber, etc. All types of detectors shall be of both electronically and manually programmable type using dipswitches or handheld programmer or from fire control panel. Reversed polarity or faulty zone wiring shall not damage the detector. The detector shall have no moving parts of components subject to wear. It shall be possible to test the detector in the field. The response of a detector shall always be clearly visible from outside by a flashing light on the base. The detector shall connect to the control unit via a fully supervised two-wire circuit. A built barrier shall prevent entry of insects into the sensor. The detector shall be designed for fast and simple cleaning. The devices must be capable of working satisfactorily in harsh environments.

All electronic circuits must be solid-state devices and virtually hermetically sealed to prevent their operation from being impaired by dust dirt or humidity. All circuitry must be protected against usual electrical transients and electromagnetic interference. All radioactive parts of the source, if any, shall be fully gold plated. The detector shall be inserted into or removed from the base by a simple push-twist mechanism to facilitate easy exchange for cleaning and maintenance.

The standard base shall be supplied with a seal plate, preventing dirt, dust, condensation or water reaching the wire terminals or the detector points. Detectors shall be provided with a MS box for entry and termination of armoured cable and to protect detectors terminals.

At the time of installation and prior to commissioning, every detector shall be allotted an identification number. All detectors shall have LED blink when it is addressed. Detectors shall not be either partially or totally recessed in ceiling or wall. Detectors shall be suitably protected where they are liable to be subjected to mechanical damage. Detectors should not be painted or coated or covered in any manner after installation, as this will adversely affect the sensitive of operation.

Smoke detectors

The smoke detector shall be an intelligent digital photoelectric detector. Detectors shall be listed for use as open area protective coverage, in duct installation and sampling assembly installation and shall be insensitive to air velocity changes. The detector communications shall allow the detector to provide alarm input to the system and alarm output from the system within four (4) seconds.

3. Loop Hooters

The loop hooters shall be so arranged that when any alarm operates all the hooters throughout the premises shall be activated. The hooters at the fire alarm shall be electronic type having frequency of suitable frequency range. The hooters shall be capable to produce a sound output of 90 db at 1 m. Hooters shall be of loop powered and no separate power is provided.

'Fault' alarm and 'Fire' alarm in a panel sounder shall be distinctly different. Fire alarm sounders shall not be used for any purpose other than for fire operations. When installed flush with a false ceiling these shall match the ceiling surface. Necessary provisions such as wooden boxing or frame work, if required, to accommodate the sounders shall be made in the ceiling in advance.

These shall be installed at a height not lower than 2.4 m, except when recessed in a false ceiling of lower height. In such cases the sounders shall be recessed at false ceiling level.

The panel sounders in the respective panels shall be actuated automatically as soon as fire alarm signal is initiated from any trigger device connected to them. These shall also be sounded when there is a fault alarm signal within their areas of control. The sound shall be continuous and of the same characteristics from all fire alarm

sounders in a building. The hooter shall be loop powered and no separate cabling shall be provided for power supply to the hooter.

4. Loop Isolators

Loop isolators shall be designed to protect one area or a number of devices, which are consecutively wired in a loop. Its function is to isolate a section of the loop if a problem develops within that section, allowing the remainder of devices connected on the loop to function correctly. Loop isolators shall be provided after every 20-30 devices in each loop.

5. Manual Call Points (MCPs)

It shall be of Re-settable type via special key, with fire resistant back box for surface mounting. The MCPs shall be recess mounted suitable to support the intelligent addressable panel. It shall form an integral part of the fire detector system. The housing shall be dust/vermin proof properly sealed. MCPs shall be easily resetable with key. The MCP should have clear instructions imprinted on it about the operational steps in case of fire.

Installation requirements: -

Manual call points shall be located at exit space and shall be installed at a height of 1.4 m above the floor at an easily accessible position. They shall be installed at easily accessible, well-illuminated positions, preferably in a contrasting background so that they are easily noticeable from either direction. They may be semi-recessed so as to project by 10mm. They shall be installed free from obstructions.

6. **Fire Control Panel**

The fire alarm control panel shall be of microprocessor controlled and of modular hardware design of intelligent addressable type. It shall be housed in a steel enclosure. It shall also be finished with hard wear textured epoxy paint/ powder coated. Cable entries shall be provided on the top and bottom of the panel.

The system capacity shall be based on the number of devices and control modules. Each device in the system shall be identified by its unique address position on the two-wire loop. The panel retains command over the alarm process, LED indicators, automatic test feature and loop hooters. The panel shall be of software programmable.

The panel shall be capable of:-

(a) Programmable at site.
(b) Automatic system test activates
(c) Detector sensitivity adjustments
(d) Alarm verification
(e) Alpha/numerical display

(f) Relay control module
(g) Maintenance alert facilities
(h) Provision to connect to PCs

The manufacturer of fire control panel, detectors and other detection devices shall have own or authorized service centre in India with spares for carrying out maintenance service during the guarantee and maintenance periods. The tenderer shall submit a brief write-up of the service centre facilities available in India along with the tender.

7. Power Supply of panel

The power supply shall drive the system from either the main electrical supply single-phase supply or the standby power supply. The standby power supply shall be derived from exclusive SMF back-up batteries of reputed make. Standby power supply shall be capable of maintaining the system in normal operation having a period of not less than 24 hrs.after the failure of normal main supply.

8. Control Cable

The control cable for wiring fire alarm system shall be of 650 Volt grade armoured FRLS Copper cable. Cables shall be laid as per relevant installation standards. The sizes of these cables are specified in schedule of requirements. 4 x 1.5 sq.mm cables shall be used to connect the addressable fire alarm panels to the 'master' addressable fire alarm panel.

9. Cable Glands

Cable glands shall be of heavy-duty single compression type of brass, chrome plated. These shall have a screwed nipple with conduit electrical thread and check nut. These shall be suitable for armoured/ unarmoured cables, which is being used.

10. Cable Connectors

Cable connectors, lugs/sockets, shall be of copper/ aluminium alloy, suitably tinned, solder less, crimping type. These shall be suitable for the cable being connected and type of function (such as power, control or connection to instruments, etc.)

INSPECTION AND TESTING

1. INSPECTION

All materials shall be offered for inspection in cleaned condition, prior to erection. At no event, site fabricated work /material shall be installed in position without inspection and approval by Client. The Contractor shall ensure that each stage of fabrication is carried out in compliance with the procedures specified in the IS standards as applicable and/or specified in this document.

The contractor shall conduct sample tests of all the materials supplied at reputed laboratories/agencies as directed by Client/consultant at his own cost and test reports are to be submitted. Inspecting officials like client, local authorities shall have the right to access the premises of the work at any time with or without giving prior notice. All the formalities or procedures for conducting the inspections by the authorities as required by them shall be arranged by the contractor free of cost.

All testing shall be carried out in the presence of Client/ statutory authorities and test registers shall be maintained by the contractor. The contractor shall provide all material, tools, equipment, instruments, services and personnel required to perform the tests and remove debris resulting from cleaning and after testing free of cost.

The original test certificates of all tests conducted are to be forwarded to Client. After conducting the tests, any defects found on materials, equipment, piping, etc. shall be got rectified/repaired / replaced by the Contractor without any extra cost.

2. TESTING

1. Fire Detection and Alarm System

The entire fire detection and alarm system shall be tested for continuity and performance as per IS-2189 code. After installation, the visual inspection of all the detectors shall be made to make sure that they are properly installed. Each detector shall be inspected to ensure that it is properly mounted and connected. Heat detectors shall be tested to initiate an alarm by a heat source such as hair drier or a shielded heat lamp. After each heat test, the detectors shall be reset. Smoke detectors shall be tested to initiate an alarm at its installed location with smoke or other aerosol. Multi detectors are to be tested for both the effect of smoke and heat. All detectors found to have the sensibility outside the approved range shall not be used.

Detectors, control and indicating panels, sounders shall be tested at the manufacturer's factory and test certificate be furnished with the supply. Type test certificate to prove conformity to the relevant contract specifications shall be furnished with the supply, from recognised testing institutions or Govt. test bodies in India or abroad.

Following tests shall be conducted in the presence of client and the test certificate shall be furnished with the record of tests.

2. Continuity test

Test for insulation resistance of the wiring work and the control and indicating panels.

3. Test for system operation.

Tests for detectors shall be conducted using a test fire at normal floor level. The system operation for fault conditions shall be conducted by introducing faults such as open circuit, short circuit, removal of detector, open/short circuit in a sounder circuit etc. Tests relevant to loop isolators shall also be conducted to confirm that it functions as required.

TECHNICAL DATA
(Fire detection and alarm system)

(To be submitted along with the tender)

Smoke Detector
Make
Model No.
Size:
Operating temp range:
Voltage range:
LED display status:
IP rating

Loop isolator
Make
Model No.
Spacing of isolators
Operating voltage
Temp. range
Size:
IP rating

Loop hooters
Make
Model No.
No. of tones
Sound output
IP rating
Size

MCPs
Make
Model No.
Size:
IP rating

Fire control panel
Make
Model No.
Maximum No. of programmable loops
Maximum No. of devices per panel
Maximum devices per loop
Maximum control cable length
Maximum resistance per loop
Length per loop
No. of slots for additional cards
Networking facilities
No. of auxiliary output for AHU shut off.
No. of repeater output

No. of hooters per loop
No. of isolators per loop
Operating voltage
Operating current
No. of display characters
Support for bacnet and modbus protocol.
Size
Weight

Battery (FCP)
Type of battery
Voltage V
Battery AH
Make of battery
Backup time of battery

Makes of following items
PVC insulated FRLS
Armoured Cu. Cable
PVC insulated armoured Cu. Cable
PVC insulated FRLS cu. wire
PVC conduits
MS conduits

APROVED MAKES OF ITEMS

Detection and alarm devices : GST/ Hochiki/ Mircom/ Honeywell

FRLS Armoured Cable : Polycab/ Havells/ Finolex/ RR KABEL